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LIMITED KNOWLEDGE AND INSURANCE PROTECTION

Implications For Natural Hazard Policy

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This study examines the factors that induce individuals to protect themselves voluntarily against the consequences of low probability events such as floods or earthquakes. The authors interview 2,055 homeowners residing in 43 areas in 13 states subject to coastal or riverine flooding and 1,066 in 18 earthquake-prone areas of California. Also, controlled laboratory experiments related to insurance purchase decisions are conducted. Data collected from these sources enabled this study to focus on: (1) how well various models explain choice under uncertainty in the pre-disaster period; (2) what role insurance can play in enabling individuals to process information and undertake appropriate measures for hazard mitigation; (3) what information and attitudes homeowners have regarding hazard mitigation and disaster relief measures; and (4) the physical characteristics of flood- and earthquake-prone areas and the economic and sociological profiles of homeowners residing in these areas. Extensive bibliography and appendices are included.

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PRE-PUBLICATION MANUSCRIPT

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Note to the Reader

This report presents the findings of an NSF-RANN research study "Reducing Losses from Selected Natural Hazards: Role of the Public and Private Sectors." A revised version of the report will be published in book form by the end of 1977. We welcome any suggested changes and additions on the manuscript and would appreciate receiving them by May 1, 1977.

Please send your comments to:

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FOREWORD

As one who has been concerned for some time with the growing tendency in our society to accord little value to individual responsibility and self sufficiency, I found the report on "Limited Knowledge and Insurance Protection" a most gratifying and valuable document. It is unfortunate that the popular and too frequently indulged expectation that we are entitled to be made whole and have our losses totally reimbursed, regardless of why or how they were incurred, has nowhere been more alarmingly evidenced than in the field of insurance.

We are currently paying the price for such profligacy in the areas of automobile insurance, medical malpractice insurance and, very likely, in product liability insurance. The message of this Report is as relevant to those situations as it is to flood and earthquake insurance, and the lessons to be drawn from it have far broader implications than the authors modestly claim.

The Report demonstrates empirically that, even given knowledge and opportunity, relatively few people will expend effort and money to avail themselves of needed protection -- either through the implementation of loss preventive techniques such as sound land-use and control measures in flood and earthquake prone areas, or through the purchase of insurance coverage. The documentation of this unfortunate phenomenon by Dr. Kunreuther and his associates confirms on a scientific basis this principle which underlay the introduction and passage of the Flood Disaster Protection Act of 1973, following the failure of most homeowners and communities to take advantage of the National Flood Insurance Program, which commenced in 1969.

Publication of the Report at this time is particularly fortuitous because of the current efforts by a small but vocal group to rewrite history and delude us into ignoring those aspects of human nature which account not only for irresponsible development of flood plains and earthquake zones, but also for the enactment after the disaster of generous relief programs that do nothing to discourage a repeat cycle of such irresponsibility. Political expediency has traditionally muffled the voice of reason against unwise development, and lending institutions and local officials all too often have been unwilling to stand in the way of "progress" even if it must occur under water or along known fault lines.

It is naive and perhaps ingenuous to depend on the common sense or good will of elected authorities or zoning commissions to voluntarily restrain local growth, even in the face of real hazards and experienced losses. Thus, as Congress recognized in the 1973 Act and as the Report reminds us, however much we might prefer unsolicited good deeds, only legislated mandates will secure the type of development that has any reasonable expectation of minimizing losses from flood and earthquake.

Similarly, without a corresponding requirement to purchase available insurance against these risks, we can be assured that few of those who could be protected will voluntarily choose to do so. If we still do not understand this human failing despite the acceptance of fire insurance only after lenders required it or conversely, after the failure of property owners to purchase burglary and robbery insurance in the absence of such a requirement by lenders, and if we do not appreciate this failing after the irrefutable lesson of public refusal to purchase flood insurance during the years when the program was voluntary, then hopefully we cannot ignore the finding of this Report that individuals will not purchase hazard insurance without some extrinsic compulsion.

The Report makes a significant contribution to, and can form the basis for a better understanding of, the interrelated areas of hazard insurance and land-use control measures. It deserves to be thoroughly studied, particularly by those who have the legislative responsibility in these areas.

George Bernstein
Attorney at Law
First Federal Insurance
Administrator
1969-74

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PREFACE

This study was initiated in July 1973, because of two disturbing trends. The first was the increasing liberal federal relief provided to victims of natural disasters which resulted in a significant cost burden to all taxpayers. The second was the growing evidence that residents in flood- and earthquake-prone areas were unwilling to protect themselves voluntarily against the consequences of these disasters by purchasing insurance or adopting other hazard mitigation measures.

At the time our study was begun there was some evidence that the attitude of the federal government towards disaster victims was changing. With the passage of the National Flood Insurance Act of 1968 Congress felt that insurance coupled with land-use regulations would eventually eliminate the need for liberal relief following severe floods. Following Tropical Storm Agnes in June, 1972, the most costly disaster in United States history, an Office of Emergency Preparedness/Office of Management and Budget Presidential Task Force was authorized to compare the federal disaster loan program with insurance. The analysis of data from three severe disasters (the San Fernando earthquake (1971), the Rapid City flood (1972), and Tropical Storm Agnes (1972)) indicated that insurance was an attractive alternative to federal disaster relief.

Since the Task Force Report, Congress has taken action to reverse the trend of providing liberal disaster assistance to victims of natural hazards. Thus in April, 1973, Congress rescinded the $5000 forgiveness grants authorized after Tropical Storm Agnes and the interest rate on disaster loans was increased from one to five percent (PL 93-24). In August, 1975 the interest rate was further raised to 6 5/8 percent (PL 94-68). There is no guarantee, however, that following a severe disaster these provisions will be maintained.

Almost six months after our study was initiated the Flood Disaster Protection Act of 1973 (PL 93-234) was passed. Among other things, this legislation required all homeowners in flood-prone areas to purchase insurance as a condition for obtaining a federally financed mortgage. This provision in the act was necessitated by a lack of interest by homeowners in voluntarily buying coverage. The results of our study will enable the reader to understand the relative importance of different factors in influencing homeowners to purchase insurance voluntarily. It also provides detailed data to interested parties which will enable them to evaluate alternative policy options regarding hazard mitigation and relief measures.

Throughout the course of the three-year investigation there were lively interchanges among members of the project staff as well as frank discussions with numerous individuals from academia and interested user agencies. It is thus difficult to assign specific responsibility for many of the ideas which emerged during the course of the study. In Appendix A.5 we have listed the names and affiliations of those individuals who have reviewed material from the project and provided insights, critical comments, and suggestions at different stages of the investigation. We owe a great debt to all of these participants, although the final responsibility for the findings and their implications for public policy is solely ours.

During the course of this investigation there have been special inputs by different members of the project staff. In fact, the study was a multidisciplinary effort requiring specialized skills. Ralph Ginsberg was primarily responsible for the detailed statistical analysis of the field survey data using multivariate methods such as contingency table analyses and logit regressions. Louis Miller was in charge of creating, maintaining, and using the computerized field survey data base as well as developing the flood model. His concern for accuracy and reliability of the survey data at all stages of the project has enabled us to present our findings with confidence. Philip Sagi ensured that the field survey was undertaken in a meaningful manner. He was primarily concerned with the sample design, the interviewing procedures, and the use of appropriate statistical analysis techniques such as Bounded Repeated Replication for specifying significant variables. Paul Slovic, Sarah Lichtenstein, and Baruch Fischoff of Decision Research (formerly with the Oregon Research Institute) were primarily responsible for designing the controlled laboratory experiments. They were assisted in this effort by Bernard Corrigan and Barbara Combs.

The field survey portion of the project was subcontracted to the Institute for Survey Research at Temple University. Members of the ISR staff gave generously of their time to insure that the survey was of the highest quality. Special thanks should go to Eugene Ericksen, who helped design the sampling plan; Richard Vanderveer, the study director; and Leonard Losciuto, director of ISR. Other staff members who helped us during different phases of

the study were Nancy Cliff, Carolyn Jenne, and Lori Kessler. Danna Cornick conducted the group depth interviews and aided in the questionnaire development. Dean Donald Carroll took a special interest in the project since its inception and has been highly supportive of our efforts. He was especially helpful at several critical points during the three year period.

The following individuals significantly contributed to the overall quality of this study: Bradley Borkan, Norman Katz, Pascal Lang, Etienne Losq, Heidi Markowitz, William Morley, Stephen Pernick, Carole Riggins, Diane Wellins-Gaus. Borkan and Katz deserve special mention. Borkan was primarily responsible for collecting data on the history and current status of the flood and earthquake insurance programs. Katz performed the prodigious amount of statistical analyses which form the basis for Chapters 5 and 6. Both individuals had unbounded energy and gave selflessly of their time in reviewing the entire manuscript and making valuable suggestions as to how to improve the exposition.

The completion of this study would have been impossible without the dedication of Laura Weinstein who has managed the project since its inception. Her good humor, warmth, and competence have enabled us to overcome the hazards of such an undertaking. A special note of thanks should also go to Diane Weinstock for her masterful typing of all the tables and figures which appear in this study.

The text is a product of the Office Automation Project which is an integral part of the Decision Sciences Department. It would not have been possible to produce an edited copy as rapidly and efficiently without the use of the computer. In particular, David Ness and William Latimer were helpful in overseeing the production phase of the first draft of the book. Considerable assistance in both inputting and correcting text were provided by Brenda Scott, Kathy Morris, and Janis McKenzie. We would also like to thank Ernie Browne and his staff for rapid duplication of the material and Theresa Twigg for proofreading the entire manuscript.

Roy Popkin fashioned the executive summary from a detailed outline and material provided by the authors. He also offered helpful editorial comments and substantive suggestions on the preliminary draft of the manuscript.

Throughout the entire project we have had excellent counsel and advice from members of our Advisory Committee and their representatives. They were:

George W. Baker	National Science Foundation
Douglas Barnert	Texas Insurance Board
Robert Bartlett	Small Business Administration
Allen Barton	Columbia University
George Bernstein	Federal Insurance Administration
Gary Cobb	United States Water Resources Council
Kenneth DeShetler	Insurance Commission of Ohio
Thomas O. Dunne	Federal Disaster Assistance Administration
Kenneth Ellis	Insurance Commission of Ohio
Herbert Fritz	Property Insurance Plans Service Office
Max Giles	Small Business Administration
C. Robert Hall	National Association of Independent Insurers
J. Robert Hunter	Federal Insurance Administration
Theodore Levin	Federal Insurance Administration
Fred Marcon	Property Insurance Plans Service Office
Don Marvin	Small Business Adminsistration
Jack McGraw	Federal Disaster Assistance Administration
Ugo Morelli	Federal Disaster Assistance Administration
Keith Muckleston	United States Water Resources Council
Cameron R. Peterson	Decisions and Designs, Inc.
George R. Phippen	United States Army Corps of Engineers
Ned Price	Texas Insurance Board
Frank Thomas	United States Water Resources Council
Gilbert White	University of Colorado
Charles Wiecking	Federal Insurance Administration
Sidney Winter	Yale University

We greatly benefited from the lively interchange of ideas which took place at these meetings, the informal discussions with individual members of the committee at other times during the three-year period, and their written comments on earlier drafts of this report.

At an early stage of the project Amos Tversky provided discerning advice in helping to structure the sequential model of choice. He also provided useful suggestions and comments on the design and interpretation of the controlled laboratory experiments. Howard Morgan developed a computerized procedure for enabling us to draw a meaningful sample from the tapes of insured individuals provided us by the National Flood Insurers Association. Edgar Jackson provided us with advice on designing our survey based on his study of homeowners in earthquake areas. He was also kind enough to furnish the project with transcripts of his taped interviews with residents facing an earthquake threat. Ward Edwards and Judith Selvidge were most helpful in developing a set of questions for the field survey to elicit subjective probabilities of a future flood or earthquake. Duane Bauman pretested a preliminary version of the flood questionnaire in New Braunfels and Seguin, Texas and provided useful comments on ways to revise it. David Cummins and Peter Diamond provided useful suggestions on ways to revise and extend the preliminary draft of the report. Eugene Klotz devoted countless hours to reviewing the manuscript and offered numerous helpful suggestion for improving

the exposition.

Throughout the project we were fortunate to have the close cooperation of the Federal Insurance Administration as well as the trade associations representing the insurance industry. Data on the insured individuals in flood-susceptible areas were provided by the National Flood Insurers Association. The data on earthquake-insured individuals were provided by the eight largest companies marketing policies in California, through the auspices of the National Committee on Property Insurance. Fred Marcon was primarily responsible for ensuring that we obtained the names and addresses of homeowners in California who had purchased earthquake insurance. C. Robert Hall was consistently helpful in providing us with considerable insight into the structure of the insurance industry with respect to flood and earthquake coverage. During the summer of 1976, we reviewed the manuscript with key administrators from the Federal Insurance Administration and executives from the insurance industry.

Approximately 120 copies of a preliminary draft of this report were mailed to interested parties in June, 1976. Many of these persons attended the Natural Hazards Workshop in Boulder, Colorado from June 30 to July 2, 1976. Gilbert White was kind enough to organize two roundtable discussions at this workshop for discussing the findings of our study. At these informal sessions we were able to obtain insightful comments on the preliminary draft from agency representatives at the local, state and federal levels and from members of the academic community.

It is difficult to acknowledge the enormous contribution that Gilbert White has made to this effort. On a personal level, he has provided me with intellectual and spiritual support over the last 10 years. During the three-year period in which this investigation was undertaken, he greatly encouraged all of us on the staff in our efforts.

The entire project was made possible by financial support from the National Science Foundation through its Directorate of Research Applied to National Needs under grants No. GI 39587 and ATA 73-03064-A03. Alfred E. Eggers Jr., Harvey Averch, Larry Tombaugh, and Charles Thiel were responsible for the program of which this study was a part. George W. Baker has critically appraised the project since its inception and provided us with the specific details necessary for an effort of this magnitude to be

successfully completed.

It is hard to describe in words the involement which all of us have had with this project since its inception. We hope the material in this book conveys the intellectual excitement which has been generated by this effort. We are only beginning to understand the decision processes utilized by individuals in dealing with uncertainty as well as the implications of those findings for public policy. Considerably more work must be undertaken in the future. We hope you agree after reading this report.

Howard Kunreuther
November, 1976
Philadelphia, Pennsylvania

EXECUTIVE SUMMARY

If flood and earthquake insurance are to have a major impact in coping with the nation's potential flood and earthquake losses, new innovative approaches to the sale of such coverage to homeowners, renters and business firms must be developed by the government and the insurance industry.

If one is to market coverage on a voluntary basis, then information must be presented to individuals in such a way that they consider the probability of the hazard to be high enough for them to treat it as a problem worthy of attention. An alternative option is to institute some form of mandatory coverage. For example, banks and financial institutions could require new residents moving into flood- or earthquake-prone areas to have insurance as a condition for a mortgage. Without changes in one of these two directions, we are likely to continue with the present confusing and sometimes contradictory mix of adjustments now used to deal with both hazard mitigation and post-disaster recovery.

These are the principal conclusions which can be drawn from our three-year study, <u>Limited Knowledge and Insurance Protection: Implications for Natural Hazards Policy</u>, carried out with funding from the Division of Environmental Research and Technology, RANN, National Science Foundation.

This study was undertaken in response to the need for providing public policy makers with additional insights into the decision processes used by individuals in coping with hazards that could result in some loss to them. Such insights are needed because these policy makers must increasingly deal with the question of the appropriate roles of the public and private sectors in undertaking measures to reduce potential losses and in providing relief in the aftermath of a disaster. Furthermore, the policy maker has quite a different perspective on hazards and insurance than the person residing in disaster-prone areas.

THE PROBLEM

Financial losses caused by natural disasters are rising steadily in the United States, particularly as a result of both riverine and coastal flooding. While earthquake losses, historically, have not been comparable to actual flood losses, the potential for large numbers of fatalities and severe property damage exists and could far exceed that caused by even the most ravaging floods.

Since 1964, when Congress passed the Alaska Reconstruction Act, the federal government has played an increasing role in post-disaster relief and rehabilitation through a steadily expanding array of programs. These include low-interest disaster loans available to homeowners, renters and businesses; disaster unemployment insurance; disaster food stamps; debris removal services; temporary housing, including mini-repairs; and individual family grants of up to $5,000. The grants, available since 1974, have replaced what was known as the forgiveness feature in the Small Business Administration and Farmers Home Administration disaster loan programs.

Under this clause a portion of the disaster victim's loan was automatically forgiven; in effect, it was an outright grant. Initiated after Hurricane Betsy in 1965, when a maximum forgiveness of $1,800 was allowed, this feature was increased repeatedly. Thus in 1972, victims of the floods caused by Tropical Storm Agnes--called the worst natural disaster in American history--had the first $5,000 of their disaster loans forgiven (and the interest rate on the remaining amount set at one percent). The forgiveness feature was repealed in 1973, to be replaced subsequently by the new grant program. The cost of these programs to the taxpayer has risen steadily as federal disaster relief programs continue to be the major adjustment policy for dealing with the losses sustained by disaster victims.

Insurance, through which the potential disaster victim shares in the cost of protecting himself against such losses, is one available alternative. Neither federally-subsidized flood insurance nor privately funded earthquake insurance have been widely purchased, even though ten percent of the American people live in designated flood hazard areas and seventy percent live in areas which could suffer destructive earthquakes.

Flood insurance was once sold by private companies, but early experience with large-scale losses in the 1920's led the industry to discontinue coverage on residential property. Until the advent of the National Flood Insurance Program even the most comprehensive homeowners policy excluded coverage against water damage except for that caused by wind-driven rain.

In 1965, the Southeast Hurricane Disaster Relief Act called for a study of the feasibility of a flood insurance program. The report recommended federally subsidized policies for present occupants of hazard prone regions but proposed that individuals moving into these areas pay actuarial rates. This was to discourage unwise development of the flood plain. The report also recommended that communities be forced to adopt permanent land-use control measures to become eligible for participation in the flood insurance program. The National Flood Insurance Act of 1968 incorporated all these features.

Although flood insurance became available in 1968 and was highly subsidized by the federal government, voluntary purchases were small. By mid-1972, fewer than 3000 out of 21,000 flood-prone communities had joined the program; less than 275,000 homeowners had bought policies. Although Rapid City, S.D., qualified for the program in 1971, only 29 policies were in force at the time of the disastrous flood in June, 1972. Only 683 policies were sold in Pennsylvania prior to Tropical Storm Agnes.

This lack of voluntary interest induced Congress to pass the Flood Disaster Protection Act of 1973 which provides that no federal financial assistance for the construction or acquisition of buildings in special flood hazard areas be available to communities that do not join the program. The legislation also required homeowners on the flood plain to buy flood insurance as a condition for a new FHA, VA or conventional loan from a federally insured or supervised lending institution. In addition, disaster victims had to buy insurance as a condition for receiving federal relief to rebuild or repair their damaged property. As a result of these mandatory provisions, the number of communities in the program as of September 30, 1976, was 14,853 and over 739,000 residential policies were in force. This total is still far below the desirable number of policies, but the program has been growing rapidly.

Earthquake insurance, on the other hand, has been widely available in California since 1916. The insurance premium for wood-frame dwellings, which comprise almost all of the residential structures in the state, varies from 11 cents to 23 cents per $100 coverage depending on the location. There is a 5 percent deductible clause on the cash value of the policy. Policies are normally written as an endorsement to the standard comprehensive homeowners policy. Few California homeowners, however, have bought coverage. Even an intensive sales campaign by several companies after the 1971 San Fernando earthquake failed to generate much interest in insurance protection among residents of the state.

Relatively few studies have investigated the decision processes used by individuals in dealing with low-probability events. Some research has been undertaken on the decision to wear seat belts as a protective measure against automobile accidents. A field survey questionnaire revealed a tendency for people to buckle up for long trips rather than short ones, and noted that seat belt usage was often influenced by another's request that a fellow passenger wear them. Although breast cancer is a leading cancer killer in American women, it was only after the publicity given Betty Ford's and Happy Rockefeller's mastectomies that voluntary examinations soared. A 1966 study made two years after the Surgeon General's report on the health consequences of smoking found that over 90 percent were aware of the dangers but still continued to smoke.

Turning to evidence on insurance buying behavior, one can contrast the lack of interest in a subsidized crime policy with the relatively high demand for flight insurance. One reason why crime insurance sales have been so low has been that agents and brokers have concentrated their sales effort in the suburbs rather than in the inner city which is where the demand for coverage may exist. A flight policy may be attractive because of the large amount of publicity given to plane crashes, the low premiums, and easy accessibility of insurance facilties at airports.

It is against this background that this study looked at the following basic question that has broad implications for public policy: What factors induce individuals to protect themselves voluntarily against the consequences of low probability events such as floods or earthquakes? To help answer this question, we interviewed 2,055 homeowners residing in 43 areas in 13 states subject to coastal or riverine flooding and 1,066 in 18 earthquake-prone areas of California. Half of those interviewed had purchased flood or earthquake insurance. In addition to the field survey, we conducted controlled laboratory experiments related to insurance purchase decisions.

The data collected from both these sources have enabled this study to focus on the following research objectives:

1. How well do various models explain choice under uncertainty in the pre-disaster period?

2. What role can insurance play in enabling individuals to process information and undertake appropriate measures for hazard mitigation?

3. What information and attitudes do homeowners have regarding hazard mitigation and disaster relief measures such as land-use regulations, building codes, and low interest loans?

4. What are the physical characteristics of flood- and earthquake-prone areas and the economic and sociological profiles of homeowners residing there?

These questions were examined from the viewpoint of two models of choice which have an important bearing on the development of public policies to encourage the purchase of flood or earthquake insurance. The expected utility model presupposes that a homeowner behaves as if he makes an intelligent and thorough cost-benefit analysis based on the probability of the occurrence of a flood or earthquake, the losses associated with these disasters, and insurance premiums. The sequential model of choice finds the homeowner reluctant to collect insurance data unless motivated by a recent disaster or media publicity. Even then he only seeks information from easily accessible sources. According to the sequential model a person is likely to be uninsured because he has limited information on the hazard and available coverage rather than because he finds the cost-benefit ratio to be unattractive.

These two models also have different public policy implications. The expected utility model implies that subsidized insurance should be an attractive buy to individuals residing in hazard prone areas. The sequential model implies that homeowners must see the hazard as having a high enough probability of occurrence for them to want to consider buying subsidized insurance voluntarily. Furthermore, information on the availability of coverage and terms of a policy will have to be disseminated more widely through insurance agents as well as through personal contact.

PRINCIPAL FINDINGS

Knowledge of Insurance

Most respondents in the field survey were aware that flood or earthquake insurance existed, with the news media being the primary initial source of such information. Only seven percent of the respondents in flood- and earthquake-prone areas first learned about insurance because their agent initiated contact with them. Of the uninsured sample in both flood- and earthquake-prone areas, over sixty percent were unaware that they were eligible to purchase coverage. The uninsured were also far less knowledgeable of the terms and costs of the insurance than were the insured. Strikingly, only a small percentage of both the insured and the uninsured had specific knowledge of the deductible clauses in the current flood and earthquake policies.

For those uninsured who provided a dollar estimate of the maximum amount they would be willing to pay for coverage, 34 percent in earthquake-prone areas and 27 percent in flood-prone areas were willing to pay more than the actual premium. Had they been aware of the current rates, they would have found a policy to be an attractive buy.

Insofar as estimates of potential damage are concerned, insured homeowners expect more damage than do their uninsured counterparts. Of particular interest is the relatively large number of policyholders and nonpolicyholders who feel a severe earthquake will cause more than $10,000 damage to their property. Since practically all of the houses in California are wood-frame structures the actual damage from a severe quake is likely to be considerably less than these subjective estimates. Conversely, a large percentage of the uninsured do not expect any damage from a severe flood or earthquake even though they are residing in hazard prone regions. As expected, uninsured individuals also estimated a lower probability of flooding than did the insured. However, there was little difference between the insured and uninsured estimates of the chances of a future severe quake.

Past Experience with Disasters

Significantly, 29 percent of the respondents in the flood sample and 21 percent in the earthquake sample had suffered disaster damage in the past. In fact, over 200 of the flood victims had experienced two or more disasters to their present home. Of the earthquake victims, 189 had experienced two or more quakes in a single house in which they lived. Of those able to report dollar losses, flood victims averaged $9,439 as compared to $1,412 for earthquake victims. One hundred sixty-seven homeowners suffered flood losses of over $5,000, while only eight earthquake victims had damage exceeding this amount.

A categorization of the magnitude of the losses suffered by different age and income groups indicates that respondents 46 years old and over experienced a higher incidence of flood or earthquake damage than did the younger homeowners. The picture is reversed when one studies the per capita losses for those with damage: the most severe losses were suffered by younger homeowners and those with the highest income. Still the dollar damage of the lowest income group is high when viewed in relation to their earnings, particularly for those residing in coastal areas.

Most people repair some of the damage from a flood or earthquake. Of the 551 flood victims all but 80 restored at least some of the losses from their most serious disaster. In contrast, only 125 of 206 earthquake victims did so. This difference can be explained by the relatively minimal losses suffered in earthquakes. Of the flood victims, 60 percent thought their home was in better shape or in the same condition after they made repairs. Only 47 percent of the earthquake victims felt this way.

<u>Sources of Disaster Relief</u>

One of the arguments raised against a system of liberal disaster relief is that expectation of aid keeps people from buying flood or earthquake insurance. The field survey revealed that a majority of both insured and uninsured homeowners expected to receive <u>no</u> aid at all from the federal government. Even for homeowners who anticipated large losses, the majority expected no federal relief. This suggests that prior to a disaster, most individuals do not think about the problem, and hence, federal aid has not been a motivating force in the decision process related to insurance.

In fact, even though most homeowners are aware that the SBA provides relief to disaster victims, they know little about the terms of the loans and do not anticipate turning to the government for such help in a future disaster. Furthermore, of those who had insurance during a past disaster, only 25 percent with severe damage not fully covered by insurance actually turned to the SBA for additional loan help. As a result, these homeowners only recovered, on the average, half their losses. Similar behavior was reported by the uninsured disaster victim group. In fact, the vast majority felt that government should pay for little or none of the losses suffered from a future disaster.

Where did those who actually suffered losses get the money for recovery? Victims with flood insurance covered most of their losses through claims payments unless their damage was in the highest category. In all damage classes, a smaller percentage of insured than uninsured homeowners obtained government loans. Personal savings were used by most, but the proportion of damage covered by such funds dropped as the amount of damage increased. Bank loans were used infrequently.

Knowledge of Hazard Mitigation Measures

We also were interested in whether homeowners had undertaken personal protective actions to improve their property's ability to withstand a future flood or earthquake. Only 27 percent of the flood area homeowners and 12 percent of the earthquake area residents reported doing so, although most agreed such actions made sense. Those with disaster experience or those who had insurance were most likely to have taken such steps. The main reasons for not doing so were cost and procrastination.

Land-use regulations and building codes are frequently used as hazard protection or mitigation methods. Yet, only twenty-five percent of the flood area residents knew of such regulations in their areas. In the earthquake areas, fewer knew about land-use regulations but over a third knew of building codes. However, 56 percent of the flood area residents and 52 percent of the earthquake area respondents favored land-use regulations. A smaller, but still substantial percentage favored improved building codes.

Flood warning systems were found to have some value in preventing losses. Of the 141 respondents who had suffered flood losses and had heard warnings, 105 took some protective action with some resultant reduction in damage. However, it must be noted that these 141 represent less than one-third of the homeowners with flood experience.

Development of Hazard Prone Areas

The development of hazard prone areas, of course, has a significant impact on potential loss and the need for insurance coverage. Data from the survey indicate that continuing development of flood areas along the rivers and coasts reflects little concern for the hazards involved. In fact, residential dwellings along the coasts have appreciated more rapidly in recent years than similar property in less hazardous areas.

Furthermore, coastal residents in the most exposed locations indicated a greater willingness to rebuild their homes after a disaster than those along the rivers. This attitude exists even though damage to homes and loss of contents is higher along the coast than along the rivers or in earthquake areas. In coastal areas, damage to household contents was roughly equal to house damage, whereas along the rivers loss of contents was considerably lower than structural loss. Reported earthquake losses in both categories were much smaller.

Factors Influencing Insurance Purchase Decision

What factors influence the decision to purchase insurance? The field survey and laboratory experiments tended to reinforce each other in suggesting that the expected utility theory is an inadequate model of choice for rationalizing behavior. When the insurance premiums were kept constant while simulated losses and hazards and associated probabilities varied, the participants in the controlled experiments were more likely to insure themselves primarily against events having a high probability of occurrence even though the loss expectation was low. Conversely, they did not insure against the high-loss, low-probability event. Hence, we can only conclude that unless the probability of an event is considered above some threshold level, individuals will not concern themselves with potential losses and hence will not even consider insurance.

The field survey data revealed that the most important variables distinguishing insured from uninsured were whether the hazard was considered to be serious and whether one knew someone who had already purchased coverage. Taken together, these two factors play a major role in the purchase decision. Thus the data indicate that there is a 55 percent difference in the probability of having insurance between those who consider the hazard as a serious problem and who know someone with insurance and those who view the hazard as an unimportant problem and do not know anyone with a policy. Past experience was the most important factor which alerted homeowners to the severity of the hazard, particularly in flood-prone areas where many residents have suffered large losses.

On the other hand, socio-economic variables had a relatively unimportant effect on the insurance purchase decision or on how people viewed the seriousness of the hazard. While income and education were statistically significant in discriminating between policyholders and nonpolicyholders, they had little impact on the probability that a person would have coverage. Higher income homeowners were more likely to have insurance, but the difference between them and the lower income group was small. The same was true for educational levels. Older people were more likely to buy insurance, but the longer one lived in a neighborhood the smaller the chance that the person would actually have coverage. A related finding is that the longer one lived in coastal or earthquake-prone regions, the less likely one was to view the hazard as serious, whereas the reverse was true for homeowners in riverine communities.

PUBLIC POLICY IMPLICATIONS

The key finding of the study is that most people refuse to worry about future losses from disasters which they perceive as having a small chance of occurrence. This denial of a potential major disaster is the principal reason they do not use insurance as a means of protecting themselves against the risk involved. If insurance is brought to their attention, people may view it as a poor *investment*, one not likely to return anything on their cash outlay.

Role of Past Experience

On the other hand, when people do see the flood or earthquake hazard as a serious problem, the relatively small premium appears to be a sound investment and they are likely to consider purchasing coverage. A good example of how experience has influenced the demand for flood insurance can be found by comparing the number of policies in force, and the number and amount of claims paid out in those states affected by both Tropical Storm Agnes in 1972 and Hurricane Eloise in 1975.

Although Eloise caused approximately sixty percent less damage to homes and their contents than Agnes, the amount of flood insurance claims was ten times greater in 1975 than in 1972; the number of policies in force in the states affected by both disasters rose from 61,228 to 258,744 during this same three year period. The extent to which the Agnes experience actually influenced the purchase of insurance, however, cannot be determined from a reading of these statistics, for it must be assumed that many of the purchasers were required to buy flood insurance to qualify for federal assistance given them in the aftermath of Agnes.

The data also do not indicate whether subsidized flood insurance represented a potential savings to the taxpayer. Had these victims from Eloise been uninsured, they might have received other federal aid such as SBA loans. To determine the financial difference between insurance and federal aid would take an exhaustive analysis of the benefits they might have received from the disaster relief programs which existed in 1975.

Importance of Disseminating Information

Another factor inhibiting the voluntary purchase of flood and earthquake insurance is the slow dissemination of information about the availability and terms of such coverage. In one area of New York State, for example, local leaders downplayed the processes through which the individual communities could join the National Flood Insurance Program because of the political sensitivity of the land-use regulations involved. As a result, most residents of those communities were not aware of the fact that they could purchase flood insurance.

Because residents in flood- and earthquake-prone areas have limited knowledge about insurance, "knowing someone with coverage" is tremendously important in differentiating policyholders from nonpolicyholders. However, relying solely on the dissemination of such information is not likely to have a significant impact on the demand for coverage. Unless the residents perceive the hazard to be a serious problem, often through past experience with a disaster, they are not likely to pay much attention to information on insurance availability, even if it is disseminated through interpersonal exchanges. In other words, the consumer himself is a prime cause of market failure insofar as flood and earthquake insurance are concerned. Policy makers must therefore find ways to emphasize the potential risk and thus create a demand for protective mechanisms such as insurance.

Unless flood and earthquake insurance coverage are to be mandated by law for all who live in areas of potential major damage, or such coverage is included in the comprehensive homeowners coverage normally required by financial institutions as a condition for a new mortgage, the policymaker must find ways to translate his community-wide concerns to the individual homeowner. The community leaders' view of aggregate risks involving many homes and locations over a period of time must be translated into the kind of concern that registers with the individual homeowner who is likely to ask "What's in it for me?"

How can the current "market failure" be alleviated? How can an educated concern be created? Our study suggests the following possibilities:

Generating Concern for the Hazard

Much more attention must be paid to disseminating information about potential problems through news media, vivid films, and talks to community groups such as homeowners' associations. What the resident sees as a low-probability event must be translated into a potential loss that is probable enough to warrant buying protection. Instead of talking about a flood which has a 1 in 100 chance of occurring next year, the talk should be about the potential of flooding over the next 10 or 25 years. This will take repeated effort, and courage, for this kind of campaign may mean opposing real estate and political interests desiring to develop potentially hazardous areas. It will take federal, state, and local government teamwork.

Role of Insurance Agent

Insurance agents can play a more important role than they now do. The study shows them to be a relatively unimportant source of information. One reason is that commissions are low because premiums are low; this dampens the agents' enthusiasm for selling flood and earthquake insurance. But agents, more than any other group, have the expertise for providing information as to the details of coverage and the extent of potential loss. They can also educate homeowners that the best return on their policies is not to have any return at all. Unless residents adopt this viewpoint, they are most likely to buy insurance only after suffering flood or earthquake losses and then may cancel their coverage after a few years because they have not experienced additional flood or earthquake damage.

Problems in Marketing Coverage

Marketing the insurance, however, will still produce only limited results unless some way is found to provide information to all who need it, especially low-income groups who are unlikely to respond to media campaigns. This segment of the population is most in need of coverage because it lives in riverine flood plains or in poorly constructed buildings in earthquake areas. Coupled with this kind of outreach, efforts must be made to assure that low-income homeowners can afford to buy and maintain coverage. Some low-income disaster victims have been provided with flood insurance for the next year under Section 408 of the Federal Disaster Relief Act Amendments of 1974. As yet there is no information available as to whether or not such families have maintained their policies when they come up for renewal.

Another factor inhibiting voluntary insurance purchase is population mobility. New residents locating in high-risk areas tend to minimize the hazard and are not likely to be told about it by real estate agents; even if they are aware of the possible consequences from a disaster, they may not know that they are eligible to purchase flood or earthquake insurance. Public officials could ease this problem by informing all residents, new and old, of the hazards facing them.

Role of Financial Institutions

However, if such voluntary means of promoting flood and earthquake insurance purchase are seen by policymakers as too costly and time-consuming, financial institutions who lend money for mortgages may be the ones to fill the gap created by the failure of the market. To protect their own investments, they could require flood and earthquake coverage as a condition for financing the purchase of residential property. In fact, the Federal Disaster Protection Act of 1973 makes flood insurance a requirement on practically all new mortgages in flood hazard areas.

Earthquake coverage, on the other hand, is purely voluntary and is normally written as an endorsement on the standard comprehensive homeowner's policy. Should banks require such coverage on new mortgages, it may be necessary to institute some form of federal reinsurance against catastrophic losses. Today the insurance industry fears there is not enough private reinsurance capacity to absorb the probable maximum loss which would result from a damaging quake in a heavily populated area.

The field survey indicates that more than three-quarters of the respondents questioned in flood-prone areas and over half of those in the earthquake-prone areas feel it would be fair for lending institutions to require such coverage as a condition for a loan. Another earlier study showed sixty percent of those questioned would favor laws requiring such purchases.

Such requirements, either by law or lending institution practice, would assure coverage on newly-acquired properties. This still leaves open the problem of coverage for existing homes which do not come on the market. Here is where the need for agent-media-community official salesmanship will continue to be of paramount importance, especially in older communities where there is little new development and a reasonably stable population.

Role of Disaster Relief

One reason for suggesting new approaches for promoting the sale of flood and earthquake insurance is that individuals today are not adequately prepared to cope financially with the consequences of natural disasters. The data from the field survey clearly revealed that the majority of uninsured homeowners do not anticipate turning to the federal government for aid should they suffer losses in the future from a severe flood or earthquake. In fact, it is likely that they have not even thought about the consequences of a disaster prior to its occurrence.

Even if flood and earthquake insurance were required tomorrow as a condition for a new mortgage, there will still be victims from future disasters who will be hurt financially. Some of them will be long-term residents who were not required to have insurance and had not voluntarily purchased coverage. Some families who are renting property will not have insurance against contents damage from floods or earthquakes. It is likely that a large proportion of this uninsured group will be in the low-income bracket either because they could not afford coverage or because they did not have sufficient information on the availability and terms of a policy. The field survey data also suggest that many of the insured victims will only have sufficient coverage to restore a portion of their losses.

A disaster relief program may be desirable for assisting these groups in their recovery efforts. In the past many of the victims have not taken full advantage of existing loan programs and other sources of aid, so their property was in worse shape after repairs had been made than it was before the disaster. If governmental aid is deemed desirable, then a concerted effort should be made to disseminate information to the affected population, so that residents can understand what relief is available to them and how they can obtain different forms of assistance. A special effort should be made to provide this information to low-income residents, the group least likely to be aware of such programs and most in need of relief.

Coordinating of Insurance with Other Adjustments

Insurance also offers policymakers the opportunity to coordinate several hazard adjustment measures by providing appropriate economic incentives. For example, both the federal government and the insurance industry could actively promote preventive measures such as flood-proofing or earthquake resistant construction. They could providing information on such measures and reduce insurance premiums for those who adopt them. The federal government, which bears the financial brunt of flood losses through insurance subsidies and reinsurance and other relief programs could even offer low interest home improvement loans to encourage such adjustments. The validity of coupling insurance with hazard mitigation measures is reinforced by study findings which show policyholders tend to favor individual and community hazard mitigations efforts but are prone to defer adopting measures themselves because of the costs involved.

NEED FOR ADDITIONAL RESEARCH

This study provides new, basic information for the consideration of policy-makers concerned with the role of insurance in protecting homeowners against flood and earthquake losses. But it also points up the need for more research to enable policymakers to better understand the decision-making processes involved. By incorporating behavioral models of choice in the pre- and post-disaster periods into a community flood and earthquake model it should be possible to evaluate the relative effects of alternative hazard mitigation and relief programs on homeowners, business and the government. An NSF-RANN study is currently underway at the University of Pennsylvania to further extend the pilot project for the flood hazard described in this study.

More work is also needed to determine:

How business firms and consumers process information on low probability events, and what social institutions are best suited for coping with the problem of market failure illustrated by this study. For example, why have banks not required flood or earthquake insurance on their own?

Why do people locate in hazard prone areas, and what is the extent of their knowledge about the potential hazard? It would be helpful to know what led those who moved into an area and subsequently bought flood or earthquake insurance to do so. Why did they bother to find out about the hazard potential?

Did exposure to insurance through the field survey change the behavior of those interviewed? If they have suffered a disaster since the study, how did the experience change their attitudes and knowledge regarding subjective damage estimates, alternative hazard mitigation and relief policies, and insurance?

Why do most low income families not protect themselves against disaster losses? Is it lack of knowledge of the hazard or the cost? Now that the federal government will underwrite the first year's premium following a disaster we can investigate this question. If these low income families renew ther policies on their own then it is likely that their previous uninsured status was due to lack of concern for the hazard or limited information on insurance. If they let their policy lapse then their uninsured status was most likely due to income constraints.

What are the similarities or differences between protective actions involving property as compared to life and health? Why do people buy flight insurance, where the probability of a plane crash is low, and not earthquake insurance even though the probability may be higher? Such a study might also add insight into consumer behavior with respect to other types of insurance and preventive actions especially in health-related areas.

All of these questions promise to increase the policymaker's understanding of how individuals and institutions operate in an uncertain world where information is a scarce commodity.

CHAPTER 1
INTRODUCTION

1.1 RESEARCH OBJECTIVES

What are the decision processes that people utilize in coping with hazards that could result in some loss to them, but which they perceive as having a small chance of occurrence? This is the main question investigated in this book. The specific hazards studied are floods and earthquakes; the primary form of protection examined is insurance. On the level of public policy, our interest is to raise questions regarding the appropriate roles of the public and private sectors in offering protection against natural hazards and in providing relief in the aftermath of a disaster.

When looking at low probability events, the viewpoints of the individual and society often conflict. For example, a homeowner residing near a river may picture a damaging flood as having a small probability of occurrence or he may not perceive his potential property losses to be very large. Yet on a national level, the probability of severe flooding somewhere next year is relatively high, and the expected aggregate costs are substantial.

There are abundant historical examples of the public's failure to adequately protect against hazards, which have resulted in severe disasters. Watt (1974) cites the following illustrations:

> The Titanic and other 'unsinkable' ships that nevertheless went down; the cities built on flood plains; Pearl Harbor and other 'military' surprises; hospitals and schools destroyed with great loss of life after repeated warnings of what fire or earthquake might do. (p. 7)

All of these disasters affected large numbers of people and produced severe destruction; yet individuals assumed these events were so improbable that they did not want to think about them. Furthermore society did not deem it necessary to undertake appropriate preventive measures.

A central factor makes this problem socially important. If people do not protect themselves against the consequences of a low probability event, then society is likely to bear a large portion of the costs following a disaster. For example, few residents of California purchased earthquake insurance prior to the San Fernando quake of February, 1971, and hence many of the victims turned to the federal government for relief. Congress then responded with low interest loans and forgiveness grants. Such behavior raises the following question that has broad implications for public policy: what factors induce individuals to protect themselves voluntarily against the consequences of low probability events such as floods or earthquakes? To help answer this question, we have collected data through a field survey of homeowners residing in flood- and earthquake-prone areas and from subjects participating in controlled laboratory experiments related to insurance purchase decisions. The data enable us to focus on each of the following research objectives of the study:

1. How well do various models explain choice under uncertainty in the pre-disaster period?
2. What role can insurance play in enabling individuals to process information and undertake appropriate protective measures for hazard mitigation?
3. What information and attitudes do homeowners have regarding hazard mitigation and disaster relief measures such as land-use regulations, building codes and low interest loans?
4. What are the physical characteristics of flood- and earthquake-prone areas and the economic and sociological profiles of homeowners residing there?

Although answers to these research questions are provided in this study, they alone do not imply a specific set of policy recommendations. In order to take this step, one must decide how responsibility for disaster mitigation and recovery must be shared between residents of hazard prone areas and federal, state and local governments. We hope that the results of this study will better enable interested parties to make these judgments and then to develop specific programs for reducing losses from future disasters.

1.2 THE DECISION TO PROTECT AGAINST FLOOD OR EARTHQUAKE LOSSES

1.2.1 Nature Of Insurance Programs

During the period from 1953 to the present, the federal government has played an increasing role in providing disaster relief. While the dollar amount of damage from natural disasters has climbed rapidly since the early 1950's, federal financial assistance during this period has grown even more rapidly.

Evidence on increased federal disaster relief through fiscal year 1976 is provided by comparative data on the SBA disaster loan program. The growth of the program is easily seen in Figure 1.1, which contrasts the first twelve fiscal years of operation (1954-1965) with the next eleven (1966-76). This growth is particularly significant in the case of home loans, where both the total number and total dollar values in the 1966-76 period were more than twenty-five times what they were in the first twelve years of the program.

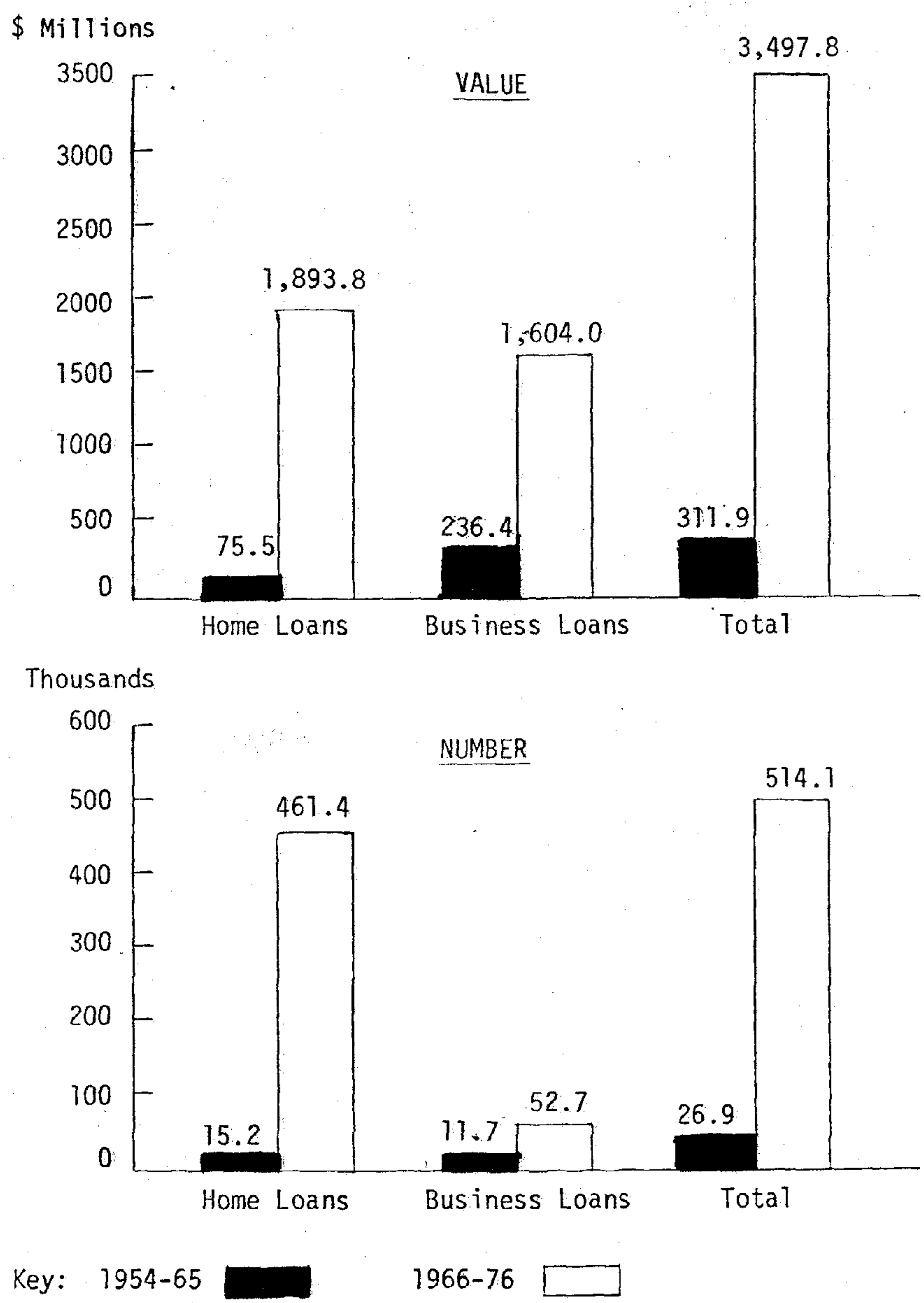
Part of this increase may have been the result of a rising trend in damage from natural disasters. But even with this cautionary note, it is striking that the $1.2 billion approved by the SBA for victims of Tropical Storm Agnes (June, 1972) represented almost four times the entire amount allocated by the SBA for all disasters between fiscal years 1954 and 1966. Interestingly enough over $540 million of the amount approved by the SBA for victims of Tropical Storm Agnes were in the form of forgiveness grants which did not have to be repaid. A more detailed discussion of the changing role of the federal government in disaster relief can be found in Kunreuther (1973).

Flood Insurance

The National Flood Insurance Program is the first positive step taken by the federal government to induce individuals to protect themselves against losses from flood disasters. The basis for the current flood insurance program was a nine month study authorized by Congress as part of the Southeast Hurricane Disaster Relief Act of 1965. The resulting 1966 report by the Department of Housing and Urban Development concluded that flood insurance was feasible, although the rates in certain hazard prone areas would be extremely high. For this reason the report recommended providing a federal subsidy to present occupants of high flood-risk areas. The study suggested that the subsidy not be given to persons who propose to build new homes in these

Figure 1.1

Comparison of Value and Number of SBA Disaster Loans, by Category, for Fiscal Years 1954-65 and 1966-76



Source: Small Business Administration, Office of Reports locations after the areas are identified as subject to special flood risks, for this would, in fact, encourage further developments in hazard prone areas. After actuarial rates had been determined for a given area, no new flood insurance coverage (including renewals) should be provided unless the community adopts permanent land-use and control measures with provisions for effective enforcement.

The National Flood Insurance Act of 1968 incorporated all these features. Although the actuarial and subsidized rates are determined by the federal government, private firms market the policies and deposit premiums into a common pool operated by the National Flood Insurers Association. A system of government reinsurance protects the private companies from catastrophic losses in any one year. Furthermore, to reduce flood damage in the United States, the sale of flood insurance was restricted to only those communities agreeing to regulate development of their flood plains.

There is substantial evidence that most individuals in flood-prone areas do not voluntarily purchase insurance. Even though coverage was subsidized approximately ninety percent by the federal government, less than 3,000 out of 21,000 flood-prone communities in the United States entered the program during its first four years of operation, and less than 275,000 homeowners voluntarily bought a policy. For example, Rapid City, South Dakota, qualified for flood insurance in April, 1971, yet only 29 policies were in force at the time of the June 1972 flood, which caused $163 million in damage. Analogous behavior was evident in states hit by Tropical Storm Agnes: only 683 residential policies were sold in Pennsylvania, 2046 in New York, and 693 in Maryland before the disaster occurred (U.S. Congress, 1975).

This lack of voluntary interest in the program on the part of homeowners and communities induced Congress to pass the Flood Disaster Protection Act of 1973 (PL93-234). Its principal provision is that no federal financial assistance for the construction or acquisition of buildings in <u>special flood hazard areas</u>[1] will be available to any flood-prone community that does not join the National Flood Insurance program. All homeowners on the flood plain are now required to purchase this insurance as a condition for new FHA and VA loans if their communities are enrolled in the program. As of September 30, 1976, 14,853 communities have joined the program and as of July 31, 1976, over 739,000 residential policies were in force. Thus, by invoking sanctions on communities and residents in flood-prone areas, the program has grown markedly since 1973.

Earthquake Insurance

Earthquake coverage has been privately marketed by American insurance companies since 1916. Premiums for wood-frame homes in California, which comprise almost all residential structures in the state, average 20 cents per $100 coverage with a 5 percent deductible clause. A policy can easily be written as an endorsement to comprehensive homeowners coverage. Few California homeowners, however, have purchased earthquake insurance.

Evidence on the unwilling market for such coverage has been provided through an experiment by the Insurance Company of North America following the San Fernando earthquake of February, 1971. Eight months after the quake the company mounted a serious campaign to market earthquake insurance in California, by placing newspaper ads in the major dailies, advertising on TV, and enabling all their California agents to mail special brochures and announcements to their customers. The following month only 61 policies were sold and then sales dropped off during the next seven months to an average of 17 per month (Syfert, 1972). The Hartford Insurance Group and Kemper Companies ran similar campaigns to market earthquake insurance. Their efforts also bore little fruit.

Chapter 2 provides a historical perspective on the development of flood and earthquake insurance. It also discusses the National Flood Insurance Program and the current status of earthquake insurance in California. Comparisons between flood and earthquake coverage are then made with respect to the rates and terms of a policy.

1.2.2 Alternative Models Of Choice

An important goal of this study is to determine the critical factors influencing the voluntary purchase of insurance by homeowners against the consequences of low probability events such as floods or earthquakes.

Chapter 3 offers a theoretical perspective on the subject by discussing two competing models of choice regarding consumer behavior under uncertainty. Economists have relied on the "expected utility model" as a basis for recommending alternative courses of action. According to this theory, a homeowner determines whether or not flood insurance is an attractive option by comparing the insurance premium, with the estimated damage to his property from future floods of different magnitudes, and the probability that each of these disasters would occur. In other words, the individual is assumed to behave as if he engages in a detailed analysis of the costs and benefits associated with the purchase of insurance. When the expected benefits of protection exceed the costs of a policy coverage is desirable; otherwise, it is not.

There is an alternative way of viewing the decision-making process that has been called by Herbert Simon, the "bounded rationality approach". According to this descriptive theory, a person is reluctant to collect data on insurance unless motivated to do so by some external event, such as a recent disaster. Even then, he may only seek information from easily accessible sources. It is thus likely that an individual will not purchase insurance because of his limited knowledge rather than because of an unattractive cost-benefit ratio. In Chapter 3 a "sequential model of choice" is developed using the concepts of the bounded rationality approach. If it correctly describes the insurance decision process, then past disaster experience, media publicity and personal influence will be extremely significant variables. These factors are not at the core of the expected utility model.

One reason for contrasting these two models of choice is that they imply radically different policies regarding protective actitivies. According to the expected utility model, homeowners currently residing in hazard prone areas will purchase insurance voluntarily if they perceive the premiums to be sufficiently low and are convinced that liberal disaster relief will not be forthcoming after the next flood or earthquake. The expected utility model also has implications for the adoption of other hazard mitigation measures. For example, if insurance rates on new structures in hazard prone areas are able to reflect risk, and if consumers process information accurately, developers will have an incentive to make new structures resistant to floods or earthquakes without the need for building codes. Similarly the development of hazard prone areas will be curtailed without the need for land-use regulations.

By contrast, the sequential model of choice implies that homeowners will have to be made graphically aware of the potential losses from the hazard before considering protective measures such as insurance. Because of the individual's reluctance to seek out new information, friends and neighbors--as well as insurance agents--can play an important role in providing data on the availability of coverage and the terms of insurance. However, if the individual views the event as having an extremely low probability then he still may not be interested in data on potential losses and insurance even if the information is spoon-fed to him. Such consumers will have little desire to purchase a policy voluntarily even though the rates are subsidized.

1.2.3 Research Instruments

Little empirical evidence has been collected to evaluate the accuracy of the expected utility model in explaining insurance purchase behavior. Nor is much known about the relative importance of factors central to the bounded rationality model. Field survey questionnaires and controlled laboratory experiments were utilized to contrast these alternative models of choice and increase our understanding of decision processes regarding low probability events. The field survey enabled us to discover differences between insured and uninsured homeowners in hazard prone areas, while the laboratory experiments permitted us to specify causal relationships between variables by specifically controlling their levels.

1.2.4 Field Survey

The sampling plan for the field survey involved face-to-face interviews with 2,055 homeowners in 13 states residing in 43 areas subject to coastal and riverine flooding, and 1006 homeowners living in 18 earthquake-prone areas of California. Half of the respondents had purchased flood or earthquake insurance and the other half had not. A more detailed description of the sampling plan, the selection of study sites, the actual phases of the field survey, and the quality of our data appear in Chapter 4.

The field survey was designed to provide answers to each of the research objectives described above. The questionnaire elicited subjective estimates by homeowners of the probability of a severe flood or earthquake and the resulting loss if a disaster caused damage to their property. Data were also obtained on an individual's knowledge of the availability of insurance and the terms of a policy (e.g. premium, deductible and coverage limits). From the information provided by the subjects, we can gain insights into how well the expected utility theory explains homeowners' insurance behavior. Data were also collected in the field survey to determine how accurately a sequential model of choice described this decision. To test the model we collected information on the awareness of the hazard, past experience with the hazard, the role of friends and neighbors, and the decision process related to the purchase of insurance. Chapter 5 uses field survey data to analyze the adequacy of the expected utility model and to isolate separate effects of important variables for inclusion in the sequential model of choice. In Chapter 6, more powerful methods of data analysis are used to study the impact of several variables simultaneously on the insurance purchase decision. These techniques also enable us to estimate the relative importance of different factors on the probability that a homeowner will buy flood or earthquake coverage.

The field survey data also enable us to determine how aware homeowners are of other hazard mitigation measures (such as land use regulations) and disaster relief programs. Such an analysis serves two interrelated purposes. It permits one to determine whether insured individuals are better informed than uninsured persons about the event against which they are protecting themselves. It also allows one to specify what effect, if any, alternative disaster programs have had on the insurance purchase decision. For example, the federal government has in the past provided low interest loans and forgiveness grants to victims of severe natural disasters. We want to know how aware individuals are of these disaster relief programs and whether they expect to rely on liberal federal aid as an alternative to purchasing insurance. A discussion of findings on hazard mitigation and relief programs appears in Chapter 8.

Finally, the field survey data provide a profile of the socio-economic attributes of homeowners living in flood- and earthquake-prone communities as well as a comparison between coastal, riverine, and earthquake areas. Chapter 9 presents a picture of the characteristics of residents in each community surveyed and shows how these data are related to U.S. Census figures. In addition, data from SBA loan files on three selected disasters enable one to examine the socio-economic characteristics of those who utilize the program for recovery.

1.2.5 Controlled Laboratory Experiments

The field survey provides information on the magnitude of the relationships between variables (e.g. previous flood experience and purchase of flood insurance), but does not enable one to specify whether causal relationships exist among variables. For example, analysis of the survey data may suggest that homeowners are likely to purchase insurance if they have previously experienced a flood, but the data will not indicate whether or not the flood experience actually triggered the purchase of insurance.

The laboratory experiments enabled us to determine causal relationships by varying specific factors while holding others constant. For example, in one experiment the probability of a disaster and the magnitude of the potential loss were varied so that the expected loss (i.e. the probability multiplied by the loss) remained constant. By keeping the insurance premium the same throughout, it was possible to study an individual's relative preferences for protection against events having different probabilities and losses.

The experimental portion of the study also had controls for retrospective bias which may be present in questionnaire data. For example, uninsured individuals who were interviewed as part of the field survey may estimate the probability of a severe flood or earthquake to be extremely low, not necessarily because they really perceive the chance to be so small, but rather as an *ex post facto* justification for their current uninsured status. The probability of a disaster is a controlled input to the insurance decision in the laboratory setting to eliminate this bias. Chapter 7 discusses the results of the experiments and synthesizes these findings with the analysis of field survey data.

1.2.6 Community Flood And Earthquake Models

To evaluate the relative performance of alternative hazard mitigation and disaster relief programs we have designed simulation models of community flood and earthquake experiences. Through an interactive computer program, interested parties are able to integrate the findings from the field survey and controlled experiments with data on flooding and earthquake phenomena. The models serve as a first step in enabling us to estimate the relative costs (to individuals in a community, governmental agencies, and the insurance industry) of various public policy alternatives. The function of integration and cost analysis are subsidiary, but necessary goals to policy evaluation. One ultimate use of the disaster models would be to provide guidance for choosing among alternative hazard mitigation and disaster relief policies. In Chapter 10 we will report on a pilot study which has been completed using the community flood model.

The study has thus been designed so that the data collection and policy analysis phases are inextricably interwoven. The field survey and controlled laboratory experiments enable us to discriminate between alternative models of choice in the pre-disaster period and to describe property and socio-economic characteristics of homeowner's residing in flood- and earthquake-prone areas. Responses to the field survey questionnaire provide data on homeowners knowledge and attitudes toward hazard mitigation and disaster relief programs. The community flood and earthquake models analyze the relative merits of alternative disaster programs based on these models. Chapter 11 summarizes our findings and discusses their implications for public policy.

1.2.7 Need For A Multi-Disciplinary Approach

In our research effort we recognized a need to integrate results from several disciplines:

(a) From Economics we have a well-developed normative theory of decision making based on the concepts of expected utility theory.

(b) From Geography, there is a large empirical literature on man's perception and adjustments to environmental hazards.

(c) From Psychology, there are controlled experimental findings which indicate the limitations of man in processing information and the resulting biases in his decision.

(d) From Sociology, there is a literature on the process of diffusion of innovations and the role of personal influence in the communication process.

1.3 OTHER STUDIES ON LOW PROBABILITY EVENTS

Relatively few studies have been undertaken to understand the decision processes used by individuals in dealing with low probability events. This section summarizes the key findings from earlier studies regarding the adoption of protective activities. These examples serve two purposes. They demonstrate that low probability hazards are a pervasive problem affecting many individuals in many contexts. They also indicate what is known and not known about a person's behavior with respect to these events.

1.3.1 The Decision To Wear Seat Belts

There is a substantial body of evidence compiled by such groups as the National Safety Council and the Institute for Highway Safety indicating that seat belts reduce deaths and prevent serious injuries in car accidents, but that people do not wear them. For example, in their publication 1973 Accident Facts, the National Safety Council estimates that the number of lives lost annually could be reduced by 25 percent if all motor vehicle occupants would make seat belt wearing a habit. In view of statistics such as these it is hard to believe that (on any particular trip) about two-thirds of all motorists wear neither lap belts, nor shoulder harnesses.

What factors induce individuals to wear seat belts? A field survey questionnaire conducted for the Department of Transportation (1974) revealed that there is a tendency to buckle up on longer trips rather than shorter ones. This behavior is consistent with the notion that the individual views the probability of an accident to be highly dependent on the length of time in the car or the speed at which he is traveling (since longer trips generally involve highway driving). Hence, one makes a decision on protecting oneself by focusing on either the time or speed dimension. The survey also found increased usage of belts on a permanent basis by those asked by others to wear them. This raises the question as to the importance of personal influence in the decision-making process.

A principal reason given for not wearing shoulder harnesses or lap belts was "I never formed the habit". This result suggests that it is difficult for an individual to change his existing pattern of behavior and make a conscious decison to use seat belts on a regular basis. Our study will shed light on the factors which appear to be important in the adoption process of such protective activities.

1.3.2 The Decision By Females To Obtain Breast Examinations

Breast cancer is the leading cancer killer in American women and the leading cause of death in the 40 to 44 year age group. It produces untold and widespread suffering and is responsible for staggering costs in primary, secondary, and tertiary health care. The chances of complete recovery for a breast-cancer victim are markedly improved if the tumor is detected and a mastectomy performed before malignant cells spread to the lymph nodes.

It is common knowledge that interest in breast cancer check-ups soared after the extensive mass media publicity surrounding Betty Ford's and Happy Rockefeller's mastectomies. The Guttman Clinic in Manhattan, which screens women for breast cancer, received 30 to 40 telephone calls a day prior to the operations. Immediately following the publicity the clinic received as many as 400 calls per day and had to place women seeking examinations on a waiting list extending several months (Time, Nov. 4, 1974, p. 107). Four hospitals in Nashville reported that there was a 100 percent increase in the number of patients found to have breast cancer in the three months following the surgery on Mrs. Ford and Mrs. Rockefeller than in the same period the year before. The comparative analysis also indicated that a large proportion of the cases were in the early stages, and hence were presumably more curable. (N.Y. Times, November 28, 1976, Section IV, p. 8).

The breast cancer experience was one in which a large number of persons ignored relatively simple protective measures until the mass media publicized the prevalence and consequences of the disease, and provided information on how one could protect oneself against potential dire consequences. This suggests that most people will ignore a low probability event until personal examples make the consequences and possibility of the hazard salient and make the protective measure socially acceptable. For our study, these findings raise interesting policy questions concerning the role of the mass media and the types of information which are useful in inducing change.

1.3.3 <u>The Decision To Stop Smoking</u>

When an individual decides to stop smoking he is undertaking a protective activity regarding his health. Tamerin and Resnik (1971) summarize a substantial body of statistical data which indicates the major risks of cigarette smoking to the individual. They note that each year 77 million working days are lost, 88 million days are spent ill in bed, and 306 million days are spent in restricted activity as a result of smoking. For those who smoke two or more packs a day the life expectancy of a man 25 years of age is reduced 8.3 years. This implies that a minute of life is forfeited for each minute of smoking.

Two years after the Surgeon General's report of 1964 on the health consequences of smoking, a survey of 3,000 individuals with a history of smoking revealed that over 90 percent were aware of the dangers it posed to them (Horn and Waingrow, 1967). Yet such people still continue to smoke today. Why have they not protected themselves?

Among the reasons given by Tamerin and Resnik, two are of particular interest for our study:

1. An absence of conscious deliberation. Smokers have been disinclined to weigh the benefit-risk relationship of their behavior.
2. Abnegation of personal responsibility for the outcome. The smoker prefers to gamble by anticipating that he will not be one of the losers punished by premature death due to this habit. He thus prefers to take his statistical chances rather than accepting the personal responsibility of quitting.

A conclusion from the experimental results (discussed in Chapter 7) is that individuals are often prone to behave as if a small probability means a zero probability. The smoker's gamble may well be an instance of this behavior. In all fairness, we note that there may be physical factors which make it difficult for some individuals to stop smoking, but we are concerned with those who have not even made the effort.

The most effective predictor of whether an individual will stop smoking is whether he knows someone whose health has been adversely affected by smoking. Studies have revealed that such individuals are three times as likely to give up cigarettes as persons who did not have acquaintances who suffered illness or death as a result of smoking. This finding is consistent with the data on breast cancer examinations which indicates that knowing someone with the disease greatly increases the desire to get a medical check-up. It thus suggests the importance of salient observations on the consequences of an event before one is willing to undertake protective measures.

1.3.4 The Decision To Purchase Subsidized Crime Insurance

In August, 1971 the Federal Crime Insurance Program was established as one means of saving the nation's ailing cities. Since World War II an increasing number of businesses have left the inner cities for the safer suburbs, and the trend has accelerated in the last decade. By providing low-cost non-cancellable crime insurance to shopowners and residents in high crime areas, it was hoped that this trend would be arrested.

The outline of the plan is simple. Homes and businesses are required to install protective mechanisms such as locks and bars and are then eligible to purchase crime insurance coverage at half the private market rate. Thus for example, a resident in a high crime area would pay $60 a year for $5,000 worth of burglary and robbery insurance while the same coverage by a private company would be $120. Policies can be sold and serviced by any registered private agent or broker.

To date, policy sales have lagged far behind the federal government's expectations. Sixteen states and the District of Columbia are participating in the Federal Crime Insurance Program, yet in March, 1976 there were only 28,500 active policies (N.Y. Times, March 14, 1976, Section IV p. 4). Recent publicity has not increased interest in the program. For example, the federal government spent $100,000 on poster and media advertising in Chicago and received only 150 applications. A direct mail campaign in Miami failed to generate enough business to pay the advertising expenses.

Why has a seemingly attractive program failed to receive attention from prospective customers? One reason is that private agents and brokers who sell federal crime insurance still concentrate on marketing policies in the suburbs rather than in the inner city for which the program was designed. Because of this, relatively few central city businesses have heard of the coverage through their agents. Homes and businesses must adopt protective mechanisms before qualifying for the insurance and some may be reluctant to incur these expenses, particularly if they have not been recently burglarized.

The experience with crime insurance raises a set of questions directly related to our study of flood and earthquake insurance. When are individuals likely to process information on insurance and adopt protective measures? When are they able to make cost comparisons between their current policy and the less expensive subsidized coverage? What market mechanisms, if any, are likely to induce interest in coverage by those who need such protection?

1.3.5 The Decision To Purchase Flight Insurance

In contrast to the lack of interest in federally subsidized crime insurance, there is a substantial demand for airline insurance. In a classic article on the subject, Eisner and Strotz (1961) showed that the price of flight insurance is considerably higher than life insurance, using objective statistics on the death rate per passenger trip.

In attempting to explain the behavior of those who buy flight insurance, Eisner and Strotz conclude that:

> People do not optimize on their insurance purchases because of an incorrect understanding of the probabilities of death from various causes, imperfect knowledge about the prices of various insurance policies, imperfections on the supply side of the insurance market or inertia in adjusting their long-term insurance programs. (p. 368)

Their study raises the possibility that individuals may have an inflated idea as to the chances of a plane crash due to the extensive publicity such accidents receive. This publicity makes people believe plane crashes are relatively frequent. A related explanation is that the location of insurance facilities within the airport itself may lead the individual to focus primarily on the potential losses from a crash. The low premium then makes such insurance very attractive. We shall explore the relative importance of these factors in our analysis of individual behavior toward natural hazards.

1.3.6 Factors Affecting Consumer Decisions

With the exception of the crime insurance statistics, all the data cited in this section relate to protective activities affecting life rather than property. Taken together, these studies indicate a general reluctance on the part of individuals to protect themselves against events which may produce severe bodily harm. Given these findings one would not expect much consumer interest in insurance protection against property damage even when rates are subsidized.

The studies do provide interesting clues as to the factors that hinder and encourage the adoption of protective activities. An analysis of the crime insurance program suggests that the lack of interest in subsidized coverage may be partially attributable to inadequate knowledge of the availability of such policies by potential buyers. In fact, a principal factor triggering the demand for breast cancer examinations was the mass media publicity relating to protective measures.

Evidence from studies on cigarette usage suggests that unless an individual knows someone who has suffered the consequences of this low probability event, he is likely to deny that smoking will affect his health. The field survey report on seat belt usage concluded that there is a high cost of habit formation which must be overcome before people will wear belts. Friends can play an important role in this process by encouraging their fellow passengers to buckle up. Finally, the demand for flight insurance suggests that individuals may either have an inflated estimate of the probability of a crash and/or may focus primarily on the loss dimension when deciding to buy coverage at the airport.

More generally, the findings from these earlier studies raise a fundamental point regarding individual decision processes and societal goals. On an objective level there is sufficient statistical evidence to indicate that use of seat belts, health examinations, and giving up smoking significantly reduce the number of lives lost and prevent serious harm to the body. For insurance protection, the data suggest that subsidized flood and crime coverage are good buys while flight insurance is unattractive when compared to life insurance. What steps, if any, should society take in regards to protecting people against themselves? This question of individual versus societal responsibility should be debated in the public arena before making policy recommendations.

1.4 SUMMARY OF CHAPTER

In this introductory chapter we indicated that the principal motivation of this book is to understand better the decision processes utilized by individuals in coping with hazards that result in some loss to them, but which they perceive as having a small chance of occurrence. The specific hazards we have studied are floods and earthquakes; the primary form of protection examined is insurance.

The data from our study of behavior with respect to flood and earthquake insurance shed considerable light on the factors influencing the consumer decision processes and suggest alternative ways of encouraging the adoption of protective measures. However in order to design a specific set of policy recommendations, one must assign the appropriate responsibility for disaster mitigation and recovery to residents of hazard prone areas and to federal, state, and local governments. The value judgments as to how the costs of disasters should be distributed between the public and private sectors must be openly debated and cannot be answered by a study such as this.

FOOTNOTES

[1] A special flood hazard area is that part of the flood plain subject to inundation by a flood that has a one percent chance of occurrence in any given year.

CHAPTER 2 - 1

THE CONTEXT: THE NATURE OF THE HAZARDS AND INSURANCE COVERAGE

2.1 NATURE OF FLOODS AND EARTHQUAKES

2.1.1 Floods

The flood hazard can be separated into two classes: riverine or inland flooding and coastal or hurricane flooding. A riverine flood occurs when water overflows its normal channel. The usual causes of such flooding are heavy rainfall or melting snow. A coastal flood is induced by surges of wind-driven water during tropical storms.

The damage potential from riverine flooding can be heightened by both natural changes and man-made causes. For example, brush and forest fires destroy ground cover that normally reduce the rate of runoff from watersheds. Unwise land development creates similar effects. In addition, hydrologic structures intended to control the effects of flooding can sometimes bring on disasters through failure or when their capacities are exceeded. This was demonstrated in February, 1972, when the dam at Buffalo Creek, West Virginia failed without warning, resulting in 125 deaths.

In coastal areas, hurricanes bring surges of water caused by abnormally high waves combined with a rising of the water surface due to reduced atmospheric pressure. These storm surges are the predominant threat to life, and the waves are capable of destroying structures and causing serious erosion to beaches, highways, and other works. Less spectacular, but nevertheless costly storms of longer duration than hurricanes with high, sustained on-shore winds must also be recognized as having the potential to create serious flooding to coastal areas.

The threat of floods exist in almost all parts of the United States. White and Haas (1975) state that:

> ...nearly every community in the nation has some kind of flood problem, chiefly resulting from inadequate drainage systems for runoff water produced by heavy rainfall from storms.

According to data collected by the Federal Insurance Administration, 1 out of 10 Americans reside in locations where flooding is likely to occur. Figure 2.1 depicts the percentage of the population of each state residing in a flood-prone area.

2.1.2 Earthquakes

Current theories suggest that earthquakes result from movements of large areas of the earth's surface called plates. Stresses between plates are relieved by fracturing and slipping, possibly as far as two thousand feet below the surface. The released energy is propagated in the form of waves which, upon reaching the surface, cause shaking of the ground and possibly large displacements. These displacements, often permanent, can be both horizontal and vertical and may result in fissures in the ground.

The resulting vibrations can cause serious damage to man-made structures such as concrete, steel, or masonry buildings; bridges; dams; and public utilities. Fire caused by the breaking of gas lines and made uncontrollable by the disruption of water lines was a major cause of damage in the 1906 San Fransico earthquake. Over 80 percent of the losses were caused by it. The failure of dams due to intense ground motion may cause severe flooding to surrounding areas. For example, during the 1971 San Fernando earthquake there was great concern that the Van Norman Dam would collapse. The resulting flood would have caused severe damage to a large populated area. It should be noted that wood-frame structures normally survive even the most intense ground shaking without much damage. Other natural hazards caused by earthquakes are often more destructive than the quake itself. There have been cases of entire villages being swept away by landslides or tidal waves.

Several million earthquakes occur annually throughout the world; however, most originate under the ocean or are of low intensity. About 700 per year are capable of producing damage, yet, few have actually occurred in populated regions. One of the more vulnerable areas in the United States is the West Coast, which is part of the Circum Pacific Belt (rim of the Pacific Ocean) the greatest seismic belt in the world. The primary faults in this region are the San Andreas fault in California, the fault system separating the Sierra Nevada from the Great Basin in Eastern California, and the fault system off the Southern coast of Alaska.

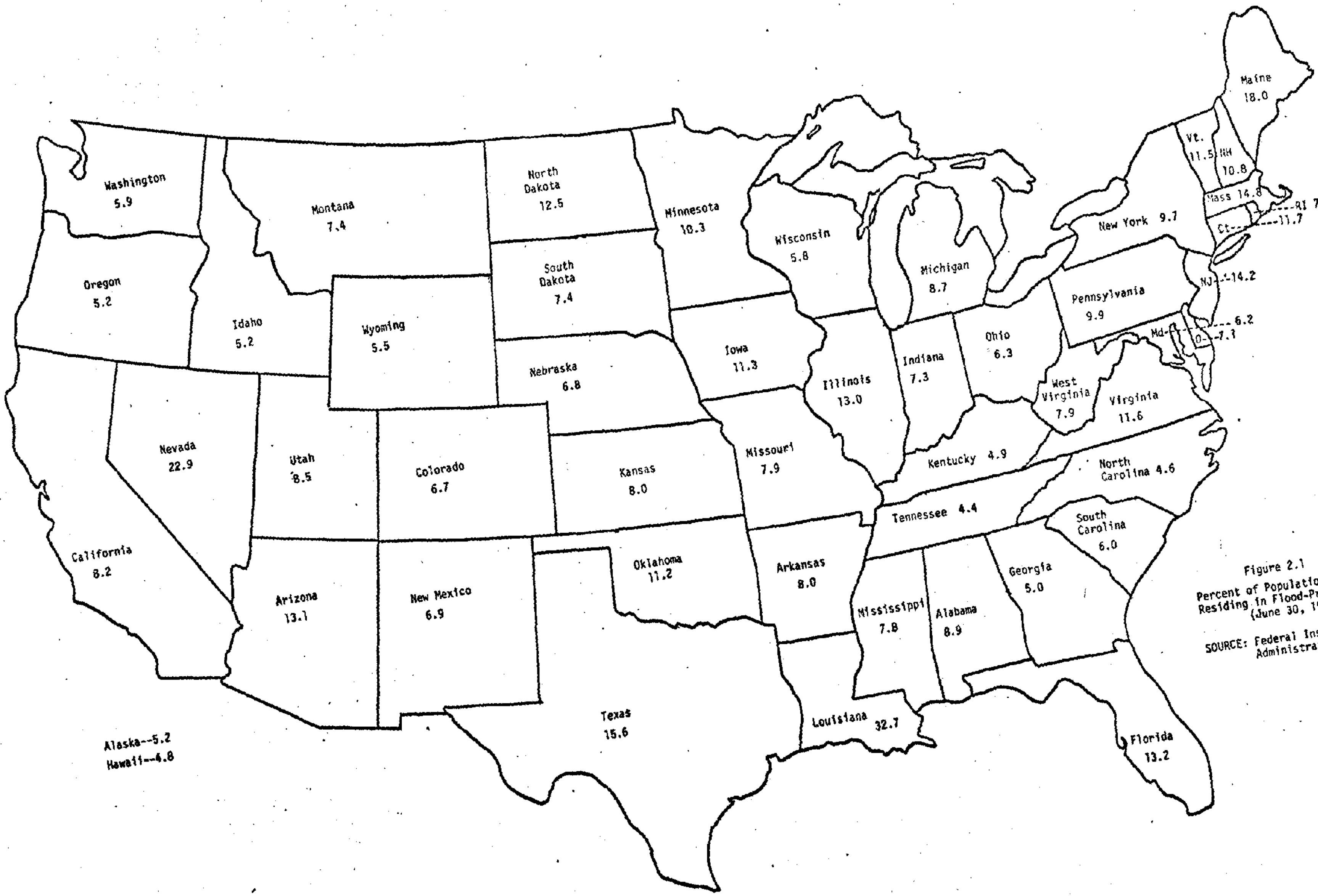


Figure 2.1
Percent of Population by State Residing in Flood-Prone Areas (June 30, 1976)

SOURCE: Federal Insurance Administration

Other areas of the country also face the threat of earthquakes as shown on the seismic risk map in Figure 2.2. It is worth noting that such Eastern cities as Boston, Mass., Charleston, S.C., and Memphis, Tenn. are classified in Zone 3, the same zone that encompasses the Western coast of California.

Though considerable work is currently underway on earthquake prediction, it is not yet possible to warn residents of such an impending disaster. Hence, an individual cannot take steps to mitigate losses just before the quake as he can for most floods.

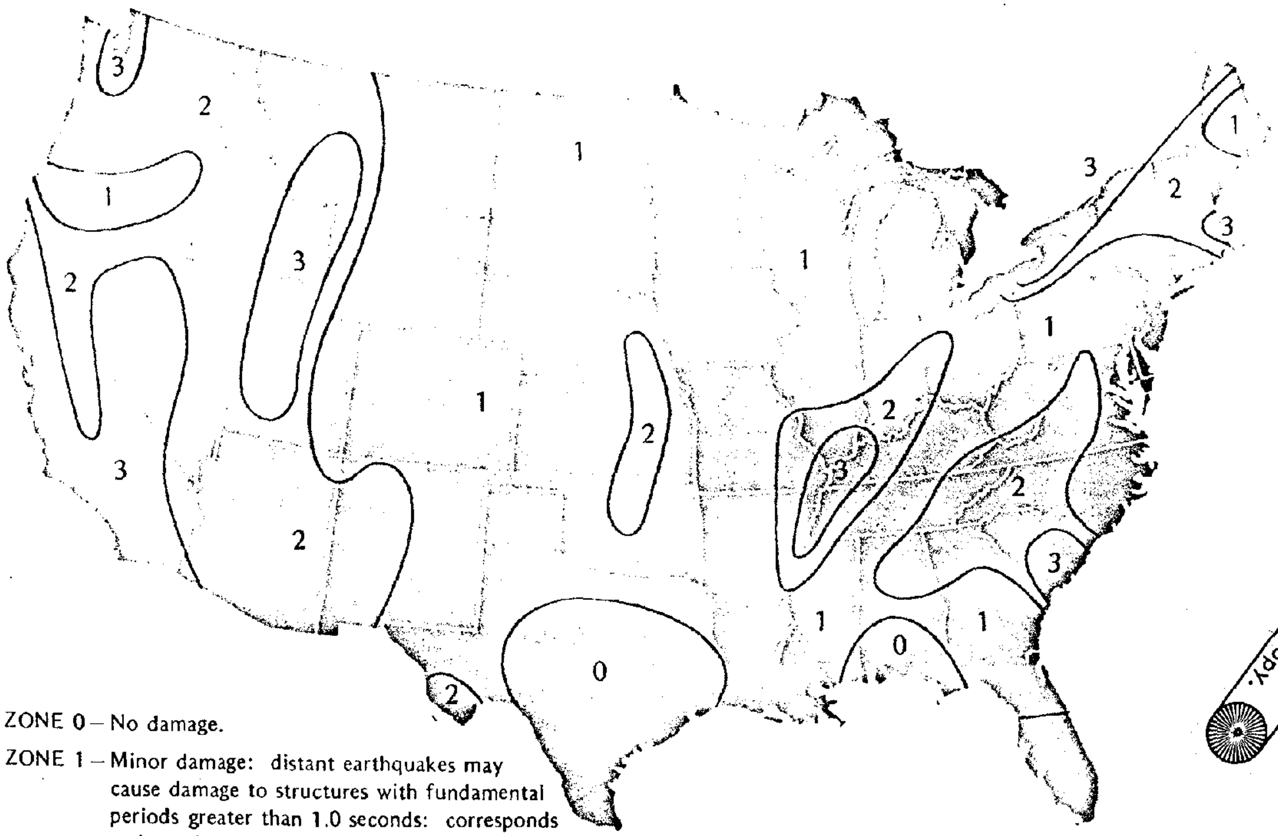
2.2 HISTORICAL PERSPECTIVE ON FLOOD AND EARTHQUAKE INSURANCE

2.2.1 Introduction

Insurance can serve two important purposes in mitigating the consequences of natural hazards. If rates reflect the risk of living in a particular area, then insurance can exercise guidance as to the extent to which hazard prone areas are developed. Secondly, following a disaster, such coverage provides a means of recovery to damaged homes and businesses. Without insurance, victims may be forced to rely on federal disaster relief, conventional bank loans, or in the case of businesses they may declare bankruptcy.

Flood and earthquake insurance are not part of the fire and extended coverage policy which is generally required as a condition for a mortgage. Flood insurance is subsidized by the federal government and sold to homeowners and businesses as a separate policy. Earthquake insurance policies are underwritten entirely by private firms and normally are sold as an endorsement on a fire and extended coverage policy.

Historically, the insurance industry has not promoted the sale of either flood or earthquake insurance because of the fear of large losses should a severe disaster occur[1]. The problem of severe losses is due to the phenomenon of adverse selection, whereby only people in hazard prone areas wish to buy insurance coverage, thus necessitating unusually high rates while at the same time concentrating coverage into risk-prone areas[2]. As a safeguard against catastrophic losses induced by this phenomenon, insurance firms can either build up large reserves or enter into reinsurance agreements to transfer part of the risk to other firms. Both of these actions are costly to them.



ZONE 0 – No damage.

ZONE 1 – Minor damage: distant earthquakes may cause damage to structures with fundamental periods greater than 1.0 seconds: corresponds to intensities V and VI of the M.M.* Scale.

ZONE 2 – Moderate damage: corresponds to intensity VII of the M.M.* Scale.

ZONE 3 – Major damage: corresponds to intensity VIII and higher of the M.M.* Scale.

*Modified Mercalli Intensity Scale of 1931.

Figure 2.2

SEISMIC RISK IN THE UNITED STATES

This map is based on the known distribution of damaging earthquakes and the M.M. intensities associated with these earthquakes; evidence of strain release; and consideration of major geologic structures and provinces believed to be associated with earthquake activity. The probable frequency of occurrence of damaging earthquakes in each zone was not considered in assigning ratings to various zones. Source: US Office of Emergency Preparedness (1972), Vol. 3.

2.2.2 History Of Flood Insurance

The history of flood insurance provides a graphic illustration of how private firms, anxious to market such protection, were severely affected by the problems of adverse selection and catastrophic losses.

In 1897, an insurance company in Illinois offered coverage against flood damage to houses, contents, and livestock along the Mississippi and Missouri Rivers. The move was inspired by the extensive losses from the overflowing of these two rivers in 1895 and 1896. Since the insurance was voluntary, only homeowners and farmers with unusually high risks purchased policies. Although the river was peaceful in 1898, severe floods along these rivers in the following year caused insured losses that were greater than the combination of premiums of the past year and the net worth of the company. Before it could recover from this cataclysmic event, another flood in the same year brought still greater insured losses. Even the home office of the company was washed away in the second flood (Manes, 1938, p. 161).

The next attempt at marketing flood insurance on residential property was in the mid-1920's. At this time insurance magazines praised thirty fire insurance companies for having placed such coverage on a sound basis. As in 1897, this insurance was written only in places extremely susceptible to flooding: low-lying areas in the vicinity of rivers and streams, as well as coastal regions. Following severe flooding in 1927 and 1928 one of the insurance magazines wrote:

> Losses piled up to a staggering total which was aggravated by the fact that this insurance was largely commonly treated in localities most exposed to flood hazard.... By the end of 1928 every responsible company had discontinued this coverage. (Manes, 1938, p. 161)

After the failure in the 1920's, few private insurance firms offered flood insurance on residential property. The rationale for this was summed up in the May 1952 Report on Floods and Flood Damage issued by the Insurance Executive Association:

> Because of the virtual certainty of the loss, its catastrophic nature, and the impossibility of making this line of insurance self-supporting due to the refusal of the public to purchase such insurance at the rates which would have to be charged to pay annual losses, companies generally could not prudently engage in this field of underwriting.

The reluctance of the private insurance industry to write such coverage led to the involvement of the federal government. Interest in federal flood insurance legislation was particularly intense after a set of severe floods and hurricanes in the 1950's and 1960's. Following the disastrous Midwestern floods of 1951 and again after the Missouri River Basin floods of 1952, President Truman proposed a federally backed flood insurance program, but both times Congress did not appropriate the necessary funds.

Hurricanes Connie and Diane, which affected the Atlantic and Northeastern states in 1955, created a clamor among victims for a government backed insurance program. As a result Congress passed the Flood Insurance Act of 1956 which provided for a $3 billion five year flood insurance program to be administered by the newly created Federal Flood Insurance Administration. Rates were to be subsidized 40 percent by the federal government and coverage was to be marketed by private insurance companies. The success of this effort was short-lived. By refusing to appropriate any funds for its operation, Congress quietly killed the first flood insurance program. One journalist commented after the program's demise that:

> The Federal Flood Insurance Administration passed out of existence with the record of having been the shortest-lived government agency in the U.S. history. It never wrote a single policy. It never did a single one of the things that it had been created to do. (National Flood Insurance Association, 1976, p. 3)

Hurricane Betsy in September 1965 finally provided the impetus for successful legislation leading to the current program. Section 5 of the Southeast Hurricane Disaster Relief Act of 1965 (PL 89-339) authorized a feasibility study on flood insurance which was to be undertaken by the Department of Housing and Urban Development. The results of this study were instrumental in initiating Congressional action which eventually culminated in the National Flood Insurance Act of 1968[3].

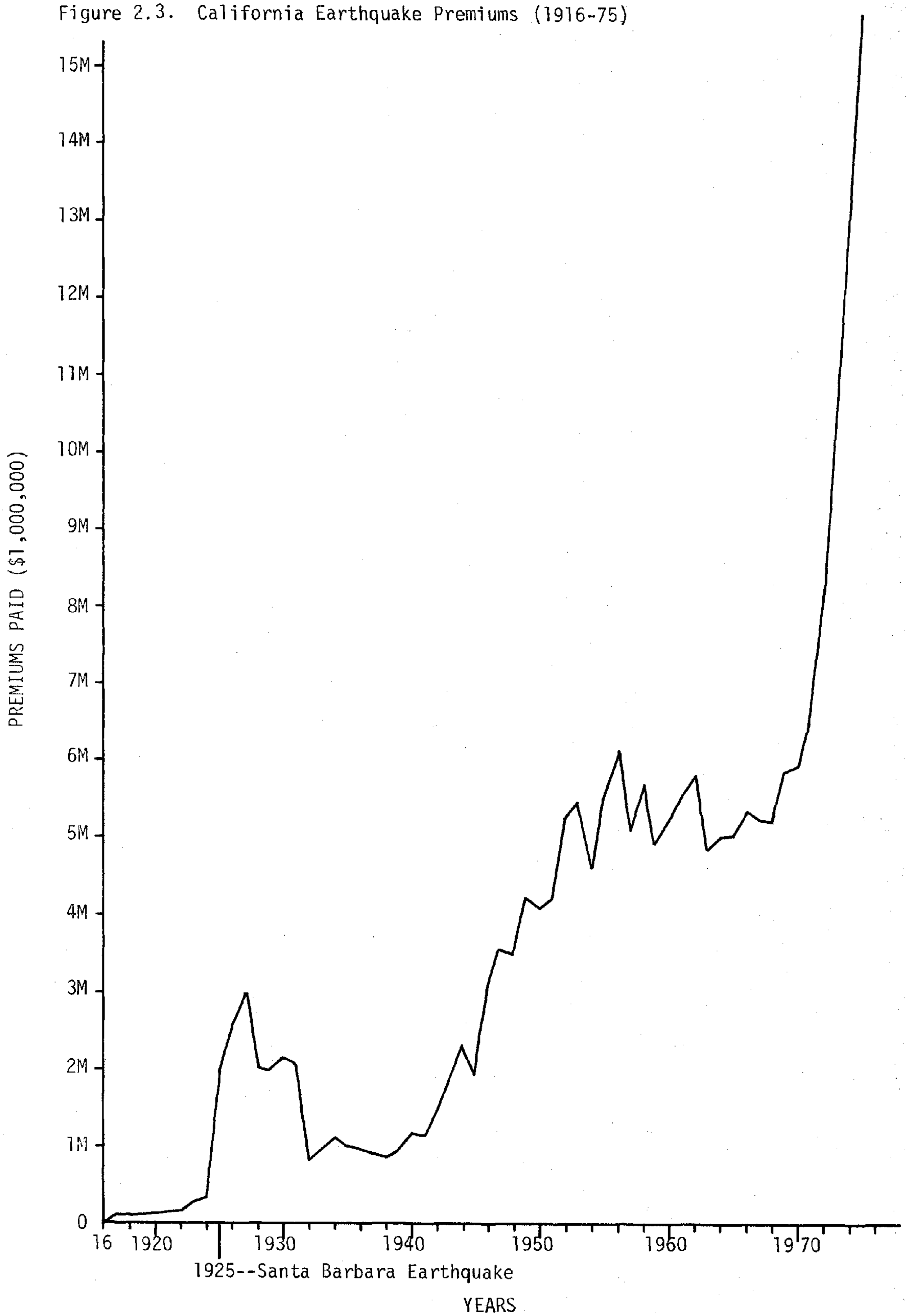
2.2.3 History Of Earthquake Insurance

Earthquake insurance has been widely available in California since 1916 (Steinbrugge, McClure and Snow 1969). At the time it was first written by American-based insurance companies, ten years after the San Francisco earthquake, such coverage was considered a novelty. Little was purchased despite a rate for dwellings of 4 cents per 100 dollars coverage (with a 5 percent deductible). The low demand was largely due to a misconception of earthquake damage. Since over 80 percent of the losses from the 1906 San Francisco earthquake were caused by fire, there was a tendency for the public to generalize from this specific incident. Their attitude was epitomized by a response from one of the homeowners currently residing in San Francisco who was interviewed in our earthquake survey. When asked what damage a severe earthquake in her area would cause to her house and its contents, she replied: "Fire would break out in homes like this. It would be totally damaged. Fire would destroy it." Homeowners and businesses, like this respondent, felt they had no reason to even consider earthquake insurance since they assumed that they would be covered by fire insurance for the bulk of the losses caused by future shocks. The insurance industry shared this view which resulted in low rates, small company reserves, and little reinsurance. Due to negligible earthquake sales in California, the insurance industry was spared significant losses following a quake in 1918 and an even more severe shock in Santa Barbara in 1925.

The Santa Barbara earthquake marked a turning point in the demand for insurance since it caused the public to become more aware of the loss potential from this hazard. For one thing no major fire followed this quake. Secondly, predictions were made of impending earthquakes in the near future in Southern California. The combination of these two factors led to a significant increase in sales immediately following the quake, as shown in Figure 2.3, which details California earthquake premiums paid by year from 1916 through 1975. Following the San Fernando earthquake in February, 1971, coverage has risen markedly though most of this increase has been due to new coverage by business establishments rather than by homeowners. In fact, in 1975 fewer than 5 percent of all homeowners in California were covered by earthquake insurance.

In the aftermath of the Santa Barbara earthquake, insurance companies offering earthquake insurance set up a special department of the Board of Fire Underwriters of the Pacific (today part of the Insurance Services Office). This department issued a standard set of regulations regarding coverage which are still in effect today.

Figure 2.3. California Earthquake Premiums (1916-75)



2.3 PRESENT STRUCTURE OF FLOOD AND EARTHQUAKE INSURANCE

2.3.1 The National Flood Insurance Program

Objectives and Operating Characteristics

The National Flood Insurance Program was enacted in 1968 as a means of offering federally subsidized flood insurance on a nationwide basis through the cooperation of the federal government and the private insurance industry. The federal government, via the Federal Insurance Administration (FIA), identifies flood-prone communities, establishes insurance rates and policy terms, subsidizes premiums, provides reinsurance, sets standards of flood plain management and enforces participating communities hazard mitigation requirements. The writing of flood insurance is overseen by the National Flood Insurers Association (NFIA), an organization which represents a pool of 124 of America's major property and casualty insurance companies. The private insurance industry, under the auspices of NFIA, commits a percentage of the risk capital, bears a portion of the expenses and insured losses, and through licensed insurance agents and brokers sells and processes flood insurance policies. Hence, government and business work in partnership to operate the program. Through an agreement between FIA and NFIA federal flood insurance was first made available in June, 1969.

The aim of the National Flood Insurance Program is to reduce flood disaster losses by encouraging state and local governments to control unwise development of flood plains by instituting appropriate land-use adjustments. This is accomplished by restricting the sale of federally subsidized flood insurance to only those hazard prone communities which have given satisfactory assurance that adequate land-use measures will be implemented and enforced. Furthermore, the subsidized rates are not available on new construction after flood insurance rate maps and elevations are provided since this would encourage further developments in flood-prone areas. However, such properties can be insured at an actuarial rate reflecting average annual damage from a flood.

When the flood insurance program began in mid-1969 it was entirely voluntary. It was assumed that once communities in flood-prone areas learned of the federally subsidized flood insurance they would pass the necessary legislation to enable their residents to purchase coverage. Similarly the residents of the eligible communities were expected to be eager to buy the highly subsidized insurance. This was not the case. Communities were slow to participate in the program, and few individuals within the eligible communities purchased coverage. As George Bernstein, former Administrator of the FIA, said in 1973:

> It is now becoming common knowledge that few people buy insurance... until they are forced to or are in imminent danger of sustaining a severe loss or have already suffered the loss. As we have said for some time, the totally voluntary nature of the program is its major defect. (Bernstein, 1973, p. 5)

By the end of 1973, fewer than 3000 out of 21,000 flood-prone communities in the United States had entered the program and only 274,000 policies had been sold to homeowners residing in these areas. This slow beginning led to the passage of the Flood Disaster Protection Act of 1973 (PL 93-234) by Congress. This legislation, which has remained in force and substantially intact to the present, increases the incentive for flood-prone communities to participate in the program and for residents of these areas to purchase flood insurance.

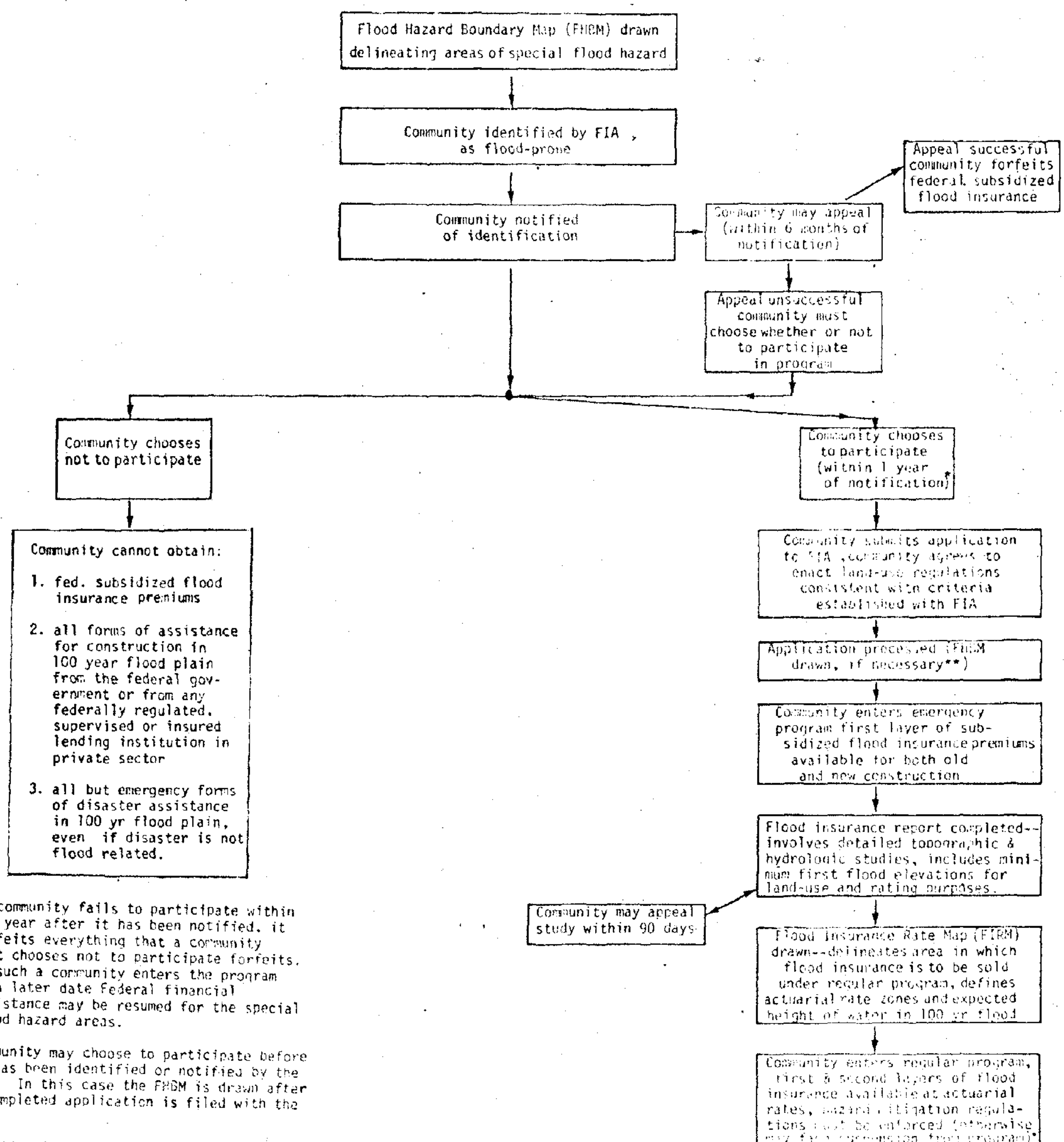
Community Participation and Eligibility

The process for community participation today is shown in Figure 2.4. An identified flood-prone community has the choice of participating in the program or forfeiting the federally subsidized flood insurance and federally related financing for construction that would be located in flood-prone areas. Although any home improvement loan less than $5000 for existing dwellings in non-participating flood-prone areas is permitted, a loan to finance the acquisition of an existing home in a non-participating flood-prone area may only be made within the first year after the area has been identified as being a special flood hazard area.

Once a community becomes eligible, homes and businesses located in the special flood hazard areas (i.e. areas subject to inundation from a flood which have a one percent chance of occurring in any given year) are required to purchase flood insurance as a prerequisite for receiving any type of federal financial assistance (e.g. Veterans Administration, Federal Housing Administration, or Farmers Home Administration mortgage loans) or conventional loans from federally insured, regulated, or supervised lending institutions (e.g. banks insured by the Federal Deposit Insurance Corporation or the Federal Savings and Loan Insurance Administration) for new acquisition or

Page 2-8a

Fig. 2.4 DIAGRAM OF COMMUNITY PARTICIPATION IN THE NATIONAL FLOOD INSURANCE PROGRAM



*If community fails to participate within one year after it has been notified, it forfeits everything that a community that chooses not to participate forfeits. If such a community enters the program at a later date Federal financial assistance may be resumed for the special flood hazard areas.

**Community may choose to participate before it has been identified or notified by the FIA. In this case the FHBM is drawn after a completed application is filed with the FIA.

+Subsidized insurance is still available on first layer for those so covered previously under emergency program and for structures erected prior to the effective date of the FIRM.

construction purposes. Homeowners with existing mortgages at the time the community enters the program have a choice as to whether or not they want to purchase flood insurance. In essence, the federal government helps pay the costs of protecting homes and businesses currently located in hazard prone areas from future losses through subsidized rates, while requiring that the communities make those areas safer places to live.

The NFIP has two levels of community eligibility--the emergency program and the regular program. To enter the emergency program a community must submit a completed application to the FIA and adopt preliminary land-use control measures pursuant to FIA regulations. The community's application must include documentation of the community's legal authority to control land-use; a statement of measures already taken to reduce flood hazards; maps delineating the flood-prone areas; and a history of the flood experience of the community. The application must also show that the community has enacted and will enact further land-use regulatory measures consistent with the criteria established by FIA for reduction of flood damage.

The minimum flood plain management measures for these hazard prone areas are incremental, depending upon the amount and type of data available. A Flood Hazard Boundary Map is drawn that identifies those areas of the community that have a special flood hazard. In order to maintain eligibility in the NFIP under the emergency program, the community's flood plain management measures must include the following for the special flood hazard areas:

1. Require building permits,
2. Review permits to determine whether proposed building sites will be reasonably safe from flooding,
3. Provide that new construction, substantial improvement, or major repairs in locally known hazard areas must:
   a. be anchored to prevent movement or collapse,
   b. be built with flood resistant materials and equipment,
   c. be built using construction methods and practices that minimize flood damage, and
4. Regulate subdivisions and new developments to:
   a. minimize flood damage,
   b. locate and construct new utilities to minimize or eliminate flood damage,
   c. provide adequate drainage,
   d. eliminate or minimize infiltration in new water and sewer systems,
   e. design on-site waste disposal systems to avoid impairment by flooding.

Once a community is eligible under the emergency program and a Flood Hazard Boundary Map has been issued, the FIA undertakes detailed flood studies in order to determine the actuarial rates to be charged. Detailed topographic (elevation) and hydrologic (water distribution) studies are performed, at no cost to the community, to develop technical information about the base flood elevation that has, on the average, a one percent chance of occurring each year (100 yr. flood). Using the data gathered in these studies, a flood insurance report is prepared for the community, and after a period of time in which the community may contest and appeal the findings of the report, a Flood Insurance Rate Map is published with an effective date. The rate map both delineates the special hazard areas and divides the mapped area into zones according to flood hazard factors. These factors translate flood frequency information into rates based on first floor elevations. A community enters the regular program (as distinguished from the emergency program) at the time the rate map is completed.

To be eligible for, and to remain in, the regular program, certain ordinances must be adopted. For example, all new or substantially improved residential structures[4] must have their lowest floor, including basement, elevated to or above the level of the 100 year flood. New and substantially improved nonresidential structures must be similarly elevated, or must be flood proofed to or above the 100 year flood level in accordance with standards defined by the Corps of Engineers in their publication Flood Proofing Regulations (1972).

In coastal high hazard areas, in addition to applying elevation and flood proofing standards for new construction, communities must ensure that existing structures that are repaired, reconstructed, or improved are:

1. located landward of mean high tide,
2. elevated above the 100 year flood level and anchored to piles, and
3. provided with space below the lowest floor free of obstruction or constructed with "breakaway walls".

Terms of a Policy

Flood insurance policies are written for one year terms under both the regular and emergency programs. Each policy carries a minimum deductible of two hundred dollars or two percent of the loss, whichever is greater. Policies may be written in any eligible area by any licensed property and casualty agent or broker. The rates and limits of insurance shown in Table 2.1 are dependent upon whether the community is in the emergency or regular program.

When a community initially qualifies for the sale of flood insurance under the emergency program limited amounts of coverage are available at subsidized rates for virtually every building, as well as the contents, regardless of the risk.

After a rate map has been prepared, and the community enters the regular program, the available limits are double those available under the emergency program. The second layer of coverage at actuarial (non-subsidized) rates is available, together with the subsidized first layer of coverage, for all existing structures regardless of location. Under the regular program, for new structures in the special flood hazard areas, both layers of coverage are made available at actuarial rates reflecting the degree of flood risk.

Actuarial premium rates reflect the risk for new construction built at required elevations. In some cases these rates are actually lower than the subsidized rates; however, the rates for new structures built improperly in the special flood hazard areas are very high.

If the owner of a single family dwelling unit has purchased sufficient insurance to cover at least eighty percent of the structure's value (or the maximum amount of coverage available to him, if that amount is less), then a claim would be paid at full replacement cost. Otherwise, the insurance payment is based on the actual cash value of the losses.

Structure of the Program

The structure of the flood program is different from other types of insurance offered by the private industry. Normally an insurance agent deals directly with the firm(s) he represents. As shown in Figure 2.5, the agent that writes flood insurance must deal with a single NFIA servicing company in his area. Servicing companies are insurance firms appointed (generally on a statewide basis) to disseminate flood insurance information to the public and to agents, to process all insurance policies, and to handle the payment of claims in that state or region. Servicing companies are reimbursed on a sliding scale determined by the volume of flood insurance they handle.

TABLE 2.1

FLOOD INSURANCE RATES

	Regular Program[2]				
	Emergency Program[1]				
	First Layer		Second Layer		
	Limit	Subsidized Rates (Per $100)	Limit	Actuarial Rates	Total Limits of Coverage
Single Family Residential	$35,000	25¢	$35,000	Varies	$70,000
Other Residential	100,000	25¢	100,000	Varies	200,000
Non-Residential	100,000	40¢	100,000	Varies	200,000
Contents, Residential (per unit)	10,000	35¢	10,000	Varies	20,000
Contents, Non-Residential (per unit)	100,000	75¢	100,000	Varies	200,000

NOTES: 1. Only the first layer of coverage is available under the Emergency Program.

2. a. Full coverage is available under the Regular Program for all structures in the community.
   b. New construction and substantial improvements in the flood hazard areas must pay actuarial rates for all coverage.
   c. All existing structures must pay actuarial rates for the second layer of coverage and have the option of paying either the subsidized or actuarial rate for the first layer, whichever is lower.
   d. New construction outside the flood hazard area is treated the same as existing structures.
   e. The maximum actuarial rate for 1-4 family residential structures is 50¢ per $100 of coverage under certain conditions.

SOURCE: Federal Insurance Administration.

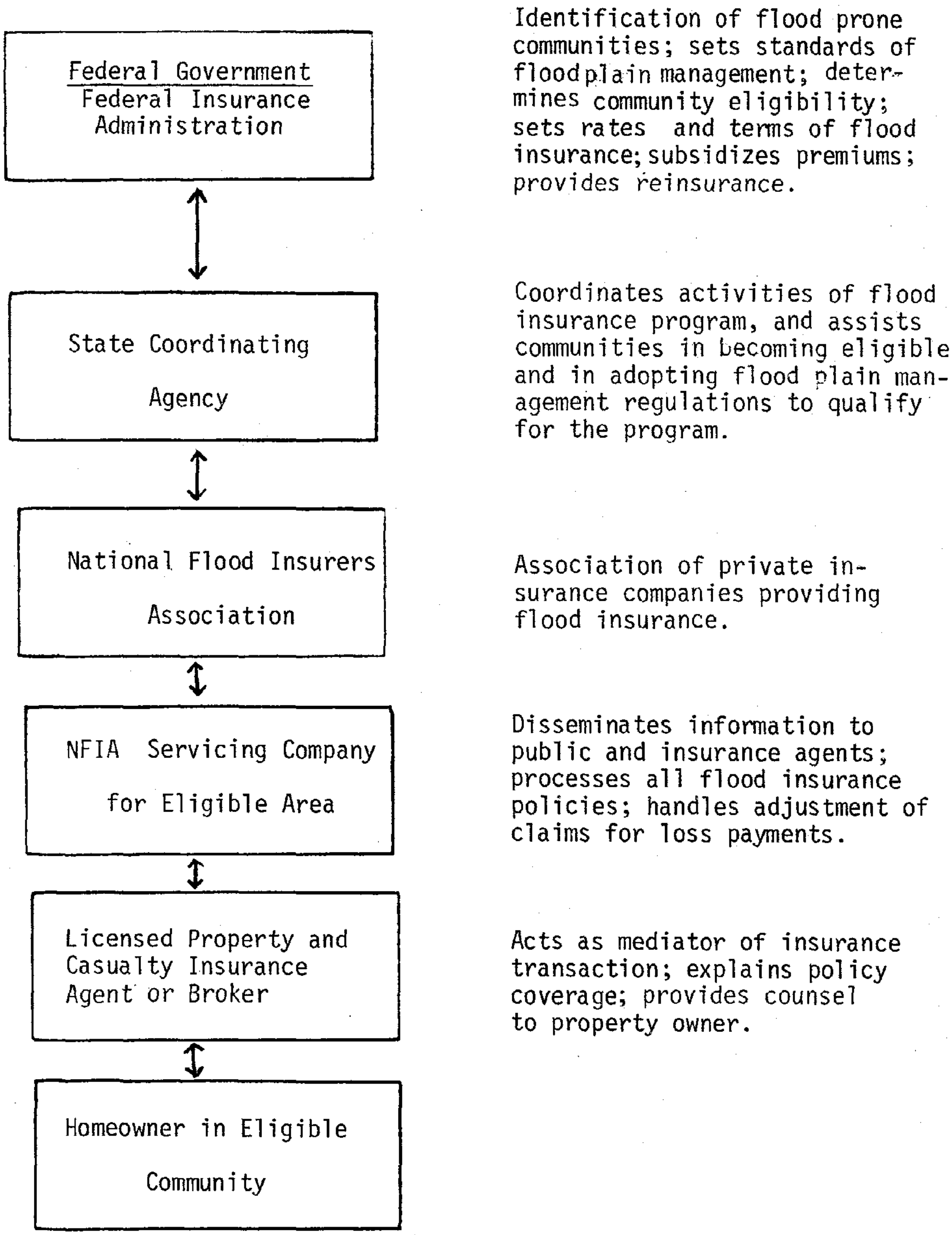


Fig. 2.5. Structure of National Flood Insurance Program

Rates and terms for flood insurance are fixed at the federal level rather than by the individual insurance firms or state regulated rating bureaus. Figure 2.5 also shows that reinsurance is made available to private firms through the federal government. For most other kinds of property insurance, firms enter into such agreements with private reinsurers. The governor of each state also appoints a coordinating agency to integrate the activities associated with the flood insurance program in that state. Such an organization does not exist in other lines of insurance.

Commission rates to agents are fifteen percent of the flood insurance premium, or $10, whichever is higher. Due to the amount of paper work involved and the time required to become familiar with the rating manual, agents have a limited incentive to actively market this coverage. This problem is exacerbated by a lack of interest in flood coverage by many residents even though they face serious potential problems[5]. The agent who initiates personal contact may find that his efforts go largely unrewarded. He is thus likely to curtail future efforts in marketing policies.

If a homeowner eligible for flood insurance does not purchase coverage and suffers flood damage, he can still receive a federal disaster loan from the Small Business Administration or Farmers Home Administration. As a condition for such assistance, however, he will be required to purchase flood insurance. In some cases, victims who cannot afford flood insurance may be provided coverage through a state grant. This provision was incorporated in the Disaster Relief Act Amendments of 1974. There is no guarantee that victims will renew their flood policy when it expires.

Despite the lack of active participation by agents, the National Flood Insurance Program has grown rapidly, as shown in Figure 2.6. The substantial increase in the number of communities and policy sales since 1974 has been related to the passage of the Flood Disaster Protection Act of 1973 with its strong inducement for participation in the program and the formal requirements by most banks and financial institutions for flood coverage as a condition for a new mortgage.

The positive impact that this legislation has had is best illustrated by comparing the number of policies in force and insurance claims paid, in areas affected by both Tropical Storm Agnes in 1972 and Hurricane Eloise in 1975. Although Eloise caused approximately sixty percent less damage to homes and

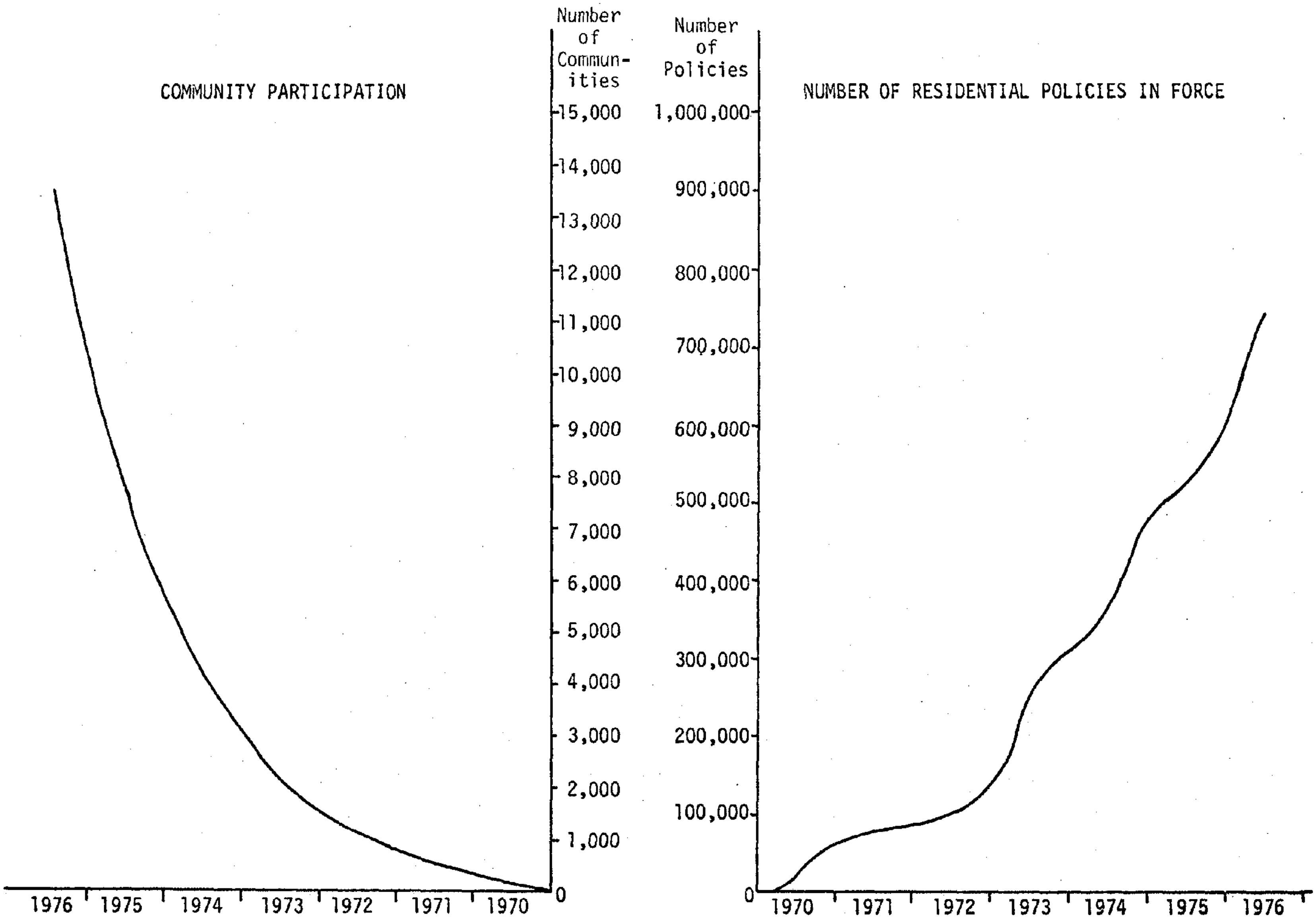


Figure 2.6. The Historical Growth of the National Flood Insurance Program.

contents than Agnes, the amount of insurance claims resulting from the 1975 hurricane was more than ten times greater than it had been after the 1972 storm. The number of policies in force in all states affected by both disasters rose from 61,000 to 258,000 in this three year period (U.S. Congress, 1975)[6].

Of the 21,000 flood-prone communities in the United States, 14,059 were part of the emergency program and another 794 were in the regular program as of September 30, 1976. As of July 31, 1976, 739,000 residential policies were in force. The distribution of communities participating in the program and the residential policies in force by states is shown in Figure 2.7. The Northeastern states have the most communities enrolled, though practically all of these localities are in the emergency program. The Gulf Coast states have the largest number of communities participating in the regular program and the most residential policies in force of any region of the country.

2.3.2 Earthquake Insurance In California

Although earthquake insurance is written by private firms throughout the United States, approximately three-quarters of all policies are purchased in California. Most of the earthquake insurance coverage in force is on commercial and industrial properties. Residential coverage is readily available; however, few homeowners have had an interest in such protection. In 1975 less than 5 percent of homeowners residing in California were covered by an earthquake insurance policy.

Earthquake insurance practices differ slightly between the Pacific Coast states and the remainder of the United States. In the West, earthquake insurance usually is written as an endorsement to the standard comprehensive homeowners policy and is subject to a minimum deductible of five, ten, or fifteen percent, depending upon the type of construction.

The structure of the California earthquake insurance industry is similar to that of most other types of property insurance. Figure 2.8 indicates that earthquake insurance is available from licensed property and casualty insurance agents. Most insurance firms writing earthquake insurance coverage in California use the rates developed by the Insurance Services Office (ISO) although they are not required to do so. Where ISO rates are not used, the deviation averages ten to fifteen percent in either direction.

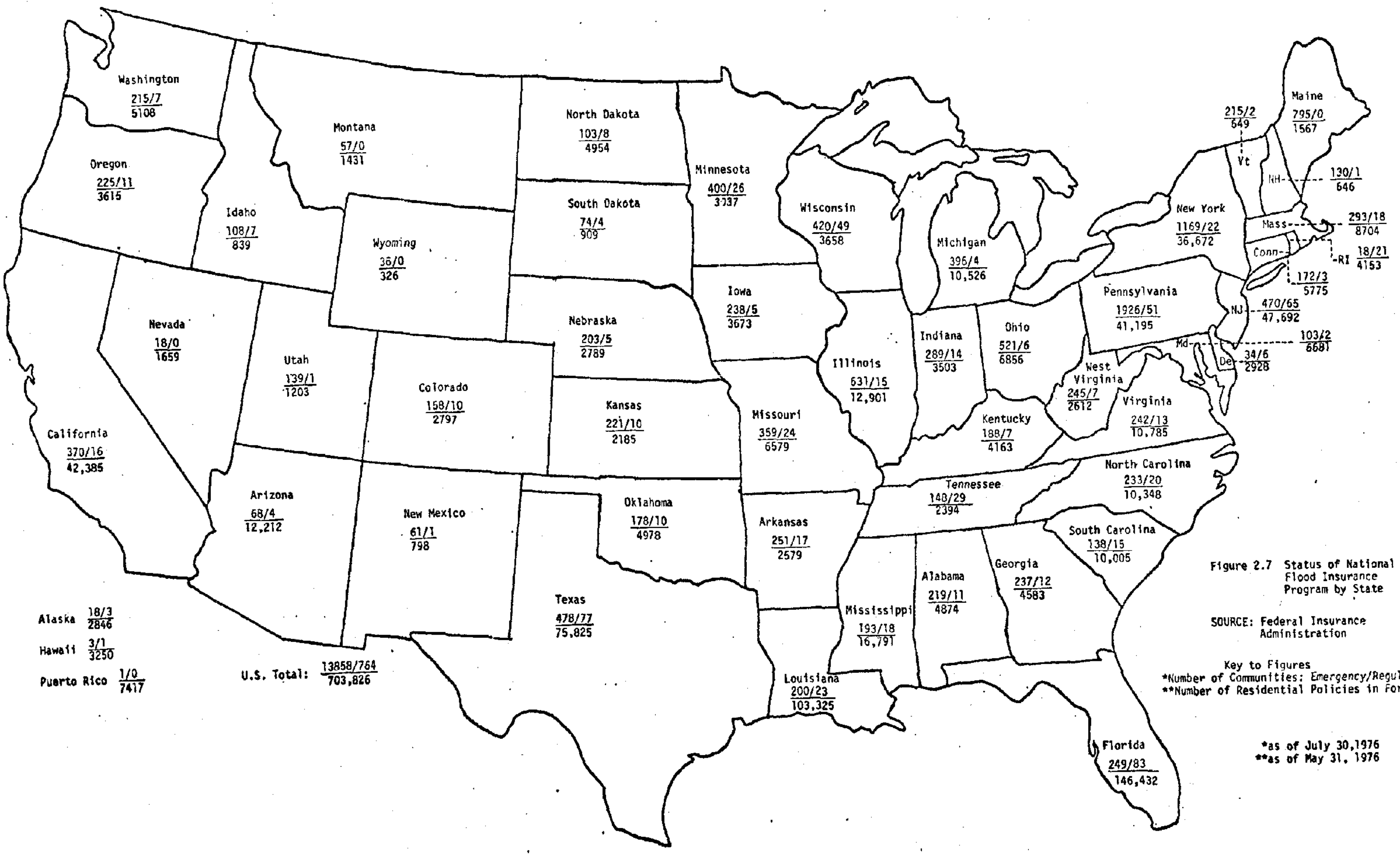


Figure 2.7 Status of National Flood Insurance Program by State

SOURCE: Federal Insurance Administration

Key to Figures
*Number of Communities: Emergency/Regular
**Number of Residential Policies in Force

*as of July 30, 1976
**as of May 31, 1976

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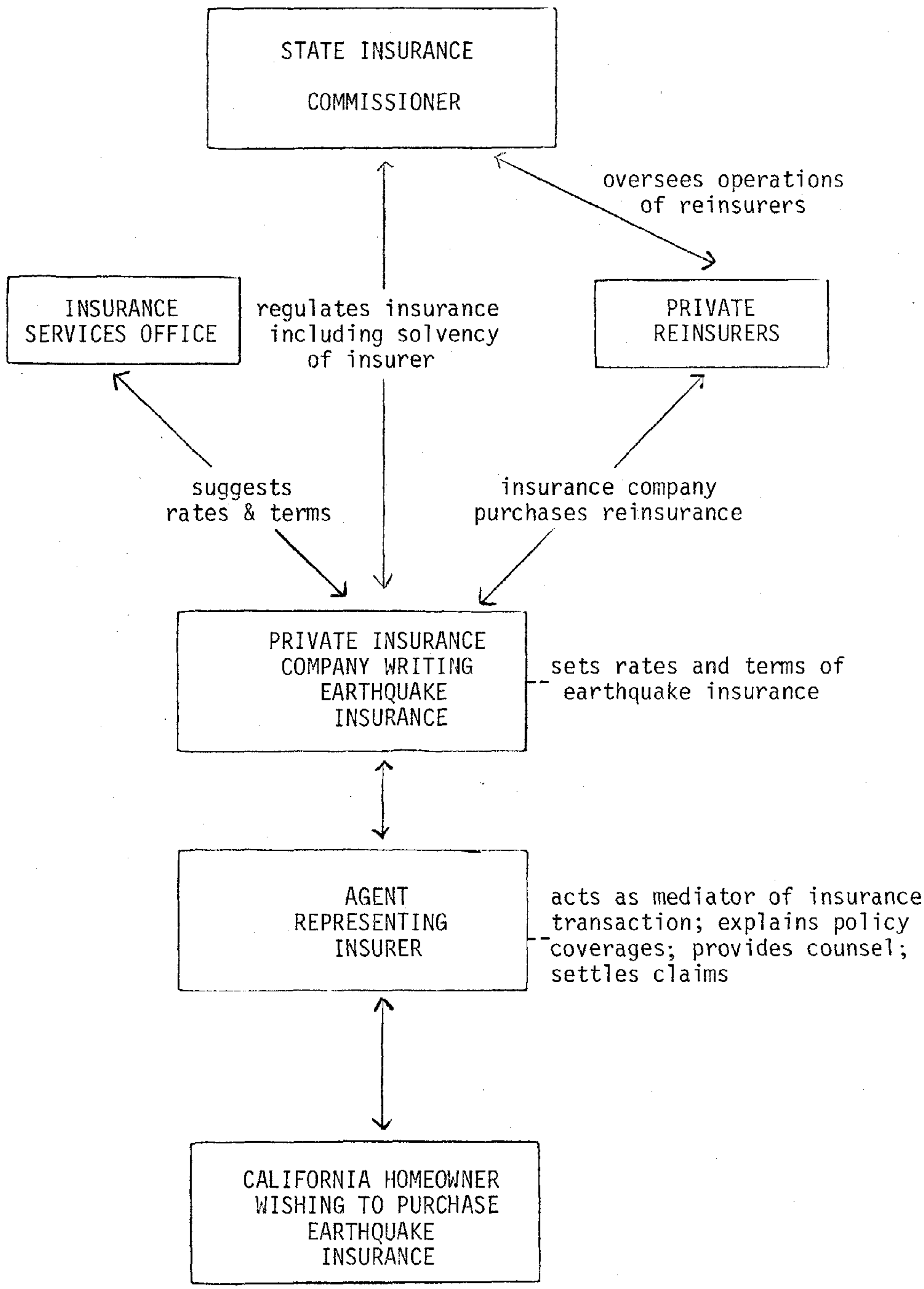

Fig. 2. 8 Structure of California Earthquake Insurance Industry

Rates are a function of the risk zone in which the structure is located and its type of construction. For California there are three different hazard zones and eight types of construction ranging from frame dwellings (the most stable), to buildings with clay, tile, unreinforced hollow concrete block, or adobe walls (the most vulnerable). Table 2.2 shows how the premiums vary by type of construction and hazard zone. Rates for frame dwellings, which comprise almost all residences in the state, vary from $0.11 to $0.23 per $100 coverage, depending on their location.

There is a five percent deductible on the actual cash value of the structure. This deductible enables insurance companies to provide coverage at the above premiums while allowing the homeowner to protect himself against catastrophic losses should his dwelling be substantially damaged or destroyed by a quake. Without the deductible, a number of controversial claims would be filed:

> ...for such things as plaster cracking and maintenance deficiences which result from settling and normal aging of a dwelling and are in no way connected with earthquake damage. (Brinley, 1973, p. 6)

Insured individuals are reimbursed at full replacement cost (minus the deductible) if at least seventy percent of the value of the structural is insured against earthquake damage. When the amount of insurance is less than seventy percent of the value of the structural damage then the company only pays a portion of the replacement cost, with the actual amount determined by how much insurance was taken out.

To safeguard against large losses, companies writing earthquake insurance generally enter into agreements with private reinsurers to transfer part of their risk. Should all homes in California be required to purchase insurance as a condition for a mortgage, the industry fears that there would not be sufficient reinsurance coverage to absorb the probable maximum loss from a damaging quake in a populated area of the state (U.S. Department of Housing and Urban Development, 1971, p. 55).

Earthquake insurance, like all lines of property insurance, is regulated by the insurance commissioner of the state in which it is written. The principal role of the commissioner is to assess the solvency of the insurers and reinsurers writing in that state and to ascertain that insurance rates are not excessive, inadequate, or unfairly discriminatory.

TABLE 2.2

CALIFORNIA EARTHQUAKE INSURANCE RATES, BUILDING RATES PER $100 COVERAGE
(Insurance Services Office)

Type of Construction	Class of Risk	Mandatory Deductible	Zone 1	Zone 2	Zone 3
Small wood frame structures as dwellings not over 3,000 square feet and not over 3 stories	I	5%	.15	.11	.23
One story all steel. Single or multistory steel frame, concrete fireproofed, concrete exterior panel walls, concrete floors and roof--moderate wall openings; otherwise Class V.	II	5%	.25	.19	.38
Single or multistory concrete frame, concrete walls, floors and roof--moderate wall openings, otherwise Class VI.	III	5%	.30	.23	.45
Large area wood frames and other wood frames not falling in Class I.	IV	5%	.35	.25	.53
Single or multistory steel frame, unreinforced masonry exterior panel walls, concrete floors and roof.	V	5%	.35	.25	.53
Single or multistory concrete frame, unreinforced masonry exterior panel walls, concrete floors and roof.	VI	5%	.40	.30	.60
Walls of cast in place or precast reinforced concrete, reinforced brick, reinforced concrete block, or reinforced brick, with floors and/or roof other than reinforced concrete. Reinforcing must be adequate.	VII	10%	.75	.56	1.12
Bearing walls or unreinforced adobe, hollow clay tile, or unreinforced hollow concrete block.	VIII	15%	2.50	1.87	3.75
Buildings which can resist earthquake of 1906 type with minimum to slight property damage.	Special Rate	5%	*	*	*

NOTES: All rates quoted in this table require 70% coinsurance. Rates in this table are for the Earthquake Damage Assumption Endorsement. All buildings during the course of construction in California are placed in one of the following classifications: I, IV, V, VI, VII, or VIII. Rates given in this table are for use with the mandatory percentage deductible. To obtain rates for other optional percentage deductible reduce rates shown in table for each percent of deductible in excess of the mandatory percentage as follows: 2% on Class I to VI and Class-Special Rate, and 1% on Class VII and VIII. The maximum percentage deductible permitted is 40%.

*Rates will be quoted upon application to ISO.

2.4 COMPARISON OF FLOOD AND EARTHQUAKE COVERAGE

Table 2.3 outlines the key differences between flood and earthquake insurance. Flood insurance has been marketed since 1969 by private licensed property and casualty agents as a separate policy with rates on existing homes subsidized by the federal government. Coverage is only available to residents in flood-prone communities who are participating in the National Flood Insurance Program. Rates and terms for flood insurance are set by the Federal Insurance Administration. Reinsurance is available from the federal government.

Earthquake insurance is similar to most lines of property insurance. It is marketed by licensed property and casualty agents and is normally written as an endorsement to a homeowners policy. The coverage has been readily available in California since 1916, at non-subsidized rates set by private insurance firms according to state regulations. Reinsurance is available to companies through private reinsurers.

2.5 SUMMARY

This chapter briefly discussed the nature of the flood and earthquake hazards and then focused on the availability of insurance against losses from these two types of disasters.

Both flood and earthquake insurance were initially marketed by private companies. The historical parallel between the two types of coverage ends there. From 1928 until 1969, few firms offered flood coverage on fixed residential property. It was not until the National Flood Insurance Program (NFIP) was established, in 1969, that coverage was made available on a nationwide basis. Earthquake insurance, on the other hand, has been marketed by private companies since the early 1900's.

In the flood program, federally subsidized insurance is marketed by private companies to homes and businesses in a flood-prone area, but only after the community has taken positive steps toward reducing potential losses by adopting permanent land-use measures and building code regulations with effective enforcement procedures. New construction can be insured at an actuarial rate reflecting average annual damage from a flood. A program of government reinsurance, whereby companies pay a small charge for protection

TABLE 2. 3

COMPARISON OF FLOOD AND EARTHQUAKE COVERAGE FOR SINGLE FAMILY RESIDENTIAL PROPERTY

	Flood	Earthquake (California)
Provided by	National Flood Insurers Association with the cooperation of the federal government as specified by the National Flood Insurance Act of 1968	Private insurance companies
Marketed by:	Any licensed property and casualty agent or broker	Any licensed property and casualty agent representing an insurance firm offering the coverage
Written as:	Separate flood insurance policy	Generally as an Earthquake Damage Assumption Endorsement to homeowners policy
Coverage:	Damage to insured buildings or contents resulting from floods, mudslides or flood-related erosion	Earthquake caused damage to insured buildings or contents. No coverage for loss from fire, explosion, flood or tidal wave resulting from earthquake
Government subsidized:	Yes, for existing structures in participating communities	No
Deductible:	2% of loss or $200, whichever is greater. Applied separately for buildings and contents	5% of actual cash value of policy
Payment of losses:	Replacement cost if insurance covers at least 80% of structure's value or maximum available coverage, whichever is less. Otherwise actual cash value of losses	Replacement cost if insurance covers at least 70% of structure's value. Otherwise homeowner pays portion of loss through coinsurance clause
Written since:	1969	1916
Where written:	Only in participating flood prone communities	Anywhere in the state
Term:	One year	Length of term of the policy to which the endorsement is attached
Regulated by:	Federal Insurance Administration	State Insurance Commissioner
Rates set by:	Federal Insurance Administration	Private insurance firms according to state legislators. Most insurance firms use Insurance Services Office rates.
Reinsurance:	From Federal Government	From private reinsurers.

from unusual losses, allays the insurance industry's concern with possible bankruptcy of firms following a severe disaster.

For the first four years of its operation, the NFIP was entirely voluntary. Yet relatively few communities chose to join the program, and demand for coverage by residents in these areas was low. As a result the Flood Disaster Protection Act of 1973 was passed. Today flood-prone communities which do not participate in the program forfeit federally-related financing for projects that would be located in special flood hazard areas. If an area joins the program, homes and businesses are required to purchase flood insurance as a prerequisite for receiving any type of financial assistance for construction or acquisiton of property. As a result of these new requirements the flood insurance program has grown rapidly since 1973.

Earthquake insurance is available in California through licensed property and casualty insurance agents representing private firms and is regulated by the state insurance commissioner. Most insurance firms writing coverage use the rates developed by the Insurance Services Office although they are not required to do so. Rates on wood-frame homes normally range from $0.11 to $0.23 per $100 coverage depending on the hazard zone in which the structure is located. There is a five percent deductible on the actual cash value of the policy. Reinsurance coverage is available from private firms.

One reason that many agents have not actively marketed earthquake policies in the past is that their companies are concerned with being able to obtain a sufficient amount of reinsurance to protect themselves. However, even when attempts were made to encourage homeowners to purchase coverage, there was little interest in such protection. In 1975, less than five percent of homeowners residing in California were covered by an earthquake insurance policy.

FOOTNOTES

[1] When the insurance industry actually promoted earthquake insurance in California after the San Fernando quake there was little interest in coverage by homeowners (see Chapter 1, section 1.2.1).

[2] Akerlof (1970) and Williamson (1975) have suggested that the problem of adverse selection is related to asymmetries in available information between the individual considering purchasing coverage and the insurance company offering policies. For example, a homeowner on a flood plain will be more aware of the potential damage to his home than the company marketing coverage unless the agent is willing to inspect each property individually. Since it is easier for the consumer to assess the risks involved than the insurance company, the average condition of property in relation to the hazard would deteriorate as the premium rises. As a result it is possible that no insurance sales will take place at any price.

[3] A more detailed discussion of the history of the federal involvement in flood insurance can be found in a booklet issued by the National Flood Insurers Association (1976).

[4] A substantial improvement is defined to be an improvement or repair of a structure, the cost of which equals or exceeds fifty percent of the market value of the structure before the improvement is started or the damage has occurred.

[5] A 1975 survey of independent agents operating in New York, New Jersey, and Connecticut revealed that 36 percent do not advise their clients of the availability of flood insurance. The major reason given for not providing this information was the agent's belief that their clients are not interested in flood insurance. Inadequate commissions were cited by a substantial minority of agents as a reason for avoiding the flood program, but this rationale was far outranked by the lack of client interest (Cummins and Weisbart, 1977).

[6] A detailed evaluation of the National Flood Insurance Program as it relates to flood plain management appears in Anderson (1974) and Platt (1976).

CHAPTER 3
THEORETICAL PERSPECTIVES

3.1 INTRODUCTORY REMARKS

Our primary interest in this book is in understanding individual decision processes regarding low probability events so that this knowledge can be utilized to develop public policies with respect to natural hazards. Up to now policy recommendations regarding the adoption of protective activities and hazard mitigation measures by individuals have been based on normative models of choice rather than on descriptive models. In particular, economists have relied on the expected utility model as a basis for recommending alternative courses of action.

A principal argument for using such a theory is that it is based on a set of postulates that to its advocates "appear as convincing as the rules of logic" (Marschak, 1968, p. 49). These axioms imply that the consistent man behaves as if he assigns probabilities to different states of nature (e.g. chance of a severe flood), assigns numerical utilities to the possible results of each course of action (e.g. a severe flood with no insurance protection), and then chooses the action which will give him the highest expected utility.

In this chapter we provide a brief overview of expected utility theory and show how it might be used to evaluate whether or not insurance is an attractive option. The main purpose in discussing this theory is to indicate how it can be subjected to empirical testing in later chapters using data from the field survey and controlled laboratory experiments. We then propose a sequential model of choice as an alternative way of viewing consumer decision making with respect to insurance purchases. A set of hypotheses implied by this model will also be examined in later chapters using data from the field survey and controlled laboratory experiments.

3.2 A MODEL OF INSURANCE BASED ON EXPECTED UTILITY MAXIMIZATION

3.2.1 Basic Principles *

The objective of expected utility theory is to provide a rational means for making decisions under conditions of uncertainty. The theory is normative in intent, concerned with prescribing the course of action that will conform most fully to the decision maker's own goals, expectations, and values.

For simple problems involving decisions under uncertainty the situation can be represented by a payoff matrix in which the rows correspond to alternative actions that the decision maker can select, and the columns correspond to possible states of nature. Expected utility theory is designed to determine what the optimal course of action should be.

An illustration of such a payoff matrix is provided in Table 3.1 where a homeowner is considering one of two options: not purchasing flood insurance or buying a policy covering the entire market value of his property.

Table 3.1

Example of a Payoff Matrix

			States of Nature	
			Severe Flood	No Flood
	A_1	Do Not Purchase insurance	no insurance severe flood (-2000)	no insurance no flood (0)
ALTERNATIVES				
	A_2	Purchase insurance covering market value of house	insurance and severe flood (-100)	insurance and no severe flood (-100)

For simplicity, assume two states of nature: a severe flood or no flood. The values in the cells of Table 3.1 represent the homeowner's utilities for the various consequences. If the probability of a severe flood and no flood are taken to be 0.1 and 0.9, respectively, we can compute the expected utility for each action, A_i, [i.e. $E[U(A_i)]$ as follows:

$$EU(A_1)=0.1(-2000)+0.9(0)=-200$$
$$EU(A_2)=0.1(-100)+0.9\ (-100)=-100$$

----

* - The material in this section can be skipped without loss of continuity.

In this situation, the individual will purchase insurance because it has greater expected utility than not buying a policy. Von Neumann and Morgenstern (1947) developed a formal justification for the expected utility criterion. They showed that if an individual's preferences among gambles satisfied certain basic axioms of rational behavior, then utilities could be assigned to outcomes in such a way that choices could be described as maximizing expected utility. Savage (1954) later generalized the theory to allow the probabilities to be subjective or personal, in place of objective data[1].

3.2.2 Application To Insurance Decisions *

The above framework can be extended to the more general case where the individual can buy any amount of insurance protection rather than being restricted to the extremes of full coverage or no protection. The utility function is thus assumed to be continuous over some relevant range. We know that those individuals with low estimates of the premium in relation to the probability of a disaster and resulting loss are most likely to purchase insurance. We need to make this statement more precise so we can test the expected utility theory using data from the field survey. A convenient way of treating this problem is to utilize a "state-preference" model.

This approach, formulated by Arrow (1953), recognizes that individuals have the opportunity to purchase tickets which can be cashed in for money if certain states of nature occur. Insurance is an excellent example of such a ticket: a policyholder can only collect when a certain state of nature, such as a flood or earthquake causing damage to his property, occurs[2].

We will consider the case where there are only two states of nature: disaster or no disaster and the person has the same utility curve whether or not he suffers a disaster[3]. To determine an optimal course of action, a person must have subjective estimates of the following variables:

p = cost per dollar value of protection (i.e. insurance premium)
z = probability of the disaster
L = loss resulting from the disaster
t = percent tax write-off on uninsured losses[4]

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* - The material in this section can be skipped without loss of continuity.

f = interest rate differential on uninsured losses due to federally subsidized disaster loans

The individual has pre-disaster wealth or assets (W) and is assumed to be averse to risk. He must then determine how much insurance coverage (I) he should purchase against a potential loss (L), so as to maximize his expected utility. Whenever the optimal amount of insurance protection (I*) is positive but less than the value of the potential loss (L), then coverage is determined by

$$\frac{(1-z)p}{z(1-p-t-f)} = \frac{U'[W-L+(1-p)I + (t+f)(L-I)]}{U'[W-pI]} \qquad (3.1)$$

where U' represents the marginal utility of a particular wealth level[5].

The left-hand side of (3.1) indicates the ratio of the expected cost of insurance should a disaster not occur (1-z)p to the expected net gain in assets from insurance should a disaster occur (z(1-p-f-t)). We will define this "contingency price ratio" to be R. The right-hand side represents the ratio of marginal utility of wealth in a "disaster state" to marginal utility of wealth in a "non-disaster" state if I dollars of insurance are purchased.

Let us now consider how the optimal amount of insurance protection (I*) varies with R. If R=1, then the right-hand side of (3.1) will be equal to 1 if I*=L, so that the homeowner will want full insurance protection. For values of R below 1 insurance is even more attractive than before, so that a person would like to purchase more insurance than his maximum loss L, if he were allowed to do so. Since he isn't, we know that I*=L whenever R<1. Naturally as R increases above 1, insurance becomes less attractive. At a high enough premium, an individual will _not_ want to purchase any insurance. Let R* represent the smallest value of R at which the individual would prefer to have no coverage at all. This value represents the ratio of the marginal utility of post-disaster wealth to pre-disaster wealth if the individual does not purchase any insurance. Whenever R>R* the optimal value of I*=0.

As one would predict, insurance will be most attractive for low income homeowners who expect severe damage and do not anticipate receiving financial disaster assistance from public agencies. Individuals in a high income tax bracket with an expectation of liberal disaster relief from the federal government will have a disincentive to purchase an insurance policy. In addition, should the homeowner expect a forgiveness grant of G dollars to restore some of his property damage from a disaster, then his estimate of net loss in equation (3.1) will be L-G and insurance will be even less attractive than without the grant provision.

3.2.3 An Illustrative Example

In order to evaluate how accurately the expected utility model describes insurance behavior, it is necessary to elicit information from a homeowner on his estimated chances of a disaster (z), the associated loss to his property (L), as well as his estimate of the insurance premium (p). Furthermore, it is necessary to know how much the homeowner expects from various sources should he suffer losses and be uninsured: his tax bracket for writing off losses (t), any grants he expects as part of federal disaster relief (G), and the interest rate differential due to federally subsidized loans (f). By constructing a person's utility function based on his current wealth (W), it can be determined how much insurance, if any, he should purchase to maximize his expected utility.

The following example illustrates how this data would be utilized to make an optimal decision. The Smith Family owns a $30,000 wood-frame home several blocks from the Green Brook in Plainfield, New Jersey. In his household Mr. Smith is the most knowledgeable person about matters related to insurance. He feels that minor flooding of the Green Brook would cause no damage to his house and contents but that severe flooding of the brook would result in a loss to him of L=$20,000. The chances of such a severe flood occurring next year are estimated by him to be 1 out of 100 so that z=.01.

The annual family income is approximately $18,000, so that with appropriate deductions the Smiths have a marginal federal income tax rate (t) of .25. Mr. Smith just became aware that flood insurance is available in Plainfield but does not know the premium. However, he estimates the cost per $1000 coverage to be $3 so that p=.003. If flood insurance actually cost him this amount, then protection against a $20,000 loss would be $60. If a severe flood caused damage to his house and he were uninsured, Smith would not expect any forgiveness grants from the federal government, but would anticipate receiving a 5 percent low interest disaster loan from the Small Business Administration to cover his entire loss. With a current market interest rate of 9 percent such a loan represents a potential write-off of f = .04.

Based on his current wealth (W), Mr. Smith has been able to specify his utility function to analyze his optimal decision with respect to purchasing insurance. In determining this utility function he must arbitrarily assign numbers to two of the outcomes, with the larger number associated with the preferred outcome[6]. As shown in Figure 3.1 Smith assigns a utility of 0 to his current wealth level (W) which is equivalent to the outcome "no insurance and no flood". For the case "no insurance and a severe flood" Smith's wealth level drops to W-20,000 and he assigns a utility of -2000 to this outcome. These pre-assigned values represent the two extreme cases for this problem, and form the end points of Smith's utility curve. Using these two values Smith can determine the utility associated with any outcome to him that results in wealth between W and W-20,000. These utilities comprise the curve in Figure 3.1.

From the data provided by Mr. Smith it is now possible to construct a payoff matrix for any set of alternatives. Table 3.2 examines the two extreme alternatives: do not purchase insurance (A_1), or purchase \$20,000 worth (A_2).

Table 3.2

Payoff Matrix for Mr. Smith

			States of Nature	
			Severe Flood (z=.01)	No Flood ((1-z)=.99)
	A_1	Do not purchase insurance	-2000	0
Alternatives				
	A_2	Purchase \$20,000 worth of coverage	-5	-5

The respective utilities for each possible outcome are specified in the appropriate cells. Note that if Mr. Smith follows action A_2 and purchases full insurance for \$60, then the utility to him of this course of action is -5 whether or not a flood occurs. If on the other hand he decides not to buy a policy, the expected utility of this alternative (A_1) would be -20 [i.e. .01(-2000) + .99(0)].

If these were the only two available options, Mr. Smith would prefer to purchase full coverage rather than no insurance since A_2 has a higher utility. If he can purchase any amount of insurance the optimal amount (I*) is determined by relating the insurance premium to the chances and consequences

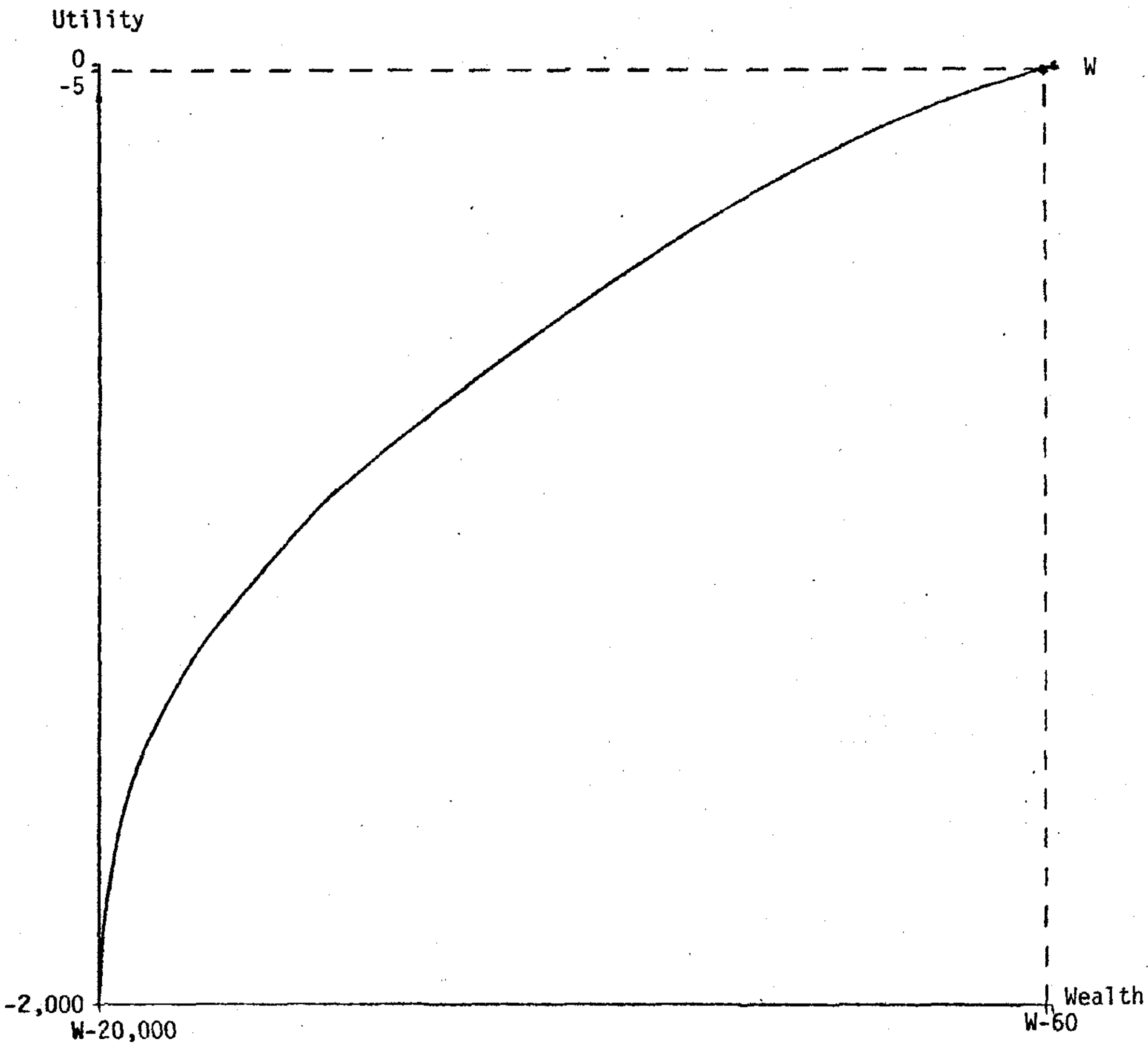

Fig. 3.1. Mr. Smith's Utility Curve.

of a severe flood. This premium/loss ratio has been termed a "contingency price ratio" in Section 3.2.2 and is given by the left-hand side of equation (3.1). Using Mr. Smith's estimates, R=.42. As discussed in Section 3.2.2, whenever R is less than 1 it is optimal to purchase full insurance coverage. Hence Smith should buy a $20,000 policy[7].

3.2.4 Incorporating Search Costs Into The Model

The above analysis assumes that there are no costs of collecting data on either the probabilities of flooding, the resulting losses, or the insurance premiums. In reality there is some time and effort involved in gathering information which may cause individuals not to purchase insurance even though the above model may suggest that they should protect themselves.

In recent years economists have begun to pay attention to these information problems by including a cost of search in models of consumer behavior[8]. Search theory, which purports to explain how individuals behave when they have imperfect or incomplete market information, has been utilized in determining an optimal strategy with respect to routine purchases such as groceries or durable goods. The objective is to specify the optimal number of price quotations to obtain if there is a fee associated with collecting information from each seller. This fee is generally interpreted as the cost of visiting a store.

Such models of search are not directly relevant to the decision-making process for purchasing insurance for several reasons. For one thing, they assume that the only unknown variable is the price of the product. In the case of insurance the decision-maker must collect information not only on the price and terms of a policy, but also on the hazard for which coverage is offered. Even if one wanted data on the likelihood of a disaster and its potential damage, it is not clear where one would turn for this information. The process may involve a detailed search of official records or discussions with friends and neighbors, with no guarantee of success.

There is a second reason why the models of search utilized by economists are not directly relevant to the insurance purchase decision. Empirical evidence from a study of consumer attitudes towards insurance suggests that quality considerations rather than price are the prime determinant of where one buys coverage. Thus in a field survey of a random sample of 2462 individuals throughout the United States undertaken in 1973 for the Sentry Insurance Group (Cummins, et. al., 1974), 38 percent of the respondents noted that the insurance company was the most important factor in the choice of an automobile and homeowners policy. Only slightly more than one-quarter picked price as the principal determinant of their purchase decision. In fact, over half of those policyholders with auto insurance, and almost three-quarters of the individuals with homeowners coverage, had not tried to compare prices charged by different companies. Among those that compared prices only 45 percent puchased insurance from the company charging the lowest premium.

Even if price were a critical input to the final decision regarding insurance, the marginal cost of obtaining this information is relatively low, since one normally can obtain information on premiums and coverage directly through telephone calls. In the survey conducted for Sentry only eight percent of the respondents felt it would be difficult to obtain comparative price data on homeowners insurance.

Our contention is that the principal factor inhibiting the search for data on insurance is human inertia. In formal terms the expected utility model can be modified so that it treats this reluctance to act as a fixed cost of getting started. Such an approach, however, provides little insight into the decision-making process of individuals. Kunreuther (1976) provides an illustrative example of how the time and effort of initiating contact with one's agent can be incorporated as a fixed cost in the expected utility framework. He shows that this factor may cause a homeowner not to buy coverage when he otherwise might want to do so.

The above modification of the expected utility model enables one to explain individual behavior on an *ex post facto* basis. Thus, by defining the costs of making decisions to be sufficiently large, or postulating a specific form of a person's utility function, it is possible to rationalize an individual's actions. But such reasoning does not tell us what factors influence his decisions. Unless one can isolate important variables which describe this process, policy recommendations for changing behavior may not produce the intended effect.

3.3 A SEQUENTIAL MODEL OF CHOICE FOR INSURANCE DECISIONS

There is a more fundamental objection to the use of expected utility theory as a descriptive model of choice under uncertainty. The individual is assumed to behave as if he satisfies the axioms upon which the theory is based. For example, his preferences between alternative policies (e.g. purchase no insurance, purchase full insurance coverage) are determined as if he multiplies utilities by probabilities. We have already noted the difficulties in obtaining information on low probability events and their associated losses. Even if a person has collected these data his computational limitations may lead him to behave in a manner which is inconsistent with the assumptions of utility theory.

Over the last 20 years leading economists have been calling for a more detailed study of individual behavior to verify the assumptions upon which formal models such as utility theory are based. Thus, Tjalling Koopmans noted as early as 1957 that:

> If, in comparison with some other sciences, economics is handicapped by severe and possibly insurmountable obstacles to meaningful experimentation, the opportunities for direct introspection by, and direct observation of, individual decision makers are a much needed source of evidence which in some degree offsets the handicap. We cannot really feel confident in acting upon our economic knowledge until its deductions reconcile directly observed patterns of individual behavior with such implications for the economy as a whole as we find ourselves able to subject to test. (Koopmans, 1957, p. 140)

In his 1970 presidential address to the American Economic Association, Wassily Leontief stated that:

> In the presentation of a new model, attention nowadays is usually centered on a step-by-step derivation of its formal properties.... By the time it comes to interpretation of the substantive <u>conclusions</u>, the assumptions on which the model are based are easily forgotten. But it is precisely the empirical validity of these <u>assumptions</u> on which the usefulness of the entire exercise depends. What is really needed, in most cases, is a very difficult and seldom very neat assessment and verification of these assumptions in terms of observed facts. Here mathematics cannot help and because of this, the interest and enthusiasm of the model builder suddenly begin to flag. (Leontief, 1971, p. 2)

Even more recently, in his 1973 presidential address to the American Economic Association, Kenneth Arrow stressed that:

> The uncertainties about economics are rooted in our need for a better understanding of the economics of uncertainty; our lack of economic knowledge is, in good part, our difficulty in modelling the ignorance of the economic agent. (Arrow, 1974, p. 1)

The leading critic of utility maximization as a descriptive theory has been Herbert Simon who observed:

> The classical theory is a theory of man choosing among fixed and known alternatives, to each of which is attached known consequences. But when perception and cognition intervene between the decision maker and his objective environment, this model no longer proves adequate. We need a description that takes into account the arduous task of determining what consequences will follow on each alternative. (Simon, 1959, p. 272)

As an alternative to the expected utility model, Simon introduced the notion of "bounded rationality", in which the decision maker's cognitive limitations force him to construct a simplified model of the world. Simon (1955) argues that in actual choice situations, man has a difficult time making the computations required to maximize some objective function. Furthermore, it may be very difficult for him to gather the information to make these decisions.

How do individuals determine that insurance is worth considering for possible purchase? We hypothesize the process to be a sequential one: if the individual perceives the hazard to be a potential problem then he is likely to search for ways to mitigate future losses, including buying insurance. This search process is likely to be very similar to the one followed by individuals who are considering the adoption of a new innovation. After the individual collects data indicating that insurance is available, he is likely to decide whether or not to purchase coverage by selectively processing information. The sequential nature of this process is represented in Figure 3.2 where three distinct stages are delineated.

Of primary importance is whether or not the hazard is considered to be a problem (Stage 1). We hypothesize that the most important variable in this initial stage is the individual's own past experience. The personal impact of a disaster will be much greater than any newspaper report or television coverage could impart. However, there is one group of people where data from the mass media may play an important role in influencing their perception of the problem. Individuals who are concerned about the potential consequences of a disaster before moving to a hazard prone area will undoubtedly collect information on the nature of the event from impersonal channels such as the mass media as well as from more personal sources. These homeowners are more likely to consider the hazard to be a problem than residents in their area who were not aware of its existence at the time they located there.

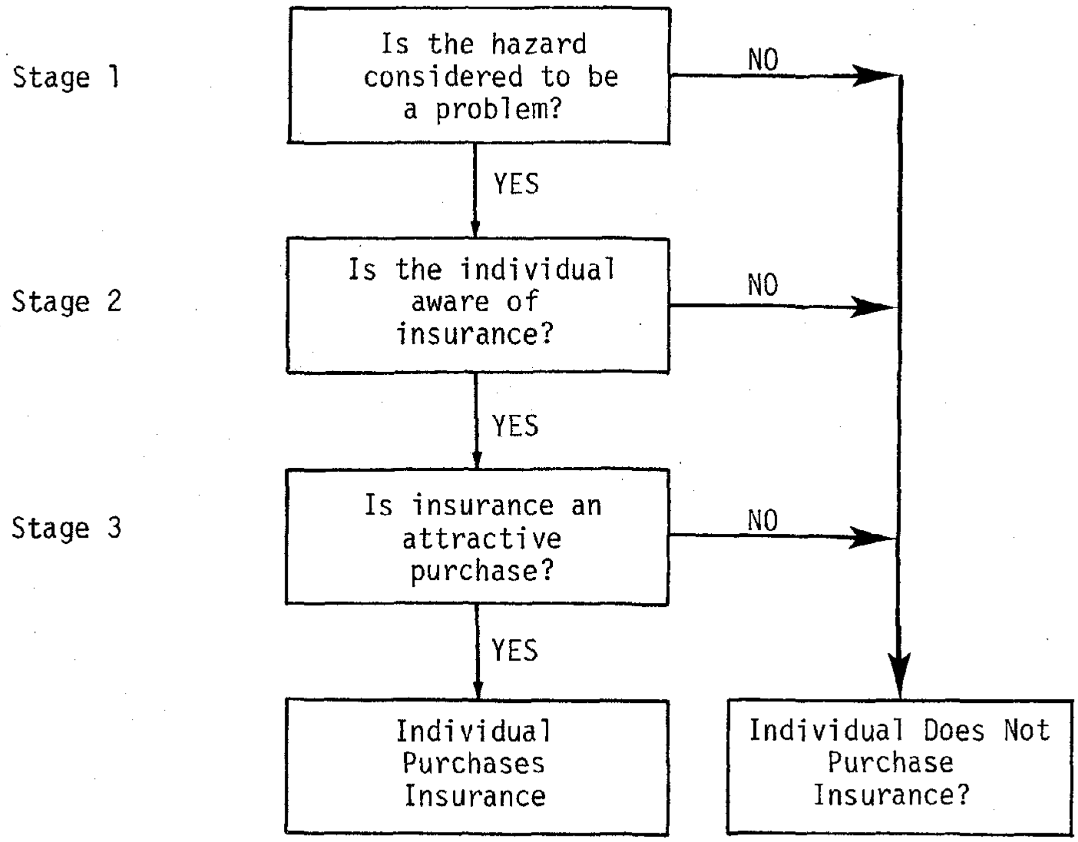

Fig. 3.2 Sequential Model of Choice

If a person views the hazard as a problem he is likely to investigate the possibility of buying insurance (Stage 2). One reason he may do so is because he wants to relieve his anxiety about the consequences of a disaster[9]. Even then, if the product is relatively new (like flood insurance) or not marketed on a mass level (like earthquake insurance), the individual may be unaware of its existence.

Individuals with an awareness of the problem and interest in insurance then must decide whether or not to buy a policy (Stage 3). A key variable characterizing this phase of the process is interpersonal communication. Such interaction is critically important, for it reduces the time and effort in obtaining data on the terms of a policy. Because of his computational limitations a person is likely to utilize simple rules in making his final decision, rather than undertaking sophisticated comparisons of benefits with costs.

3.4 FOUNDATIONS OF A SEQUENTIAL MODEL OF CHOICE

The sequential model postulates that unless an individual perceives the hazard to be a problem he will not want to protect himself against its consequences by buying insurance. Once he attends to insurance, he may not be able to think logically about all the factors which should influence his decisions: probabilities, losses, premiums, deductibles, etc. There is considerable empirical evidence which is consistent with this information processing perspective.

3.4.1 Role Of Personal Experience

Interestingly enough, one of the earliest studies that indicates man's limitations in making decisions is in the natural hazards area. Kates (1962) obtained field data on individual attitudes and adjustments toward the flood problem through a detailed study of 110 individuals in LaFollette, Tennessee on the basis of which he conjectured that:

> Men on flood plains appear to be very much prisoners of their experience.... Recently experienced floods appear to set an upper bound to the size of loss with which managers believe they ought to be concerned. (p. 140)

Thus, Kates hypothesizes that individuals in flood plains have an extremely difficult time dealing with complex information on probability distributions and potential losses from future floods. Hence they "simplify the world in order to deal with it" by relying on their own experience as a guide to the future.

One explanation as to why individuals rely on past experience for making decisions, has been offered by Tversky and Kahneman (1973). They hypothesize that individuals utilize a heuristic, which they call availability, whereby one judges the probability of an event by the ease with which such instances are readily retrieved from memory.

The notion of availability coupled with the concept of denial, may explain why individuals have been reluctant to protect themselves against hazards until they personally experience a loss. By refusing to think about, or denying the consequences of disasters before they occur, and hence suppressing information, people are likely to assign a low probability to such events if they utilize the availability heuristic. Once they treat the chances of the hazard as being small, people can justify not making decisions about protecting themselves against possible future losses.

The limited ability of individuals to deal with information on natural hazards and their reliance on past experience has been reinforced through a series of cross-cultural field surveys summarized in White (1974) and Burton, Kates and White (1977). In the latter book the three geographers characterize individual behavior involved in hazard adjustments by postulating that the choice process does not begin unless a first threshold of awareness of actual or anticipated loss is reached. If one relates this notion of "awareness of the problem" to past experience, then this factor is again seen to play a key role in an individual's decision-making process.

The idea that personal experience with misfortune is a stimulus to action has also played a key role in the development of behavioral theories of decision-making in the firm and organization. Cyert and March (1963, pp. 48-52) argue that the search for new alternatives is normally generated by a situational response. They cite as an example the case where a firm with a strong concern for safety was motivated to look for safer overhead cranes with magnetic controllers only after one of their employees using old equipment was killed on the job.

Thus, rather than evaluating protective activities from the point of view of a detailed benefit-cost analysis, action in an organization is frequently triggered by a failure to meet one's goals. March and Simon (1958) have made this point in their analysis of organizational change. They hypothesize that the individual or organization does not search for new alternatives unless the present course is perceived to be unsatisfactory. Once a problem exists there is a need to consider taking action.

Katona (1975) also reaches similar conclusions in his description of the learning process of consumers based on an analysis of data from Survey Research Center studies[10]. In the first stage of the process, which he calls problem recognition, there frequently is little reaction by individuals to a new stimulus. Inertia and old established habit lead the consumer to classify the new stimuli as familiar. It takes sufficient personal experience for the consumer to become aware of a particular problem.

3.4.2 Diffusion Of Information

Once the individual is aware of the problem, he is receptive to ways in which he can alleviate its consequences. However, he may not have adequate information on protective measures open to him. In the case of flood insurance, subsidized policies have only been marketed in the United States since 1969, so that this form of protection is viewed as a new product by individuals on the flood plain. Even though earthquake insurance has been readily available in California since 1916, some homeowners do not know of its existence or assume the premium is much higher than it actually is. Other families who recently moved to the state may have just become aware of the availability of such coverage. Empirical evidence supporting this point comes from a field survey also by Jackson (1974) of 302 residents living in four earthquake-prone cities on the West Coast[11]. Although earthquake insurance was readily available in each of these cities, more than one out of five respondents were not aware that they could purchase a policy.

The expected utility approach does not address the question as to how data is collected nor when it is likely to be demanded. An individual is assumed to have information accessible to him on insurance, perhaps at some cost, and decides whether or not to purchase a policy by comparing the premium to the potential benefits of coverage. Because the model is static in nature, it ignores the fact that information is a scarce resource and its diffusion takes time. Studies on the adoption of innovations provide us with considerable insight into how information is spread among individuals.

The process is best illustrated by the findings of two classic studies -- one by Ryan and Gross (1943) on the adoption of a new type of hybrid corn by farmers in two small Iowa communities and the other by Coleman, Katz and Menzel (1966) on the adoption of a new medical drug by doctors in four midwestern communities[12]. In the hybrid corn study, most farmers first learned about the innovation from sources such as salesmen or the mass media, but neighbors were the most frequent channel leading to the actual adoption of the product. The medical drug study demonstrated a similar pattern: salesman and direct mail were the most frequent sources of original knowledge about the drug, but just prior to adoption the doctor was most likely to consult with a colleague or seek information from a professional journal article. The authors conclude that these channels serve a legitimating role and were required before the doctor would be willing to prescribe the drug to his patients[13].

These findings on the importance of personal influence in the adoption process are consistent with our picture of the individual who is reluctant to expend much time and effort in collecting information. In fact, neighbors and colleagues are likely to have played exactly such an information dissemination role in the two studies just discussed. In the case of hybrid corn, the farms, as well as the farmers, undoubtedly transmitted detailed visible and verbal information on the returns from planting the new seed. Since these yields were considerably better than those from existing varieties, the farmer was persuaded to adopt the new product. Similarly, doctors undoubtedly turned to their colleagues or professional journals for detailed information on the physical reactions of patients to the new drug. Once they learned of its remarkable success they were willing to prescribe its use. Information of this type would normally not have been available to them from their initial sources of knowledge about the drug.

Personal communication may also be a particularly important source of information because there is a tendency to implicitly trust the judgment of a friend or colleague. After discussing a new product with someone who has adopted it, one is likely to feel that this person has carefully evaluated the information upon which to base a decision. By making such an assumption, which may not necessarily be correct, an individual considering the purchase of a new product can justify not having to collect detailed information[14].

We hypothesize that a similar process characterizes the adoption of insurance and other protective activities. An individual generally will be first made aware of the existence of insurance through the mass media or an insurance agent. Before buying he is likely to discuss the subject with friends or neighbors to obtain more information about the terms of a policy and/or the need for such protection. If he learns that his friend or neighbor has purchased coverage his need to process information is further reduced, and he then may decide to buy a policy.

There are two major differences, however, betweeh the perceived characteristics of insurance and those of new products such as hybrid corn or medical drugs. Insurance lacks observability, since it represents a contract rather than a product which can be physically seen. Furthermore, it does not offer any immediate return. In fact, it has value only if a particular state of nature such as a flood or earthquake occurs[15]. For this reason, the decision to purchase insurance is likely to be closely related to the individual's awareness of the specific problem with which it is associated. Empirical data is thus required to determine the effect that these differences between insurance and other products have on the adoption process.

3.4.3 Processing Of Information

The literature on adoption of innovations suggests ways in which individuals obtain data, but does not address the question as to what information they collect and how they process it. Should the individual be presented with figures upon which a decision is to be made, he is likely to use simpler decision rules than the one implied by expected utility theory. Suggestive data are provided by Slovic and Lichtenstein (1968), who undertook controlled laboratory experiments to determine what factors influenced the relative attractiveness of different gambles and the amounts that subjects were willing to bid to play each gamble. On the basis of protocols and statistical analysis the authors concluded that responses to gambles are "overwhelmingly determined by one or two risk dimensions and remarkably unresponsive to large changes in values of the less important factors." (p. 9) Payne and Braunstein (1971) obtained similar results in a related laboratory experiment[16].

Field studies also suggest that consumers know very little about the product they have purchased. For example, the Sentry study on homeowners and automobile coverage revealed that policyholders have limited knowledge on the nature and terms of their coverage. In the area of consumer credit, surveys show that many consumers do not know the interest rates charged on their department store credit cards (Mandall, 1973) or on their installment loans. (Juster and Shay (1964)).

In summary, these earlier studies suggest that a consumer will have little interest in collecting information on insurance unless he feels the hazard in question presents a serious problem. The diffusion of information on the availability of coverage takes time so that the adoption process is likely to be slow even if people are interested in coverage. In deciding whether or not to buy, a person is likely to use limited data and follow simple decision rules rather than behave as if he maximized the expected utility.

3.5 SUMMARY AND CONCLUSIONS

The first part of this chapter developed a model of insurance buying behavior based on expected utility theory. We showed that the individual must be able to estimate probabilities and losses associated with the hazard as well as the cost of insurance to determine his optimal amount of coverage. The utility model can rationalize an individual's insurance decision but provides little insight into the behavioral process.

There is considerable evidence implying that man will be reluctant to collect information on insurance unless he perceives the hazard to be a problem. The studies on adoption of innovations further suggest that information on insurance may not be diffused rapidly so that some people who are interested in coverage may not be aware of its existence. Earlier field surveys and controlled laboratory experiments have revealed how little data consumers utilize in their purchase decisions and how limited they are in their ability to process information.

This literature provides the ingredients for a sequential model of choice regarding insurance purchase decisions. We hypothesize that the individual must first consider the hazard to be a problem (Stage 1) and then be aware of insurance (Stage 2) before he determines whether or not to buy coverage (Stage 3). Past experience will play a key role in making him aware of the problem and interpersonal communication will be a primary means of gathering information on the terms of a policy. If he reaches Stage 3, his final decision will be based on simpler criteria than those implied by the expected utility model.

The field survey and controlled laboratory experiments undertaken in this study will enable us to contrast the explanatory power of the expected utility model with a sequential model of choice. Data from the field survey will be used to specify the relative importance of different factors as they affect the insurance puchase decision, but the analysis will not necessarily imply a cause and effect relationship. The controlled laboratory experiments will enable us to vary specific types of information such as probability of loss and amount of loss to see how such changes affect the subject's demand for insurance. However these data are collected in an artificial setting and thus must be synthesized with the field survey results before drawing implications for public policy.

FOOTNOTES

[1] A discussion of the axioms of utility theory and their intuitive meaning appears in Luce and Raiffa (1957). A more technical discussion can be found in Kranz, Luce, Suppes and Tversky (1973).

[2] For illustrations of the application of a state preference model to investment and insurance decisions see Marshall (1969), Hirshliefer (1970), Brainard and Dolbear (1971), Kihlstrom and Pauly (1971), Ehrlich and Becker (1972), Edelstein (1972), Arrow (1973), Zeckhauser (1973) and Marshall (1974).

[3] The case of n-possible outcomes instead of just 2 and a utility curve which can change with each outcome is treated by Arrow (1973).

[4] For simplicity and without loss of generality, t is assumed to be independent of the magnitude of the loss.

[5] A discussion of how this result was obtained appears in Kunreuther (1976).

[6] For an expository article on how one constructs personal utility functions, see Swalm (1966).

[7] If R was greater than 1, it would be necessary to compare its value to the ratio of marginal utilities so that equation (3.1) is satisfied. These marginal utilities are determined by the slope of the utility function plotted in Figure 3.1 at appropriate wealth levels. Such an exercise is obviously tedious unless the utility function can be approximated by an equation, so that one can derive an explicit expression for the marginal utility curve.

[8] The seminal work in this area is by Stigler (1961). For a recent treatment of the subject and a comprehensive set of references, see Rothschild (1974).

[9] For an interesting discussion of this point in the context of low probability events, see Zeckhauser (1975).

[10] A summary of the behavioral research undertaken at the Survey Research Center can be found in Morgan (1972).

[11] Personal interviews were conducted with 100 individuals in Los Angeles, 50 each in Vancouver and Victoria, British Columbia and 102 in Anchorage, Alaska.

[12] For an interesting comparison of the diffusion process for these two innovations, see Katz (1961).

[13] A number of studies support the importance of personal influence in the adoption process. The seminal work in this area is by Katz and Lazarsfeld (1955) who analyzed the flow of influence in decision making by women in Decatur, Illinois in four different areas: (1) daily household marketing, (2) area of fashion, (3) attendance at movies, and (4) formation of opinions on current local public affairs. Arndt (1967) suggested the importance of interpersonal communication in his detailed study of adoption of a new coffee product available only to residents of an apartment complex. A summary of other studies can be found in Rogers with Shoemaker (1971) and Robertson (1971).

[14] It is thus conceivable that the diffusion process may be accelerated because individuals are under the impression that others have processed certain types of information when, in fact, they have not.

[15] Rogers with Shoemaker (1971) suggests that this lack of an

immediate reward accounts for the low adoption rate associated with buying insurance, using auto seat belts or getting innoculations against disease. (p. 139)

[16] Detailed summaries of experimental work on decision behavior are provided in the following excellent review articles: Edwards (1954, 1961), Becker and McClintock (1967), Payne (1973), Slovic, Fischhoff and Lichtenstein (1977).

CHAPTER 4
SOME CONSIDERATIONS IN DESIGNING THE FIELD SURVEY

4.1 INTRODUCTION

We now describe the design of the sampling plan and the questionnaire for the field survey of homeowners in flood- and earthquake-prone areas. A principal reason for including this material as a separate chapter in the book is to illustrate our concern with developing an accurate instrument for obtaining data for drawing meaningful policy recommendations.

The field survey was undertaken by the Institute for Survey Research (ISR) at Temple University. The physical proximity of Temple to the University of Pennsylvania enabled the project staff to maintain close contact with ISR during all phases of the survey, from the design of the sampling plan to the coding of the interview responses.

4.2 THE SAMPLING PLAN [1]

The sampling plan for the flood and earthquake survey was designed to satisfy the principal objective of our study -- to understand differences between insured and uninsured homeowners in hazard prone areas. A secondary interest is to determine the factors that influence the insurance decision for the different hazards: hurricanes, riverine flooding, and earthquakes. The critical comparisons are between policyholders and nonpolicyholders. On the basis of statistical considerations we decided to interview equal numbers of both these groups for each of the three hazards.

In the case of flood-prone areas, the eligible respondents were chosen from the entire list of insured homeowners in communities that were part of the "regular" National Flood Insurance Program as of August 31, 1973 (See Chapter 2 for a description of this program). Budgetary considerations necessitated geographical clustering of interviews. Therefore, the only counties eligible for sampling were those with at least 25 policyholders. Our flood sample was limited to areas where the majority of housing units were not occupied on a seasonal basis (according to the 1970 Census) so as to increase the possibility of interviewing individuals in their primary residence[2]. Subject to the above restrictions, there was an equal chance of any policyholder in the regular program being selected for inclusion in the survey.

The policyholders for the earthquake sample were chosen from a list of names and addresses of homeowners who had paid premiums in the period August 1, 1972 through July 31, 1973 to eight of the largest insurance companies marketing earthquake insurance in California. These data, which have been kept in strict confidence, enabled us to select communities for the earthquake survey. The sample was restricted to those 11 counties where at least one out of every 150 homeowners had purchased earthquake insurance[3].

The critical decision with regard to the design of the study was how to sample uninsured homeowners. Two important, but conflicting criteria, made the choice of plans particularly difficult. On the one hand, we would have liked nonpolicyholders to be representative of all uninsured homeowners in communities participating in the regular flood insurance program and in earthquake-prone areas within California. On the other hand, our interest in differentiating between the decision processes utilized by insured and uninsured homeowners required comparability between the groups with respect to socio-economic and property characteristics as well as geographic location. If we had based our sample plan on the first criterion then we would have included homeowners who lived primarily in areas least likely to experience a disaster. Few policyholders reside in such areas. A sample designed to satisfy the second criterion would have included only those uninsured homeowners who resemble the insured population. This selection process would not have enabled us to obtain statistically meaningful estimates for the uninsured population in communities participating in the regular flood program.

The final sampling plan evolved from ideas contained in the following three competing sampling plans:

1. A sample of insured and uninsured homeowners from six communities, two each in earthquake- and hurricane and riverine flood-prone areas, of which one had suffered a recent disaster and the other had not. The main advantage of this plan is that it would enable us to isolate two variables thought to be important to the insurance purchase decision: type of natural hazard and recency of a disaster. The principal disadvantage of

this plan is that these communities may not reflect the characteristics of other flood- and earthquake-prone communities. Hence, the plan would not enable us to make the necessary inferences for developing policies on a national or even regional basis.

2. A national equal probability sample of policyholders and an equal probability sample of nonpolicyholders from the same communities in which the policyholders had been chosen. Such a plan provides representative national samples of insured and uninsured individuals. However, within the selected communities the two groups would differ from each other in important ways. For example in the flood-prone areas, the policyholders would have been likely to live near the river or ocean while the nonpolicyholders would have tended to live in lower risk areas.

3. An equal probability sample of policyholders and a matched sample of nonpolicyholders such as next door neighbors. This plan has the attractive features of minimizing the differences between policyholders and nonpolicyholders on variables such as objective risk, value of property, and income. Hence, such a plan maximized the chance to study other relevant determinants of the decision-making process such as past experience and interpersonal communication. The principal disadvantage of this plan is that it does not reflect the actual distribution of nonpolicyholders since they are arbitrarily pre-selected to live next door to insured homeowners. Statistical generalizations to the population in our sample universe is thus impossible.

The sampling plan actually employed for choosing uninsured homeowners incorporates features of each of the foregoing plans while maintaining standards of statistical rigor. To illustrate, consider the design of the flood sample. Hydrographic surveys had been carried out in each of the communities in the regular program. Based on these studies, maps were drawn which delineated geographic zones corresponding to objective probabilities of flood damage. A simple random sampling plan would have resulted in more of the insured respondents being in the high hazard zones (A or V) and most of the uninsured individuals being in the low-hazard zones (B and C)[4]. (For ease of presentation the high and low hazard zones will henceforth be referred to as A and B respectively). To improve the ability to discriminate statistically between the two groups we thus utilized a non-proportionate sampling plan by oversampling uninsured homeowners in Zone A. A similar procedure was utilized for the earthquake portion of the survey.

The desired total number of interviews was 3,000; half with insured homeowners, half uninsured homeowners. Approximately 2,000 of these interviews were expected to be in flood-prone areas and the remaining 1000 in earthquake-prone areas. Since the rate of purchasing flood insurance was much higher in coastal than in riverine areas, we decided to interview 1250 homeowners in coastal communities and 750 in riverine areas. Even with this non-proportionate split, policyholders were still selected at a much higher rate in the riverine areas than in the coastal communities. All insured and uninsured individuals were given weights corresponding to their objective probability of selection. By utilizing these weights in the analysis of our survey data we have been able to generalize the results to the population of hazard prone counties from which the samples were drawn. Table 4.1 presents data on the actual number of insured and uninsured homeowners in each of the respective samples.

4.3 SELECTION OF STUDY SITES

4.3.1 Flood Survey

All counties in the regular program where at least 25 insurance policies had been sold were eligible for selection in the flood sample. The hurricane stratum included all counties bordering either the Atlantic or Gulf Coasts in a belt stretching between New England and Southern Texas. All other counties were placed in the riverine stratum. As of August 31, 1973, there were 109,453 policies sold for residential property in the hurricane flood-prone stratum and 14,304 in the riverine flood-prone stratum. The more policies sold in any county, the more likely it would be selected for inclusion in the sample.

An average of 50 interviews, 25 with policyholders and 25 with nonpolicyholders, constituted a "hit". For counties with a large number of policyholders more than one hit could be expected. Thus, for example, in Minot, North Dakota, which had 1053 policyholders at the end of August, 1973, we had 2 hits and anticipated interviewing 100 persons.

Figure 4.1 depicts the location of the communities and counties in the flood portion of the survey. As can be seen from the map, many of the sites are concentrated in Florida and other Gulf Coast states. This is due to the large number of flood insurance policies which have been sold in this part of the country. Table 4.2 provides data on the population of each of the areas selected as well as the number of flood insurance policies sold in each of these communities at the time the sample was drawn. For comparative purposes we have also listed the number of flood insurance policies sold in these areas as of June 30, 1976, to indicate the growth of the program in most communities. The table also lists the number of interviews in each community and the number of respondents in the high hazard areas (Zone A) and the less hazardous portions of the community (Zone B), who are policyholders and

TABLE 4.1

NUMBER OF INSURED AND UNINSURED HOMEOWNERS IN FIELD SURVEY

	Insured		Uninsured		Total	
Coastal Flood	774	1,103	639	952	1,413	2,055
Riverine Flood	329		313		642	
Earthquake	461		545		1,006	

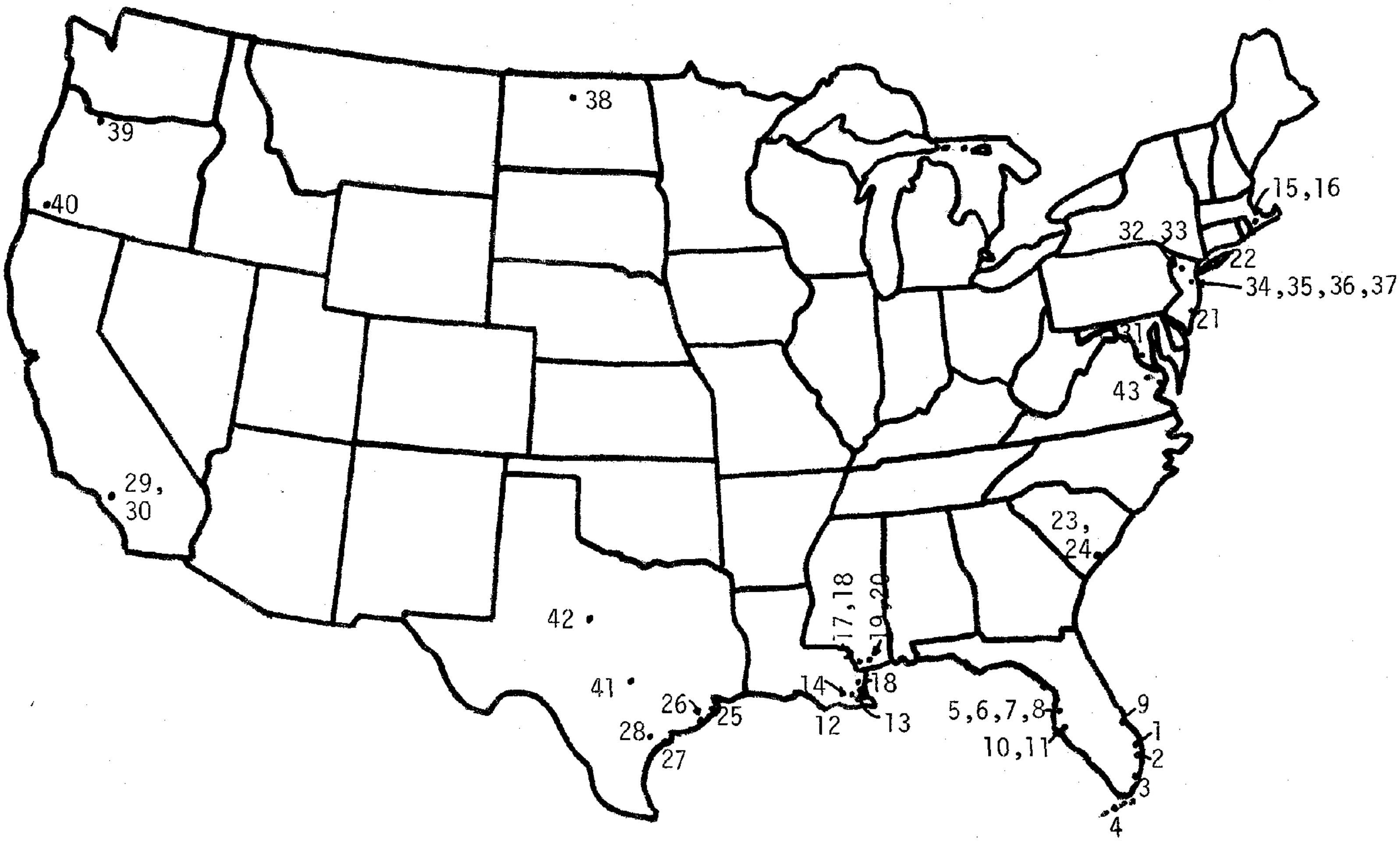

Fig. 4.1. Communities in the Flood Portion of the Survey
(Numbers refer to community name in Table 4.2)

Page 4.4b

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TABLE 4.2

COMMUNITIES IN THE FLOOD PORTION OF THE SURVEY

	Community*	Population from Which Sample was Drawn	Date Community entered Emergency Program	Date Community entered Regular Program	Flood Insurance Policies Sold 8/31/73	Flood Insurance Policies Sold 6/30/76	Number of Interviews Insured A	Insured B	Uninsured A	Uninsured B	Total
	Coastal										
1.	Ft. Lauderdale, Fla.	93,895	11/20/70	11/ 3/72	2,410	5,122	13	21	5	38	77
2.	Hollywood, Fla.	102,988	6/ 4/71	11/ 3/72	653	2,072	17	9	4	17	47
3.	Dade County, Fla. (Miami Beach, Miami, Homestead)	137,896	8/14/70	9/29/72	5,733	16,428	12	3	4	0	19
4.	Monroe County, Fla. (Islamorada)	3,308	6/12/70	6/15/73	2,704	6,194	15	0	9	0	24
5.	Indian Rocks, Fla.		7/17/70	5/ 7/71**	44	199					
	Belleair, Fla.	30,762	6/30/70	5/14/71	604	799	78	0	14	0	92
6.	Redington Beach, Fla.	22,224	5/15/70	5/ 7/71	450	645	34	0	3	0	37
	Maderia Beach, Fla.		6/ 5/70	5/ 7/71	709	1,101					
7.	St. Petersburg, Fla.	108,765	6/19/70	5/28/71	2,310	7,389	32	6	20	19	77
8.	Treasure Island, Fla.	45,202	6/30/70	5/ 7/71	1,061	1,514	38	0	15	0	53
	St. Petersburg Beach, Fla.		5/22/70	5/14/71	1,103	1,786					
9.	Ocean Ridge, Fla.	13,872	9/18/70	4/ 9/71	105	245	14	1	7	0	22
	Gulf Stream, Fla.		7/16/71	1/24/73	78	117					
10.	Sarasota County, Fla. (Englewood, Nokomis)	6,869	7/10/70	7/30/71	1,152	4,839	9	0	11	0	20
11.	Venice, Fla.	13,446	8/28/70	7/30/71	197	703	14	11	6	2	33
12.	Jefferson Parish, La. (Avondale, Gretna, Harvey, Kenner, Metairie)	196, 576	-	6/25/69	9,808	23,634	57	33	62	49	201
13.	New Orleans, La.	174,339	7/10/70	10/20/72	11,295	30,028	45	19	48	32	144
14.	St. Bernard Parish, La.	80,448	-	3/13/70	3,087	8,136	35	21	11	5	72
15.	Marion, Mass.	10,398	10/ 8/71	4/ 6/73	83	140	15	0	1	0	16
16.	Wareham, Mass.	2,035	7/10/70	5/28/71	610	827	11	0	19	6	36
17.	Hancock County, Miss. (Pearlington, Bay St. Louis	1,551	6/30/70	7/11/70	1,294	1,669	7	0	68	0	75
18.	Waveland, Miss.	2,270	6/30/70	9/11/70	441	759	19	0	0	4	23
19.	Harrison County, Miss. (N. Biloxi)	5,942	7/17/70	9/18/70	2,344	4,506	6	1	28	0	35
20.	Long Beach, Miss.	6,010	6/19/70	9/11/70	266	534	5	0	1	0	6
21.	Atlantic City, N.J.	4,197	6/30/70	6/18/71	451	1,208	5	0	6	0	11
22.	Islip, N.Y.	9,631	10/16/70	11/17/72	641	1,291	3	11	17	39	70
23.	Charleston, S.C.	61,930	10/30/70	4/ 9/71	383	1,480	8	0	8	1	17
	Folly Beach, S.C.		9/11/70	4/ 2/71	220	322					
24.	Isle of Palms, S.C.	5,374	9/ 4/70	4/ 2/71	187	405	10	0	1	0	11
25.	Galveston County, Tex. (Galveston City, Kemah, League City, Hitchcock, San Leon)	67,442	6/19/70	4/ 9/71	5,368	5,903	65	7	30	18	120
26.	Matagorda County, Tex. (Bay City)	387	6/19/70	4/30/71***	896	1,066	6	0	3	0	9
27.	Aransas Pass, Tex.	4,390	6/19/70	6/25/71	145	199	7	12	0	2	21
28.	Sinton, Tex.	5,563	6/19/70	3/26/71	594	598	18	21	5	1	45

TABLE 4.2--*Continued*

Community	Population from Which Sample was Drawn	Date Community entered Emergency Program	Date Community entered Regular Program	Flood Insurance Policies Sold 8/31/73	6/30/76	Number of Interviews Insured A	B	Uninsured A	B	Total
Riverine										
29. Los Angeles County, Cal. (Los Angeles County Union, Altadena, Malibu)	9,964	7/10/70	8/27/73	398	646	1	8	16	2	27
30. La Puente, Cal.	58,719	9/11/70	6/25/71	197	317	0	11	0	15	26
31. Prince's George's County, Md. (Prince Georges, Queens Chapel Manor, College Park, Hyattesville)	26,445	8/ 7/70	8/ 4/72	518	563	0	3	12	6	21
32. Pompton Lakes, N.J.	79,779	6/ 5/70	9/ 4/70	131	249	21	0	20	0	41
33. Wayne Twp., N.J.	44,389	7/10/70	2/16/73	216	420	15	3	25	1	44
34. Clark Twp., N.J.	39,745	7/10/70	12/23/71	42	150	14	9	0	7	30
35. Cranford Twp., N.J.	82,404	6/19/70	6/25/71	277	228	44	11	11	10	76
36. Elizabeth, N.J.	59,540	5/22/70	5/ 7/71	344	541	23	1	19	29	72
37. Plainfield, N.J.	45,057	6/19/70	6/25/71	53	478	10	20	13	27	70
38. Minot, N.D.	19,110	-	3/17/70	1,053	3,090	44	10	28	0	82
39. Clackamas County, Ore. (Milwaukie, Oregon City, Portland, Eagle Creek)	18,662	4/ 2/71	8/25/72	229	414	0	12	0	4	16
40. Josephine County, Ore. (Grants Pass)	4,906	12/31/70	9/10/71	129	213	19	1	1	0	21
41. New Braunfels, Tex.	3,326	12/ 4/70	12/ 1/72	241	243	9	5	0	6	20
42. Abilene, Tex.	48,587	6/19/70	7/23/71	196	598	13	8	10	0	31
43. Alexandria, Va.	25,214	-	8/22/69	384	484	5	9	27	24	65

*Communities in parenthesis indicate where interviews took place within the county.

**Suspended from regular program 9/15/72 for failure to adopt land-use measures, reinstated 3/17/73.

***Suspended 1/1/72; reinstated 6/2/72.

nonpolicyholders.

It should be kept in mind that the current insurance status of the homeowner may be different from what was expected when the property was selected for inclusion in the sample. One reason is that the family may have bought insurance or cancelled their policy between August, 1973, and the interview date. Another reason is that the house may have changed hands in this interim period. In such cases, the insurance status of the new homeowner may have been different from that of the previous family.

4.3.2 Earthquake Survey

The areas to be included in the earthquake portion of the survey were selected in a manner analogous to those in the flood sample. Each of eight insurance companies cooperating with the study provided a list of all homes and addresses of their policyholders who bought earthquake coverage in two randomly selected months in the period August, 1972 through July, 1973. Altogether about 6,000 names were provided by the companies. We then grouped these names by county and estimated the rates at which homeowners had bought insurance in each county.

In selecting the uninsured sample we grouped the policyholders supplied by the insurance companies into communities and estimated the rate of policy buying in each one. All uninsured homeowners living in communities where there were at least five policyholders from the sample of 6,000 names were included in the universe. We estimate that the communities in our universe include 96 percent of all policyholders in the 11 county area. The counties and communities were chosen in a manner analogous to the selection of the flood sample. Data on the populations of the selected areas in California as well as the number of interviews are listed in Table 4.3. The locations of the counties are depicted in Figure 4.2.

The rate of insurance purchase was about twice as high in Northern California communities (except for San Francisco and Oakland) as in the remaining areas of the state. For this reason, we oversampled uninsured homeowners in Northern California just as we oversampled nonpolicyholders in high-hazard areas of the flood plain.

TABLE 4.3

CALIFORNIA COMMUNITIES IN THE EARTHQUAKE PORTION OF THE SURVEY

	Community	Population from which sample was drawn	Number of Interviews		
			Insured	Uninsured	Total
1.	Walnut Creek	19,892	7	73	80
2.	San Raphael	15,778	2	12	14
3.	Daly City	12,714	13	15	28
4.	San Bruno	7,048	8	23	31
5.	San Mateo	7,934	13	20	33
6.	Palo Alto	11,272	11	18	29
7.	San Jose	20,754	63	49	112
8.	Sunnyvale	15,170	13	24	37
9.	Fremont	6,294	4	23	27
10.	San Leandro	10,108	6	24	30
11.	Oakland	20,010	16	33	49
12.	San Francisco	6,284	19	23	42
13.	Los Angeles	47,772	54	120	174
14.	Long Beach	10,226	8	24	32
15.	Huntington	9,284	3	13	16
16.	San Bernadino	19,218	8	26	34
17.	Misc. Los Angeles County	N.A.	126	13	139
18.	Misc. San Francisco Bay Area	N.A.	87	12	99
	Total		461	545	1,006

N.A. = Non Applicable.

Fig. 4.2. California Communities in the Earthquake Field Survey
(Numbers refer to community name in Table 4.3)

4.4 CONDUCTING THE SURVEY

4.4.1 Pre-Survey Analysis

In preparation for the development of the flood and earthquake questionnaires, six focus group-depth interviews were conducted by the Institute for Survey Research. Two of the group-depth interviews were in Norristown, Pennsylvania (a riverine flood-prone community), two in Biloxi, Mississippi (a coastal flood-prone community), and two in Bakersfield, California (an earthquake-prone community). One interview was with insured homeowners and the other with uninsured homeowners.

To be eligible for the group the person participating had to be the one most knowledgeable about financial decision making within the household. This person would undoubtedly be able to provide more precise information on the decision process regarding insurance than any other member of the household. Prior to the group-depth interviews we developed an outline of topics to be covered in the questionnaire based on the alternative models of choice, and knowledge of hazard mitigation and disaster relief programs. The group-depth interviews were structured around these topics with the moderator probing for answers while still permitting participants to interact freely with each other.

These informal interactions generated several hypotheses which have been examined more formally in Chapter 5 on pre-disaster behavior. For example, most participants suggested that to be interested in purchasing flood insurance one must personally experience flood losses. In other words, most people are unwilling or unable to generalize from the negative flood experience of others to themselves even if the others are neighbors or close friends. This supports Kates' (1962) conjecture that "people are prisoners of their own experience."

Another hypothesis emerging from the group-depth interviews was the lack of awareness of flood insurance by uninsured individuals, even though many claim to have actively attempted to obtain information on its availability. Most participants had been unwilling to invest much time and energy to obtain information on premiums and coverage for either flood or earthquake insurance.

Perhaps the most important benefit of the group-depth interviews is clues provided by discussants on the decision process regarding the purchase of insurance, and the available knowledge and behavior with respect to hazard mitigation measures and disaster relief programs. Transcripts of the six taped sessions have provided extensive anecdotal accounts filled with expressions of emotions and graphic descriptions. This type of dialog would ordinarily not be obtained in structured interview settings. In subsequent chapters such comments will be utilized to supplement the analysis of the field survey data.

To provide background material for the development of the survey we abstracted earlier studies on natural hazards. We also reviewed questionnaires previously utilized in flood- or earthquake-prone areas[5]. Edgar Jackson provided us with transcripts of six interviews taped on the West Coast related to individual perception of the earthquake problem. These were valuable supplements to our group depth interviews.

Preliminary versions of the flood and earthquake questionnaires were pretested in Atlantic City, New Jersey (coastal flood-prone area), and San Francisco, California (earthquake-prone area). The final version was pretested in nearby Norristown, Pennsylvania (riverine area), so that members of the project staff could conduct the interviews.

4.4.2 Structure Of The Questionnaire

The questionnaire utilized in the field survey provides the following types of quantitative and qualitative information:

a. A set of questions provides data to contrast the explanatory power of the sequential model of choice with the expected utility model. For the sequential model of choice, a number of questions were incorporated to measure each stage of the decision-making process detailed in Chapter 3. To determine how well the expected utility model described behavior, respondents were asked questions on their estimates of future damage to their property and contents from a severe flood or earthquake, their estimated probability of such a disaster, and what sources of funds and amounts they expected to obtain to restore damage from the disaster. To our knowledge this is the first questionnaire which has attempted to obtain such detailed quantitative estimates from respondents. Interviewers found that homeowners had little difficulty in answering these questions and generally were able to give dollar estimates rather than resorting to a card with dollar ranges on it, which they had an option to use. These data are analyzed in Chapter 5.

b. Another series of questions provides data on the awareness and importance of alternative hazard mitigation and disaster relief programs to homeowners residing in flood or earthquake prone areas. For example, questions address such hazard mitigation measures as warnings, land-use regulations, building codes, and insurance. Other questions relate to disaster relief measures for long-term recovery provided by federal, state, and local government agencies as well as the Red Cross. The questionnaire also focuses on personal disaster mitigation measures undertaken by homeowners in flood- and earthquake-prone areas. These data are analyzed in Chapter 8.

c. Questions on age, income, religion, occupation, and education provide a profile of the socio-economic characteristics of homeowners living in flood- and earthquake-prone areas. We also obtained detailed descriptive data on the homeowner's property and the magnitude of previous damage from recent floods or earthquakes. These figures, which are essential for constructing profiles of flood and earthquake communities, will be discussed in Chapter 9.

Appendix A.3 provides an outline of the flood questionnaire which shows how each question relates to either the decision process regarding insurance, alternative hazard mitigation and relief programs, or to the characteristics of homeowners and their property. The earthquake questionnaire is almost identical in design with a few minor exceptions, the most notable one being that questions on earthquake prediction replace those on flood warnings. A copy of the flood questionnaire is provided in Appendix A.4.

4.4.3 Field Activities For The Surveys

The first major problem encountered in interviewing was that a smaller percentage of households were found to be eligible than was originally expected. In other words, many housing units were found to be non-owner occupied, despite a purposeful attempt to eliminate from our sample areas where such housing predominates. In an effort to offset the problem of eligibility, which was concentrated in the non-policy portions of the sample, an additional list of approximately 1,000 addresses was sent into the fields.

Once an eligible household was found, the person who knew the most and made decisions about such matters as insurance was interviewed. If two respondents in the family claimed knowledge then the person whose surname came first in the alphabet was the one chosen to be interviewed. If this process had not been followed there would be no way of knowing whether a "Don't Know" response to insurance-related questions might have been different if the question had been asked to another member of the household.

There were some negative repercussions caused by this screening process. Even though complete identification materials were provided, interviewers were sometimes rejected because the caller was viewed as an insurance salesperson.

This negative feedback was exacerbated by a more general problem affecting the field of survey research. A number of authors have recently reported an increase in the refusal rate. In several of the California communities in our sample, well-to-do residents viewed themselves as prime targets for theft and hence were unwilling to admit an interviewer who might "case" the house. Telephone calls made by ISR personnel confirmed this fear.

In an effort to reduce the magnitude of the non-response problem two major steps were taken. First, a news release was issued by the Temple University News Bureau to the media serving the communities in the survey. Interviewers were advised of this action and told to use this publicity to their advantage in completing the interviews. The numerous news clippings which ISR received, as well as the responses of interviewers and respondents alike, indicated that press coverage was prompt, accurate, and well received by its target audience.

In addition, two letters were used to increase the perceived legitimacy of the study. Each of the 1,000 housing units added to the sample received a letter advising them of the nature of the study and urging their cooperation. Furthermore, anyone from either the original sample or supplementary list who refused to be interviewed received a letter providing not only the above information, but also a stronger plea for cooperation. Like the news releases, this technique was well received. Not only was the conversion rate from refusals to completed interviews unusually high, but ISR actually received numerous phone calls from prior refusals asking to be interviewed.

The extra time and effort spent in the data collection phase have yielded direct benefits. The total number of interviews completed, and the high response rates have increased the extent to which the findings may be generalized. Tables 4.4 and 4.5 summarize the relevant statistics regarding interviews attempted and completed as well as response rates for the six different groups classified in the sample plan. As shown in Table 4.4 the response rates varied from 76 percent (earthquake nonpolicyholders) to 83 percent (coastal flood nonpolicyholders) with an average of 79.6 percent. The magnitude of the effort undertaken by ISR is clearly demonstrated in Table 4.5 where we see that 6206 individuals were sampled, of whom 4440 were eligible respondents (i.e. homeowners). The percent completion among eligibles varied from 64.1 percent (riverine nonpolicyholders) to 70.8 percent (coastal nonpolicyholders) with an average of 68.9 percent.

TABLE 4.4

INTERVIEW COOPERATION

	Coastal Flood (Policy)	Coastal Flood (Non Policy)	Riverine Flood (Policy)	Riverine Flood (Non Policy)	Earthquake (Policy)	Earthquake (Non Policy)	Total
Completed Interviews	579	834	305	337	460	546	3,061
Household Refused	80	95	34	33	73	99	414
Interviews Refused	49	74	44	69	63	71	370
Interviews Attempted	708	1,003	383	439	596	716	3,845
% Completed of Attempted	81.8	83.2	79.6	76.8	77.2	76.2	79.6

Table 4.5

COMPLETIONS AMONG ELIGIBLE RESPONDENTS

	Coastal Flood		Riverine Flood		Earthquake		
	(Policy)	(Non Policy)	(Policy)	(Non Policy)	(Policy)	(Non Policy)	Total
Total Sampled	1033	1890	542	766	797	1178	6206
Ineligibles	197	712	91	240	128	398	1766
Eligibles	836	1178	451	526	669	780	4440
Completed Interviews	579	834	305	337	460	546	3061
% Completion Among Eligibles	69.3	70.8	67.6	64.1	68.8	70.0	68.9

4.5 DETERMINING THE QUALITY OF DATA

During all phases of the field survey, great care has been taken to insure high quality data. Interviewers were well trained, the questionnaire was extensively pretested, and quality control checks were used in the subsequent processing of data. Nevertheless, certain kinds of errors are inherent in all data collection. As Fienberg and Goodman (1975) have stressed, most analyses of surveys treat problems of data accuracy superficially at best:

> The absence of a discussion of data accuracy seems unfortunate as a matter of principle and statistical standards, and it may also lead to misunderstandings and mistakes. For example, the relatively innocent reader may note a difference between two tabulated values dominated by random variation and conclude that some real pattern exists when in fact this is not the case. (p. 7).

In this section we will discuss the quality of data under the headings of reliability, bias, and validity. These possible sources of error should be considered in interpreting our data analyses presented in the following chapters.

Reliability

Reliability refers to the amount of non-error variation in the answers to a particular question by respondents. Low reliability of a particular question implies that respondents are not very consistent in their response so that answers are dominated by random variation. For example, a homeowner who has no idea of the potential damage to his property from a severe flood may estimate his losses to be $20,000 today. However, two months from now he might respond to the same question with a figure of $10,000. If most answers to a question on potential property damage from a severe flood are unreliable, then this variable should not be given as much importance in a model of the insurance purchase decision as it would have if homeowners were consistent in their answers.

One way to obtain reliability estimates on questions is to reinterview a portion of the respondents in the survey after a sufficient time has elapsed so that the individual answers are not conditioned by memory. A persistent problem in reliability studies of this kind is to distinguish unreliability from systematic changes in response due, for example, to changed conditions between interviews (e.g. the occurrence of a severe flood).

Although we have not been able to undertake a study of this kind, an effort was made to increase the chances of reliable responses by interviewing the person in the household who knew the most and made decisions about insurance. The strong statistically significant associations found in our data suggest reliabilities of useful magnitude.

Bias

Bias is comprised of four different elements: (1) systematic interviewer bias, (2) systematic coding and keypunching errors, (3) non-response from homeowners who could not be located or refused to be interviewed, and (4) a pattern of misstatements by respondents.

ISR has instituted strict procedures to minimize the first three elements of bias. They attempted to minimize interviewer bias through extensive two day training sessions throughout the country. They eliminated systematic coding and keypunching errors by coding all the interviews and questionnaires twice and comparing the two codings for discrepancies. Errors found were corrected. They reduced the non-response rate by utilizing extensive call-back procedures. However, it is difficult to determine whether or not there is a pattern of misstatements by respondents.

Misstatements by respondents can be caused by the wording of specific questions. One question in our survey which appeared to be misunderstood by some respondents was "In this neighborhood, do insurance companies write policies covering damage from floods (earthquakes)?" Approximately ten percent of the flood <u>insured</u> homeowners answered "No" to this question. On the other hand, less than one percent of the insured homeowners in earthquake-prone areas misunderstood the question. In retrospect what apparently happened is that homeowners who bought flood insurance learned from their agents that their policy was officially handled by a servicing company located outside their neighborhood. Earthquake policies are processed directly by the homeowner's company so this confusion would not arise. If we had worded the question to read "Do insurance companies write policies covering damage from floods occurring in this neighborhood?" then it is more likely that it would have been interpreted correctly.

U.S. Census data, which we have collected for tracts and counties in our survey, may provide another clue as to possible systematic bias regarding socio-economic characteristics of the respondents such as age, income, house value, and educational level. Our sample consists entirely of homeowners while the Census data reflects characteristics of the entire population. Unless one knew that the two groups were similar in certain respects, these data are more appropriate for showing differences between the communities rather than reflecting misstatements by respondents. We will present these comparisons in our discussion of the communities in Chapter 9.

Validity

Validity refers to how well an individual's subjective estimate corresponds to objective data. Given the nature of our study and an interest in the individual's ability to process information, we would like to know how well respondents provide accurate data. In some instances, validity may be ascertained. To illustrate, we can compare each respondent's reported flood insurance premium with the actual cost. We will provide such a comparison in Chapter 5.

Data from the field survey will also enable future studies to compare the respondent's subjective estimate of the probability of a severe flood with an estimate of an objective probability based on hydrological data. To do this one would first determine the elevation of the structure in relation to the river. Then one would be able to determine whether subjective probability estimates of homeowners are systematically biased and how they may be affected by such variables as recency and resulting damage from the last disaster.

4.6 SUMMARY

This chapter described the rationale behind the design of the field survey. We presented and evaluated three competing sampling plans, and showed how the final sampling plan incorporated features from each one. The statistical procedures for selected sampling study sites in the flood and earthquake survey were then outlined and we specified the location, population, and insured status of each site in which interviewing took place. The chapter then discussed the pre-survey analyses, the structure of the questionnaire, and the field activities for the survey. The high response rate, due to extensive effort by the Institute for Survey Research, has increased the extent to which to findings may be generalized. The final portion of the chapter discussed steps taken to ensure high quality data from the field survey. We also noted that three possible sources of error - reliability, bias, and validity - should be considered in interpreting the data, the subject to which we now turn.

FOOTNOTES

[1] This section is based on the sampling report by Eugene Ericksen which appears as Appendix A.1 of the book.

[2] Less than two percent of the respondents in the flood sample were interviewed in their second home.

[3] Two counties, Del Norte and Santa Cruz, with slightly higher rates of buying, were excluded because of their isolated locations.

[4] Zones A and V are defined to be those parts of the floodplain for which the annual probability of flooding is at least .01. Zone V also has special velocity problems. Zone B has an annual probability of flooding between .01 and .002. Zone C has a probability of less than .002.

[5] Kates (1962), Czamanski (1967), Jackson (1974) and Burton, Kates and White (1977) all developed questionnaires which provided valuable perspective on the subject.

CHAPTER 5

ANALYSIS OF PRE-DISASTER BEHAVIOR USING FIELD SURVEY DATA

5.1 INTRODUCTION

One of the most significant findings to emerge from our analysis of the field survey data is the limited information homeowners have on both the hazard itself and the insurance option. Furthermore, a substantial proportion of individuals who have collected these data are behaving in a manner inconsistent with what expected utility theory suggests. These findings are discussed in the first part of the chapter. Data from the field survey are then utilized to delineate those variables which, using a sequential model of choice, are likely to differentiate insured and uninsured homeowners. At appropriate parts of the text, personal comments from the group depth interviews are included to indicate the decision processes used by homeowners regarding the purchase of insurance. Following the chapter, the variables used in the analysis of the field survey data are defined in Table 5A. Table 5B presents relationships among variables from the field survey which relate to the sequential model of choice. Table 5C gives the statistical significance of the variable pairs associated with the specific figures and tables in the chapter.

5.2 FACTORS RELEVANT TO THE EXPECTED UTILITY MODEL

5.2.1 Awareness Of Insurance Availability

The field survey was intentionally designed to cover only those communities where flood or earthquake insurance could be purchased. Data from the field survey indicated that ten percent of the uninsured homeowners in flood-prone areas and one quarter of the uninsured homeowners in earthquake-prone regions of the California were unaware that insurance existed.

Figure 5.1 depicts the means by which those who knew such insurance existed first heard about coverage. In both the flood and earthquake surveys the mass media and the insurance agent were the principal initial sources of knowledge on insurance. These findings are consistent with empirical studies on the adoption of innovations, which emphasize the importance of impersonal communication at the initial stage of the diffusion process. Thus less than fifteen percent of the homeowners in our survey first heard of insurance from friends, neighbors or relatives.

In contrast to earlier studies on the diffusion of innovations where the salesman was the primary initial contact, the field survey data revealed that only 7 percent of the respondents in flood- or earthquake-prone areas learned about insurance because their agent called them first. The other individuals who claimed their insurance agent was an initial source of contact were undoubtedly concerned enough about the hazard to seek out information on their own.

In some instances, a person learned about insurance from his agent only because he was under the mistaken impression that he was already covered. For example, a resident of Norristown, Pennsylvania whose property was flooded by Tropical Storm Agnes thought his homeowner's policy protected him against damage:

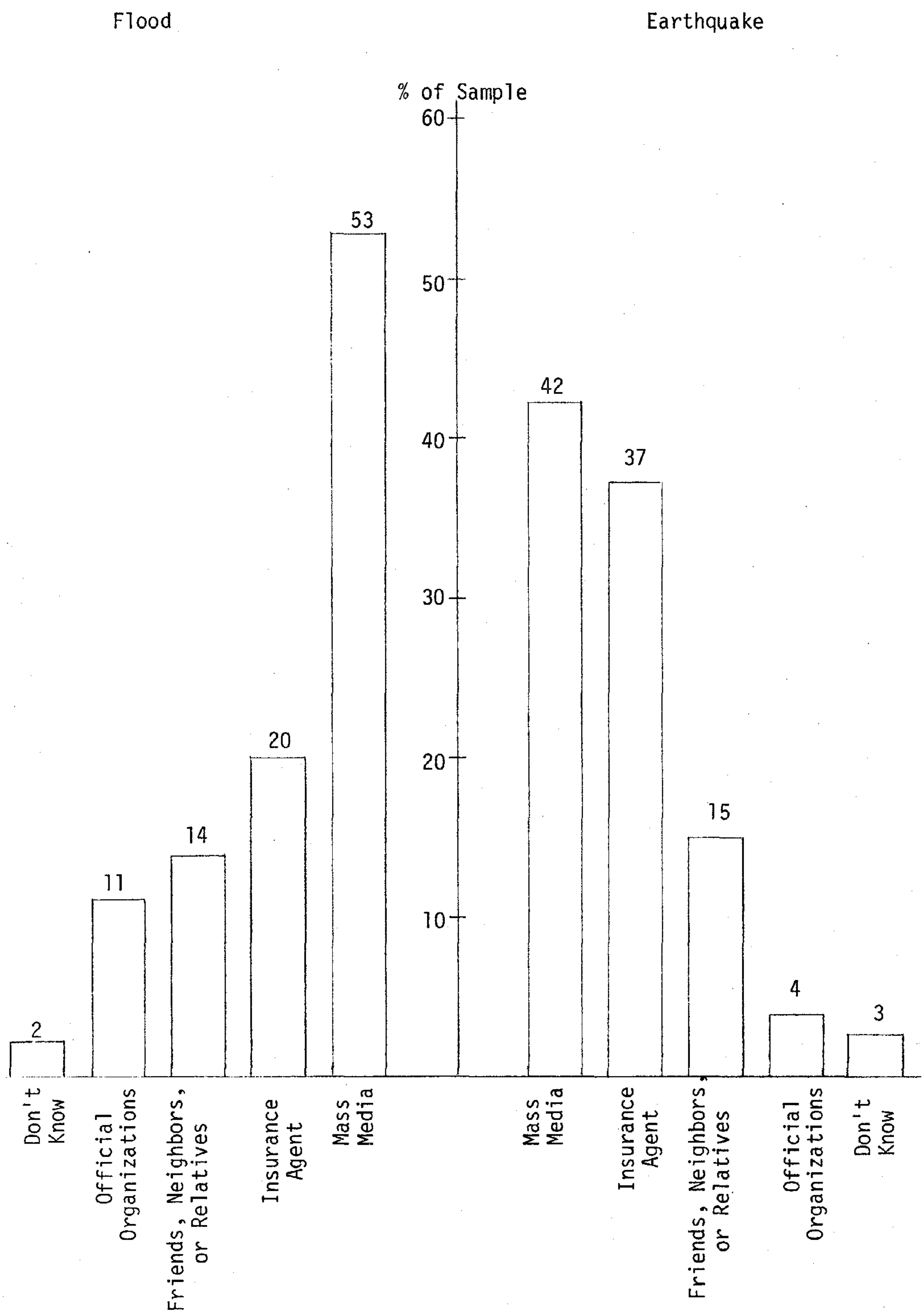
> I may be naive but when I came home I said to my neighbor 'I'm covered'. When I called my agent, he said 'You're not covered'. I had homeowner's insurance. That's the best policy I can get. And I found out I wasn't covered. I said 'What is this? I'm paying for insurance and getting nothing.' My agent said 'Well, if the water came in the roof and damaged the inside of your house, you're covered.' When the gas man first came and saw my home after the flood he said 'You know what I'd do? I'd put a match to it. And then you'd be covered by fire insurance.'

Even though a person may be aware of the existence of insurance, he may not realize he is eligible for coverage. Surprisingly enough, over 60 percent of the uninsured homeowners had no idea that they could cover their house against damage from floods or earthquakes. Some individuals did not know that coverage was available in their neighborhood because they were unable to buy a policy in previous years. For example, an uninsured homeowner from Bakersfield, California remarked that after the severe quakes of 1952, he had tried unsuccessfully to buy earthquake insurance:

> We had two earthquakes in less than a month and both of them did severe damage to the city. And you can see what a panic it set the insurance companies in. We inquired about earthquake insurance afterwards. We had so much insurance, I thought we had that. But,

Figure 5.1

Initial Source of Contact Regarding Insurance
for Those Aware of Coverage



> of course, we didn't. I never kept up with the times well enough to see if it was available. I just assumed it wasn't because I remembered they wouldn't write it in years gone by.

In contrast to most individuals participating in the group-depth interviews, one insured individual was willing to go to extreme lengths to get information on flood insurance. His own personal experience illustrates the problem others may have faced had they made any effort to obtain coverage before the community was part of the flood insurance program:

> Before all the floods happened, I inquired about flood insurance just because I was living on the river. I thought my homeowner's policy would not take care of a flood. I had heard that flood insurance was available. Now I called my insurance agent and he didn't know a thing about it. He said you can't get it. Write the federal government. I said O.K. I wrote a letter, I think I still have the letter somewhere; maybe it fell in the flood, I don't know-- I wrote "Flood Insurance, Washington, D.C." trying to find out about it. I wrote a letter and everything--well I got that letter back saying "No address". I tried to find out and then finally I just forgot about it. So one thing! It wasn't publicized enough: where to get it and whom to see, that was the first thing. I didn't have my insurance at that time when I got hit. I would have had it if I had found someone to sell me a policy.

This homeowner eventually did buy flood insurance after he found out it was available in Norristown, but others still had no knowledge of coverage two years after the community entered the flood program. Of those homeowners that thought about buying a flood policy, one out of three found it unavailable when they inquired about coverage, presumably because their community was then not part of the National Flood Insurance Program. In the earthquake sample, where insurance had been available since 1916, only one-sixth of the nonpolicyholders who tried to get information on insurance were under the mistaken impression that they could not purchase coverage.

5.2.2 Awareness Of Costs And Deductibles

For those individuals who are aware that insurance is available in their neighborhood, it is of interest to know what information they have on the terms of the policy. In the case of flood insurance, the premium on existing homes is subsidized by the federal government so that such information would be an inducement for residents of the flood plain to purchase coverage. The data from the field survey indicate that three quarters of the insured individuals know that they are paying a subsidized rate. Of the uninsured individuals more than half are unaware that premiums are subsidized. Earthquake insurance is marketed privately, yet approximately 10 percent of the individuals in our survey incorrectly believe that rates are subsidized[1].

Why do homeowners have only limited knowledge on the nature of the rates? An insured homeowner participating in the group depth interviews, who was able to find out that flood insurance premiums were extremely low, suggested that a principal reason for this lack of knowledge was insufficient dissemination of information:

> Publicity has been nothing. All we know is that there is now available flood insurance, period. That's all. But if the people did know that a great percentage of this was available at a very small, nominal amount, I believe that they'd do a terrific business with it.

If there is misinformation on a basic point related to rate subsidization, one would also expect to find inaccurate estimates of the actual premiums. Figure 5.2 summarizes these findings by looking at the rate estimates of those homeowners. It should come as no great surprise that approximately one-quarter of the nonpolicyholders were unable to provide any estimate of the cost of insurance even when prodded by the interviewer to offer their best guess. Less than seven percent of the policyholders were in this category. They either did not remember the amount or were unaware of the cost when they purchased coverage. This latter possibility is illustrated by the behavior of an individual in Bakersfield who was not sure whether he had earthquake insurance. He had arranged for his agent to add coverage to his homeowner's policy if the premium was not too high.

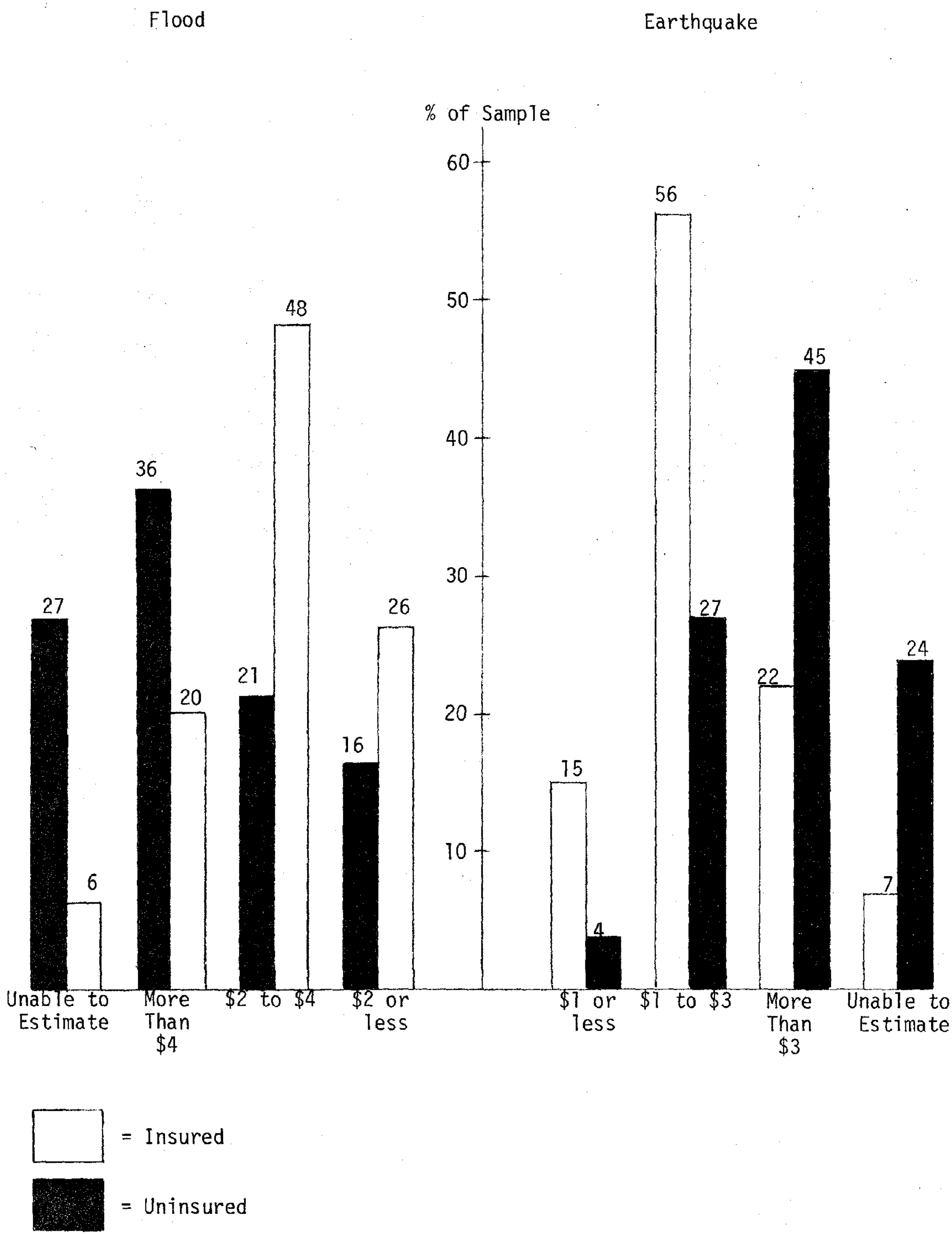
How accurately could respondents estimate the cost of insurance? The subsidized flood rate is between $2.50 and $3.50 per $1000 coverage, depending on the proportion of coverage devoted to structure and contents. The earthquake premium on wood-frame homes in California averages $2 per $1000[2]. Hence any homeowner who estimates the respective rates between $2 and $4 for flood coverage and $1 and $3 for earthquake insurance will be classified as reasonably accurate.

Figure 5.2 shows that most of the insured homeowners were accurate in their estimate, and those who were not within this range generally underestimated the amount. The uninsured individuals present quite a different picture. A much smaller percentage estimate premiums within one dollar of the actual rates; approximately 36 percent of those in the flood sample and 45 percent in the earthquake sample overestimate the premium by

Page 5-9a

Figure 5.2

Subjective Estimates by Individuals of Cost of Flood or Earthquake Insurance per $1,000 Coverage



more than one dollar. This finding suggests that the nonpolicyholders have not made any conscious effort to obtain information on rates from their agent even if they know coverage is available.

Data from the field survey on the maximum amount that homeowners are willing to pay for their desired amount of flood or earthquake coverage is consistent with this hypothesis. Consider the group of uninsured homeowners who could provide such a dollar estimate[3]. In Figure 5.3a we have varied the premium per $1000 coverage (Z) from $0 to $10 and plotted the percentage of nonpolicyholders willing to pay Z or more for this desired coverage. Point A indicates that 34 percent of this subset of uninsured homeowners would be willing to pay more than the average rate for earthquake coverage. Point B indicates that 27 percent would be willing to pay more than the current subsidized flood insurance rate. Had they been aware of the actual premiums these nonpolicyholders should have been willing to buy coverage.

Most of the policyholders in flood- and earthquake-prone areas feel they are getting a bargain with respect to their coverage. When asked what the annual cost of insurance would have to be to make them cancel a policy, 64 percent of the flood insured sample and 61 percent of the earthquake insured sample were able to provide a dollar figure. Figure 5.3b indicates the percentage of this group of insured individuals who would be willing to pay Z or more dollars for $1000 worth of coverage. The area labelled "consumer surplus" represents the aggregate benefit derived by individuals who are willing to pay more for insurance than its actual cost. Thus we find that 56 percent of the insured flood individuals would pay a premium of at least $6 per $1,000 for coverage, whereas the current rate is approximately $3 per $1,000. The earthquake insured group is less enthusiastic about increasing their premiums above the current rate. This is understandable since rates are not subsidized and hence this coverage should be less attractive than flood insurance. A small group of policyholders are willing to pay less than the current premium. These people either misunderstood the question or did not know the cost of their insurance policy.

One of the insured homeowners in Biloxi made the following comment, which indicates how a misperception of rates may cause individuals to neglect a possibly attractive option:

> I had a conversation with a person months ago and I mentioned that flood insurance would be a good idea for him and he said, 'I can't afford it', not realizing that he could get it at a low rate.

Figure 5.3a

Maximum Premium Uninsured are Willing to Pay for Insurance per $1,000 Coverage

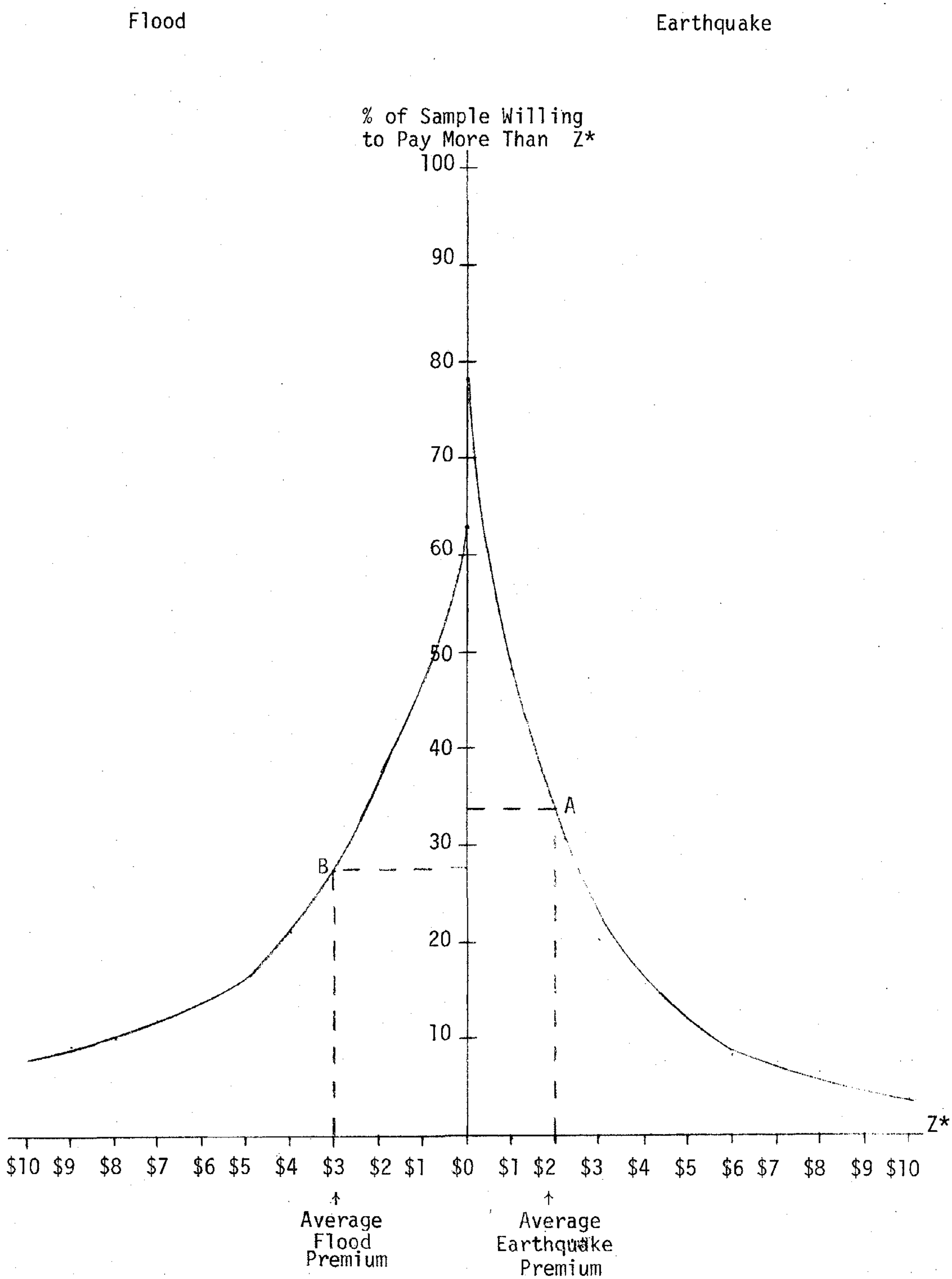
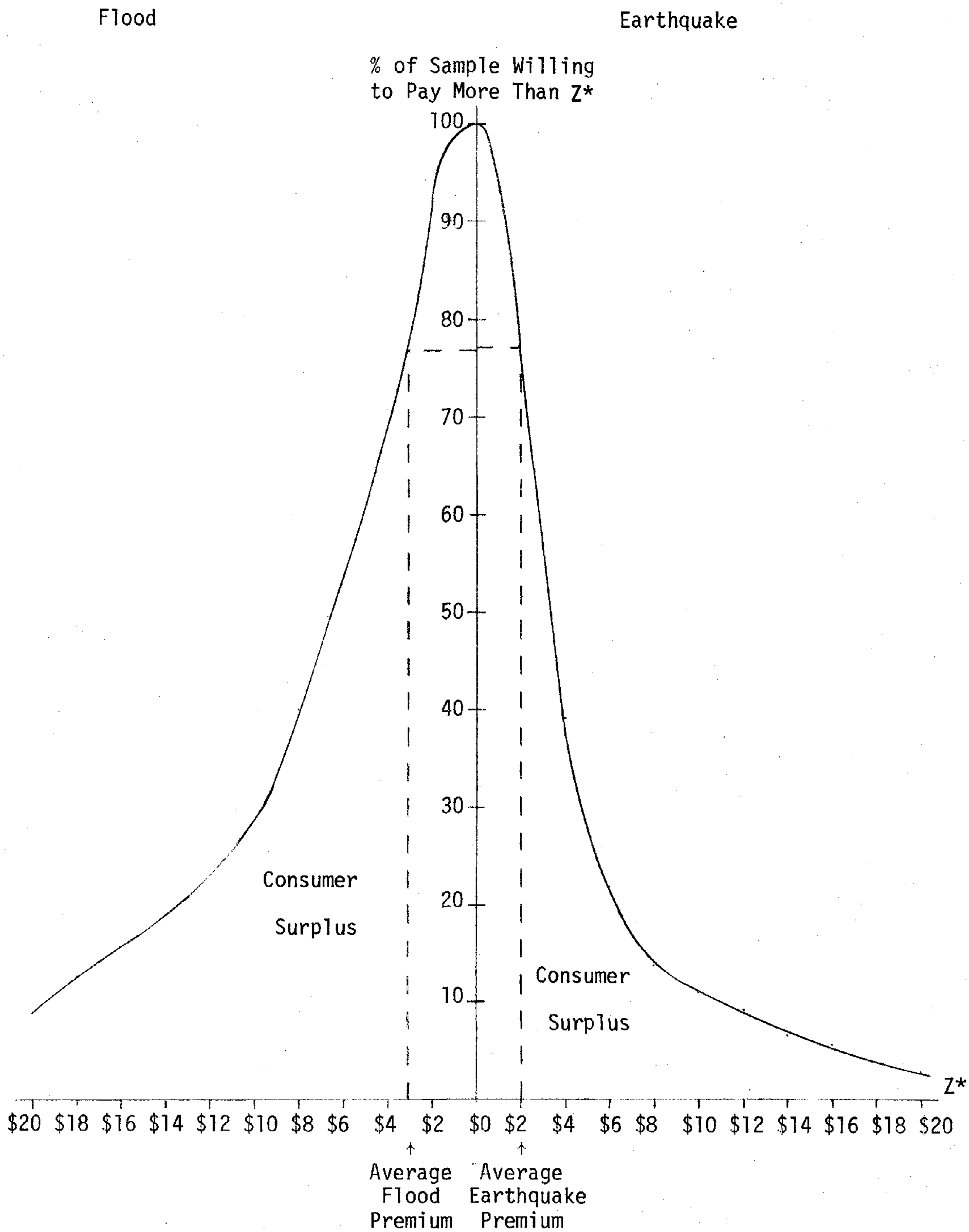


Figure 5.3b

Maximum Premium Insured are Willing to Pay for Insurance per $1,000 Coverage



People also know little about the deductible clause in a flood or earthquake insurance policy, as shown in Figure 5.4. It is understandable that the majority of the uninsured individuals would not know whether there is a deductible in a policy, but it is surprising that a relatively large proportion of the insured population can neither estimate the deductible nor have correct information on it. Should any of these insured individuals suffer earthquake damage, they undoubtedly would be surprised to find that their insurance agreement states that there is a 5 percent deductible on the actual cash value of their policy[4]; and thus, they would not collect anything if their loss were relatively small.

This misperception of the earthquake deductible is illustrated by the following comment from a policyholder in Bakersfield:

> If you get hit by an earthquake, it would be unusual to have more than $500 or $1000 worth of damage.... The chance of me getting $20,000 worth of earthquake damage in my lifetime is nil.

Undoubtedly this person has never attempted to make a claim on his earthquake insurance policy. Once he does, it is a safe bet that he will cancel his coverage. Further evidence on the expectation of using earthquake insurance as a primary source of recovery on small losses is presented in Chapter 8.

5.2.3 Awareness Of Future Damage

Even if homeowners can estimate the cost of insurance they will not be in a position to utilize the expected utility model unless they can provide estimates of the probability and associated damage to their property from a future flood or earthquake. To increase the likelihood that homeowners would be able to estimate the dollar losses to their house and contents from a severe disaster, the questionnaire first asked respondents to describe the actual damage resulting from a minor flood or earthquake. A similar series of questions then elicited estimates for a severe disaster.

Figure 5.5 presents the distribution of damage estimates expected from a severe flood or earthquake. Most individuals could provide figures on their anticipated losses. Not surprisingly, insured homeowners in both flood- and earthquake-prone areas expect more damage from a severe disaster than do uninsured individuals.

Figure 5.4

Subjective Estimates by Homeowners of Deductible on a Policy

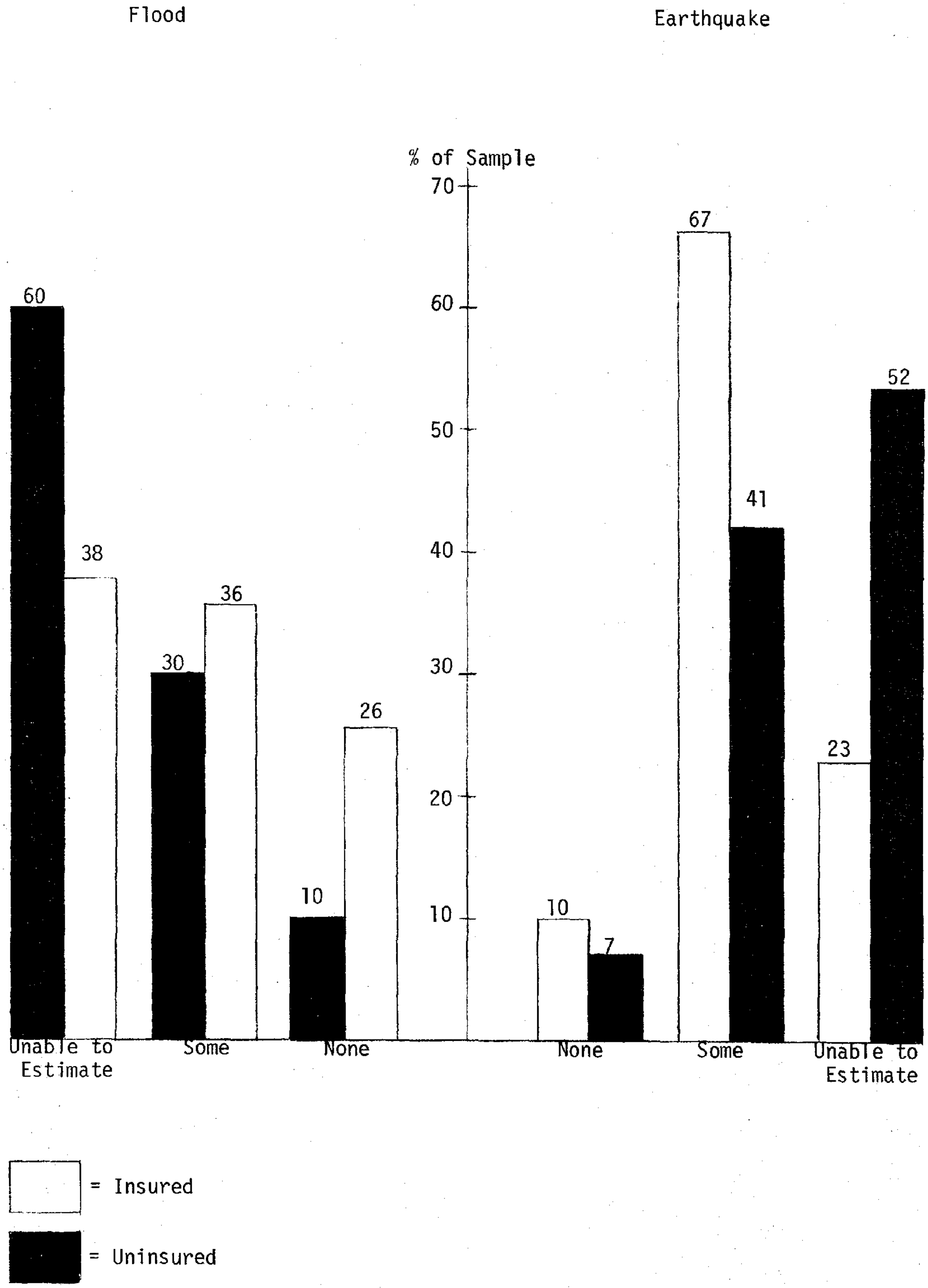
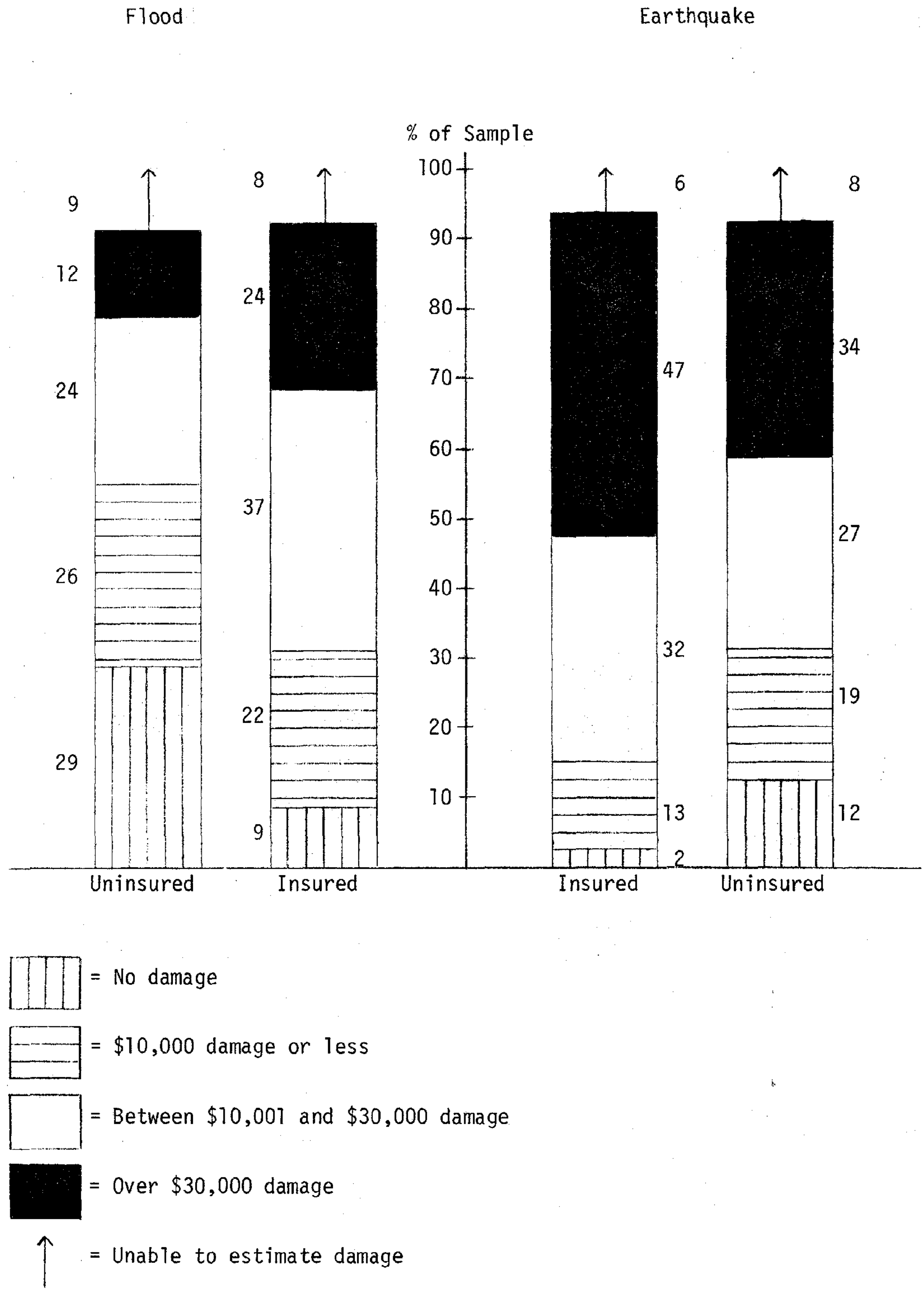


Figure 5.5 Page 5-66

Estimates of Damage from a Severe Flood or Earthquake



Of particular interest is the relatively large number of individuals who feel that a severe earthquake will cause more than $10,000 damage to their property. Since practically all of the houses in California are wood-frame structures, the actual damage from a severe quake is likely to be considerably less than these subjective estimates. If homeowners were utilizing the expected utility model, this overestimate of potential loss might influence some of them to purchase insurance, even when the objective damage figures would suggest that coverage was not worthwhile.

On the other side of the coin, there are a large percentage of uninsured individuals who estimate that they will receive no damage from a severe flood or earthquake in the area. More detailed objective data (e.g. location of the structure in relation to the nearby earthquake fault(s) or the elevation of the home in relation to the appropriate river) are needed to determine whether these subjective estimates parallel reality.

Some insight into the basis for estimating future damage from a flood or earthquake can be gleaned from the group-depth interviews. In discussing the process of estimating how much one is going to lose in a future flood an uninsured homeowner indicated the importance of past experience:

> It just depends on what you have in the house and on what damage was done prior to that. We had two floods in the area and each time it did the same amount of damage. In other words, the water had reached the same height both times and did the same identical amount of damage. The only thing was, the second time, it got more houses.

5.2.4 Awareness Of Probability

In order to evaluate the insurance purchase decision in the context of the expected utility model it is also necessary to obtain data on the homeowner's subjective estimate of the probability of a severe flood or earthquake. Considerable work has been undertaken by psychologists and decision-theorists in eliciting estimates of probability through a series of hypothetical gambles. Such methods would have been difficult and time-consuming to administer in a large field survey. Furthermore, they are not necessarily the best ways to measure subjective probability in this particular context.

We thus took a somewhat different approach. The respondent was shown a card which depicted the chances of males being alive at different ages. Thus, the card showed that 1 out of every 2 male babies born today will be alive at age 70 while only 1 out of 100,000 will be alive at the age of 108. A number of ages between 70 and 108 were depicted on the card along with the respective probabilities of living longer than that age. The individual was then asked to use this card to estimate the chance of a severe flood or earthquake causing damage to his property[5].

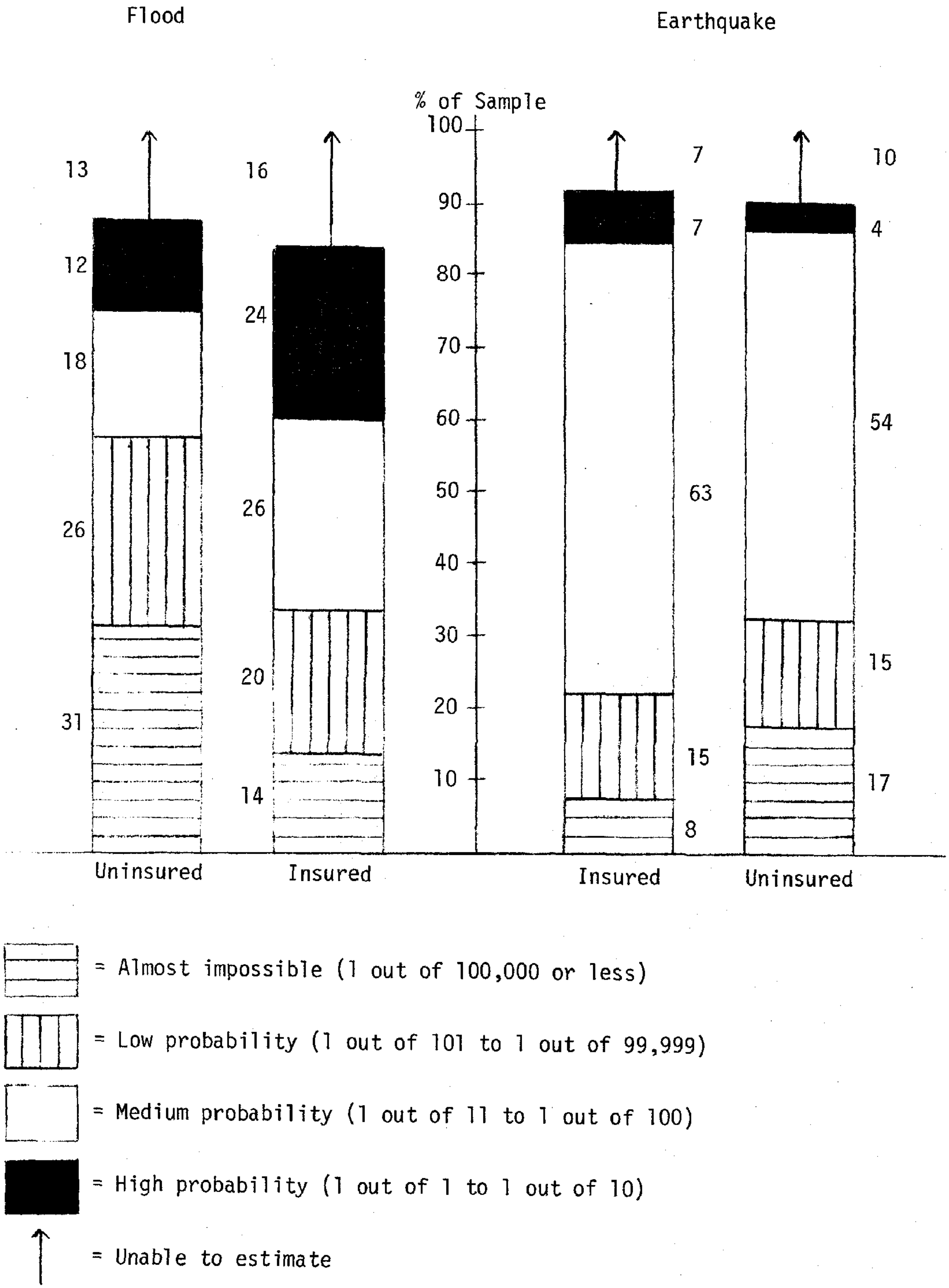
Figure 5.6 presents the subjective probability estimates of a flood or earthquake causing severe damage to one's property within the next year[6]. This probability is conditional on the respondent's earlier estimates of damage to property and contents from a future severe flood or earthquake. Those unable to estimate these losses based their subjective probability estimates on $10,000 damage to their property and contents. Not unexpectedly, uninsured individuals in flood-prone areas estimate a much lower subjective probability of a flood next year than do insured individuals. In earthquake-prone areas the difference between the two groups is much smaller.

The most interesting aspect of Figure 5.6 is the large percentage of uninsured individuals in both flood- and earthquake-prone areas who estimate the probability of a severe disaster in their area to be almost impossible (i.e. 1 in 100,000 or less). Some of these uninsured individuals may have provided such a low estimate, not necessarily because they really perceive the chance of a flood or earthquake to be so small, but rather as an <u>ex post facto</u> justification for their current uninsured status. The same bias may be true in reverse for insured homeowners who estimate a high probability of a future flood or earthquake. There is no way to determine the actual rationale for estimates on the basis of our survey. This is one of the principal reasons for undertaking the controlled laboratory experiments discussed in Chapter 7. They enable us to determine the importance of probability by varying its level and seeing what effect different magnitudes have on a person's insurance decisions.

In estimating the probability of a future severe flood or earthquake, do individuals view the occurrence of the disaster as a random event or one that follows some systematic pattern? Through the use of a story describing four people's view of the pattern of future floods or earthquakes we were able to determine how homeowners in the field survey treated the probability of a

Figure 5.6

Subjective Annual Probability of Severe Flood or Earthquake Causing Damage to Home in Next Year



future disaster. (This story appears as Question 137; see Appendix A.4).

Over two-thirds of our sample in flood-prone areas felt the hazard was a random event[7], while less than half of the homeowners viewed earthquakes as being random. There is some scientific basis for individuals treating these two hazards differently. Hydrologists consider floods to be random events while seismologists have provided evidence that once a severe earthquake occurs, the stress on the fault is relieved and another severe quake is less likely to occur in the near future. Perhaps for this reason 40 percent of the respondents in the earthquake portion of the survey felt that the most probable description of the process was given by the person in the story who claimed that "when a severe earthquake occurs, it is less likely that it will occur again soon."

Of course, for purposes of testing the expected utility model it is only necessary to obtain a subjective estimate of the probability of the disaster, without concerning oneself as to why the individual elicited such a response. On the other hand, if one is concerned with the process utilized by individuals in making their insurance decisions, then the above information could be very valuable. For example, an uninsured individual in Norristown pointed out that his neighbor did not renew his insurance after experiencing two floods in two years "because he figured the probability of it happening again was so slim." By educating such individuals that floods are actually random events, they may be more likely to keep their insurance policies or decide to purchase one.

5.2.5 Expectation Of Federal Aid

One of the arguments raised against a system of liberal disaster relief in the form of forgiveness grants and low interest loans is that it discourages individuals from purchasing insurance in the pre-disaster period. Since 1953 the Small Business Administration has provided disaster loans to victims of natural disasters for the general purpose of restoring "a victim's home or business property as nearly as possible to its pre-disaster condition." (SBA, 1964)

Between 1964 and 1972 Congress authorized the SBA to provide increasingly liberal disaster relief. This generosity is best exemplified by legislation following Tropical Storm Agnes that effectively converted the disaster loan program into primarily a grant program (PL 92-385). The SBA was permitted to forgive the first $5,000 of each loan and provide one percent interest rates on the remaining portion. If property damage to a home or business was greater than thirty percent of its pre-disaster market value, the agency could refinance any mortgage against the property. The only restriction on home refinancing was that the monthly payment of the loan could not be less than the pre-disaster payment.

The cost of disaster loans to the Federal government skyrocketed in 1972 so that in April, 1973 Congress rescinded the $5,000 forgiveness grants and increased the annual interest rates on SBA loans from 1 to 5 percent (PL 93-24); in August, 1975, the SBA loan rate was raised to 6 5/8 percent (PL 94-68). There is no guarantee, however, that following a future severe disaster these provisions will be maintained.

Our field survey was conducted in areas where few of the respondents had suffered any flood or earthquake losses since the time that the forgiveness loan provisions had been rescinded[8]. We therefore anticipated that many of the homeowners in our sample would expect to turn to the federal government for help should they suffer losses from a future disaster.

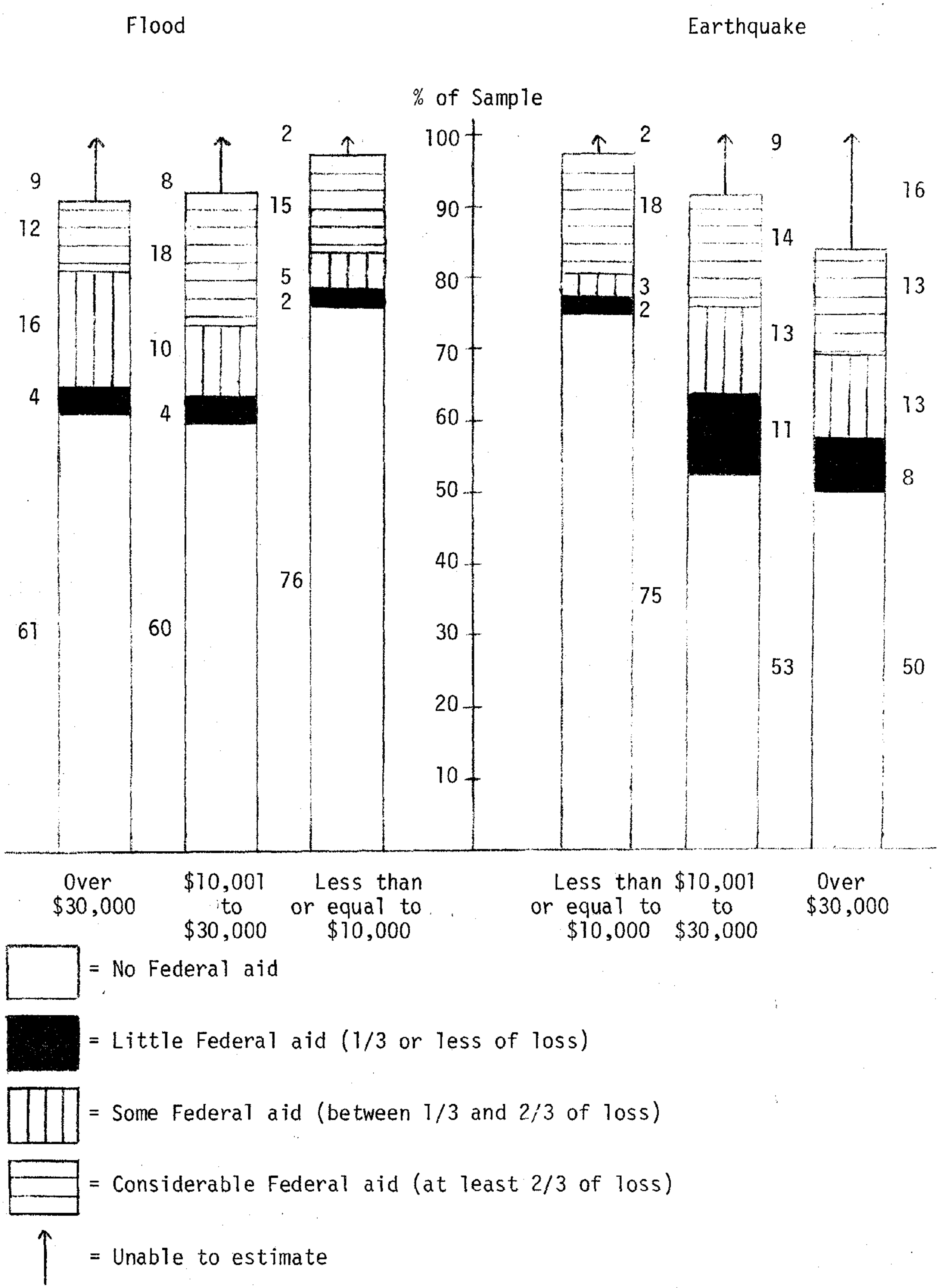
To obtain these data each respondent was asked to enumerate the sources of aid and the expected dollar amounts he anticipated receiving to restore the damage to property and contents from a severe flood or earthquake. To assist him in answering the question, the homeowner was given a possible list of sources including federal aid. Even though the government was explicitly mentioned as a potential source of relief, a majority of both insured and uninsured homeowners did not expect to receive any funds at all from federal agencies.

It is clear that insured homeowners will have no need to rely on the federal government for relief, except to cover the deductible portion of their policy or the loss in excess of their total coverage. As expected, the data revealed that over three-quarters of this group would not turn to the federal government for any relief.

However, a large number of uninsured homeowners in both flood- and earthquake-prone areas also expect <u>no</u> federal aid regardless of their estimated loss from a future disaster. Figure 5.7 graphically depicts these results for the three damage classes delineated earlier. When the losses are

Figure 5.7

Proportion of Federal Aid Expected as a Function of Future Damage for Uninsured Homeowners



$10,000 or less, approximately three-quarters of both the flood and earthquake uninsured respondents expect no aid. Even for homeowners who anticipate large losses, the majority expect no federal relief. A relatively small proportion expect more than two-thirds of their damage to be covered by federal grants or loans. As might be anticipated, the proportion of homeowners who do not know how much they will receive from the federal government increases as the anticipated loss increases.

These findings suggest that prior to a disaster most individuals have not thought about whether the federal government will help them should they suffer severe losses. In fact, it may very well be the case that they have not consciously considered how they would recover in the wake of a flood or earthquake.

Even if individuals anticipate low interest loans from the federal government, insurance may still be a very attractive option. One homeowner in Bakersfield, who was unaware of the availability of earthquake insurance, made this point when commenting on the effects of an earthquake on the recovery process:

> Economically, it would be a disaster to a lot of people who can't afford to rebuild and don't have that insurance. We might be called a disaster area, but when we get a loan from the government, that still doesn't help the situation.

These findings suggest that expectation of future federal aid has <u>not</u> been a motivating factor in the decision process related to insurance[9].

5.3 EVALUATING THE EXPECTED UTILITY MODEL

The figures presented in the previous section indicate that many individuals residing in hazard prone areas have limited knowledge about the flood or earthquake problem or the availability of insurance. A significant number of uninsured individuals are not aware that policies can be bought in their neighborhood, or they are unable to estimate the insurance premium, potential damage, or probability of a future disaster. These individuals have not collected enough information to be able to utilize the expected utility model for evaluating the attractiveness of insurance.

At the other extreme there is a small group of individuals in our sample who were required to purchase flood or earthquake insurance and hence were not given the chance to weigh the relative merits and disadvantages of obtaining coverage. In the earthquake sample only 25 out of 461 insured respondents were forced to purchase insurance coverage as a condition for a mortgage. In the flood sample there was an additional reason why 136 out of the 1103 insured respondents had to purchase a policy. The Small Business Administration was authorized after Tropical Storm Agnes to require this insurance as a condition for a disaster loan. One of the homeowners in Norristown described his experience with SBA after suffering property damage from that severe storm:

> We had to show proof of insurance before we could receive our check from the SBA. I went down there and the man said, 'We're going to give you so much on this loan, but you're going to have to get insurance' and they told me I had to have the minimum, which is $3,000 contents and $4,000 structure. That was the policy. Of course, we applied for it and she gave us a cash receipt. We took this to the SBA... they in turn gave us the allotment for the loan.

It is clear from this example that the individual only bought insurance to get the loan. In fact, he purchased the minimum possible coverage which cost him $25 per year. Whether these homeowners will renew their policy in future years, unless they were required to do so or suffer additional flood damage, is an open question.

5.3.1 Analysis Of Contingency Price Ratio

What about the behavior of those individuals who had free choice regarding insurance coverage, expected some damage from a future flood, and were able to estimate both the probability of such a disaster and the premium? Did their final decision regarding insurance conform to what would be predicted by the expected utility model?

In Chapter 3 we developed a measure for evaluating the attractiveness of insurance to an individual on the basis of the expected utility model. Using his subjective estimate of the probability of a future flood or earthquake (z) and his estimated cost of insurance (p) we could compute his contingency price ratio (R). The value of R reflects the costs of insurance in relation to its potential benefits. Hence, if R is less than or equal to 1, insurance should be attractive to individuals who are averse to risk. As the value of R exceeds 1 insurance becomes progressively less attractive to the individual.

Figure 5.8 plots the percentage of insured and uninsured homeowners with subjective estimates of R below any given value in the range from 0 to 1,000. The letters A and B on the diagram enable one to determine at a glance the proportion of individuals whose behavior is inconsistent with the expected utility model. Thus, point A enables one to determine the proportion of insured individuals whose estimates yield values of R above 10. If R exceeds this magnitude, then the cost of insurance in relation to its potential benefits is so high that it is unlikely that a person would have voluntarily protected himself against flood and earthquake losses if he were maximizing expected utility. Almost 30 percent of insured homeowners in the flood sample and almost 40 percent of the insured homeowners in the earthquake sample fall into this category.

In fact, there were a number of insured individuals who estimated such a low probability of a future severe disaster that their value of R exceeded 100. It is conceivable that this group of insured individuals were actually purchasing coverage to protect themselves against damage from moderate or minor disasters. Although there is no quantitative data from the field survey data to test this hypothesis, we feel it is much more likely that they bought a policy for reasons having little to do with comparisons between premiums and probabilities, which form the basis for the determination of R. Evidence supporting this alternative viewpoint will be presented in the concluding section of this chapter and in Chapter 7 on controlled laboratory experiments.

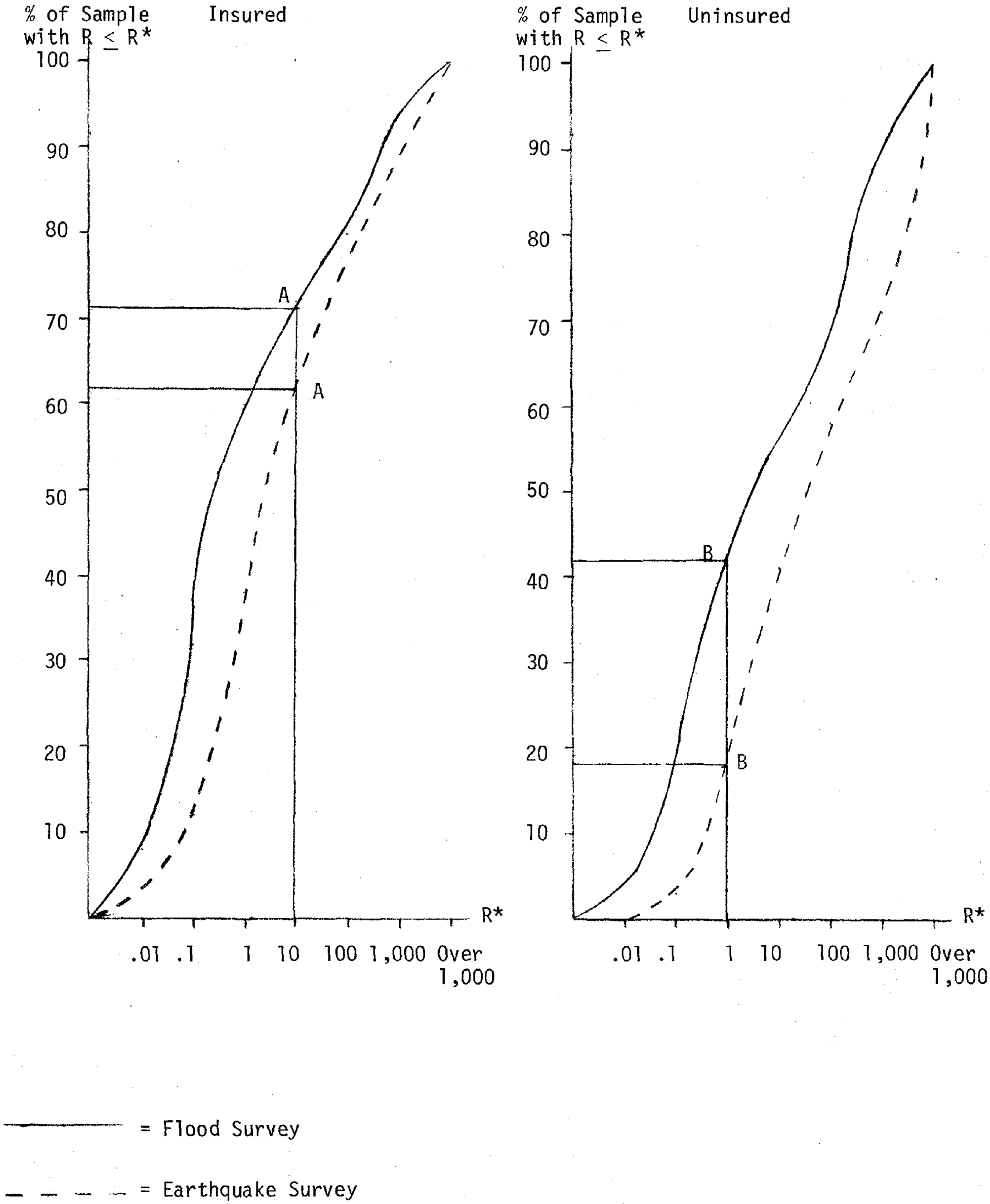
Point B indicates that over 40 percent of the uninsured homeowners in the flood sample and almost 20 percent in the earthquake sample had estimates of R below one, and hence <u>should</u> have purchased insurance if they were trying to maximize expected utility. These individuals viewed insurance as being subsidized to them. Note the large number of uninsured homeowners in the flood sample whose subjective estimates implied values of R less than .1, so that coverage would have been highly desirable to them[10]. These individuals generally had relatively high subjective probability estimates of future damage from a flood and low estimates of the insurance premiums.

5.3.2 Effect Of Search Costs On Behavior

As shown in Chapter 3, a utility theorist might argue that a principal reason that many uninsured individuals have not taken out coverage is the time

Figure 5.8

Contingency Price Ratio (R) for Insured and Uninsured



and effort required to obtain information on the terms of a policy. The field survey data do not support this contention. Over one quarter of the uninsured individuals in earthquake-prone areas of California and almost two-thirds of the uninsured homeowners in the flood-prone communities had not even thought about purchasing coverage. When asked how likely they were to buy a policy in the future, over seventy-five percent of the uninsured responded that they would probably or definitely not buy coverage. The primary reason given for a lack of interest in insurance was "I don't need it." These results suggest that the majority of uninsured homeowners have made little effort to obtain data on an insurance policy because they are unconcerned with the consequences of the hazard rather than because it is difficult to obtain information from their agent.

An uninsured homeowner in Bakersfield who was interested in learning more about earthquake insurance before coming to the group depth interview had no difficulty in obtaining information on the terms of a policy by initiating contact with his agent as illustrated by the following remarks:

> I called my insurance man this morning before I came to this meeting because I thought we were going to be discussing something on that order. My agent works for State Farm Insurance, and he tells me that $1,000 of coverage in this valley costs two dollars a year.... So that means if you have a $20,000 home, you can spend $40 a year for the premium. This is all it is. And he tells me that there is a 5 percent deductible to protect the insurance companies from false claims. If the property is worth $20,000 then the first $1,000 is your loss if the entire property goes down.
>
> He made the statement that this state is divided into three zones for earthquakes.... The biggest requirement as far as they're concerned is that he has to come out and inspect your property. Because all that they're really afraid of is these false claims. So what he said to me was that when they have an earthquake that destroys, it's a rolling earthquake. In most cases the house that goes down is the slab concrete for the simple reason that when the ground rolls, it brings the concrete up.... After the inspection it's nothing to get it [a policy]. He says it is easier to get than flood insurance.

Interestingly enough this particular homeowner had lived in the Bakersfield area for 26 years but had never inquired about earthquake insurance until he knew that this was likely to be a subject for discussion. Once he shared this information with the rest of the participants, all of whom were uninsured, a number of them expressed amazement at how inexpensive a policy actually was and how simple it was to purchase coverage.

In the case of earthquake insurance it is typical for a person to purchase a policy as an endorsement to his homeowner's coverage. The majority of the policyholders interviewed in the survey simply followed this procedure and first bought earthquake coverage at the time they renewed their homeowner's policy. Flood insurance, on the other hand, must be issued as a separate policy, yet 25 percent of the respondents still bought flood coverage when they renewed their homeowners coverage. One uninsured person in Norristown remarked at the group depth interviews that:

> I'm really waiting to buy flood insurance until my homeowner's policy is renewed which won't happen for almost another year. I'm hoping that a flood won't occur during that time.

Once an individual knows that he wants flood insurance, there is no rational basis for him to wait to buy a policy for another year, as this person planned to do.

5.3.3 Summary Of Findings On Utility Theory

Table 5.1 summarizes the findings regarding the adequacy of the expected utility model in explaining behavior. Only forty-two percent of the flood-insured individuals and thirty-three percent of the earthquake insured individuals had estimates of z and p that were clearly consistent with the expected utility model. Another nine percent of the flood-insured group and twenty percent of the earthquake-insured might have been sufficiently risk averse (i.e. $1<R<=10$) to have been expected utility maximizers. Other insured persons either did not have enough information to utilize the model, had unusually large estimates of R (i.e. $R>10$), or expected no damage from the hazard. Thus their behavior could not be explained by resorting to the standard expected utility framework.

The uninsured individuals present an even more disturbing picture regarding the adequacy of utility theory to explain their behavior. Approximately ten percent of them had a sufficiently high value of R for insurance to be unattractive. Most respondents did not even have enough information to utilize the expected utility model. It is certainly true that twenty-nine percent of the uninsured respondents in flood-prone areas and twelve percent of those in earthquake areas estimated no damage from a severe disaster. The fact that these individuals reside in hazard prone regions of the country suggests that they have not even considered the potential consequences of a flood or earthquake in their decision process regarding insurance. Evidence from the field survey data support this conjecture. Most uninsured persons had not even thought about buying insurance. When asked why

TABLE 5.1

CATEGORIZATION OF INSURED AND UNINSURED INDIVIDUALS IN FLOOD AND EARTHQUAKE SURVEYS
(Percent of Sample)*

	Flood Survey		Earthquake Survey	
	Insured	Uninsured	Insured	Uninsured
Expect zero damage	10	29	2	12
Do not expect zero damage				
Cannot estimate premium or probability of loss	19	50	12	66
Insurance highly attractive ($R \leq 1$)	42	9	33	5
Insurance possibly attractive ($1 < R \leq 10$)	9	3	20	4
Insurance unattractive ($R > 10$)	20	9	33	13
Total	100	100	100	100

*Homeowners required to buy insurance are not included.

they did not intend to buy coverage, the majority claimed that they did not need it.

5.4 ELEMENTS OF A SEQUENTIAL MODEL OF CHOICE

This section investigates the merits of the sequential model of choice (detailed in Chapter 3) for describing the behavior of individuals toward insurance. Field survey data provide insight into homeowners views on the hazard and insurance. It also enables one to delineate the important variables for determining whether or not a homeowner will purchase a policy. The process we are following is a retrospective one. Considerable statistical analyses have been undertaken using multivariate tools such as contingency tables and logit regressions. These methods will be discussed in the next chapter. In this section we are summarizing the variables which, after analyzing our data in great detail, have been found to be important in explaining behavior at each stage of the decision process.

5.4.1 Awareness Of Problem (Stage 1)

Before individuals are even willing to consider ways of protecting themselves voluntarily they must have some personal concern with the hazard. The survey data show that almost three quarters of the homeowners residing in flood-prone areas did not think that there were flood problems in their immediate neighborhood when they moved there. Even though California is known to be a seismologically active state, over forty percent of the residents we interviewed did not think that there was an earthquake problem in their area at the time they bought their house. For those who had prior knowledge there may have been a tendency to minimize the problem by relating it to other hazards elsewhere in the country, as evidenced by the remarks of one homeowner in Bakersfield:

> I'm not nearly as concerned about earthquakes here in Bakersfield as I would be about tidal waves if I were living in Biloxi, tornadoes if I lived in Oklahoma or hurricanes if I lived in a New England state. Because you can have a severe earthquake and it would still only hurt a few people and it will only damage few properties on the whole. Whereas when you have one of those tidal waves, it wipes out the whole shootinmatch.

A primary reason why a large number of families are unaware of the hazard when they buy their house is that there is no incentive for the current property owner, real estate agent, or developer to inform them about the potential problems one may face by moving there. Thus in the earthquake portion of the survey thirty percent of the homeowners did not know how far their house was from a fault. As one Bakersfield resident succinctly put it:

> When you go out to buy a piece of property, the real estate agent doesn't say I want you to understand that there's a fault running right down the middle of this thing. You buy the house, and six years later somebody tells you you're sitting on top of a fault.

Not only is it rare for potential buyers to get information on the hazard voluntarily before they move to an area, but occasionally they may be given misinformation. One graphic example comes from Minot, North Dakota, which has had five floods between 1969 and 1976 that have forced residents in the area to temporarily evacuate their homes. Earl Beck, President of the County Commissioners, bought an $85,000 house 120 feet from the river. In an interview with a N.Y. Times reporter just prior to bracing himself for the 1976 flood he commented:

> I wasn't going to buy here because I was afraid of the river. But the bankers convinced me it was okay. Can you believe that? (N.Y. Times, April 15, 1976, p. 20).

Once located in a particular neighborhood, families may obtain sufficient information on the hazard so that they then view it as a problem. Homeowners were asked whether or not they felt their neighborhood was a place where floods or earthquakes could occur and and how they would rank the hazard in relation to other problems typically facing residents in a community (i.e. crime, education, housing, public transportion). By combining the responses to these questions we classified homeowners' current perception of the problem as being either serious, minor or non-existent.

For those homeowners who were aware of the flood or earthquake hazard at the time they moved into the area, over 95 percent feel that it is a serious or minor problem today. For those who were unaware of the hazard when they purchased a house, 6 out of 10 residents in flood-prone areas and three-quarters of those in earthquake country feel the hazard is either a minor or serious problem today. Their perception appears to be influenced primarily by past experience with the hazard. Two-thirds of those who were unaware of the flood problems before they moved into their house but felt it was a problem today indicated that their perception changed through past experience. For quake-prone areas, over 40 percent of those unaware of the hazard at the time they moved volunteered past experience as the principal reason for considering it to be a problem today.

5.4.2 Awareness Of Insurance (Stage 2)

How did individuals in hazard prone areas become interested in buying flood or earthquake insurance? Figure 5.9 indicates that the awareness of the hazard was the factor that started most people thinking about buying insurance protection. Evidence on the importance of past experience in stimulating an interest in insurance is seen from the comments by participants in the group-depth interviews. One uninsured homeowner summed up his view of the decision process in the following way:

> The biggest thing is that you have to be in it [a flood]. Then you make your decision as to whether or not you want insurance. But if you're not in it, you couldn't care if it's flooding or what it's doing outside. Once you've experienced it, then it rolls through your mind, shall I or shall I not buy insurance and how much shall I get.

An insured homeowner even went so far as to suggest that the only type of information that would convince an individual to consider insurance would be personal involvement in a disaster:

> Unless you've experienced something like this, you're not apt to take it [insurance] out. Somebody could move into your house and not renew though you've told them about it. They'd say what can happen and they wouldn't renew it. Like in two years nothing happened, and they wouldn't renew. And then boom.

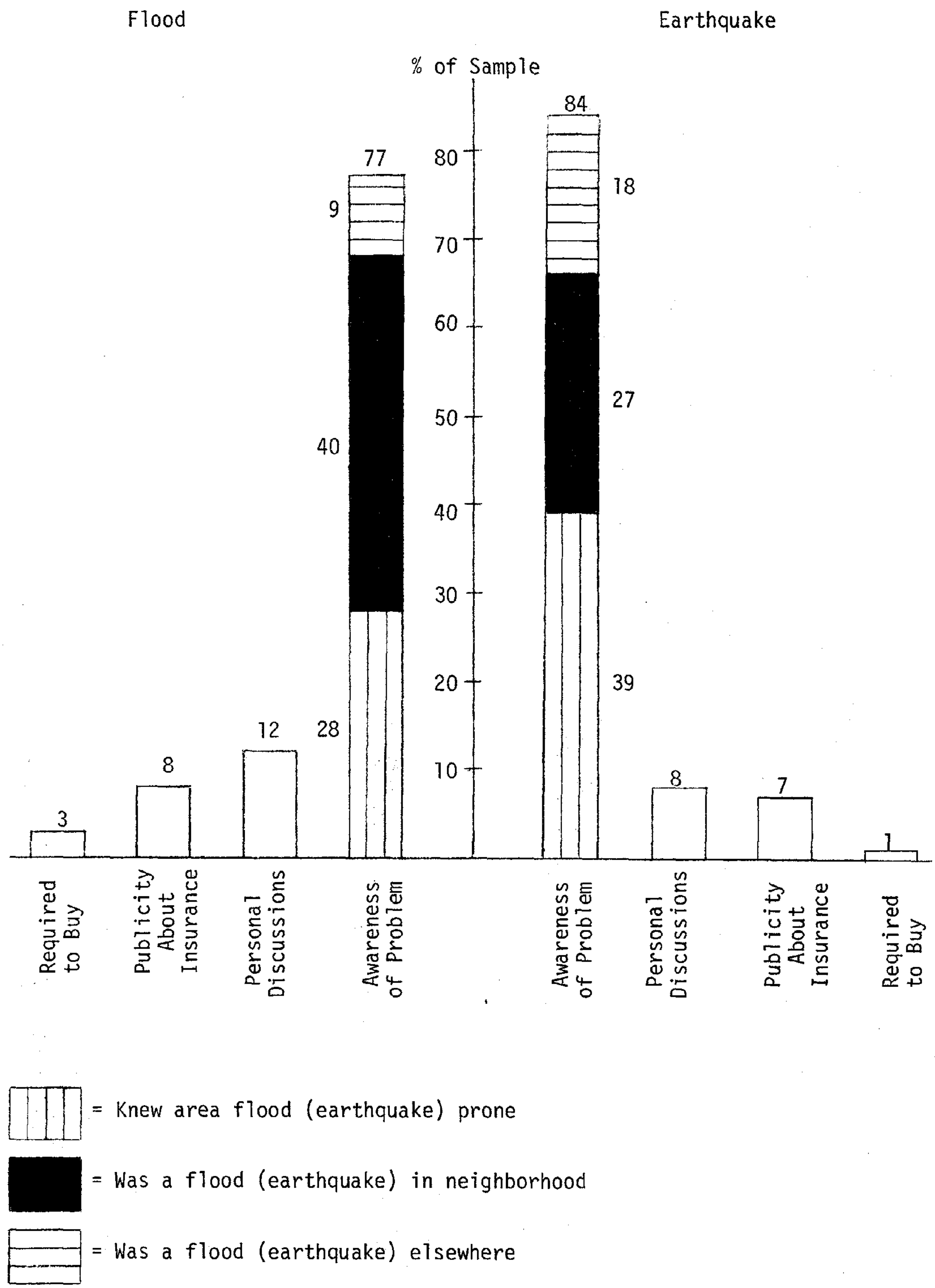
One of the conclusions of the experimental study (discussed in Chapter 7) is particularly relevant here. People often behave as if a low probability was a zero probability. Hence, there is a critical threshold which must be crossed before an individual treats a perceived hazard as a problem. Only if he reaches that stage is insurance worth considering.

5.4.3 The Insurance Adoption Decision (Stage 3)

The conversion process from interest in buying a new product to actually purchasing the item is complicated and not fully understood. One common point made by almost all empirical studies on the diffusion of innovations is that there is a long interval between the awareness of the new item and the actual

Figure 5.9

Principal Factor Triggering Interest in Insurance



adoption decision. If individuals do have a difficult time collecting and processing information and making decisions, then it is understandable why good intentions may not actually be carried out immediately.

Our field survey was not designed to investigate the diffusion process over time with respect to the insurance adoption decision. However, the data do enable us to examine what factors appear to influence this decision. In fact, the principal reason for designing the sample to be equally divided between insured and uninsured homeowners was to strengthen the possibility of isolating those variables which discriminate between these two groups. This section summarizes key factors which were found to be important in differentiating insured from uninsured homeowners. The statistical importance of each of these factors and interaction effects between variables will be presented in Chapter 6, utilizing recently developed tools for analyzing qualitative and quantitative variables.

Perception of the Problem

From the discussions in the previous sections one would expect that homeowners who perceive the hazard to be a problem are more likely to purchase insurance then those who do not. Figure 5.10 suggests the importance of this variable by depicting the proportion of insured and uninsured homeowners who feel the hazard is a serious, minor, or unimportant problem. In the flood survey there are a significant number of insured who view the problem to be severe while relatively few uninsured individuals fall in this category. In the case of earthquakes, few homeowners view the problem to be severe but a larger proportion of the insured than uninsured fall in this category.

Past Experience

One of the main variables influencing the perception of the problem and hence the decision to purchase insurance is the individual's past experience with the hazard. One reason most individuals in California do not consider earthquakes to be a severe problem is that they have not suffered major damage from such a disaster. Table 5.2 illustrates this finding by focusing on the cumulative dollar losses caused by floods or earthquakes prior to the date the homeowner purchased insurance, or the interview date should the homeowner be uninsured. As one might expect, small flood or earthquake losses had a negligible or even negative effect on the purchase of insurance. Given the

Figure 5.10

Perception of the Problem

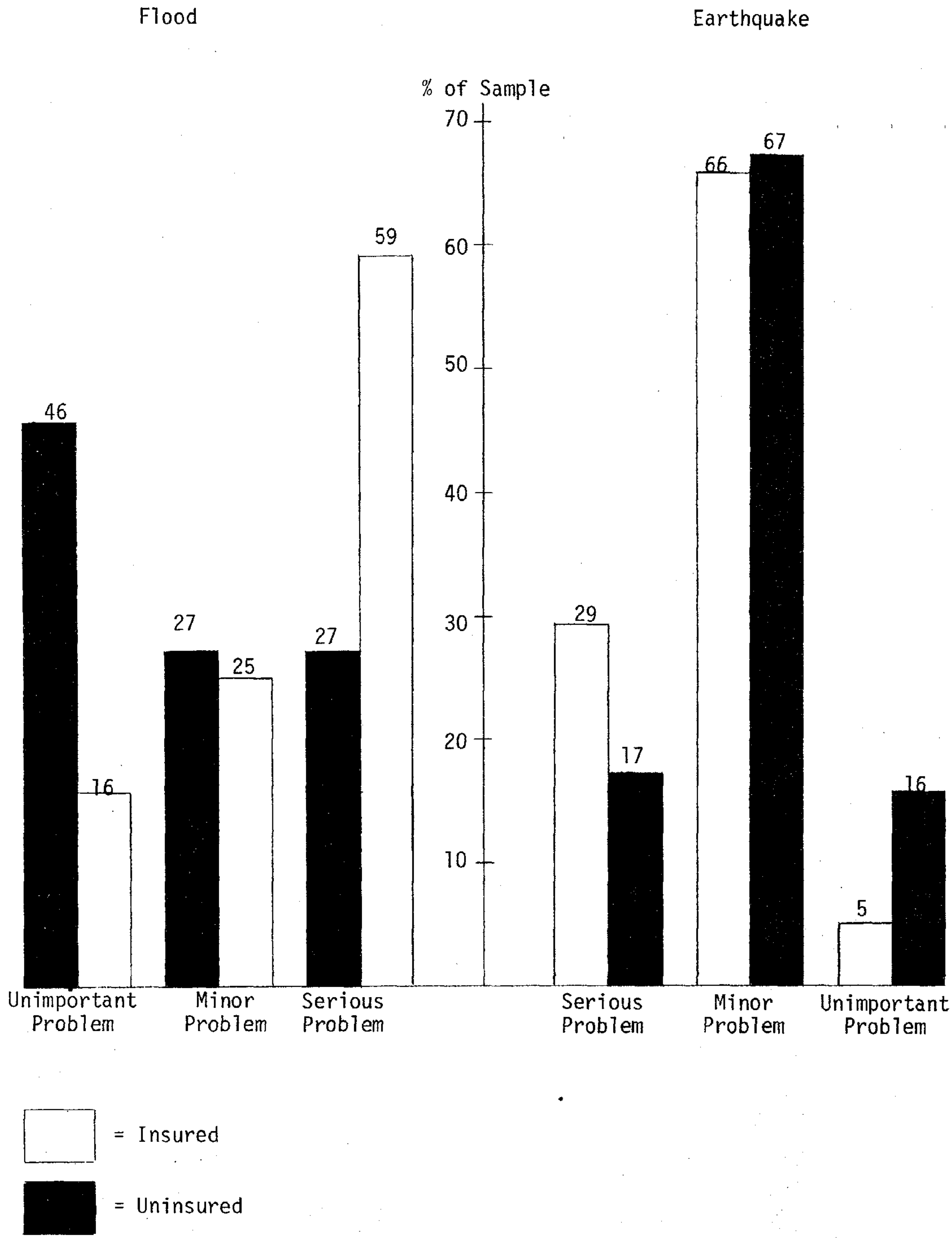


TABLE 5.2

CUMULATIVE FLOOD OR EARTHQUAKE DAMAGE TO PRESENT HOME
(Percent of Sample)

	Number	% Insured*
	Flood Survey	
No damage	1,569	48
$ 1 - $ 1,000	124	59
$1,001 - $ 5,000	138	77
$5,001 - $10,000	98	68
Over $10,000	126	83
	Earthquake Survey	
No damage	825	46
$ 1 - $ 500	95	38
$ 501 - $2,500	46	48
Over $2,500	40	58

*Cumulative damage prior to purchasing insurance.

deductible clauses in the flood and earthquake policies, homeowners may have learned after a disaster that it did not pay to have coverage if they experienced only small losses.

As shown in Table 5.2 few homeowners had cumulative earthquake losses exceeding $2,500 and the majority suffered losses of less than $500. Many flood victims suffered large losses and most of these homeowners then purchased insurance. This table suggests that prior experience influences the insurance decision only if the damage is relatively high. Otherwise the experience will have no effect or may even have a negative relationship to the purchase of insurance.

The importance of suffering severe damage before buying insurance is illustrated by the comment of one homeowner in Norristown who had not purchased a policy before Tropical Storm Agnes:

> You ask me why I didn't have insurance before the June, 1972 flood. We had the flood in September of '71 and I had two feet of water in my basement. And I felt this I can tolerate, and this is probably as high as it will ever get.

To his chagrin this individual suffered severe property damage in 1972 and then decided that he <u>needed</u> insurance.

Another example of the influence of past experience upon the insurance purchase decision is reflected in the sale of flood insurance in Northern New Jersey. Three of the sampled communities, Plainfield, Clark, and Cranford, suffered severe flood damage on August 2 and 3, 1973. In Plainfield, during 1973, 329 policies were sold; however, 220 of these were sold in August and September of that year. In Clark, 38 policies were sold in 1973 of which 25 were sold in August and September. Of the 416 policies sold in 1973 in Cranford Township, 263 were purchased by homeowners during the two months following the flood.

The following comment also suggests the importance of past experience in prompting homeowners to buy coverage:

> I've talked to the different ones that have been bombed out. This was their feeling: the $60 (in premiums) they could use for something else. But now they don't care if the figure was $600. They're going to take insurance because they have been through it twice and they've learned a lesson by it.

For such individuals the notion of insurance apparently has meaning only after there is tangible evidence that they would have reaped a return from investing in a policy.

Level of Income

What role does income level play in the decision process regarding insurance? Homeowners participating in the group depth interviews revealed that one reason individuals have not purchased insurance is because they cannot afford it. For example one uninsured worker responded to the question "How does one decide on how much to pay for insurance?" by saying:

> A blue-collar worker doesn't just run up there with $200 [the insurance premium] and buy a policy. The world knows that ninety percent of us live from pay day to pay day.... He can't come up with that much cash all of a sudden and turn around and meet all his other obligations.

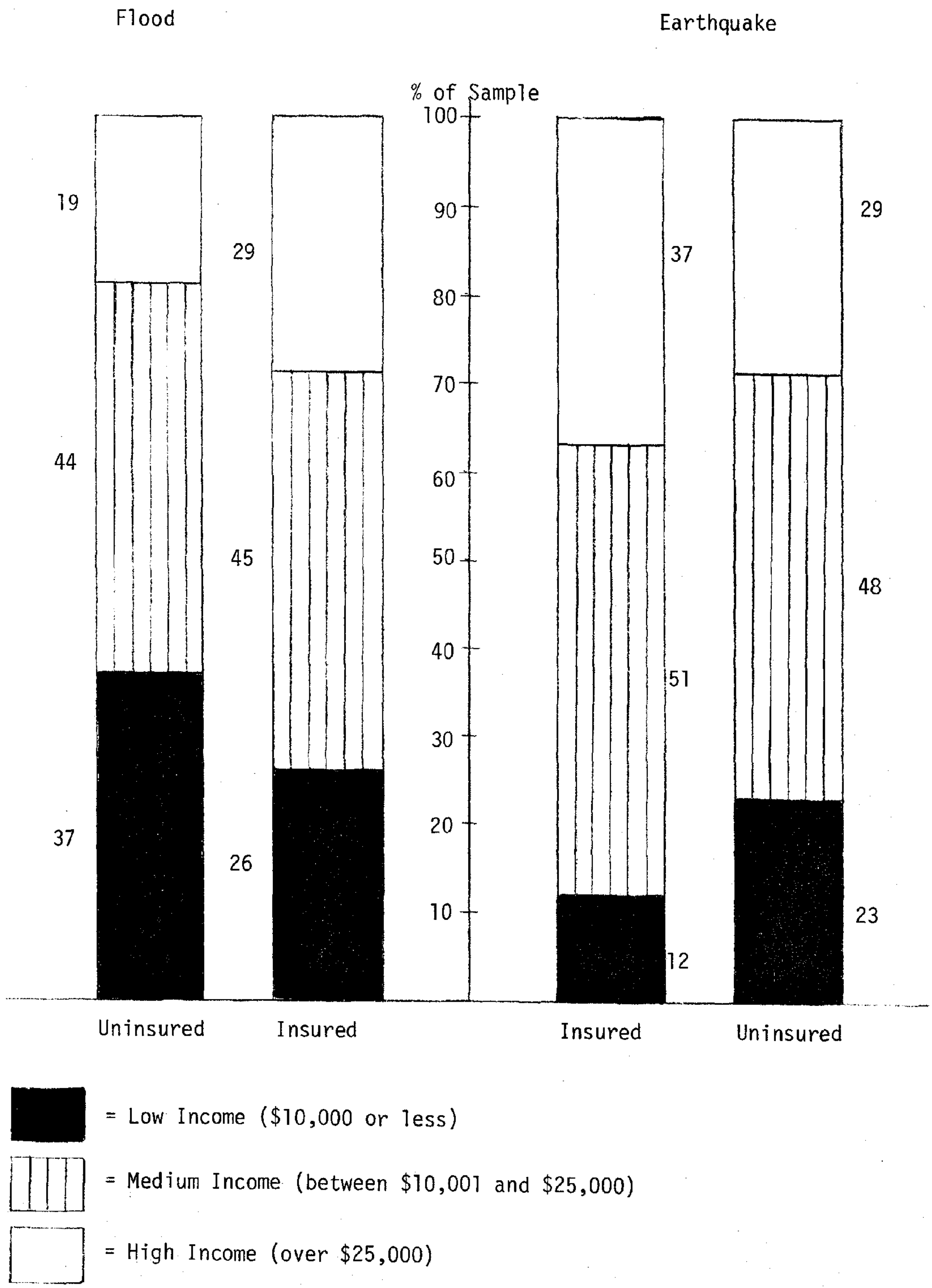
According to this view, budget constraints may be a factor in the insurance purchase decision and prohibit those individuals with limited income from buying a policy whether or not they feel it is likely that they will suffer severe losses from a future disaster. Figure 5.11 shows that insured individuals have a higher income level than the uninsured group in both the flood and earthquake samples[11]. The statistical analyses presented in the next chapter show that the income variable is relatively unimportant in differentiating policyholders from nonpolicyholders. One reason that high income individuals may be more likely to purchase coverage is because they have more at stake should they be hit be a severe flood or earthquake. On the other hand, the casualty loss deduction on federal income tax forms is an incentive for them to self-insure.

Degree of Risk Aversion

Other things being equal one would expect interest in insurance to increase as a person becomes more averse to risk. To measure risk aversion, all respondents were asked a series of questions to determine other insurance they may have purchased voluntarily. On the basis of five different types of policies (life, automobile, medical, health, disability and homeowners) we classified respondents into three different groups. Those who voluntarily had bought either none or one policy were considered to have little risk aversion; those who voluntarily purchased two or three policies were classified as

Figure 5.11

Annual Income of Insured and Uninsured



having some risk aversion while those who voluntarily had purchased four or five policies were treated as highly risk averse.

Figure 5.12 plots the proportion of insured and uninsured in each category. Most homeowners had purchased at least two policies voluntarily so there were relatively few classified as being mildly risk averse. The data shows that the insured individuals tend to be more risk averse than the uninsured group. Thus, we find that forty-six percent of the insured individuals in flood-prone areas were considered highly risk averse compared to 36 percent of the uninsured group. Only five percent of the insured flood group were mildly risk averse while twelve percent of the nonpolicyholders were. Similar, but less pronounced differences between the insured and uninsured groups exist for the earthquake sample[12].

Estimate of Probability

Figure 5.6 has already shown that insured individuals are likely to have a higher estimate of the probability of a disaster than those who are uninsured. These data taken alone are consistent with both expected utility theory as well as a sequential model of choice. The following rationale given by an uninsured homeowner in Norristown for his failure to purchase a policy suggests that he considered only the chances of a flood occurring without thinking about the potential losses from the event:

> Say the going rate is $60. When you sit down and figure out the chances of a flood, you say I could use that $60 for something else. We'll take our chances. And this is the outlook that the majority of the people take.

This view does not provide support for the expected utility model but is consistent with a sequential model of choice.

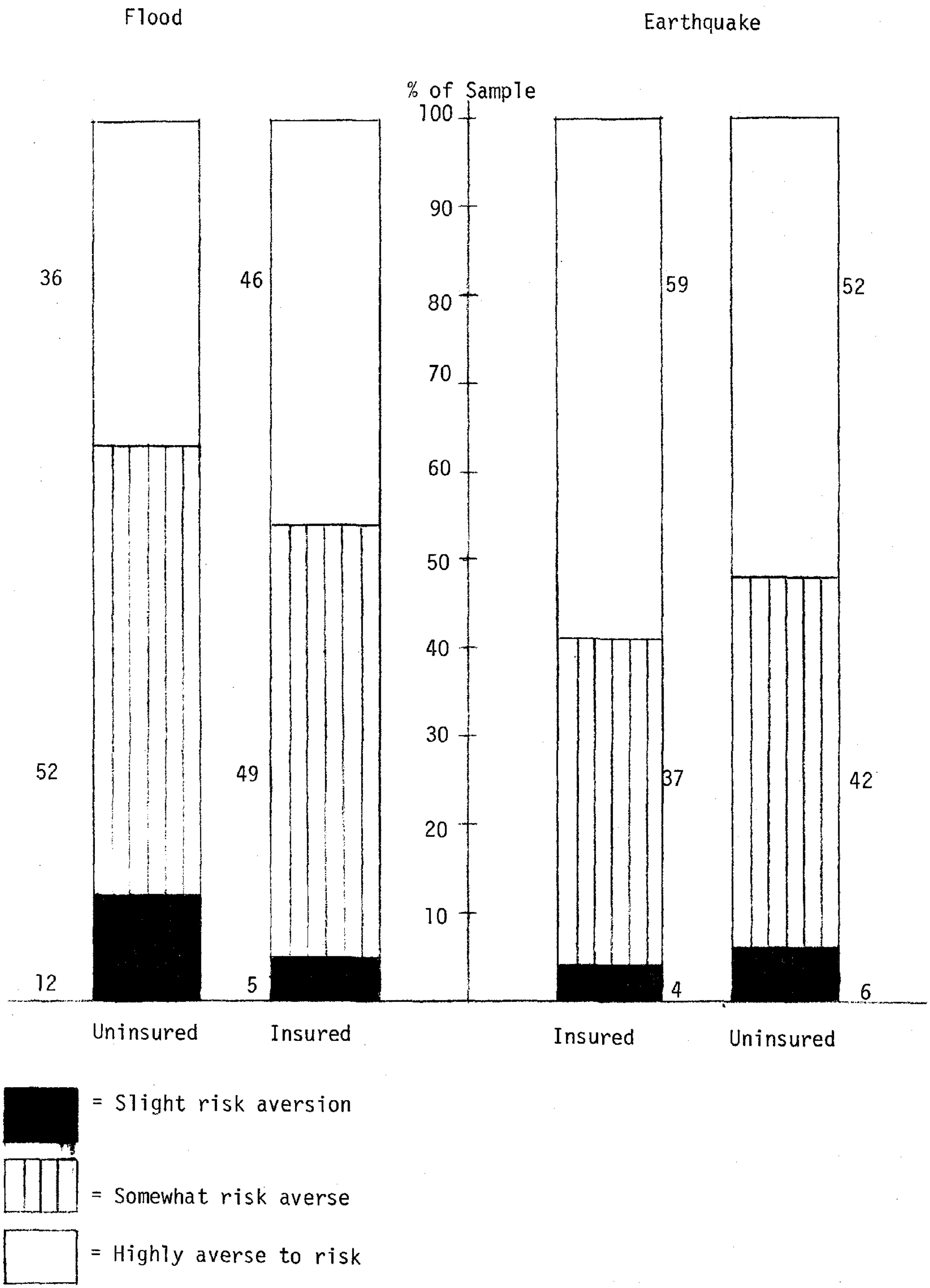
Similar feelings were frequently expressed by homeowners in all the group-depth interviews. The following comments made in Bakersfield illustrate this attitude with respect to earthquake insurance:

> I think $2 per $1000 (coverage) when you consider the odds is ridiculous. How often does an earthquake occur? I mean, what are the odds? You have to pay the insurance company $40 a year for how many years before you have even a tremor in earthquake country.

Another uninsured homeowner in Bakersfield clearly indicated that the probability dimension played a key role in his decision <u>not</u> to take out insurance:

Figure 5.12

Aversion to Risk of Insured and Uninsured



> If I lived in Kansas where they might have a tornado come through there 10 or 25 times a year then I would be willing to buy the insurance because the odds would be so much greater, because I know that on an average of a dozen times a year the wind's going to come through and do some damage. In this area here we have earthquakes maybe every twenty years, maybe every 100 years. I think the first recorded one was in 1800, and how many have we had since then? We did not have over 50.

Such an emphasis on the probability dimension should lead to a substantial increase in insurance demand if people hear that an earthquake is predicted in their area and believe that the prediction may, in fact, come true. For example after an April 20, 1976 forecast by James Whitcomb, a professor at the California Institute of Technology, that a quake of magnitude of 5.5 to 6.5 would occur in the San Fernando valley within the next year, demand for earthquake insurance increased substantially. As Kurt Sussman, an Allstate agent remarked: "We've seen a hell of an increase in the last couple of weeks. Many have been calling and just saying 'Add it'. They don't even inquire about the price." (N.Y. Times, May 15, 1976). The chances are that these individuals had not even considered the limited damage that a quake of such magnitude would cause to their property nor did they have any understanding of the five percent deductible on their insurance policy.

More detailed evidence on the importance of the probability dimension in influencing the insurance purchase decision will be presented in Chapter 7, which describes the results of the controlled laboratory experiments. These data provide further confirming evidence that, before a disaster, individuals ignore insurance if they believe the event will occur with a relatively small probability. In essence, most people are unwilling to consider the consequences of the hazard if they feel that the chances of it occurring are very small.

Interpersonal Communication

The analysis of our field survey data suggests that interpersonal communication is an important factor in the decision-making process. Expected utility theory has not emphasized the value of such contact because the model is not concerned with how information is obtained upon which to base a decision. Other studies on the diffusion process recognize that friends and neighbors are seen as convenient and reliable sources of information. These factors, coupled with a desire for conformity, suggest that interpersonal communication plays a key role in the insurance adoption process.

To examine the importance of personal influence on the insurance decision, all respondents were asked whether they had discussed flood or earthquake insurance with anyone and if they knew anyone who had a policy. Figure 5.13 shows that a much larger proportion of policyholders than nonpolicyholders had discussed insurance with a friend, neighbor or relative. Similar differences hold with respect to the proportion of insured and uninsured homeowners who knew someone that had purchased a policy.

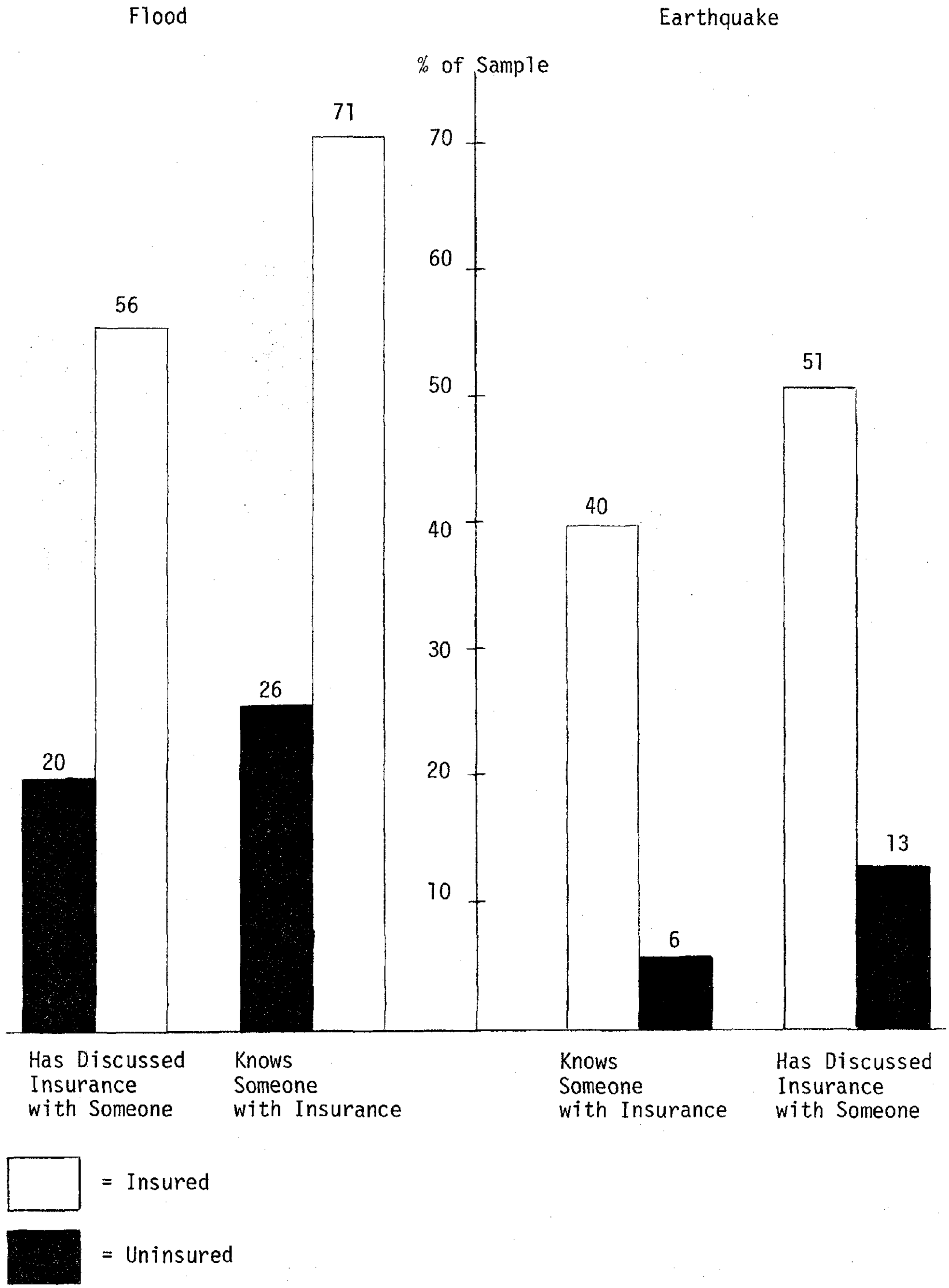
These data alone do not indicate whether a discussion with a friend or neighbor triggered the purchase of a policy or whether an individual engaged in such conversations after he had already bought coverage. We also cannot determine directly from the questionnaire when an insured respondent may have learned that a friend, neighbor or relative had purchased a policy. On the basis of findings on the adoption process regarding new products discussed in Chapter 3, one could argue that it is likely that such interchanges took place before the homeowner purchased insurance and that through these discussions, the nonpolicyholder learned that some of his peers had already bought coverage.

The following example illustrates this point. In a pretest of the earthquake questionnaire in San Francisco, a homeowner responded to a question by saying that he did not have insurance against earthquake damage. A friend who was listening to the interview could not resist commenting that he himself had purchased such insurance a couple of years before. The respondent was dumbfounded and asked the friend about the availability of coverage and its cost. He then added, "I am going to have to look into earthquake insurance myself."

Suppose one contended that interpersonal communication only occurred after a homeowner purchased insurance. Such a process can be modeled more formally in the following way. Assume each insured individual discusses his purchase decision with n individuals in a community having a population of N inhabitants. Suppose also that uninsured individuals can only learn about others having insurance if they are contacted by an insured person. Insured individuals may learn about the status of others either through their own initiative or by having another insured person contact them.

Figure 5.13

Differences in Amount of Interpersonal Communication between Insured and Uninsured



Using data on the proportion of insured and uninsured homeowners in our sample universe it is possible to determine values of n and N which rationalize the differentials between insured and uninsured homeowners depicted above in Figure 5.13. If n or N turns out to be unusually large then it is safe to conclude from this analysis that some uninsured individuals initiated contact with insured people and a proportion of them only decided to purchase a policy after such discussion. In any case, further research should be undertaken to determine the role that friends and neighbors play in transmitting information and influencing the adoption process.

To conclude our discussion of the importance of personal influence, it is appropriate to return to the pioneering study by Katz and Lazarsfeld (1955) which has had a major impact on all subsequent work in this area. In their discussion of the part played by people, the authors noted that mass communications research was joining those fields of social research which have been recognizing the importance of the *primary group* (i.e. informal, interpersonal relations) within situations previously treated as strictly formal and atomistic. Katz and Lazarsfeld then provide four examples of empirical research, including their own study, each of which began with a very simple model that did not include the primary group as a variable. At some point in the research the 'model' did not quite explain what was going on; at this stage clues were unearthed which pointed to the primary group, leading to the recognition of the important role played by interpersonal relations.

Our study of insurance behavior has followed a similar pattern. Our research initially made the conventional assumption of economic theory that the consumer makes decisions on his own without engaging in interpersonal communication. Only after undertaking group depth interviews in flood- and earthquake-prone areas and pretesting our questionnaire did we come to realize the importance of interpersonal relations. We then modified our model to take into account the role that the primary group plays in the insurance adoption process.

5.5 SUMMARY

The data from our field survey of insured and uninsured homeowners indicate that many individuals do not have enough information to utilize a model based on expected utility theory for determining their insurance purchase decision. Furthermore, a significant number of those who do have enough information frequently behave in a manner inconsistent with what would be predicted by the approach. We also investigated the merits of the sequential model of choice using the field survey data. A comparison between insured and uninsured homeowners suggests that the most important variables which influence the decision process are the individual's perception of the problem and interpersonal communication.

The examination of the separate effects of variables on the purchase of insurance, as reported in this chapter, yields suggestive results but does not make full use of the information present in the survey data. In the next chapter, multivariate analysis will be undertaken to examine the joint effects or several qualitative independent variables and to determine the quantitative importance of different factors on the insurance buying decision.

FOOTNOTES

[1] Although earthquake insurance is not subsidized, nine percent of the insured and thirteen percent of the uninsured incorrectly assumed that premiums were.

[2] Ninety-eight percent of the homes in our survey are wood-frame structures.

[3] Approximately two-thirds of the uninsured homeowners in both flood- and earthquake-prone areas provided an estimate of the maximum amount that they would be willing to pay for insurance.

[4] The deductible for flood insurance is $200 or two percent of the loss, whichever is larger.

[5] Five other questions on probability were included in the questionnaire but the above question was the easiest for the respondents to understand. For a more detailed analysis of the responses to these different probability questions see Borkan and Strevel (1976).

[6] The flood respondents were asked to estimate the probability of such a flood occurring in the next year. Earthquake homeowners were asked to estimate the chance of such an earthquake occurring in the next ten years. We approximated the annual probability by dividing this estimate by ten.

[7] Similar findings on the perception of the flood hazard are reported by Burton, Kates and White (1977) in their summary of cross cultural studies and by Lorelli (1975) in his study of four flood-prone communities in Pennsylvania.

[8] Since 1973 only seven percent of the flood homeowners and less than one percent of the earthquake respondents had suffered damage to their homes.

[9] We investigated income level and education of uninsured individuals to see if either of these variables affected anticipation of federal relief. However, neither factor was statistically significant.

[10] Few of these individuals had any knowledge of the deductible clause in the insurance policy so including this factor would not have changed the results of this analysis perceptibly.

[11] For the 14.5 percent of homeowners who were not willing to provide an income figure we used the interviewer's best estimate.

[12] This measure is an imperfect proxy for aversion to risk. For example, some respondents might have purchased health insurance voluntarily had they not been automatically covered by their employer. Automobile insurance is normally required by most states so the consumer has no free choice on whether to take out coverage.

TABLE 5A.1

DEFINITION OF VARIABLES

Variable Name	Question Numbers Used in Creating Variable	Definition	Categories
AGE	Screening form	Age of the household head	1 = Less than 30 years 2 = Between 30 and 49 years 3 = Between 50 and 64 years 4 = 65 years or older
ALL. EXPER	67	Hazard experience in any house	1 = No disaster experience 2 = Suffered one disaster 3 = Suffered more than one disaster
AWAR. INSUR	15	Awareness of the availability of hazard insurance in neighborhood	1 = Is aware 2 = Unaware
CONTACT. INSUR	14	Initial source of contact regarding hazard insurance	1 = Mass media 2 = Insurance agent 3 = Friends, neighbors, relatives 4 = Official organizations 5 = Don't know
CONTINGENCY. PRICE (R)	17, 19, 20, 32, 52 53, 119, 120, 121, 122, 126, 196	Relates insurance premium to the chances and consequences of a severe disaster	Continuous variable
COST. INSUR	17, 19, 20, 32, 52, 53, 196	Best estimate of the cost of insurance per $1,000 coverage	1 = Unable to estimate 2 = Estimate less than actual cost 3 = Estimate approximates actual cost 4 = Estimate greater than actual cost
DEDUCTIBLE	21	Subjective estimate of deductible amount written into insurance policy	1 = Some deductible 2 = No deductible 3 = Don't know
DISCUSS	170	Has discussed hazard insurance with friend, neighbor, or relative	1 = Yes 2 = No

TABLE 5A.1 --Continued

Variable Name	Question Numbers Used in Creating Variable	Definition	Categories
EDUCATION	207, 213	Education	1 = Less than high school graduate 2 = At least high school graduate
EMPLOYMENT	208, 214	Employment status of household head	1 = Not retired 2 = Retired
EXPERIENCE	66	Hazard experience in present house	1 = No disaster experience 2 = Suffered one disaster 3 = Suffered more than one disaster
FATE	204, 205	Perception of the role fate plays in life	1 = Important role 2 = Some importance 3 = Little importance
FUT. DAMAG	119, 120, 121, 122	Subjective estimate of future damage in a serious disaster	1 = Unable to estimate 2 = No damage 3 = $10,000 damage or less 4 = Between $10,001 and $30,000 damage 5 = More than $30,000 damage
GOVERN. AID	119, 120, 121, 122 125	Subjective estimate of proportion of federal aid expected as a function of damage from a serious disaster	1 = No government aid 2 = Less than 1/3 of loss covered by government aid 3 = Between 1/3 and 2/3 4 = More than 2/3 5 = Unable to estimate
HAVE. INSUR	32	Insurance status	1 = Insured 2 = Uninsured
HOMEOWNERS	181	Required to buy homeowner's ins.	1 = Was required 2 = Not required
HOUS. VALUE	196	Current value of house and land	1 = Less than $30,000 2 = Between $30,000 and $59,999 3 = $60,000 or more
INCOME	218, 220	Income	1 = $10,000 or less 2 = Between $10,001 and $25,000 3 = More than $25,000

TABLE 5A.1 --Continued

Variable Name	Question Numbers Used in Creating Variable	Definition	Categories
INTEREST. INSUR	27, 28	Principal factor triggering interest in insurance	1 = Aware of hazard 2 = Personal discussions 3 = Publicity about insurance 4 = Required to buy
KNEW. PRONE	5	Awareness of hazard proneness of neighborhood when moved in	1 = Was aware 2 = Unaware or lived entire life in neighborhood
KNOWONE	172	Knows friend, neighbor, or relative with hazard insurance	1 = Yes 2 = No
KNOW. PREMIUM	19, 20, 32, 52	Ability to estimate cost of hazard insurance	1 = Can estimate 2 = Unable to estimate
LIKELY. MOVE	190	Likelihood of moving in next five years	1 = Definitely move 2 = Probably move 3 = Probably not move 4 = Definitely not move
MARITAL. STAT	212	Marital status	1 = Married 2 = Not married
MAX. PREMIUM	32, 35, 36, 53, 65, 196	Maximum premium homeowners are willing to pay per $1,000 of insurance coverage	Continuous variable
MINOR.FUT. DAMAG	112, 113, 114, 115	Subjective estimate of future damage in a minor disaster	1 = Unable to estimate 2 = No damage 3 = $5,000 damage or less 4 = Between $5,001 and $15,000 damage 5 = More than $15,000 damage
NUMB. CHILDREN	Screening form	Number of children under 18	1 = No children 2 = One child 3 = Two children 4 = Three or more children

TABLE 5A.1 --Continued

Variable Name	Question Numbers Used in Creating Variable	Definition	Categories
NUMB. DISASTER	131	Subjective estimate of probability of disaster occurring (as related to number of disasters occurring in given time period)	1 = High probability (greater or equal to .1) 2 = Medium probability (between .09 and .02) 3 = Low probability (.01) 4 = Almost impossible (less than .01) 5 = Unable to estimate
PAST. DAMAG	47, 68, 69, 70	Cumulative past damage suffered while not covered by hazard insurance	For Flood 0 = No damage 1 = $1,000 damage or less 2 = Between $1,001 and $5,000 damage 3 = Between $5,001 and $10,000 damage 4 = More than $10,000 damage For Earthquake 0 = No damage 1 = $500 damage or less 2 = Between $501 and $2,500 damage 3 = More than $2,500 damage
PROBABILITY	126	Subjective estimate of probability of disaster occurring (as related to chance of living to different ages)	1 = High probability (greater or equal to .1) 2 = Medium probability (between .0999 and .01) 3 = Low probability (between .00999 and .000011) 4 = Almost impossible (less than or equal to .00001) 5 = Unable to estimate
PROBLEM	1, 3	Perception of hazard problem	1 = Serious problem 2 = Minor problem 3 = Non-existent problem
RISK. AV	175, 179, 181	Aversion to risk	1 = Highly averse to risk 2 = Somewhat risk averse 3 = Slight risk aversion
SAVINGS	219	Savings last year	1 = $500 or less 2 = Between $501 and $2,000 3 = More than $2,000 4 = Unable to estimate

TABLE 5A.1 --Continued

Variable Name	Question Numbers Used in Creating Variable	Definition	Categories
SERVICE. CONTRACT	186	Number of service contracts purchased for appliances	1 = Bought 4 service contracts 2 = Bought 3 contracts 3 = Bought 2 contracts 4 = Bought 1 contract 5 = Did not buy any service contracts
TOTAL. DAMAG	69, 70	Cumulate past damage	For Flood 0 = No damage 1 = $1,000 damage or less 2 = Between $1,001 and $5,000 damage 3 = Between $5,001 and $10,000 damage 4 = More than $10,000 damage For Earthquake 0 = No damage 1 = $500 damage or less 2 = Between $501 and $2,500 damage 3 = More than $2,500 damage
YEAR. HOUS	194	Years lived in present house	1 = Less than 4 years 2 = Between 4 and 14 years 3 = At least 15 years
YEARS. NEIGHB	4	Years lived in neighborhood	1 = Less than 4 years 2 = Between 4 and 14 years 3 = At least 15 years

TABLE 5B.1

DESCRIPTION OF ASSOCIATION OF VARIABLE PAIRS ACCORDING TO SEQUENTIAL MODEL OF CHOICE

Flood Survey

Second Variable	χ^2	Degrees of Freedom	Significance Level *	Trend Description (based on .05 significance level)
A. Awareness of Problem (Stage 1)-- PROBLEM				
AGE	5.74	6	0.453	Not significant
ALL. EXPER	216.72	4	0.0	The more important the problem, the more likely one is to have experienced a flood.
EDUCATION	7.33	2	0.026	The more important the problem, the more likely one is to have graduated from high school.
EXPERIENCE	248.48	4	0.0	The more important the problem, the more likely one is to have suffered a flood in their present home.
INCOME	7.17	4	0.127	Not significant.
KNEW. PRONE	238.95	2	0.0	The more important the problem, the more likely one is to have known the area was flood prone when they moved there.
TOTAL. DAMAG	188.35	8	0.0	The more important the problem is, the more flood damage one tends to have suffered.
YEARS. HOUS	7.19	4	0.126	Not significant.
YEARS. NEIGHB	5.84	4	0.212	Not significant.
B. Awareness of Insurance (Stage 2)-- AWAR.INSUR				
AGE	3.24	3	0.356	Not significant.
EDUCATION	41.00	1	0.0	Those that are aware of insurance in their neighborhood are more likely to have graduated from high school.
INCOME	28.14	2	0.0	Those that are aware of insurance in their neighborhood tend to have higher incomes.

*Significance level of 0.0 indicates less than 0.00005.

TABLE 5B.1 Continued

Flood Survey

Second Variable	χ^2	Degrees of Freedom	Significance Level *	Trend Description (based on .05 significance level)
PROBABILITY	81.47	4	0.0	Those that are aware of insurance in their neighborhood tend to feel that floods have a higher chance of occurring.
PROBLEM	145.38	2	0.0	Those that are aware of insurance in their neighborhood tend to view floods as a more important problem.
YEARS. HOUS	12.49	2	0.002	Those that are aware of insurance in their neighborhood tend not to have lived in their present house for a long period of time.
YEARS. NEIGHB	7.54	2	0.023	Those that are aware of insurance in their neighborhood tend not to have lived in the area for a long period of time.
C. Awareness of Insurance (Stage 2)- KNOW.PREMIUM				
AGE	3.21	3	0.361	Not significant.
EDUCATION	0.31	1	0.578	Not significant.
INCOME	17.71	2	0.0001	Those that are able to estimate the insurance premium tend to have higher incomes.
PROBABILITY	34.79	4	0.0	Those that are able to estimate the insurance premium tend to feel that there is a higher chance of a flood occurring in their neighborhood.
PROBLEM	41.55	2	0.0	Those that are able to estimate the insurance premium tend to view floods as a more important problem.
YEARS. HOUS	2.22	2	0.329	Not significant.
YEARS. NEIGHB	3.07	2	0.215	Not significant.

*Significance level of 0.0 indicates less than 0.00005.

TABLE 5B.1 --Continued

Flood Survey

Second Variable	χ^2	Degrees of Freedom	Significance Level *	Trend Description (based on .05 significance level)
D. Insurance Adoption Decision (Stage 3)--HAVE. INSUR				
D.1. Socio-Economic Factors				
AGE	7.68	3	0.053	Those that have insurance tend to be older.
EDUCATION	29.16	1	0.0	Those that have insurance are more likely to have graduated from high school.
EMPLOYMENT	0.92	1	0.338	Not significant.
INCOME	42.10	2	0.0	Those that have insurance tend to have higher incomes. (See section 5.4.3 for more information.)
MARITAL. STAT	19.18	1	0.0	Those that have insurance are more likely to be married.
NUMB. CHILDREN	11.54	3	0.009	Those that have insurance tend to have fewer children.
SAVINGS	20.37	2	0.0	Those that have insurance tend to save more of their yearly income.
D.2. Relationship of Homeowner to Property				
LIKELY. MOVE	14.55	3	0.002	Those that have insurance are less likely to move from their present home.
HOUS. VALUE	23.50	2	0.0	Those that have insurance tend to own more valuable houses.
YEARS. HOUS	18.06	2	0.0001	Those that have insurance tend not to have lived in their present house for a long period of time.
YEARS. NEIGHB	16.32	2	0.0003	Those that have insurance tend not to have lived in the neighborhood for a long period of time.

*Significance level of 0.0 indicates less than 0.00005.

TABLE 5B.1 .--Continued .

Flood Survey

Second Variable	χ^2	Degree of Freedom	Significance Level *	Trend Description (based on .05 significance level)
D.3. Relationship of Homeowner to Hazard				
ALL. EXPER	118.23	2	0.0	Those that have insurance are more likely to have experienced a flood.
EXPERIENCE	125.67	2	0.0	Those that have insurance are more likely to have suffered a flood in their present home.
FUT. DAMAG	194.04	4	0.0	Those that have insurance tend to expect large amounts of damage. (See section 5.2.3 for more information.)
MINOR. FUT. DAMAG	19.02	4	0.001	Those that have insurance tend to expect greater damage.
NUMB. DISASTER	101.74	4	0.0	Those that have insurance tend to believe that more floods will occur in their neighborhood.
PAST. DAMAG	102.16	4	0.0	Those that have insurance tend to have suffered more flood damage. (See section 5.4.3 for more information.)
PROBABILITY	140.53	4	0.0	Those that have insurance tend to feel that the probability of a flood occurring is higher. (See section 5.2.4 for more information.)
PROBLEM	282.08	2	0.0	Those that have insurance tend to view flooding as a more important problem. (See section 5.4.3 for more information)
D.4. Personal Influence				
DISCUSS	278.89	1	0.0	Those that have insurance are more likely to have discussed insurance with someone. (See section 5.4.3 for more information.)

*Significance level of 0.0 indicates less than 0.00005.

TABLE 5B.1 --Continued

Second Variable	χ^2	Degree of Freedom	Significance Level *	Trend Description (based on .05 significance level)
				Flood Survey
KNOWONE	417.28	1	0.0	Those that have insurance are more likely to know someone else with insurance. (See section 5.4.3 for more information.)
D.5. Aversion to Risk				
HOMEOWNERS	11.60	1	0.001	Those that have insurance are more likely to have voluntarily purchased homeowner's insurance.
RISK. AV	44.03	2	0.0	Those that have insurance tend to be more averse to risks. (See section 5.4.3 for more information.)
SERVICE. CONTRACT	2.79	4	0.593	Not significant.
D.6. Fate Control				
FATE	0.32	2	0.852	Not significant.

*Significance level of 0.0 indicates less than 0.00005.

TABLE 5B.2

DESCRIPTION OF ASSOCIATION OF VARIABLE PAIRS ACCORDING TO SEQUENTIAL MODEL OF CHOICE

Earthquake Survey

Second Variable	χ^2	Degrees of Freedom	Significance Level *	Trend Description (based on .05 significance level)
A. Awareness of Problem (Stage 1)--PROBLEM				
AGE	12.69	6	0.048	The more important the problem, the more middle aged one tends to be.
ALL.EXPER	15.03	4	0.005	The more important the problem, the more likely one is to have experienced an earthquake.
EDUCATION	5.78	2	0.056	The more important the problem, the more likely one is to have graduated from high school.
EXPERIENCE	7.85	4	0.097	Not significant.
INCOME	3.62	4	0.460	Not significant.
KNEW.PRONE	105.18	2	0.0	The more important the problem, the more likely one is to have known the area was earthquake prone when they moved there.
TOTAL.DAMAG	16.75	6	0.010	The more important the problem, the more earthquake damage one tends to have suffered.
YEARS.HOUS	3.05	4	0.549	Not significant.
YEARS.NEIGHB	3.26	4	0.515	Not significant.
B. Awareness of Insurance (Stage 2)--AWAR. INSUR				
AGE	9.16	3	0.027	Those that are aware of insurance in their neighborhood tend to be younger.
EDUCATION	47.07	1	0.0	Those that are aware of insurance in their neighborhood are more likely to have graduated from high school.
INCOME	35.04	2	0.0	Those that are aware of insurance in their neighborhood tend to have higher incomes.

*Significance level of 0.0 indicates less than 0.00005.

TABLE 5B.2 --Continued

Second Variable	χ^2	Degrees of Freedom	Significance Level *	Trend Description (based on .05 significance level)
		Earthquake Survey		
PROBABILITY	19.40	4	0.001	Those that are aware of insurance in their neighborhood tend to feel that quakes have a higher chance of occurring.
PROBLEM	49.62	2	0.0	Those that are aware of insurance in their neighborhood tend to view quakes as a more important problem.
YEARS.HOUS	26.57	2	0.0	Those that are aware of insurance in their neighborhood tend to have lived in their present house for a shorter period of time.
YEARS.NEIGHB	20.35	2	0.0	Those that are aware of insurance in their neighborhood tend to have lived in the area for a shorter period of time.
C. Awareness of Insurance (Stage 2)--KNOW. PREMIUM				
AGE	6.48	3	0.091	Not significant.
EDUCATION	1.63	1	0.201	Not significant.
INCOME	5.96	2	0.051	Those that are able to estimate the insurance premium tend to have higher incomes.
PROBABILITY	9.73	4	0.045	Those that are able to estimate the insurance premium tend to feel that there is a higher chance of an earthquake occurring in their neighborhood.
PROBLEM	13.88	2	0.001	Those that are able to estimate the insurance premium tend to view earthquakes as a more important problem.
YEARS.HOUS	6.69	2	0.035	Those that are able to estimate the insurance premium tend not to have lived in their present house for a long period of time.
YEARS.NEIGHB	5.22	2	0.074	Not significant.

*Significance level of 0.0 indicates less than 0.00005.

TABLE 5B.2 --Continued

Second Variable	χ^2	Degrees of Freedom	Significance Level *	Trend Description (based on .05 significance level)
		Earthquake Survey		
D. Insurance Adoption Decision (Stage 3)--HAVE.INSUR				
D.1. Socio-Economic Factors				
AGE	7.48	3	0.058	Those that have insurance tend to be middle aged.
EDUCATION	33.13	1	0.0	Those that have insurance are more likely to have graduated from high school.
EMPLOYMENT	4.19	1	0.041	Those that have insurance are more likely not to be retired.
INCOME	21.13	2	0.0	Those that have insurance tend to have higher incomes. (See section 5.4.3 for more information.)
MARITAL.STAT	6.50	1	0.011	Those that have insurance are more likely to be married.
NUMB.CHILDREN	2.86	3	0.414	Not significant.
SAVINGS	14.09	2	0.001	Those that have insurance tend to save more of their yearly income.
D.2. Relationship of Homeowner to Property				
LIKELY.MOVE	6.83	3	0.077	Not significant.
HOUS.VALUE	12.25	2	0.002	Those that have insurance tend to own more valuable houses.
YEARS.HOUSE	14.31	2	0.001	Those that have insurance tend not to have lived in their present house for a long period of time.
YEARS.NEIGHB	9.44	2	0.009	Those that have insurance tend to have lived in the neighborhood for a shorter period of time.
D.3. Relationship of Homeowner to Hazard				
ALL.EXPER	0.54	2	0.763	Not significant.

*Significance level of 0.0 indicates less than 0.00005.

TABLE 5B.2 --Continued

Earthquake Survey				
Second Variable	χ^2	Degrees of Freedom	Significance Level *	Trend Description (based on .05 significance level)
EXPERIENCE	0.54	2	0.764	Not significant.
FUT.DAMAG	53.29	4	0.0	Those that have insurance tend to expect larger amounts of damage. (See section 5.2.3 for more information.)
MINOR.FUT.DAMAG	16.39	4	0.003	Those that have insurance tend to expect greater damage.
NUMB.DISASTER	56.06	4	0.0	Those that have insurance tend to believe that more earthquakes will occur in their neighborhood.
PAST.DAMAG	4.70	3	0.200	Not significant.
PROBABILITY	26.88	4	0.0	Those that have insurance tend to feel that the probability of an earthquake occurring is higher. (See section 5.2.4 for more information.)
PROBLEM	41.44	2	0.0	Those that have insurance tend to view earthquakes as a more important problem. (See section 5.4.3. for more information)
D.4. Personal Influence				
DISCUSS	172.06	1	0.0	Those that have insurance are more likely to have discussed insurance with someone. (See section 5.4.3 for more information.)
KNOWONE	172.85	1	0.0	Those that have insurance are more likely to know someone else with insurance. (See section 5.4.3 for more information.)
D.5. Risk Aversion				
HOMEOWNERS	2.10	1	0.349	Not significant.
RISK.AV	6.50	2	0.039	Those that have insurance tend to be more averse to risks. (See section 5.4.3 for more information.)

*Significance level of 0.0 indicates less than 0.00005.

TABLE 5B.2 --Continued

Earthquake Survey				
Second Variable	χ^2	Degrees of Freedom	Significance Level *	Trend Description (based on .05 significance level)
SERVICE CONTRACT	8.42	4	0.077	Not significant.
D.6. Fate Control				
FATE	3.18	2	0.204	Not significant.

*Significance level of 0.0 indicates less than 0.00005.

TABLE 5C.1

DESCRIPTION OF ASSOCIATION OF VARIABLES IN FIGURES AND TABLES

Figure or Table	Variables	Flood χ^2	Flood Degrees of Freedom	Flood Significance Level **	Quake χ^2	Quake Degrees of Freedom	Quake Significance Level **	Section in Text for Interpretation
Figure 5.1	CONTACT. INSUR	*			*			5.2.1
Figure 5.2	HAVE. INSUR COST. INSUR	211.84	3	0.0	89.66	3	0.0	5.2.2
Figure 5.3	MAX. PREMIUM	*			*			5.2.2
Figure 5.4	HAVE. INSUR DEDUCTIBLE	63.29	2	0.0	51.75	2	0.0	5.2.2
Figure 5.5	HAVE. INSUR FUT. DAMAG	194.04	4	0.0	53.29	4	0.0	5.2.3
Figure 5.6	HAVE. INSUR PROBABILITY	140.53	4	0.0	26.88	4	0.0	5.2.4
Figure 5.7	FUT. DAMAG GOVERN. AID	32.53	8	0.0001	35.91	8	0.0	5.2.5
Figure 5.8	CONTINGENCY. PRICE (R)	*			*			5.3.1
Table 5.1	HAVE. INSUR FUT. DAMAG KNOW. PREMIUM PROBABILITY CONTINGENCY.PRICE (R)	*			*			5.3.3
Figure 5.9	INTEREST. INSUR	*			*			5.4.2
Figure 5.10	HAVE. INSUR PROBLEM	282.08	2	0.0	41.44	2	0.0	5.4.3
Table 5.2	HAVE. INSUR PAST. DAMAG	102.16	4	0.0	4.70	3	0.200	5.4.3
Figure 5.11	HAVE. INSUR INCOME	42.10	2	0.0	21.13	2	0.0	5.4.3
Figure 5.12	HAVE. INSUR RISK. AV	44.03	2	0.0	6.50	2	0.039	5.4.3
Figure 5.13	HAVE. INSUR KNOWONE	417.28	1	0.0	172.85	1	0.0	5.4.3
Figure 5.13	HAVE. INSUR DISCUSS	278.89	1	0.0	172.06	1	0.0	5.4.3

*Not applicable.

**Significance level of 0.0 indicates less than 0.00005.

CHAPTER 6

ANALYSIS OF SURVEY RESULTS USING MULTIVARIATE METHODS

6.1 INTRODUCTION

The previous chapter discussed the effects of several factors on whether or not a homeowner had purchased insurance. These factors were examined one at a time, and the results were summarized in a series of two-way tables and graphs. There are two fundamental limitations of such two-way analyses that require one to study the impact of several variables simultaneously and to use more powerful methods of data analysis.

First, an observed relationship (or lack of relationship) may be spurious in that the two variables are related only because each is associated with a third variable which, when ignored, produces the apparent relationship. For example, the number of firemen at a fire and the extent of the damage are highly correlated, obviously because both factors are related to the severity of the fire. Presumably if the third factor is controlled, and explicitly taken into account, the apparent relationship will disappear. The elimination of spurious correlation is logically equivalent to explaining why and how the two variables are related. Moreover, taking into account other factors that affect insurance purchase and removing their spurious influence enables one to obtain a more valid measure of the "true" impact of any given factor on the decision.

A second limitation not only of two-way analysis, but also of the general approach to measurement through the elimination of other factors, is that it tacitly assumes that there is such a thing as the relationship between two variables. It may turn out, however, that the effect of a given variable depends on whether or not a third variable is present. Thus, to anticipate a bit, an individual's estimate of the seriousness of a flood problem has little effect on insurance purchase unless he knows and has talked to someone who himself has purchased insurance; i.e. for people who know a policyholder the variable "seriousness" has a large effect; for those who do not, "seriousness" has a small effect. When the effect of one variable is contingent on the value of other variables these variables are said to interact. Clearly, when interactions are present one must severely qualify any statement concerning the impact of each variable separately. On a more positive note, interactions enable one to specify more precisely the circumstances under which people buy insurance and to identify groups of people who are particularly responsive (or unresponsive) to various influences and appeals.

The next section provides an intuitive discussion of the main statistical findings. The results presented there demonstrate that homeowner behavior in flood- and earthquake-prone areas is consistent with the sequential model of choice. Moreover, the behavior reveals the relative importance of certain factors in making residents aware of the hazard and differentiating insured from uninsured homeowners. The remainder of the chapter is more technical in nature and can be skipped without loss of continuity. This material is included to illustrate the use of multivariate analyses, to demonstrate the care taken in analyzing our survey data, and of course, as a necessary feature for those who wish a more detailed treatment of the methodology employed. We have attempted to present this material so it is intelligible to the general reader[1].

In this chapter, then, multivariate methods are utilized to test for possible interactions and to measure more precisely than in Chapter 5 the effects of different factors on the sequential model of choice. The statistical analyses are based on seventy-five percent of the flood and earthquake samples randomly picked from the responses. In addition, the two samples have been combined in order to test for similarities between the two types of hazards. The equation which best discriminates between policyholders and nonpolicyholders will then be used to predict the insurance status of the remaining twenty-five percent sample, thus permitting us to determine how well the final model generalizes to new data. Following the chapter, we have included separate tables for the flood and earthquake samples.

6.2 TESTING THE SEQUENTIAL MODEL CHOICE

Through the use of multivariate methods we are able to isolate factors which provide explanations for homeowner's behavior at each stage of the sequential model of choice discussed in Chapter 5. The results presented in this section are based on ordinary least squares regression analyses and illustrate the main results of this chapter[2].

6.2.1 Awareness Of The Problem (Stage 1)

Data from the field survey enabled us to isolate those variables which best explain when a homeowner is likely to consider the flood or earthquake hazard to be a serious problem in his immediate neighborhood. Table 6.1 presents the best fitting model for the combined flood and earthquake samples. Following the chapter (Table 6.13) we present the same equation in a somewhat different form with t-ratios showing the statistical significance of each variable.

The constant term in the equation indicates that a homeowner who has just moved to an area subject to earthquakes or floods without being aware that it was hazard prone, and has never experienced a disaster, has an 11.4 percent chance of considering the hazard to be a serious problem. The fact that there is some positive probability that this individual may view this hazard as a serious threat indicates that we were not able to explain all the variation in our data through this model.

The constant term should be viewed only as a benchmark for judging the relative importance of other factors. Thus we see from Table 6.1 that homeowners who knew the area to be hazard prone before moving there have a 23.2 percent greater chance of considering floods or earthquakes to be a serious problem than those who were unaware. We also see that past experience plays an important role in influencing hazard perception. Homeowners who had experienced one disaster in their current home have a 22.1 percent greater chance of viewing the hazard as serious than those who have not been victims. Those with more than one experience have this probability increased by another 21.5 percent. Thus there is a .436 probability difference between those who have suffered more than one disaster and those with none.

Table 6.1 also illustrates an interaction effect between the type of hazard prone area and the length of time one has lived in his current house. In coastal and earthquake-prone areas the longer one lives in a house the less chance that the homeowner will view the hazard as a serious problem. On the other hand, in riverine areas this probability increases as one resides longer

TABLE 6.1

REGRESSION FOR 75% COMBINED SAMPLE

Probability of homeowner thinking hazard is a serious problem = .114 +

$$\left\{\begin{array}{ll} .0 & \text{if didn't know area hazard prone when moved in or} \\ & \text{lived whole life in neighborhood} \\ .232 & \text{if knew area was hazard prone when moved in} \end{array}\right\} +$$

$$\left\{\begin{array}{ll} .0 & \text{if never experienced disaster} \\ .221 & \text{if experienced one disaster} \\ .436 & \text{if experienced more than one disaster} \end{array}\right\} +$$

$$\left\{\begin{array}{l} .283 - .0047 \times \text{years lived in house if in coastal zone A} \\ .032 - .0003 \times \text{years lived in house if in coastal zone B} \\ .289 + .00096 \times \text{years lived in house if in riverine zone A} \\ .079 + .00059 \times \text{years lived in house if in riverine zone B} \\ .0 - .00051 \times \text{years lived in house if in earthquake area} \end{array}\right\}$$

in the area. With the exception of coastal Zone A, the small coefficient associated with a change in the length of time in one's house, suggests that this variable is not very important in predicting whether or not the person will view the hazard as serious.

These figures also illustrate intuitively appealing differences between hazard prone areas. Homeowners are most likely to view the hazard as being serious if they live in the high hazard coastal and riverine areas (Zone A). Hence the coefficients of .283 and .289 associated with these areas compared to .032 and .079 for the less hazardous coastal and riverine areas (Zone B). Residents in earthquake-prone areas are the least likely to view the hazard as serious as indicated by the zero coefficient. This is undoubtedly due to the infrequency of severely damaging quakes in California.

Figure 6.1 graphically depicts the interaction effect between hazard area and length of time residing in the current house based on the coefficients in Table 6.1. The downward slopes of the lines depicting behavior in coastal and earthquake areas reflect the inverse relationship between number of years in the house and chances of viewing the hazard as a serious problem. The reverse relationship is true for homeowners in the riverine areas. The height of the lines at the point "0 years in neighborhood" reflect the chances of viewing the hazard as serious for different areas. The figures graphically show that homeowners in Zone A are more likely than those in Zone B to view the hazard as a serious threat when they first move into the area.

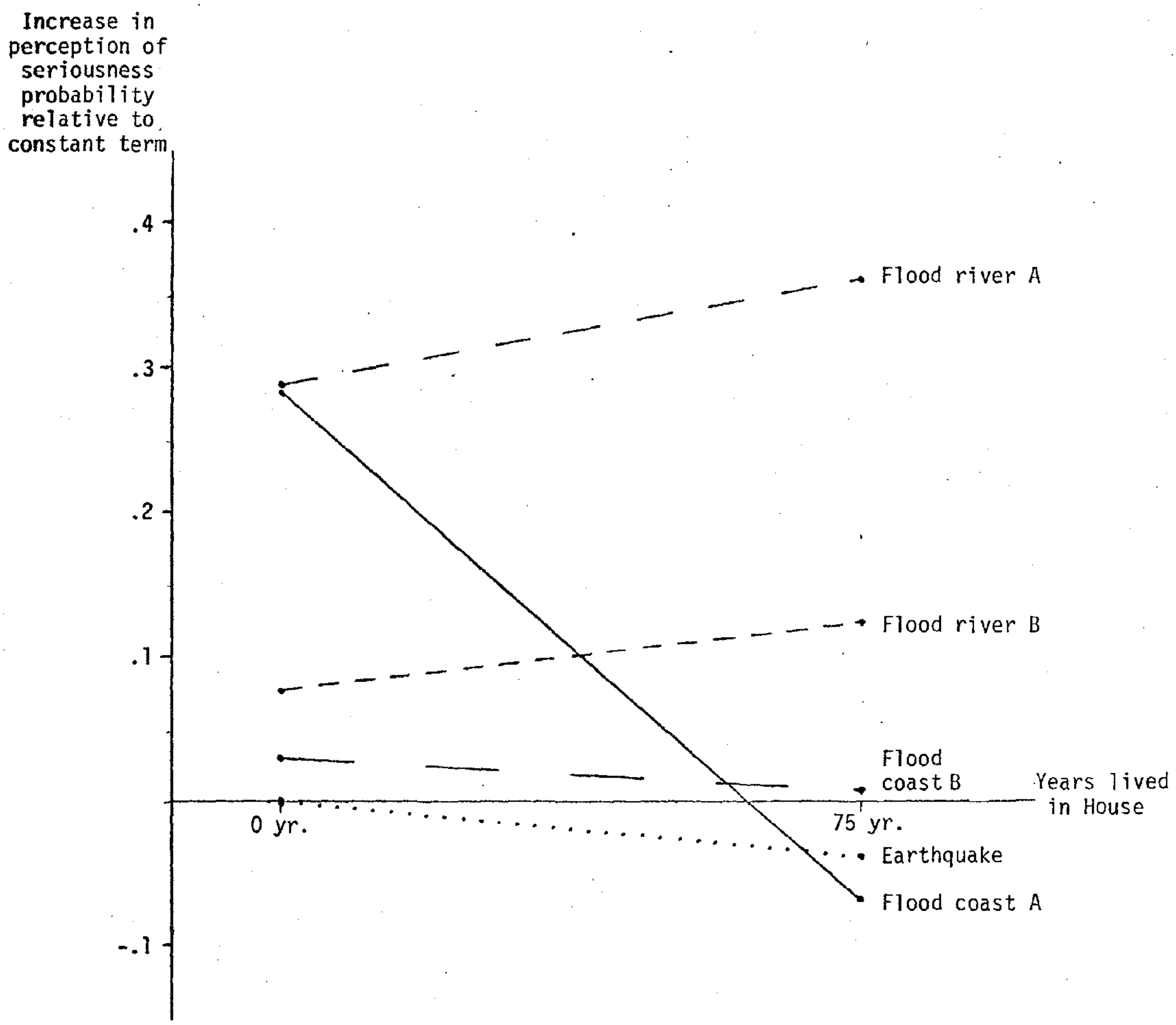
Following the chapter (Tables 6.14 and 6.15) we have specified separate least squares regression results for homeowners in flood-prone areas and those in earthquake-prone regions. These results indicate the differences between the two samples in terms of how they perceive the hazard, and can be interpreted in the same manner as the coefficients in Tables 6.1 and 6.13.

6.2.2 Awareness Of Insurance (Stage 2)

What variables account for differences between homeowners' knowledge of whether flood or earthquake insurance is available in their neighborhoods? The actual regression models for both the combined sample and separate hazards are reproduced following the chapter (Tables 6.16 - 6.18). We will briefly summarize the principal findings here.

Figure 6.1

Least Squares Regression Model for 75% Combined Sample--
YEARS.HOUS × HAZARD Effect



NOTE: Only differences are meaningful.

The most significant variables differentiating those aware that insurance is available in their neighborhood from those unaware were "problem" and "education". People who considered the hazard to be a serious problem were more likely to know that they could purchase insurance than those who felt the problem was minor or unimportant. But the problem variable interacted with educational level. Homeowners who considered the hazard to be a minor or serious problem were much more likely to know insurance was available to them if they had graduated from high school than if they had not. For those considering the problem to be unimportant, there was a much lower chance that such homeowners would know that coverage was available, whether or not they had graduated from high school.

Several other factors had an influence on a person's awareness of coverage but they were less important than either educational level or whether they considered the hazard to be a problem. Higher income and single people were more likely to be aware of insurance than their respective counterparts. The higher the perceived probability of a flood or earthquake, the more likely one would know about insurance availability in their neighborhood. This result is consistent with the hypothesis that unless the person feels the chances are sufficiently high that a disaster will occur, he will not think about its possible consequences or ways he can protect himself against resulting losses.

Homeowners in flood-prone areas were also more likely to know that they could purchase insurance than those in earthquake areas. This result may be due in part to an artifact of our final sample. In flood-prone areas approximately 54 percent of the respondents currently had insurance and hence had to know that it was available. In the earthquake sample only 46 percent of the homeowners actually had coverage. For this reason alone a homeowner in the flood sample would have a greater chance of knowing that he was eligible to purchase insurance than a respondent in the earthquake sample.

6.2.3 Adoption Of Insurance (Stage 3)

Most of the statistical analyses were undertaken to determine those variables which differentiated the policyholders from the nonpolicyholders. The field survey enabled us to isolate a few significant variables which are consistent with the sequential model of choice. Table 6.2 presents data on

TABLE 6.2

REGRESSION FOR 75% COMBINED SAMPLE

Probability of homeowner purchasing insurance = -.033 +

{ .0 if not high school graduate; .078 if at least high school graduate } +

{ .0 if low income; .044 if medium income; .050 if high income } +

{ .0 if not married; .050 if married } +

{ .0 if mildly risk averse; .055 if some risk aversion; .114 if highly risk averse } +

{ .551 if thinks hazard serious problem and knows someone with insurance;
.471 if thinks hazard minor problem and knows someone with insurance;
.237 if thinks hazard not a problem and knows someone with insurance;
.182 if thinks hazard serious problem and doesn't know anyone with insurance;
.108 if thinks hazard minor problem and doesn't know anyone with insurance;
.0 if thinks hazard not a problem and doesn't know anyone with insurance } +

{ .0178 × log (subjective probability of disaster) } +

{ .0034 × age (in years) } +

{ -.00036 × years lived in house } +

{ -.0092 if can't estimate future damage;
-.181 if thinks will suffer no future damage;
.00095 × estimate of future damage (in $1000) if think will suffer some } +

{ .034 if lives in coastal zone A;
.049 if lives in coastal zone B;
-.013 if lives in riverine zone A;
.058 if lives in riverine zone B;
.0 if lives in earthquake area }

the final model for the combined earthquake and flood samples.

By far the most important variables in the analysis are whether the person considers the problem to be serious and if he knows someone who has purchased the insurance. These two factors interact with each other. If someone thinks the hazard is a problem and also knows a policyholder, he is more likely to purchase insurance than these variables would imply separately. As shown in Table 6.2 there is a .551 difference in the probability of having insurance between people who know someone with a policy and think the hazard is a serious threat and those who do not know someone and think there is no problem.

Another significant variable is whether or not the person expects any future damage from a flood or earthquake. The data in Table 6.2 show that a person who expects <u>no</u> damage is 18.1 percent less likely to have insurance than one who expects some damage. For every $10,000 increase in anticipated future damage, the probability increases by less than one percent (.0095).

All the coefficients in the model represent the effects of a given variable when all other factors are held at the same level. The socio-economic variables are statistically significant but do not have much effect on the probability of having insurance. Homeowners most likely to have insurance are older residents who are married, have at least a high school education, and have incomes above $25,000. As a person becomes more averse to risk, he will be more likely to have purchased coverage.

Finally, we see from Table 6.2 that those who have lived in their house for some length of time are less likely to have purchased insurance than if they are relatively new to the area. The coefficient associated with this variable is so small (-.00036) however, that it will not change the overall probability of having insurance by very much (less than a 2 percent decrease in probability between one who just moved to his house and a homeowner residing there for 50 years).

In concluding this section, it is interesting to note that the model which fitted the data best is generally consistent with the earlier two-way analyses depicted in Chapter 5. The multivariate statistical techniques, however, provided us with considerably deeper insight into the process of choice and enabled us to determine significant interaction effects (such as between "PROBLEM" and "KNOWONE"). Furthermore, and perhaps most importantly, these techniques permitted us to measure in a quantitative manner the relative importance of different factors on the perception of the problem (Stage 1), awareness of insurance (Stage 2), and purchase of coverage (Stage 3).

On the basis of the statistical analyses we can conclude that the seriousness of the hazard problem and the knowledge of others having insurance are the dominant factors differentiating the insured from uninsured homeowners. These two variables interact with each other, implying that a person is most likely to have insurance if he views the hazard to be a problem (Stage 1) and is aware of insurance through personal contact (Stage 2). The results are thus consistent with the decision process implied by the sequential model of choice.

6.3 DETECTING ANY MEASURING EFFECTS *

6.3.1 Screening For Spurious Correlation And Interactions

In order to test for spurious correlation and interactions, contingency tables were formed in which the simultaneous effects of several key variables on having insurance could be explored. For illustrative purposes we shall concentrate here on income, perceived seriousness of problem, knowing someone who has purchased insurance, and hazard type. The precise definition of the variables and the way they have been categorized is presented in Table 6.3.

The logic of tests of effect generalizes the familiar chi-square (X^2) test of two-way tables and is easy to grasp intuitively. Suppose we wanted to test, for example, whether "knowing someone" has an impact on the purchase decision when the influence of other factors has already been taken into account. To do this we (1) try to predict having insurance as best we can without considering "knowing someone" (i.e. assuming purchase is <u>independent</u> of knowing someone) and compare our predictions with the data to see how well they "fit" (e.g. by a chi-square criterion). We then (2) predict purchase by explicitly taking into account "knowing someone" and again calculate the "fit". If the fit is substantially improved then "knowing someone" has an effect, otherwise it does not.

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* - The material in this section can be skipped without loss of continuity.

TABLE 6.3

DEFINITION OF VARIABLES

Variable Name	Question Numbers Used in Creating	Definition	Categories
AGE	screening form	Age of household head	Continuous variable
AWAR.INSUR	15	Awareness of hazard insurance in neighborhood	1 = Aware of insurance 2 = Unaware of insurance
EDUCATION	207,213	Education	1 = Less than high school graduate 2 = At least high school graduate
EXPERIENCE	66	Past hazard experience in present home	1 = Has not suffered any disasters 2 = Suffered 1 disaster 3 = Suffered more than 1 disaster
FUT.DAMAG	119,120,121,122	Subjective estimate of future damage in a serious disaster	1 = Unable to estimate damage 2 = No damage 3 = $1 damage 4 = $400,000 damage (3–4: continuous variable between limits)
HAVE.INSUR	32	Insurance status	1 = Has hazard insurance 2 = Doesn't have hazard insurance
HAZARD		Type of hazard	1 = Flood coastal zone A 2 = Flood coastal zone B 3 = Flood riverine zone A 4 = Flood riverine zone B 5 = Earthquake
INCOME	218,220	Income	1 = Low (less than or equal to $10,000) 2 = Medium ($10,001-$25,000) 3 = High (more than $25,000)
KNEW.PRONE	5	Awareness of hazard problem when moved into neighborhood	1 = Was aware 2 = Unaware or lived in neighborhood entire life
KNOWONE	172	Knows friend, neighbor, or relative with hazard insurance	1 = Yes 2 = No
LOG.PROBAB	126	Logarithm of subjective estimate of probability of a disaster occurring	Continuous variable

TABLE 6.3--Continued

Variable Name	Question Numbers Used in Creating	Definition	Categories
MARITAL.STAT	212	Marital status	1 = Married 2 = Not Married
PAST.DAMAG	47,68,69,70	Cumulative past damage while not covered by hazard insurance	1 = No damage 2 = $1 damage } continous variable between limits 3 = $200,000 damage
PROBLEM	1,3	Perception of hazard problem	1 = Views as serious problem 2 = Views as minor problem 3 = Does not view as a problem
RISK.AV	175,179,181	Risk aversion	1 = Highly averse to risks 2 = Somewhat risk averse 3 = Slight risk aversion
YEARS.HOUS	194	Years lived in present house	Continuous variable

Similarly, to test whether knowing someone and perceived seriousness "interact" we compare (a) the fit of a model in which each variable has a separate effect but in which the effects of one do <u>not</u> depend on the other (i.e. no interaction effect) with (b) a model in which both the separate and interaction effects of the two variables are included, to see whether there is any improvement in fit. From a statistical point of view, the difference in X^2 values between the two models [(a) and (b)] tests the significance of the interaction effect on improving the explanatory power of the model.

Finally, it should be noted that the X^2 values computed in (a), (b), (1) or (2) compare each of these models with the perfect predictions that could be made by taking all of the data into account, so in a sense they measure the fit of the model <u>per se</u>[3].

Table 6.4 presents the results of several such tests. The contingency table analyzed cross-classifies insurance purchase with seriousness of the problem, knowing someone with a policy, income, and hazard zone. The results indicate that PROBLEM and KNOWONE are very important variables in differentiating between insured and uninsured homeowners. This can be seen through a comparison of models without each of these variables and ones in which they are present. These results are shown on the right hand panel of Table 6.4. The resulting high X^2 of 115.64 and 276.52 respectively (see lines 3 and 4 of Table 6.4) indicate the relevance of each of these variables. As shown on lines 2 and 5, income and hazard type are also significant (X^2 = 21.19;2 degrees of freedom[d.f.] and 11.97;4 d.f. respectively) though not nearly as significant as the previous two variables.

Now it may turn out that a variable does not have an effect when considered alone but does have substantial interaction effects when combined with other variables, as shown earlier in Figure 6.1. Such interactions are also tested in Table 6.4. We note that PROBLEM and KNOWONE have a significant interaction effect (Line 9: X^2 = 8.64;2 d.f.) whereas other combinations of variables are not significant. These tests, however, have to be interpreted with caution because the overall test may obscure significant components. This problem will be examined in detail presently.

Finally, the left hand panel of Table 6.4 reveals that Model 5, in which INCOME, PROBLEM and KNOWONE each enter independently (but there is no hazard effect) provides a reasonably good fit of the data (X^2 = 100.77; 84 d.f.;

TABLE 6.4

TESTS OF EFFECTS IN CONTINGENCY TABLE MODELS
FOR 75% COMBINED SAMPLE

Model Number	Terms Added to (+) or Deleted from (-) Baseline Model	Goodness of Fit Model		Comparison of Model with Baseline	
		X^2 (P = Goodness of Fit)	Degrees of Freedom	X^2 (P = Significance)	Degrees of Freedom
1. Baseline includes: INCOME, PROBLEM, KNOWONE, HAZARD		88.80 (P = .234)	80	--	--
2.	-INCOME	109.99 (P = .021)	82	21.19 (P < .01)	2
3.	-PROBLEM	204.44 (P = 0)	82	115.64 (P < .01)	2
4.	-KNOWONE	365.32 (P = 0)	81	276.52 (P < .01)	1
5.	-HAZARD	100.77 (P = .103)	84	11.97 (P < .05)	4
6.	+INCOME*PROBLEM	82.62 (P = .282)	76	6.18	4
7.	+INCOME*KNOWONE	87.30 (P = .221)	78	1.50	2
8.	+INCOME*HAZARD	83.85 (P = .161)	72	4.95	8
9.	+PROBLEM*KNOWONE	80.16 (P = .411)	78	8.64 (P < .05)	2
10.	+PROBLEM*HAZARD	78.87 (P = .271)	72	9.93	8
11.	+KNOWONE*HAZARD	81.21 (P = .320)	76	7.59	4
12.	+ all terms from model numbers 6 thru 11	50.79 (P > .5)	52	38.01	28

significance level P = .103). Model 9, with a PROBLEM * KNOWONE interaction term fits very well indeed (X^2 = 80.16; 78 d.f.; P = .411).

Tables 6.5 and 6.6 summarize the analysis of the same variables for the flood and earthquake samples separately in order to examine more closely the differences between these types of hazards. Table 6.5 shows that all of the independent variables have a significant impact in the flood sample. Again PROBLEM and KNOWONE are very powerful predictors and their joint effect is also significant. Model 9 which includes this interaction is an excellent fit (X^2 = 64.76; 61 d.f.; P = .347).

In the earthquake sample (Table 6.6) PROBLEM and KNOWONE are highly significant, although the interaction effect is not quite significant at the .05 level (Line 7). Model 7 which is similar to Model 9 in the flood sample provides an excellent fit (X^2 = 7.02; 10 d.f.; P>.5).

In a parallel series of analyses not presented here, we studied the effects of education on our conclusions. The analysis suggests that education has an important but moderate effect in the overall sample and flood subsample and a rather strong effect in the earthquake sample. The effects of education cannot be attributed to income or personal influence nor can these latter variables be explained by education. The interactions involving education in these tables are for the most part small.

In summary, then, the above analyses show that KNOWONE and PROBLEM are powerful predictors of owning insurance; the effects of these factors cannot be attributed to any other variables. These two variables also have an interaction effect which we will want to analyze further. There also appear to be differences between hazard types which cannot be attributed to variations in the kinds of people (income, etc.) interviewed in the subsamples. Education has an important effect on discriminating between insured and uninsured homeowners, especially in the earthquake zones, but the influence of income is unclear.

6.3.2 Effects Of The Independent Variables: Contingency Table Methods

The previous section illustrated how to determine which variables and combinations of variables have significant effects, but it did not analyze the nature of these effects. We now undertake this analysis. We want to measure

TABLE 6.5

TESTS OF EFFECTS IN CONTINGENCY TABLE MODELS
FOR 75% FLOOD SAMPLE

Model Number	Terms Added to (+) or Deleted from (-) Baseline Model	Goodness of Fit Model		Comparison of Model with Baseline	
		χ^2 (P = Goodness of Fit)	Degrees of Freedom	χ^2 (P = Significance)	Degrees of Freedom
1. Baseline includes: INCOME, PROBLEM, KNOWONE, HAZARD		70.74 (P = .235)	63	--	--
2.	-INCOME	85.20 (P = .047)	65	14.46 (P < .01)	2
3.	-PROBLEM	172.15 (P = 0)	65	101.41 (P < .01)	2
4.	-KNOWONE	242.84 (P = 0)	64	172.10 (P < .01)	1
5.	-HAZARD	81.95 (P = .089)	66	11.21 (P < .05)	3
6.	+INCOME*PROBLEM	61.60 (P = .383)	59	9.14	4
7.	+INCOME*KNOWONE	69.33 (P = .217)	61	1.41	2
8.	+INCOME*HAZARD	67.03 (P = .171)	57	3.71	6
9.	+PROBLEM*KNOWONE	64.76 (P = .347)	61	5.98 (P < .05)	2
10.	+PROBLEM*HAZARD	61.07 (P = .332)	57	9.67	6
11.	+KNOWONE*HAZARD	68.23 (P = .218)	60	2.51	3
12.	+ all terms from model numbers 6 thru 11	42.53 (P = .362)	40	28.21	23

TABLE 6.6

TESTS OF EFFECTS IN CONTINGENCY TABLE MODELS
FOR 75% EARTHQUAKE SAMPLE

Model Number	Terms Added to (+) or Deleted from (-) Baseline Model	Goodness of Fit Model		Comparison of Model with Baseline	
		χ^2 (P = Goodness of Fit)	Degrees of Freedom	χ^2 (P = Significance)	Degrees of Freedom
1. Baseline includes: INCOME, PROBLEM, KNOWONE		11.03 (P > .5)	12	--	--
2.	-INCOME	19.65 (P = .142)	14	8.62 (P < .05)	2
3.	-PROBLEM	27.62 (P = .016)	14	16.59 (P < .01)	2
4.	-KNOWONE	117.84 (P = 0)	13	106.81 (P < .01)	1
5.	+INCOME*PROBLEM	7.73 (P = .461)	8	3.30	4
6.	+INCOME*KNOWONE	9.13 (P > .5)	10	1.90	2
7.	+PROBLEM*KNOWONE	7.02 (P > .5)	10	4.01	2
8.	+ all terms from model numbers 5, 6, and 7	1.70 (P > .5)	4	9.33	8

how the probability (or the odds) of purchasing insurance changes as the levels of the variables - income, education, knowing someone, perceived seriousness of the problem and hazard - jointly change. As explained in the introduction, to eliminate spuriousness we require that our measures be as free as possible of the effects of the other variables.

The same contingency table methods utilized in the previous section to test for statistically significant effects are appropriate for this phase of analysis. The procedure is easy to grasp intuitively using an illustrative example. Consider Model 1 of Table 6.4. This model hypothesizes that INCOME, PROBLEM, KNOWONE, and HAZARD each have an effect on the insurance purchase decision and that the effect of each variable does not depend on the levels of the others (because there are no interaction terms). If this model "fits" (which it does), this suggests that the effect of KNOWONE, for example, on purchase, can be measured by examining the relationship between these two variables in the predicted table[4].

More precisely, we measure the effect of knowing someone by comparing the logarithm of the odds (or logit) of having insurance for people who know someone having insurance with people who do not know someone. The larger the logit, the larger the probability of purchase; the larger the difference in logits, the larger the difference in probability. As a convenient rule of thumb, when logit differences are less than 2, the difference in purchase probability is equal to about 1/4 of the difference between logits. When logit differences exceed 2, the probability differences will be less than 1/4 the logit difference, the amount depending on the size of the logit differences.

It should be clear that our measured effects depend on the specific model under consideration since the predicted table depends on the model; i.e. the measured effect depends on what other variables one adjusts for, and the measure is derived from relationships in the predicted table.

Table 6.7a displays the effects on the predicted logits implied by Model 1 of Table 6.4. Table 6.7b displays approximate probability differences using the above rule of thumb. A positive difference indicates an increase in probability, a negative difference a decrease, when all other effects are controlled but ignored. We see immediately what was already apparent in the X^2 from Table 6.4, viz., that seriousness and knowing someone have very large

TABLE 6.7

MEASURES OF EFFECT IN CONTINGENCY TABLE

Model: 75% Combined Sample*

a. Logits

Variable Name	Level	Logit
INCOME	Low	- .330
	Medium	.110
	High	.218
PROBLEM	Serious	.630
	Minor	.118
	Non-existent	- .748
KNOWONE	Yes	.820
	No	- .820
EDUCATION	Less than high school graduate	- .198
	At least high school graduate	.198
HAZARD	Flood coastal zone A	.190
	Flood coastal zone B	.140
	Flood riverine zone A	- .338
	Flood riverine zone B	- .026
	Earthquake	.032

b. Implied Probability Difference

Variable Name	Logit Difference	Probability Difference
INCOME		
High vs. Low	.548	.137
High vs. Medium	.108	.027
PROBLEM		
Serious vs. Minor	.512	.128
Serious vs. None	1.378	.345
KNOWONE		
Yes vs. No	1.640	.410
EDUCATION		
At least high school graduate vs. less than high school graduate	.396	.099
HAZARD		
Coast A vs. Coast B	.050	.013
River A vs. River B	- .312	- .078
River A vs. Coast A	- .528	- .132
Earthquake vs. Coast B	.108	.027

*Derived from Table 6.4 model 1 except for EDUCATION which is taken from a different run.

effects compared to the other two variables. People who know someone have a 41 percent greater chance of being insured than those who are not aware of others with a policy. Similarly those who think the hazard is a serious problem have a 34.5 percent greater chance of having insurance than those who feel there is no problem.

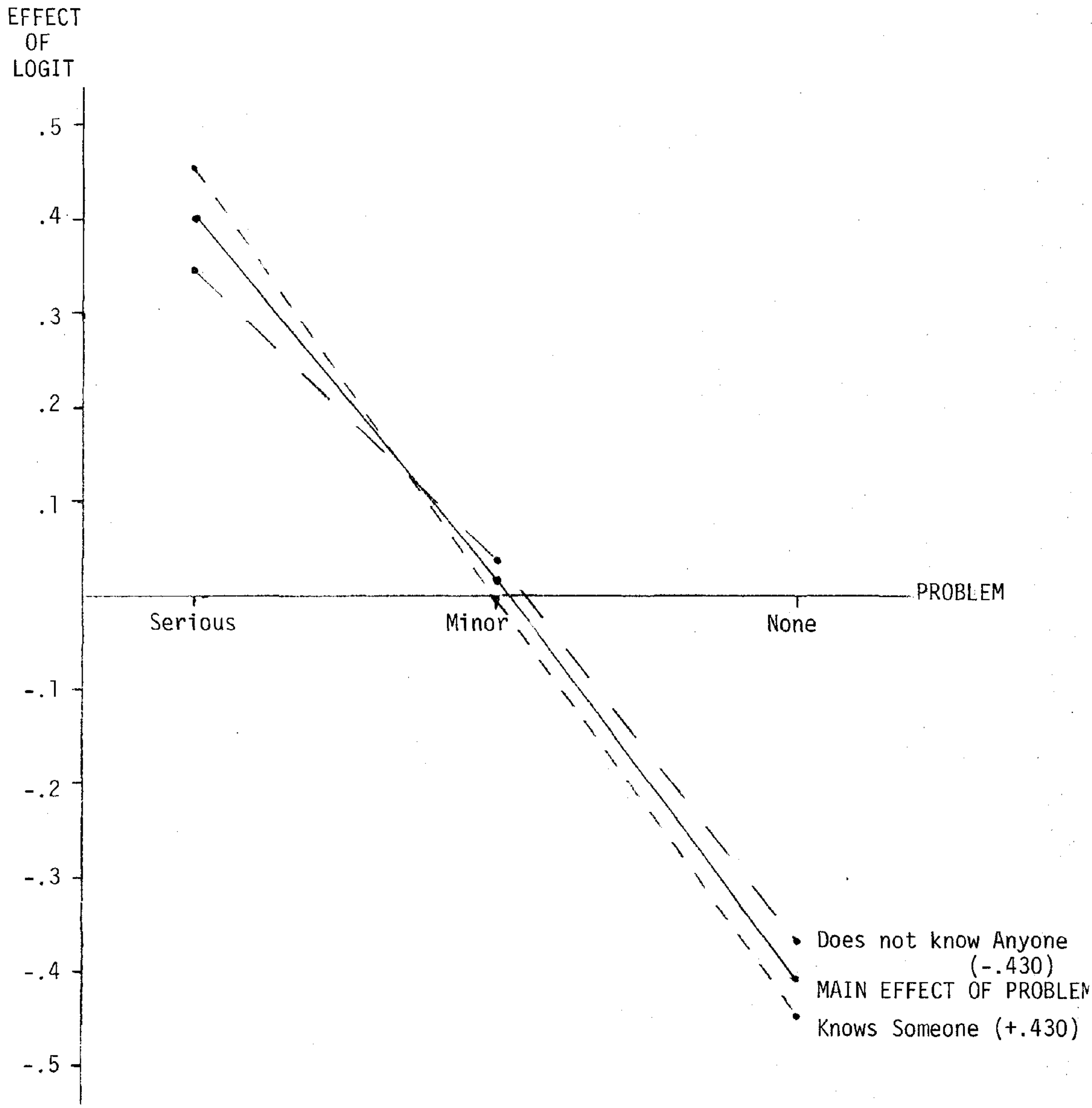
Tables 6.7a and b also indicate -- and this is not apparent in the X^2 from Table 6.4 -- that differences between zones are largely due to the contrast between the high-hazard portions of riverine areas (Riverine Zone A), which has a lower purchase probability, and the remainder of the sample. Moreover, we can also see that income has a small but positive effect: the higher a person's income the more likely he is to be a policyholder. PROBLEM also has a positive effect. The effect of education is positive implying that people who have graduated from high school are more likely to have insurance than those who do not have a high school degree. These separate effects reflect the general tendencies in the data.

Let us now turn to an exploration of the interaction effects isolated in the previous section. These joint effects are most easily grasped from a graph of the logits. The logits of PROBLEM for each level of KNOWONE are plotted in Figure 6.2. These logits are derived from Model 12 of Table 6.4, which fits the data very well and in which all 2-factor interactions are present. In these plots the very large effect of knowing someone has been removed so that the interaction is easier to see. The interaction is revealed by the fact that the line describing the effect of PROBLEM for people who know someone with insurance and the line describing PROBLEM for people who do not know someone are <u>not</u> parallel. PROBLEM has a stronger effect (steeper line) for those who know someone than for those who do not (flatter line).

Thus if someone thinks the hazard is a serious problem and also knows a policyholder, he is more likely to purchase insurance than these variables would imply separately. In a figure such as 6.2, a horizontal line implies there is no effect for different levels, a steep line reflects a strong effect. The line labeled "main effect of problem" represents the average effect at each level of problem for the two KNOWONE groups. In order to calculate the logit for each combination of KNOWONE and PROBLEM the lines of each "know" group have to be shifted parallel to themselves by the amount indicated in parenthesis next to the line. This amount is the average effect of knowing someone or not knowing someone as the case may be.

Figure 6.2

Contingency Table Model for 75% Combined Sample--
PROBLEM × KNOWONE Effect



MODEL: α = .5; ALL 2-FACTOR TERMS, LOGIT

NOTE: The dashed lines contain only the main effect of PROBLEM and the interaction; to get the total effect, shift each line by the value of the main effect of KNOWONE (in parenthesis).

A difference of .L on the logit scale = 1/4(.L) on the probability scale; the KNOWONE main effect ≥ a difference of .2 on the probability scale.

6.4 MODELS OF PURCHASE: REGRESSION ANALYSIS *

The measures of effect derived from the contingency table analyses of the last two sections are actually coefficients of a kind of regression model - a logit or logistic regression - in which the logodds of purchasing insurance are assumed to be a linear function of the independent variables and their combinations. These contingency table models are very useful as a heuristic device for exploring interactions and presenting results in readily understandable ways. For our data the number of independent variables that can be analyzed simultaneously in any one model is, however, limited to four or five. (With more variables the number of observations per cell gets so small that results lose their meaning.) Moreover, grouping quantitative variables into categories in order to form the table can create artifactual results.

In this section we will develop a detailed model of the probability of purchasing insurance using logistic and simple linear regression models which permit including qualitative and quantitative variables and can simultaneously handle a large number of independent factors. The variables and interactions that we concentrate on are those which emerged as being important in the two-way analyses of Chapter 5 and the contingency table analyses above.

The logistic regressions are generalizations of the contingency table models and their coefficients have the same interpretation. The "linear probability" models treat the probability of purchase itself (rather than the logodds) as a linear function of independent variables and estimates coefficients by ordinary least squares (OLS). These OLS models are more familiar and easier to interpret than the logistic models. On the other hand, the OLS models lead to nonsensical results in many instances while the logistic regressions are always meaningful. Table 6.8 specifies these models. As in the previous sections we will keep the technical detail to a minimum and concentrate on results.

The regression analyses presented in Table 6.9 illustrate our main results. The ordinary least squares and logit models each take up a panel of the table. The coefficients are given in the second and fourth columns for

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* - The material in this section can be skipped without loss of continuity.

TABLE 6.8

SPECIFICATION OF INSURANCE PURCHASE
REGRESSION MODEL

Linear Probability Model:

$$P(\text{HAVE.INSUR} = 1) = a + b_1\text{EDUCATION}(2) + b_2\text{INCOME}(2) + b_3\text{INCOME}(3) + b_4\text{MARITAL.STAT}(1) + b_5\text{RISK.AV}(2) + b_6\text{RISK.AV}(1) + b_7(\text{PROBLEM}(1)*\text{KNOWONE}(1)) + b_8(\text{PROBLEM}(2)*\text{KNOWONE}(1)) + b_9(\text{PROBLEM}(3)*\text{KNOWONE}(1)) + b_{10}(\text{PROBLEM}(1)*\text{KNOWONE}(2)) + b_{11}(\text{PROBLEM}(2)*\text{KNOWONE}(2)) + b_{12}\text{LOG.PROBAB} + b_{13}\text{AGE} + b_{14}\text{YEARS.HOUS} + b_{15}\text{FUT.DAMAG}(1) + b_{16}\text{FUT.DAMAG}(2) + b_{17}\text{FUT.DAMAG}(4) + b_{18}\text{HAZARD}(1) + b_{19}\text{HAZARD}(2) + b_{20}\text{HAZARD}(3) + b_{21}\text{HAZARD}(4)$$

Estimation method: ordinary least squares, with the usual normality assumption.

Logistic Regression:

$$\ln\left[\frac{P(\text{HAVE.INSUR} = 1)}{P(\text{HAVE.INSUR} = 2)}\right] = a + b_1\text{EDUCATION}(2) + b_2\text{INCOME}(2) + \ldots + b_{21}\text{HAZARD}(4)$$

$$P(\text{HAVE.INSUR} = 1) = \frac{1}{1 + e^{[-a-b_1\text{EDUCATION}(2)-b_2\text{INCOME}(2)-\ldots-b_{21}\text{HAZARD}(4)]}}$$

Estimation method: maximum likelihood.

TABLE 6.9

REGRESSION FOR 75% COMBINED SAMPLE

Name of Variable	Ordinary Least Squares Coefficient	Ordinary Least Squares T-ratio	Logit Coefficient	Logit Effect on Probability (Approx.)	Logit T-ratio
Homeowner has insurance	Dependent Variable				
Constant term[1]	- .033		-2.942	.050	
Education					
At least high school graduate	.078	3.3	.455	.027	3.4
Income					
Medium	.044	1.8	.243	.013	1.8
High	.050	1.8	.265	.014	1.7
Marital Status					
Married	.050	2.0	.302	.016	2.2
Risk Aversion					
Medium	.055	1.5	.358	.020	1.7
High	.114	3.1	.697	.046	3.2
Problem and Know Someone					
Serious Yes	.551	17.6	2.881	.435	14.8
Minor Yes	.471	13.6	2.276	.289	11.4
None Yes	.237	5.6	1.216	.101	5.4
Serious No	.182	5.5	.936	.068	5.2
Minor No	.108	3.7	.623	.039	3.8
Log (probability of disaster)	.018/unit	3.3	.100/unit	.025/unit	3.3
Age	.0034/yr.	5.1	.020/yr.	.005/yr.	5.2
Years lived in house	- .00036/yr.	-4.2	- .0022/yr.	- .0006/yr.	-4.4
Future damage					
Can't estimate	- .0092	- .25	- .060	- .003	- .30
No damage	- .181	-6.3	-1.081	- .033	-6.2
Some damage	.00095/$1000	2.3	.0049/$1000	.0012/$1000	2.1
Type of hazard					
Coastal zone A	.034	1.4	.205	.011	1.5
Coastal zone B	.049	1.5	.287	.016	1.6
Riverine zone A	- .013	- .39	- .105	- .005	- .56
Riverine zone B	.058	1.6	.360	.020	1.7
R^2 = .286					

[1]Estimated probability of homeowner purchasing insurance who:
- (a) is not a high school graduate,
- (b) has low income,
- (c) is not married,
- (d) is not risk averse,
- (e) thinks there is no hazard problem while not knowing anyone with insurance,
- (f) expects $1 future damage, and
- (g) lives in an earthquake area.

OLS and logit models respectively. Next to them are the estimated t-ratios which test the statistical significance of the term. A t-ratio greater than 1.65 is significant (one tailed test) at the .05 level; a t value greater than 2.33 is significant at the .01 level (again one tailed). All of the coefficients measure the increase or decrease in purchase probability or logodds relative to the constant term.

For qualitative variables or variables that have been grouped into categories, like hazard or income, the category included in the constant term has a coefficient of 0.0 and the other coefficients represent the difference in purchase probability relative to this normalized group. For example, in the OLS model, less than high school education is included in the constant term and .078 for the group that has graduated from high school means that they have a 7.8 percent higher purchase probability than the group without a high school degree. For fully quantitative variables, like age, the coefficient represents the change in probability (or logodds in the logit regression) per unit change in the variable. Thus the chances of being a policyholder in the OLS Model 1 is 3.4 percent higher per 10 years increase in age.

Some variables in our models, like future damage and past damage, have quantitative and qualitative components. For example FUT.DAMAG(1) and FUT.DAMAG(2) act like qualitative variables and constrast purchase probabilities for "don't knows" and people who say "zero" damage, with FUT.DAMAG(3), people who anticipate a small positive amount ($1), the group included in the constant term. The "don't knows" are almost identical to the $1 group (coefficient = -.0092, not significantly different from 0.0 because t = 0.25). The "zero damage" group has an 18.1 percent lower probability of purchasing insurance than those who anticipate $1 damage and this difference is highly significant (t = 6.3). FUT.DAMAG(4) is like a quantitative variable and shows the increase in probability per $1,000 estimated damage among those people who think there will be some (non-zero) damage. For every $10,000 increase in anticipated future damage the probability increases by almost 1 percent.

The model in Table 6.9 is our best fitting regression for the combined sample. In general the results of the contingency table analyses are not changed by the additional variables (age, years lived in neighborhood, probability of a disaster, and estimated future damage) included in the model.

Income is barely significant and its effect is positive. Again education differences are significant between people who have not graduated from high school and those who have. The hazard differences are small but the difference between Riverine A and the rest are significant. The interaction between PROBLEM and KNOWONE is also highly significant: there is a 55 percent difference in the probability of having insurance between people who know someone and think the problem is serious and people who do not know someone and think there is no problem. We have already commented on future damage variables. Age, years lived in neighborhood and estimated probability are all important and their effects are in the expected direction.

The logit model in Table 6.9 is included here for purposes of comparison. The column labeled "effect on probability" indicates approximate probability differences for people who, on the basis of all other variables, have a 50-50 chance of having insurance. For continuous variables, such as age, these figures are obtained by dividing the logit regression coefficients by 4. Thus the difference between less than high school education and high school graduate is approximately 2.7 percent. This agrees reasonably well with the ordinary least squares regression. By and large, the pattern of significance is very much the same in the logit and the ordinary least squares models.

There are, however, circumstances in which the ordinary least squares model breaks down and the logit becomes necessary. In Table 6.10, for example, which analyzes the earthquake subsample, a medium income person who thinks earthquake is a serious problem, knows someone with insurance and has suffered $20,000 past damage is predicted to have a probability of 1.123 of purchasing insurance which is obviously absurd. In the comparable logit model that person has probability .966. Regardless of other factors, the ordinary least squares model predicts a difference in probability of .676 between people who know someone with insurance and think earthquake is a serious threat and people who do not know someone and think there is no threat. This does not leave much room for other factors before the difference in probability exceeds 1. The logit model predicts a comparable difference of .729 for the low income group who have suffered $1 past damage.

For those with higher incomes or larger losses, this difference would decline from .729 so that the probability of having insurance will always be between 0 and 1. Thus, for example, for someone who has suffered $20,000 past damage, all other things being equal, the difference between the "serious

TABLE 6.10

REGRESSION FOR 75% EARTHQUAKE SAMPLE

Name of Variable	Ordinary Least Squares: Coefficient	Ordinary Least Squares: T-ratio	Logit: Coefficient	Logit: Effect on Probability (Approx.)	Logit: T-ratio
Homeowner has insurance	Dependent Variable				
Constant term[1]	.159		-1.632	.164	
Income					
Medium	.120	2.6	.623	.104	2.6
High	.120	2.5	.625	.104	2.5
Past damage					
No damage	.093	1.8	.500	.080	1.9
Some damage	.0084/$1000	.51	.0301/$1000	.0075/$1000	.38
Log (probability of disaster)	.028/unit	2.9	.145/unit	.036/unit	2.9
Problem and Know Someone					
Serious Yes	.676	8.5	3.752	.729	6.4
Minor Yes	.591	8.8	2.847	.608	7.4
None Yes	.197	1.2	.996	.183	1.3
Serious No	.189	3.0	.899	.161	2.8
Minor No	.120	2.2	.615	.102	2.2
$R^2 = .207$					

[1]Estimated probability of homeowner purchasing insurance who:
(a) has low income,
(b) has suffered $1 past damage, and
(c) thinks there is no hazard problem while not knowing anyone with insurance.

problem - know someone" group and "no problem - don't know someone" group is .566. (This figure is not shown in Table 6.10). To obtain this difference we note that the first group has probability .966 as before, but the homeowners who do not think earthquakes are a problem and do not know someone with insurance have a probability of purchasing insurance equal to .400.

We now comment briefly on some other regression results not presented here in detail. Models containing PROBLEM fit better (higher R^2) than models with "past damage", so the former variable seems to be a better predictor of having insurance than the latter. Past damage, however, does play a role because differences between hazard zones become very small when past and future damage are taken into account. This result suggests that these two variables explain the hazard effect. Knowing someone and thinking the hazard problem is serious are by far the most important variables, and these interact in a reinforcing way. Other effects like education, age, and years lived in house are significant but relatively small. The interaction between PROBLEM and KNOWONE is very significant as shown in Figure 6.3 (derived from Table 6.9). We see that the interaction is due to a stronger contrast between "none" and "minor" problem in the group that knew someone with insurance than in the don't know someone group, which is what we found previously.

6.5 IMPLICATIONS OF SAMPLE PLAN ON STATISTICAL ANALYSIS *

This section is more technical than the previous one but nevertheless deals with an extremely important aspect of the interpretation of our survey results. We have thus far treated the statistical aspects of our analysis without considering the design of the sample. Our primary concern has been to identify the main determinants of insurance purchase, to eliminate spurious effects, and to specify in detail the conditions under which people are likely to have a policy. The results of our survey, like the results of any survey, are subject to random fluctuations: by using a different sample, we would have obtained different tables, different measures of effect, different X^2's, and different coefficients.

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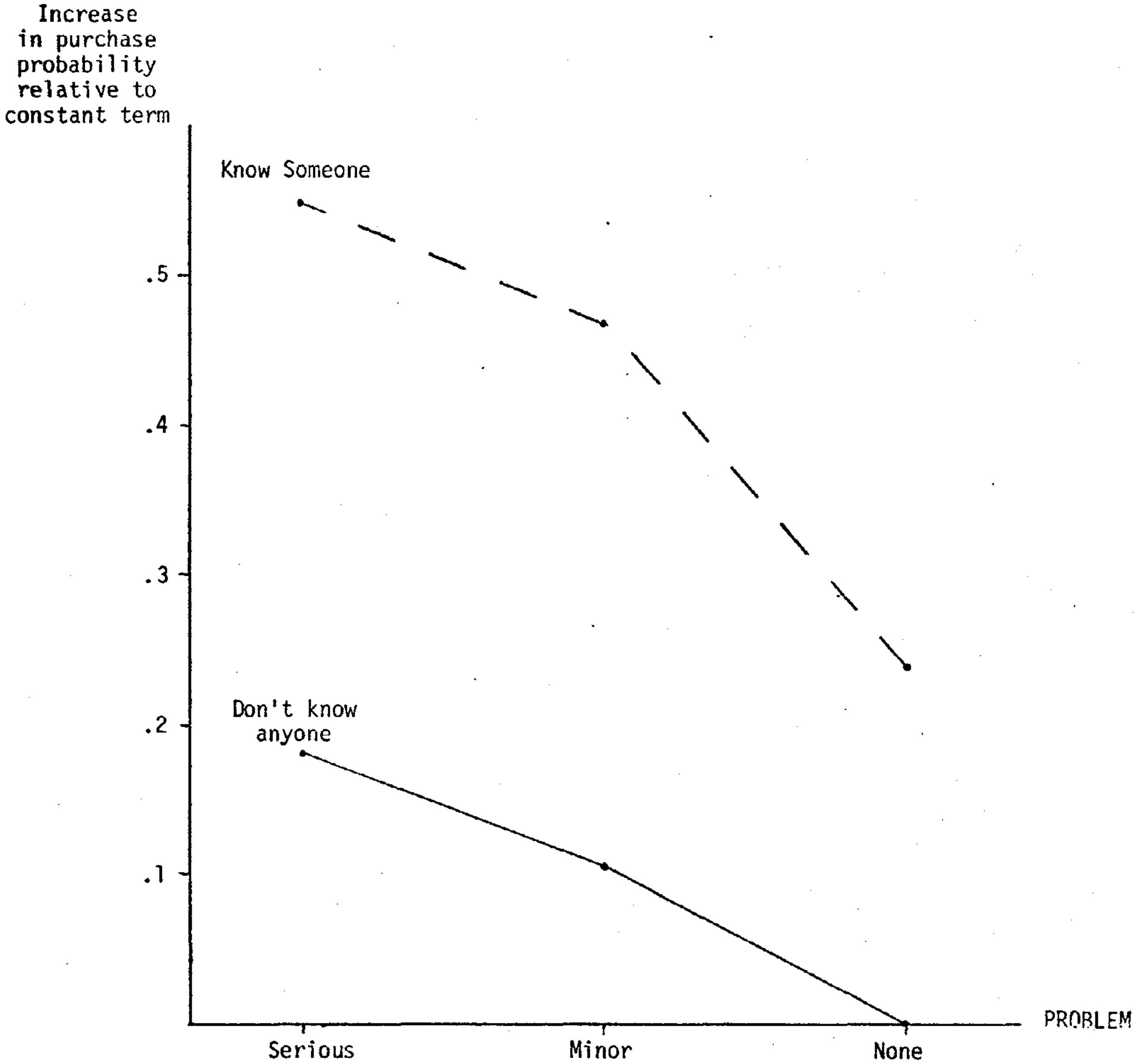
* - The material in this section can be skipped without loss of continuity.

Figure 6.3

Least Squares Regression Model for 75% Combined Sample--
PROBLEM × KNOWONE Effect



NOTE: Only differences are meaningful.

As explained in Chapter 4, our sampling plan was complex. It was drawn in such a way as to keep the random aspects of the results as small as possible given the budget constraints. The statistical tests are designed, of course, to estimate how likely it is that our results are random rather than systematic. These tests are, however, based on the assumption of simple random sampling and while they are generally serviceable and robust, prudence requires us to check our results with more precise statistical tools which reflect the design of the sampling plan for this study.

Three relevant features of the sampling plan are the clusters of homeowners that form the ultimate unit sampled, the non-proportionate sampling of homeowners (i.e. the over-representation in our sample of insured individuals) and the use of a 25 percent subsample. As discussed in Chapter 4, clustering and non-proportionate sampling are designed to improve the chance of detecting effects and interactions. The technique employed in this study to adjust our tests of hypotheses for the clustering effect is called Balanced Repeated Replications (BRR)[5]. A weighting procedure was used to compensate for the over-representation of policyholders as attention shifted from identifying significant effects to the estimation of the proportion of homeowners actually having insurance in hazard prone areas. The 25 percent subsample was drawn to determine the accuracy of the results if the study were to be replicated. We discuss each of these procedures in turn.

6.5.1 Cluster Sampling And Balanced Repeated Replications

A frequent, if not typical, practice in survey research is to perform and interpret calculations as if the data were a simple random sample when, in fact, the sampling plan is otherwise. The practice, though understandable, will at times yield misleading results. For example, with a cluster sample, if the clusters are relatively homogeneous, estimates of means are unbiased but their estimated standard errors are too low. The degree of this bias in the standard errors is termed the "design effect." The design effect for cluster sampling is the relative increase in standard errors over values which would have occurred if the survey were based on a simple random sampling plan. The typical practice of ignoring the design effects may lead to false impressions of the precision of results. It is important therefore either to calculate standard errors of estimate by appropriate formulas or to estimate the design effects and make appropriate corrections.

For some simple statistics the proper formulas are available, but for regression coefficients and correlations the correct formulas are not known. Design effects can, however, be estimated through repeated replications. Intuitively this method estimates coefficients in a large number of replicates (or subsamples of the main sample) and the variation among these estimates is used to calculate the design effect. The problem is to determine how best to use the data at hand to construct these replications. The strategy of BRR is to use selected halves of the sample of clusters to form half sample replicates. The method prescribes the number of half samples to be used and how to choose them.

6.5.2 Weighted And Unweighted Samples

As just mentioned, the sampling plan for this study oversampled policyholders and homeowners in areas of greatest risk. This sample is called the unweighted sample. It is not a mini-representation of the population of all homeowners nor is it meant to be. Its purpose is to improve the chances of detecting important effects and interactions. The unweighted sample may mislead the researcher if his intent is to estimate proportions holding insurance policies among categories of homeowners in the population. Weighting each element in the sample with a number proportional to the inverse of the probability of its having been selected enables us to estimate the proportions holding insurance policies among homeowners based on the actual distribution.

6.5.3 Examples Of BRR And Weighting

Applications of BRR and weighting to multivariate analysis are illustrated by data presented in Table 6.11. Column (1) contains the estimated coefficient of the model presented in Table 6.9 applied here to the 75 percent coastal subsample with unweighted data. Column (2) contains estimated standard errors of these effects based on procedures that assume simple random sampling. The ratio of column (1) to column (2) forms the t-ratio in column (3). Design effects, estimated by BRR are listed in column (4). Generally, the design effect is somewhat larger than one and reflect the effects of cluster sampling.

TABLE 6.11

BALANCED REPEATED REPLICATION USING ORDINARY LEAST SQUARES FOR 75% COASTAL FLOOD SAMPLE

Variable Name		Unweighted Data (1) Coefficient	(2) Standard Error	(3) T-ratio	(4) Design Effect	(5) Corrected T-ratio	Weighted Data (6) Coefficient	(7) Standard Error of Design Effect
Homeowner has Insurance			Dependent Variable					
Constant term[1]		- .064	.085				.115	.148
Education								
At least high school graduate		.072	.033	2.2	1.6	1.4	- .025	.055
Income								
Medium		.041	.033	1.2	.49	2.5	- .020	.049
High		.079	.040	2.0	.77	2.5	- .121	.092
Marital Status								
Married		.022	.036	.61	.95	.64	- .014	.107
Risk Aversion								
Medium		.077	.050	1.6	1.4	1.1	.124	.056
High		.166	.051	3.2	1.4	2.3	.280	.084
Problem and Know Someone								
Serious	Yes	.491	.044	11.2	1.2	9.3	.454	.109
Minor	Yes	.425	.048	8.8	1.8	4.8	.116	.305
None	Yes	.223	.054	4.1	.64	6.4	.049	.127
Serious	No	.181	.048	3.8	1.2	3.3	.084	.071
Minor	No	.168	.045	3.7	1.6	2.3	.159	.189
Log (probability of disaster)		.014/unit	.008	1.7	.53	3.3	.017/unit	.009
Age		.0038/yr.	.0009	4.0	.45	8.9	- .0005/yr.	.002
Years Lived in House		- .00027/yr.	.0001	- 2.2	1.0	- 2.2	- .0001/yr.	.0003
Future Damage								
Unable to estimate		.019	.053	.37	2.3	.16	.287	.198
No damage		- .140	.042	- 3.4	.98	- 3.4	- .116	.044
Some damage		.0020/$1,000	.272	2.9	1.4	2.1	.0034/$1,000	1.279
Hazard								
Zone A		- .004	.031	- .12	2.3	- .05	- .051	.110

R^2 for 75% unweighted Coastal Flood sample = .278

[1]Estimated probability of homeowner purchasing insurance who:

a. is not a high school graduate,
b. has low income,
c. is not married,
d. is slightly averse to risk,
e. thinks there is no hazard problem while not knowing anyone with insurance,
f. expects $1 future damage, and
g. lives in zone B.

The standard errors in column (2) when multiplied by the design effects of column (4) yield the adjusted standard error of estimate. The adjusted t-ratios are then calculated by dividing column (3) by column (4). In the case of risk aversion, for example, the design effect was greater than one and the t-ratios decreased, thus indicating that this variable may be somewhat less significant statistically than we had previously supposed. Nevertheless, for those who are highly risk averse, the size of the coefficient (.166) and adjusted t-ratio (2.3) indicates that this is still a significant variable. The coefficient for those who exhibit medium risk aversion (.077) is not significant at the .05 level when the design effect is incorporated (t-ratio = 1.1).

Column (6) in the table contains estimates of coefficients for the weighted sample. Comparing columns (1) and (6) gives the effect of weighting on the values of the coefficients. For example, when a weighted sample is utilized, the length of time lived in a house has a smaller negative effect on the probability of purchasing insurance and the degree of risk aversion has a larger positive effect than for the unweighted sample. In most instances, when the corrected t-ratios indicate non-zero effects, the weighting reduces the absolute value of the estimated effects. The standard errors of these effects for the weighted sample are estimated again using BRR and presented in column (7). Tables 6.31 and 6.32 following the chapter present Balanced Repeated Replication results for the riverine flood sample and the earthquake sample[6].

6.5.4 Testing The Accuracy Of The Model (25% Subsample)

The 25 percent subsample was chosen randomly from the main sample and reserved in order to estimate possible "shrinkage" of our results. Shrinkage refers to the loss of ability to predict or classify when a complex model is applied to a new situation. It is a common phenomenon, though few researchers try to prevent it. The practice of choosing the best model from among many possible models, in a situation where many variables and interactions are measured, is likely to result in a good "fit". However, the high correlation coefficient may be partially due to random phenomena in the data. Tests of significance do not protect against this source of false claims. The 25 percent subsample permits us to test how well the best model derived from the 75 percent subsample predicts insurance status of another sample of homeowners. Since the random oddities of the main (75 percent) sample are not likely to be repeated in the 25 percent subsample, consistency in results indicates the presence of "true" systematic effects[7].

The validation procedure is illustrated by Table 6.12. The best-fitting OLS regression model (Table 6.9) was applied to the 75 percent flood subsample. The estimated coefficients were then used to calculate the expected probability of having insurance for each person in the 75 percent sample and to predict the probability of having insurance in the 25 percent sample. If the calculated or predicted probability was .4 or less, we classified the person as a nonpolicyholder; if the calculated or predicted probability was .6 or greater we classified him as a policyholder. Those whose probability fell between .4 and .6 were categorized as "unable to classify". Because the model is not a perfect fit, some individuals are misclassified by this procedure, but the question is: are the errors much greater for the 25 percent sample than for the 75 percent sample on which the predictions are based. It is clear from Table 6.12 that there is very little "shrinkage". Indeed, the model does better in predicting insurance status in the 25 percent sample than in the 75 percent sample! Thus the models we have constructed appear to have considerable validity in differentiating between policyholders and nonpolicyholders.

6.6 SUMMARY OF STATISTICAL PROCEDURES

The methodology for analyzing the survey data is summarized in Figure 6.4. Step 1 utilizes the entire sample data for developing cross tabulations and contingency tables. These procedures enable us to isolate those variables which may be significant in discriminating between insured and uninsured individuals. We then randomly divide the data into two parts: 75 percent of the sample is used for developing the coefficients of a regression equation (Step 2), thus indicating the relative importance of variables isolated from Stage 1. Balanced repeated replication determines which of these variables are statistically significant (Step 3). The coefficients of this subset of variables are re-estimated and comprise the test equation (Step 4). The final step in the process is to utilize this equation on the remaining 25 percent of the sample to test how accurately it can classify homeowners into the insured and uninsured categories.

TABLE 6.12

CALCULATED PROBABILITY FOR 75% FLOOD SAMPLE
COMPARED TO
PREDICTED PROBABILITY FOR 25% FLOOD SAMPLE

For individuals having insurance:

	Correctly Classified	Unable to Classify	Incorrectly Classified
75% sample	64	21	15
25% sample	65	21	14

For individuals not having insurance:

	Correctly Classified	Unable to Classify	Incorrectly Classified
75% sample	59	25	16
25% sample	59	28	13

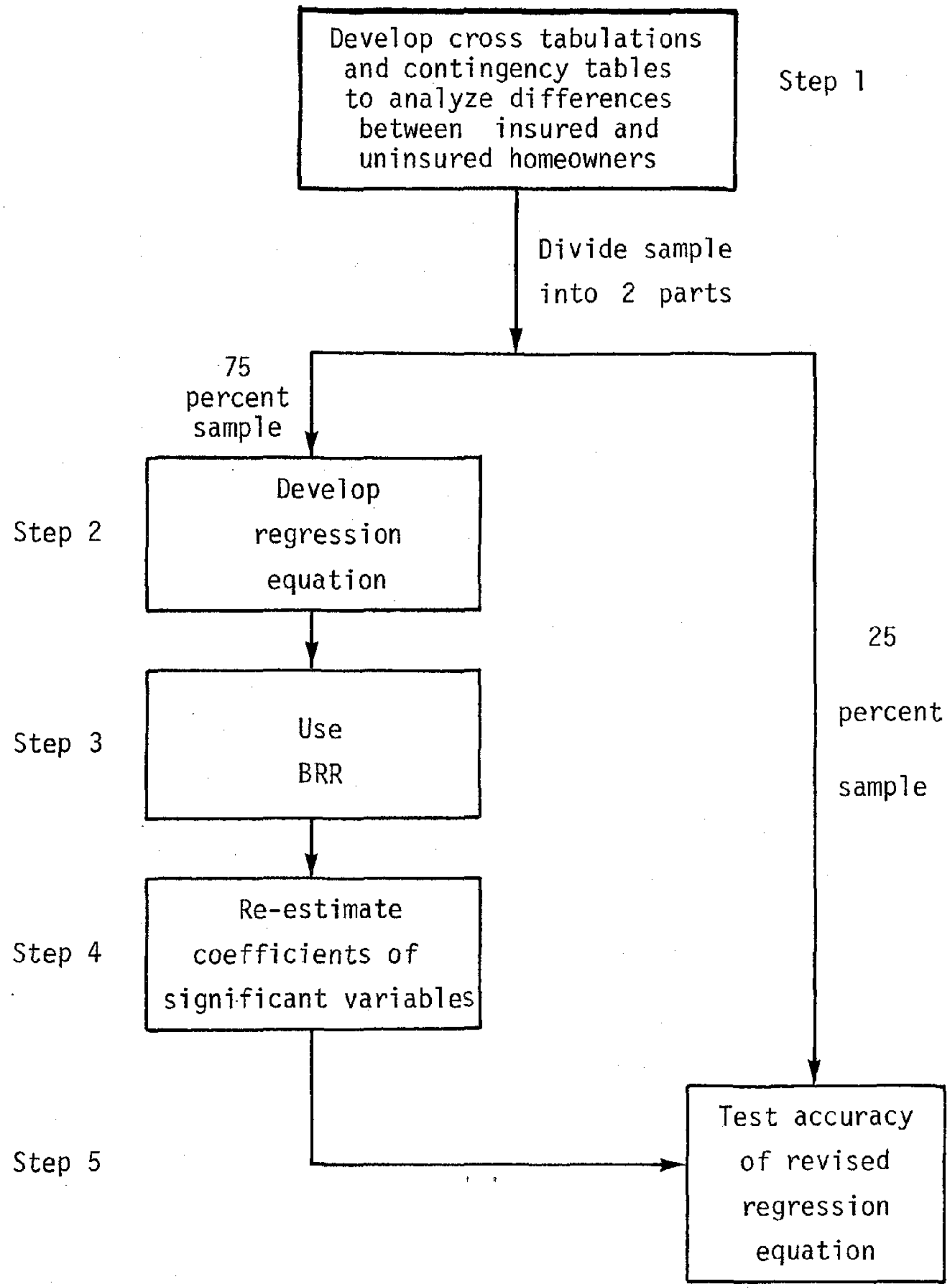


Fig. 6.4 Procedure for Systematically Analyzing Survey Data

FOOTNOTES

[1] These multivariate methods are discussed in Bock(1975), Cox (1970), Ginsberg (1972), Goodman (1972a, 1972b), Grizzle et. al. (1969), McFadden (1973, 1974), Nerlove and Press (1973), and Theil (1970).

[2] Under certain circumstances, more sophisticated methods may be required to provide meaningful results. These approaches are illustrated in the more technical portion of the chapter (notably Section 6.4).

[3] If fit is measured by the (likelihood ratio) X^2, the difference between X^2 in (1) and (2) and (a) and (b) is X^2 distributed.

[4] This effect is already adjusted for the effects of PROBLEM, INCOME, and HAZARD because of the way Table 6.4 is constructed. This is essentially a validating procedure.

[5] For a discussion of the BRR procedure see Frankel (1971).

[6] The small design effects for the earthquake portion of the survey are a result of the sampling plan. Further investigations are underway to explain more fully the phenomenon of design effects less than 1.

[7] This is essentially a validating procedure. There is no theory, to our knowledge, that specifies how large the subsample should be. The selection of a 25 percent sample may seem wasteful, but in view of an absence of a proper theory, and in view of the larger waste incurred if an improper insurance program is formulated and implemented, it seems reasonable to err on the high side.

TABLE 6.13

REGRESSION FOR 75% COMBINED SAMPLE

	Ordinary Least Squares	
Name of Variable	Coefficient	T-ratio
Hazard is a serious problem	Dependent Variable	
Constant term[1]	.114	
Knew area hazard prone when moved in		
Yes	.232	11.5
Disaster experience		
One disaster	.221	7.7
More than one disaster	.436	12.1
Years lived in house and Type of hazard		
Coastal zone A	.283 - .0047/yr.	8.5
Coastal zone B	.032 - .0003/yr.	.73
Riverine zone A	.289 + .00096/yr.	6.4
Riverine zone B	.079 + .00059/yr.	1.5
Earthquake	.000 - .00051/yr.	- 3.0

R^2 = .203

[1]Estimated probability of homeowner thinking hazard is a serious problem who:
(a) didn't know area was hazard prone when moved in or has lived there whole life and
(b) has never experienced a disaster.

TABLE 6.14

REGRESSION FOR 75% FLOOD SAMPLE

Name of Variable	Ordinary Least Squares Coefficient	T-ratio
Hazard is a serious problem	Dependent Variable	
Constant term[1]	.162	
Knew area hazard prone when moved in		
Yes	.307	11.8
Disaster experience		
One disaster	.290	8.3
More than one disaster	.479	12.1
Years lived in house and Type of hazard		
Coastal zone A	.201 - .0048/yr.	3.9
Coastal zone B	-.032 - .0037/yr.	- .55
Riverine zone A	.198 + .0010/yr.	3.3
Riverine zone B	.000 + .00087/yr.	.30
R^2 = .239		

[1]Estimated probability of homeowner thinking hazard is a serious problem who:
(a) didn't know area was hazard prone when moved in or lived there whole life and
(b) has never experienced a disaster.

TABLE 6.15

REGRESSION FOR 75% EARTHQUAKE SAMPLE

Name of Variable	Ordinary Least Squares Coefficient	 T-ratio
Hazard is a serious problem	Dependent Variable	
Constant term[1]	.202	
Knew area hazard prone when moved in		
Yes	.109	3.5
Disaster experience		
One disaster	.064	1.3
More than one disaster	.250	2.8
Years lived in house	-.0045/yr.	- 2.7
R^2 = .035		

[1]Estimated probability of homeowner thinking hazard is a serious problem who:
(a) didn't know area was hazard prone when moved in or lived there whole life and
(b) has never experienced a disaster.

TABLE 6.16

REGRESSION FOR 75% COMBINED SAMPLE

Name of Variable	Ordinary Least Squares Coefficient	T-ratio
Homeowner is aware of hazard insurance	Dependent Variable	
Constant term[1]	.283	
Income		
Medium	.060	2.4
High	.092	3.2
Marital Status		
Married	.071	2.8
Education and Problem		
Low Serious	.240	4.6
High Serious	.352	7.9
Low Minor	.027	.51
High Minor	.269	6.1
High None	.099	2.2
Log (probability of disaster) and Type of hazard		
Coastal zone A	.154 + .005/unit	2.9
Coastal zone B	.162 + .028/unit	2.1
Riverine zone A	.151 + .049/unit	2.4
Riverine zone B	.165 + .052/unit	2.0
Earthquake	.000 + .0046/unit	.49

R^2 = .121

[1] Estimated probability of homeowner being aware hazard insurance is available in neighborhood who:
(a) has low income,
(b) is not married, and
(c) is not a high school graduate and does not view the hazard as a problem.

TABLE 6.17

REGRESSION FOR 75% FLOOD SAMPLE

	Ordinary Least Squares	
Name of Variable	Coefficient	T-ratio
Homeowner is aware of hazard insurance	Dependent Variable	
Constant term[1]	.488	
Income		
Medium	.034	1.2
High	.067	2.0
Marital Status		
Married	.071	2.4
Education and Problem		
Low Serious	.206	3.7
High Serious	.337	7.0
Low Minor	.063	1.1
High Minor	.240	4.8
High None	.106	2.2
Log (probability of disaster) and Type of hazard		
Coastal zone A	-.021 + .0061/unit	- .83
Coastal zone B	-.008 + .0316/unit	-2.5
Riverine zone A	-.017 + .050/unit	-4.3
Riverine zone B	.000 + .0553/unit	2.8

R^2 = .125

[1]Estimated probability of homeowner being aware hazard insurance is available in neighborhood who:
(a) has low income,
(b) is not married, and
(c) is not a high school graduate and does not view the hazard as a problem.

TABLE 6.18

REGRESSION FOR 75% EARTHQUAKE SAMPLE

Name of Variable	Ordinary Least Squares Coefficient	T-ratio
Homeowner is aware of hazard insurance	Dependent Variable	
Constant term[1]	.149	
Income		
Medium	.144	2.9
High	.171	3.1
Marital Status		
Married	.061	1.3
Education and Problem		
Low Serious	.468	3.1
High Serious	.430	3.8
Low Minor	.028	.24
High Minor	.348	3.2
High None	.110	.93
Log (probability of disaster)	.0020/unit	.21

R^2 = .119

[1]Estimated probability of homeowner being aware hazard insurance is available in neighborhood who:
(a) has low income,
(b) is not married, and
(c) is not a high school graduate and does not view the hazard as a problem.

TABLE 6.19

MEASURES OF EFFECT IN CONTINGENCY TABLE

Model: 75% Flood Sample*

a. Logits

Variable Name	Level	Logit
INCOME	Low	- .312
	Medium	.056
	High	.256
PROBLEM	Serious	.670
	Minor	.100
	Non-existent	- .770
KNOWONE	Yes	.752
	No	- .752
EDUCATION	Less than high school graduate	- .120
	At least high school graduate	.120
HAZARD	Flood coastal zone A	.190
	Flood coastal zone B	.146
	Flood riverine zone A	- .320
	Flood riverine zone B	- .016

b. Implied Probability Difference

Variable Name	Logit Difference	Probability Difference
INCOME		
High vs. Low	.568	.142
High vs. Medium	.200	.050
PROBLEM		
Serious vs. Minor	.570	.143
Serious vs. None	1.440	.360
KNOWONE		
Yes vs. No	1.504	.376
EDUCATION		
At least high school graduate vs. less than high school graduate	.240	.060
HAZARD		
Coast A vs. Coast B	.044	.011
River A vs. River B	- .304	- .076
River A vs. Coast A	- .510	- .128

*Derived from Table 6.5 model 1 except for EDUCATION which is taken from a different run.

TABLE 6.20

MEASURES OF EFFECT IN CONTINGENCY TABLE

Model: 75% Earthquake Sample*

a. Logits

Variable Name	Level	Logit
INCOME	Low	- .416
	Medium	.214
	High	.202
PROBLEM	Serious	.528
	Minor	.110
	Non-existent	- .636
KNOWONE	Yes	1.032
	No	-1.032
EDUCATION	Less than high school graduate	- .494
	At least high school graduate	.494

b. Implied Probability Difference

Variable Name	Logit Difference	Probability Difference
INCOME		
High vs. Low	.618	.155
High vs. Medium	- .012	- .003
PROBLEM		
Serious vs. Minor	.418	.105
Serious vs. None	1.164	.291
KNOWONE		
Yes vs. No	2.064	.516
EDUCATION		
At least high school graduate vs. less than high school graduate	.988	.247

*Derived from Table 6.6 model 1 except for EDUCATION which is taken from a different run.

TABLE 6.21

REGRESSION FOR 25% COMBINED SAMPLE

Name of Variable	Ordinary Least Squares Coefficient	Ordinary Least Squares T-ratio	Logit Coefficient	Logit Effect on Probability (Approx.)	Logit T-ratio
Homeowner has insurance	Dependent Variable				
Constant term[1]	.001		-2.913	.052	
Education					
At least high school graduate	.023	.55	.098	.005	.41
Income					
Medium	.043	1.1	.225	.012	.97
High	.055	1.1	.329	.019	1.1
Marital Status					
Married	- .013	- .31	- .073	- .003	- .30
Risk Aversion					
Medium	.063	1.0	.362	.021	.98
High	.088	1.4	.542	.034	1.5
Problem and Know Someone					
Serious Yes	.660	12.4	3.620	.618	9.6
Minor Yes	.659	10.6	3.561	.605	8.2
None Yes	.480	6.8	2.623	.376	6.1
Serious No	.264	4.6	1.571	.156	4.4
Minor No	.217	4.2	1.387	.127	4.0
Log (probability of disaster)	.021/unit	2.3	.121/unit	.030/unit	2.3
Age	.0025/yr.	2.0	.015/yr.	.004/yr.	2.1
Years lived in house	- .00023/yr.	-1.4	- .0014/yr.	- .0004/yr.	-1.5
Future damage					
Can't estimate	.0048	.084	.121	.006	.37
No damage	- .116	-2.4	- .706	- .025	-2.2
Some damage	.0012/$1000	2.0	.0094/$1000	.0024/$1000	2.1
Type of hazard					
Coastal zone A	.048	1.1	.289	.016	1.2
Coastal zone B	- .004	- .074	- .034	- .002	- .11
Riverine zone A	- .038	- .68	- .235	- .010	- .71
Riverine zone B	.030	.44	.255	.014	.58
R^2 = .327					

[1] Estimated probability of homeowner purchasing insurance who:
- (a) is not a high school graduate,
- (b) has low income,
- (c) is not married,
- (d) is not risk averse,
- (e) thinks there is no hazard problem while not knowing anyone with insurance,
- (f) expects $1 future damage, and
- (g) lives in an earthquake area.

TABLE 6.22

REGRESSION FOR 100% COMBINED SAMPLE

Name of Variable	Ordinary Least Squares: Coefficient	Ordinary Least Squares: T-ratio	Logit: Coefficient	Logit: Effect on Probability (Approx.)	Logit: T-ratio
Homeowner has insurance	Dependent Variable				
Constant term[1]	- .022		-2.873	.054	
Education					
At least high school graduate	.065	3.2	.372	.022	3.2
Income					
Medium	.048	2.3	.261	.015	2.2
High	.054	2.3	.299	.017	2.2
Marital Status					
Married	.033	1.5	.199	.011	1.7
Risk Aversion					
Medium	.056	1.8	.343	.020	1.9
High	.105	3.3	.632	.043	3.4
Problem and Know Someone					
Serious Yes	.576	21.4	3.007	.480	17.6
Minor Yes	.514	17.1	2.526	.361	14.1
None Yes	.298	8.3	1.534	.154	7.9
Serious No	.199	7.0	1.046	.085	6.6
Minor No	.132	5.2	.764	.055	5.2
Log (probability of disaster)	.018/unit	4.0	.102/unit	.026/unit	4.0
Age	.0032/yr.	5.4	.019/yr.	.005/yr.	5.5
Years lived in house	- .00033/yr.	-4.4	- .0020/yr.	- .0005/yr.	-4.5
Future damage					
Can't estimate	- .0046	- .15	- .015	- .001	- .088
No damage	- .164	-6.6	- .976	- .033	-6.5
Some damage	.0010/$1000	3.0	.0059/$1000	.0015/$1000	3.0
Type of hazard					
Coastal zone A	.036	1.7	.212	.012	1.8
Coastal zone B	.035	1.3	.202	.011	1.3
Riverine zone A	- .025	- .87	- .165	- .008	-1.0
Riverine zone B	.046	1.4	.291	.017	1.5
R^2 = .292					

[1]Estimated probability of homeowner purchasing insurance who:
(a) is not a high school graduate,
(b) has low income,
(c) is not married,
(d) is not risk averse,
(e) thinks there is no hazard problem while not knowing anyone with insurance,
(f) expects $1 future damage, and
(g) lives in an earthquake area.

TABLE 6.23

REGRESSION FOR 75% FLOOD SAMPLE

Name of Variable	Ordinary Least Squares Coefficient	Ordinary Least Squares T-ratio	Logit Coefficient	Logit Effect on Probability (Approx.)	Logit T-ratio
Homeowner has insurance	Dependent Variable				
Constant term[1]	.045		-2.450	.079	
Education					
At least high school graduate	.051	1.9	.284	.023	1.8
Income					
Medium	.029	1.0	.146	.011	.92
High	.055	1.7	.307	.026	1.6
Marital Status					
Married	.030	1.1	.191	.015	1.1
Risk Aversion					
Medium	.069	1.7	.402	.035	1.7
High	.131	3.1	.771	.078	3.1
Problem and Know Someone					
Serious Yes	.549	15.9	2.850	.519	13.2
Minor Yes	.434	10.6	2.078	.329	8.9
None Yes	.245	5.6	1.257	.153	5.2
Serious No	.198	5.1	1.034	.116	4.8
Minor No	.142	3.8	.789	.080	3.8
Log (probability of disaster)	.017/unit	2.6	.094/unit	.024/unit	2.5
Age	.0032/yr.	4.1	.019/yr.	.0046/yr.	4.1
Years lived in house	- .00039/yr.	-3.9	- .0023/yr.	- .00058/yr.	-4.0
Future damage					
Can't estimate	.015	.35	.086	.007	.35
No damage	- .159	-4.9	-.890	- .045	-4.6
Some damage	.0015/$1000	2.7	.0083/$1000	.0021/$1000	2.5
Type of hazard					
Coastal zone A	- .026	- .73	- .155	- .011	- .73
Coastal zone B	- .010	- .25	- .060	- .004	- .25
Riverine zone A	- .068	-1.7	- .420	- .026	-1.8
R^2 = .307					

[1]Estimated probability of homeowner purchasing insurance who:
(a) is not a high school graduate,
(b) is low income,
(c) is not married,
(d) is not risk averse,
(e) thinks there is no hazard problem while not knowing anyone with insurance,
(f) expects $1 future damage, and
(g) lives in riverine zone B.

TABLE 6.24

REGRESSION FOR 25% FLOOD SAMPLE

Name of Variable	Ordinary Least Squares Coefficient	Ordinary Least Squares T-ratio	Logit Coefficient	Logit Effect on Probability (Approx.)	Logit T-ratio
Homeowner has insurance	Dependent Variable				
Constant term[1]	.044		-2.525	.074	
Education					
At least high school graduate	- .030	- .64	- .213	- .013	- .74
Income					
Medium	.059	1.3	.308	.024	1.1
High	.033	.58	.220	.017	.62
Marital Status					
Married	- .009	- .18	- .087	- .006	- .28
Risk Aversion					
Medium	.024	.34	.097	.007	.22
High	.055	.75	.337	.027	.74
Problem and Know Someone					
Serious Yes	.638	11.3	3.477	.647	8.6
Minor Yes	.603	8.0	3.186	.585	6.2
None Yes	.442	6.2	2.415	.398	5.4
Serious No	.254	4.0	1.449	.180	3.7
Minor No	.161	2.6	1.077	.116	2.7
Log (probability of disaster)	.021/unit	2.0	.131/unit	.033/unit	2.0
Age	.0036/yr.	2.7	.023/yr.	.0057/yr.	2.6
Years lived in house	- .00030/yr.	-1.6	- .0020/yr.	- .00049/yr.	-1.7
Future damage					
Can't estimate	.040	.60	.366	.029	.92
No damage	- .094	-1.7	- .561	- .030	-1.5
Some damage	.0025/$1000	2.5	.019/$1000	.0049/$1000	2.5
Type of hazard					
Coastal zone A	.018	.28	.010	.001	.02
Coastal zone B	- .038	- .55	- .323	- .019	- .71
Riverine zone A	- .057	- .82	- .426	- .024	- .92
R^2 = .370					

[1]Estimated probability of homeowner purchasing insurance who:
(a) is not a high school graduate,
(b) is low income,
(c) is not married,
(d) is not risk averse,
(e) thinks there is no hazard problem while not knowing anyone with insurance,
(f) expects $1 future damage, and
(g) lives in riverine zone B.

TABLE 6.25

REGRESSION FOR 100% FLOOD SAMPLE

Name of Variable	Ordinary Least Squares Coefficient	Ordinary Least Squares T-ratio	Logit Coefficient	Logit Effect on Probability (Approx.)	Logit T-ratio
Homeowner has insurance	Dependent Variable				
Constant term[1]	.047		-2.438	.080	
Education					
At least high school graduate	.030	1.3	.158	.012	1.2
Income					
Medium	.041	1.7	.216	.017	1.6
High	.054	1.9	.317	.027	1.9
Marital Status					
Married	.018	.73	.112	.009	.76
Risk Aversion					
Medium	.056	1.6	.314	.026	1.5
High	.109	3.0	.641	.062	2.9
Problem and Know Someone					
Serious Yes	.570	19.4	2.957	.547	15.8
Minor Yes	.473	13.2	2.297	.384	10.9
None Yes	.297	8.0	1.532	.207	7.4
Serious No	.209	6.3	1.095	.127	5.9
Minor No	.147	4.6	.840	.088	4.6
Log (probability of disaster)	.017/unit	3.1	.099/unit	.025/unit	3.0
Age	.0033/yr.	4.8	.019/yr.	.0048/yr.	4.8
Years lived in house	- .00037/yr.	-4.2	- .0022/yr.	- .00055/yr.	-4.2
Future damage					
Can't estimate	.020	.56	.135	.011	.66
No damage	- .143	-5.1	- .799	- .043	-4.7
Some damage	.0017/$1000	3.6	.011/$1000	.0026/$1000	3.4
Type of hazard					
Coastal zone A	- .015	- .47	- .101	- .007	- .54
Coastal zone B	- .015	- .44	- .103	- .007	- .50
Riverine zone A	- .067	-1.9	- .413	- .026	-2.0
R^2 = .317					

[1]Estimated probability of homeowner purchasing insurance who:
(a) is not a high school graduate,
(b) is low income,
(c) is not married,
(d) is not risk averse,
(e) thinks there is no hazard problem while not knowing anyone with insurance,
(f) expects $1 future damage, and
(g) lives in riverine zone B.

TABLE 6.26

REGRESSION FOR 75% EARTHQUAKE SAMPLE

	Ordinary Least Squares		Logit		
Name of Variable	Coefficient	T-ratio	Coefficient	Effect on Probability (Approx.)	T-ratio
Homeowner has insurance	Dependent Variable				
Constant term[1]	- .119		-3.753	.023	
Education					
At least high school graduate	.150	3.0	.982	.036	3.3
Income					
Medium	.082	1.7	.456	.013	1.7
High	.049	.92	.264	.007	.89
Marital Status					
Married	.099	2.1	.612	.019	2.3
Risk Aversion					
Medium	.039	1.3	.355	.009	.80
High	.099	.51	.688	.022	1.6
Problem and Know Someone					
Serious Yes	.598	7.6	3.622	.444	5.9
Minor Yes	.524	7.9	2.674	.231	6.7
None Yes	.112	.69	.580	.017	.70
Serious No	.138	2.2	.726	.023	2.1
Minor No	.068	1.3	.434	.012	1.5
Log (probability of disaster)	.020/unit	2.1	.120/unit	.030/unit	2.3
Age	.004/yr.	3.1	.026/yr.	.0065/yr.	3.4
Years lived in house	- .00030/yr.	-1.9	- .0021/yr.	- .00052/yr.	-2.2
Future damage					
Can't estimate	- .040	- .59	- .250	- .005	- .69
No damage	- .237	-3.6	-1.822	- .019	-3.5
Some damage	.00029/$1000	.45	.0013/$1000	.00034/$1000	.40
R^2 = .251					

[1]Estimated probability of homeowner purchasing insurance who:
(a) is not a high school graduate,
(b) has low income,
(c) is not married,
(d) is not risk averse,
(e) thinks there is no hazard problem while not knowing anyone with insurance, and
(f) expects $1 future damage.

TABLE 6.27

REGRESSION FOR 25% EARTHQUAKE SAMPLE

Name of Variable	Ordinary Least Squares: Coefficient	Ordinary Least Squares: T-ratio	Logit: Coefficient	Logit: Effect on Probability (Approx.)	Logit: T-ratio
Homeowner has insurance	Dependent Variable				
Constant term[1]	- .194		-11.039	.00002	
Education					
At least high school graduate	.182	2.1	1.044	.00003	2.1
Income					
Medium	.011	.13	.096	0	.21
High	.067	.67	.454	.00001	.85
Marital Status					
Married	- .032	- .40	- .138	0	- .32
Risk Aversion					
Medium	.175	1.4	1.182	.00004	1.5
High	.203	1.7	1.370	.00005	1.7
Problem and Know Someone					
Serious Yes	.842	5.4	11.748	.670	5.3
Minor Yes	.810	6.3	11.248	.552	6.1
None Yes	1.043	3.1	19.204	.999	3.1
Serious No	.362	2.7	8.936	.109	2.6
Minor No	.365	3.2	8.935	.109	3.2
Log (probability of disaster)	.025/unit	1.5	.138/unit	.035/unit	1.5
Age	- .0006/yr.	- .23	- .0011/yr.	- .00028/yr.	- .075
Years lived in house	.00019/yr.	.57	.00082/yr.	.00021/yr.	.47
Future damage					
Can't estimate	- .067	- .57	- .411	0	- .64
No damage	- .196	-1.6	- 1.286	- .00001	-1.6
Some damage	.00022/$1000	.26	.00081/$1000	.00020/$1000	.15
R^2 = .290					

[1] Estimated probability of homeowner purchasing insurance who:
(a) is not a high school graduate,
(b) has low income,
(c) is not married,
(d) is not risk averse,
(e) thinks there is no hazard problem while not knowing anyone with insurance, and
(f) expects $1 future damage.

TABLE 6.28

REGRESSION FOR 100% EARTHQUAKE SAMPLE

Name of Variable	Ordinary Least Squares: Coefficient	Ordinary Least Squares: T-ratio	Logit: Coefficient	Logit: Effect on Probability (Approx.)	Logit: T-ratio
Homeowner has insurance	Dependent Variable				
Constant term[1]	- .149	·	-3.821	.021	
Education					
At least high school graduate	.168	3.9	1.028	.036	4.1
Income					
Medium	.062	1.5	.342	.008	1.5
High	.054	1.2	.282	.007	1.1
Marital Status					
Married	.064	1.6	.409	.010	1.9
Risk Aversion					
Medium	.086	1.3	.626	.018	1.6
High	.133	2.1	.882	.029	2.3
Problem and Know Someone					
Serious Yes	.641	9.3	3.764	.464	7.3
Minor Yes	.584	10.1	3.022	.289	8.4
None Yes	.299	2.1	1.566	.073	2.1
Serious No	.183	3.2	1.005	.035	3.2
Minor No	.130	2.7	.779	.024	2.8
Log (probability of disaster)	.021/unit	2.6	.124/unit	.031/unit	2.8
Age	.0030/yr.	2.6	.019/yr.	.005/yr.	2.9
Years lived in house	- .00022/yr.	-1.5	- .0015/yr.	- .0004/yr.	-1.8
Future damage					
Can't estimate	- .041	- .71	- .250	- .005	- .81
No damage	- .207	-3.6	-1.464	- .016	-3.6
Some damage	.00031/$1000	.63	.0018/$1000	.0005/$1000	.65
R^2 = .248					

[1]Estimated probability of homeowner purchasing insurance who:
(a) is not a high school graduate,
(b) has low income,
(c) is not married,
(d) is not risk averse,
(e) thinks there is no hazard problem while not knowing anyone with insurance, and
(f) expects $1 future damage.

TABLE 6.29

REGRESSION FOR 75% COMBINED SAMPLE

Name of Variable	Ordinary Least Squares Coefficient	Ordinary Least Squares T-ratio	Logit Coefficient	Logit Effect on Probability (Approx.)	Logit T-ratio
Homeowner has insurance	Dependent Variable				
Constant term[1]	.254		-1.170	.237	
Income					
Medium	.091	4.0	.485	.098	4.0
High	.117	4.6	.609	.126	4.5
Past damage					
No damage	- .025	- .99	- .109	- .019	- .79
Some damage	.0015/$1000	1.2	.0129/$1000	.0032/$1000	1.3
Log (probability of disaster)	.021/unit	3.8	.110/unit	.027/unit	3.8
Problem and Know Someone					
Serious Yes	.607	18.9	2.991	.624	15.6
Minor Yes	.513	14.5	2.352	.528	12.1
None Yes	.249	5.8	1.174	.264	5.5
Serious No	.208	6.2	.999	.220	5.7
Minor No	.130	4.4	.680	.143	4.2
Type of hazard					
Coastal zone A	.015	.59	.081	.015	.62
Coastal zone B	.013	.41	.086	.016	.51
Riverine zone A	- .102	-3.1	- .582	- .089	-3.2
Riverine zone B	- .031	- .81	- .148	- .026	- .73
R^2 = .246					

[1]Estimated probability of homeowner purchasing insurance who:
(a) has low income,
(b) has suffered $1 past damage,
(c) thinks there is no hazard problem while not knowing anyone with insurance, and
(d) lives in an earthquake area.

TABLE 6.30

REGRESSION FOR 75% FLOOD SAMPLE

Name of Variable	Ordinary Least Squares Coefficient	Ordinary Least Squares T-ratio	Logit Coefficient	Logit Effect on Probability (Approx.)	Logit T-ratio
Homeowner has insurance	Dependent Variable				
Constant term[1]	.261		-1.102	.249	
Income					
Medium	.080	3.0	.437	.090	3.1
High	.126	4.2	.676	.146	4.1
Past damage					
No damage	- .078	-2.6	- .415	- .069	-2.4
Some damage	.00082/$1000	.65	.0063/$1000	.0016/$1000	.69
Log (probability of disaster)	.018/unit	2.7	.094/unit	.024/unit	2.6
Problem and Know Someone					
Serious Yes	.590	16.7	2.895	.608	13.8
Minor Yes	.471	11.3	2.150	.491	9.5
None Yes	.251	5.6	1.189	.272	5.2
Serious No	.215	5.4	1.040	.235	5.0
Minor No	.151	4.0	.786	.172	3.9
Type of hazard					
Coastal zone A	.048	1.3	.234	.046	1.2
Coastal zone B	.048	1.2	.259	.052	1.2
Riverine zone A	- .075	-1.8	- .441	- .073	-1.9
R^2 = .266					

[1]Estimated probability of homeowner purchasing insurance who:
(a) has low income,
(b) has suffered $1 past damage,
(c) thinks there is no hazard problem while not knowing anyone with insurance, and
(d) lives in Riverine zone B.

TABLE 6.31

BALANCED REPEATED REPLICATION USING ORDINARY LEAST SQUARES FOR 75% RIVERINE FLOOD SAMPLE

Variable Name	Unweighted Data (1) Coefficient	(2) Standard Error	(3) T-ratio	(4) Design Effect	(5) Corrected T-ratio	Weighted Data (6) Coefficient	(7) Standard Error of Design Effect
Homeowner has Insurance		Dependent Variable					
Constant term[1]	.279	.125				.224	.543
Education							
At least high school graduate	.001	.049	.03	1.2	0.02	- .003	.012
Income							
Medium	- .022	.053	- .41	1.1	- .36	.031	.245
High	- .027	.060	- .46	1.5	- .30	- .032	.239
Marital Status							
Married	.069	.050	1.4	1.6	.83	- .002	.095
Risk Aversion							
Medium	.032	.072	.44	.93	.47	- .059	.107
High	.047	.076	.62	.67	.92	.031	.116
Problem and Know Someone							
Serious Yes	.632	.056	11.2	3.2	3.5	.090	.081
Minor Yes	.432	.082	5.3	2.8	1.9	.282	.293
None Yes	.270	.075	3.6	.84	4.3	.130	.109
Serious No	.275	.068	4.0	2.4	1.7	- .024	.127
Minor No	.064	.066	.97	1.5	.63	.007	.104
Log (probability of disaster)	.021/unit	.011	1.8	1.8	1.0	.022/unit	.030
Age	.0016/yr.	.0016	1.0	1.6	.65	- .003/yr.	.0025
Years Lived in House	- .00059/yr.	.00017	- 3.4	1.3	- 2.5	- .00008/yr.	.00044
Future Damage							
Unable to estimate	- .010	.078	- .13	.87	- .15	.604	.511
No damage	- .184	.051	- 3.6	1.4	- 2.5	.049	.066
Some damage	.00025/$1,000	.395	.25	.90	.28	.0022/$1,000	.844
Hazard							
Zone A	- .100	.039	- 2.5	3.7	- .69	- .059	.312
R^2 for 75% unweighted Riverine Flood sample = .410							

[1]Estimated probability of homeowner purchasing insurance who:

a. is not a high school graduate,
b. has low income,
c. is not married,
d. is slightly averse to risk,
e. thinks there is no hazard problem while not knowing anyone with insurance,
f. expects $1 future damage, and
g. lives in zone B.

TABLE 6.32

BALANCED REPEATED REPLICATION USING ORDINARY LEAST SQUARES FOR 75% EARTHQUAKE SAMPLE

Variable Name	Unweighted Data (1) Coefficient	(2) Standard Error	(3) T-ratio	(4) Design Effect	(5) Corrected T-ratio	Weighted Data (6) Coefficient	(7) Standard Error of Design Effect
Homeowner has Insurance		Dependent Variable					
Constant term[1]	- .119	.129				- .162	.074
Education							
At least high school graduate	.150	.049	3.0	1.1	2.8	.047	.071
Income							
Medium	.082	.049	1.7	1.0	1.7	.032	.058
High	.049	.054	.92	.96	.96	- .002	.063
Marital Status							
Married	.099	.047	2.1	.94	2.3	.071	.056
Risk Aversion							
Medium	.039	.077	.51	1.1	.47	- .030	.078
High	.099	.076	1.3	1.5	.90	- .042	.079
Problem and Know Someone							
Serious Yes	.598	.078	7.6	.64	11.9	.488	.219
Minor Yes	.524	.066	7.9	.78	10.0	.475	.156
None Yes	.112	.163	.69	1.1	.61	.260	.135
Serious No	.138	.063	2.2	.67	3.3	.047	.048
Minor No	.068	.053	1.3	.82	1.6	.069	.029
Log (probability of disaster)	.020/unit	.010	2.1	1.7	1.2	- .018/unit	.010
Age	.004/yr.	.001	3.1	.86	3.6	.0025/yr.	.0009
Years Lived in House	- .0003/yr.	.00016	- 1.9	1.0	- 1.8	- .00007/yr.	.0001
Future Damage							
Unable to estimate	- .040	.068	- .59	1.0	- .58	.0008	.060
No damage	- .237	.067	- 3.6	1.1	- 3.3	- .105	.026
Some damage	.00029/ $1,000	.256	.45	1.1	.42	.00052/$1,000	.187
R^2 for 75% unweighted Earthquake sample = .251							

[1]Estimated probability of homeowner purchasing insurance who:

a. is not a high school graduate,
b. has low income,
c. is not married,
d. is slightly averse to risk,
e. thinks there is no hazard problem while not knowing anyone with insurance, and
f. expects $1 future damage.

TABLE 6.33

CALCULATED PROBABILITY FOR 75% EARTHQUAKE SAMPLE
COMPARED TO
PREDICTED PROBABILITY FOR 25% EARTHQUAKE SAMPLE

For individuals having insurance:

	Correctly Classified	Unable to Classify	Incorrectly Classified
75% sample	38	36	26
25% sample	42	30	27

For individuals not having insurance:

	Correctly Classified	Unable to Classify	Incorrectly Classified
75% sample	66	29	5
25% sample	62	32	6

CHAPTER 7
CONTROLLED LABORATORY EXPERIMENTS

7.1 INTRODUCTION

The field survey described in the preceding chapters has provided considerable information about the factors associated with insurance decisions. The experimental work presented in this chapter is intended to supplement the field studies and increase the extent to which the research can be generalized.

As noted in Chapter 3, there has been little experimental work of any type on insurance decisions. Yaari (1965) presented data suggesting that purchase of insurance and gambling are due to subjective exaggeration of the probabilities of rare losses or gains. Irwin and Tolkmitt (1969) did a small study of insurance purchasing but make it clear that the study was not motivated by any interest in "commercial insurance". Not surprisingly, their results provide little insight into the problems that concern us here. Williams (1966) distinguished between pure risks (offering no chance of gain) and speculative risks (where chance of loss is tolerated in pursuit of some gain). He did an experiment showing that people's attitudes towards pure risks are unrelated to their attitudes towards speculative risks; neither kind of attitude toward risk predicted people's insurance behavior outside of the laboratory. (For similar results, see Greene, 1963, 1964). As Williams observed, most experimental studies of risk taking have involved speculative risks. A recent review of such laboratory studies by Slovic, Fischhoff and Lichtenstein (1977) indicates that the expected utility theory poorly accounts for preferences among speculative gambles except in some very simple situations.

7.2 THE EXPERIMENTER'S DILEMMA

How does one create a laboratory situation analogous to that faced by property owners residing in hazard prone areas? It is not difficult to create risks with comparable probabilities of occurrence. Simulating the loss of a home or business is another matter. Certainly, it is immoral for an experimenter to threaten a person's economic well-being, even in return for some substantial reward for subjecting himself to the possibility of large losses; it would also be improper to exploit an existing situation for the sake of experimental knowledge (e.g. willfully manipulating the policies offered to subjects living in hazard prone areas). One option is to provide subjects with a substantial asset that could then be put at risk. The economics of scientific research, however, preclude making those staked assets very substantial.

7.2.1 The Urn Solution

Rather than providing subjects with some minimal assets to be put at risk and then hoping that these assets would be safeguarded in the same way as one would protect large-scale real assets, we decided to pose insurance questions in the abstract. The "hazard" which our subjects faced was the drawing of a blue ball from an urn composed predominantly of red balls. Their potential losses and the insurance premiums for policies which would protect them against such losses were measured in undefined "points". Subjects never actually played these abstract games; rather, they were asked what insurance they would purchase were they to participate. Thus, all of the "urn" studies described below reflect the way people believe they would behave, given a hypothetical situation.

As an isolated research tool, such urn studies would be clearly inadequate. In conjunction with the field survey and the farm game simulation (described below), however, they comprise part of a multi-method research package. If these three different approaches produce similar results, we have much greater confidence in our conclusions than would be justified on the basis of any one research design. In the field survey, we trade control for realism; in the lab, the trade-off is reversed. The package of studies should indicate the results that would be obtained in that realistic <u>and</u> controlled study which is beyond our power to conduct.

We will have more to say about the limitations of urn studies. However, one could also argue that insurance-buying behavior will be closest to that implied by the utility theory in those abstract situations in which subjects are presented with reliable information about all the variables needed to make economically sound decisions. Such conditions are seldom if ever matched in real life. Use of an urn to generate "disasters" allows experimental control of the perceived probability and eliminates idiosyncratic attempts at wishful thinking or second-guessing Mother Nature.

7.3 THE URN GAME ITSELF

Each urn experiment was prefaced with the following introduction:

> In the present booklet, we are going to describe a series of gambling games. Each game has the possibility of negative outcomes. Each allows you to buy insurance against the negative outcomes, although it is not compulsory. We are not going to ask you to play any of the games. Instead, we are going to ask you to consider each and then tell us how you would play were they for real. Try to take each as seriously as possible even though nothing is at stake.

Subjects were then told that each game consisted of drawing one ball from each of a set of urns; each urn contained a different mixture of red and blue balls. Drawing a blue ball incurred a loss, unless the subject had purchased insurance at some fixed premium. Unless otherwise noted, the cost of the premium was set at one point for each urn and the loss (L) and probability of loss [P(L)] were adjusted so that the expected loss from drawing one ball from the urn [P(L) multiplied by L] was also one point. For example, an urn might contain one blue ball in one thousand balls, the drawing of which incurred a loss of one thousand points. Thus, in each case, subjects were offered actuarially fair or "pure" insurance. In real-life situations, the premium would, of course, be greater than the expected loss, to cover the insurer's administrative and marketing expenses and profit. To clarify subjects' goals in the game, they were told:

> As you can see, you can only lose in this sort of game (either by drawing a blue ball or by buying insurance). Your object is to lose as little as possible. For each game figure out what insurance you would buy to end up with the fewest negative points.

A typical game is presented in Table 7.1. In this game:

1. Subjects incur only losses and no gains.
2. Subjects have no accrued assets (or nest egg) to protect.

3. Only one ball is to be drawn from each urn.
4. There are six urns, comprising a portfolio of risks.
5. The premium is the same for each urn.

For each of these attributes, the urn game resembles some real-life situations and differs from others. The effects of changes in some of these attributes are investigated below; the effects of other changes await further research.

TABLE 7.1

A TYPICAL URN GAME. SUBJECTS WERE ASKED TO IMAGINE DRAWING ONE BALL FROM EACH URN AND TO INDICATE THE URNS FOR WHICH THEY WOULD PURCHASE INSURANCE

Game 1

Urn No.		Ball Color Blue	Red	Insurance Premium	Would You Buy Insurance? (Yes or No)
1.	No. of Balls	1	999	1	
	No. of Points	-1,000	0		________
2.	No. of Balls	5	995	1	
	No. of Points	- 200	0		________
3.	No. of Balls	10	990	1	
	No. of Points	- 100	0		________
4.	No. of Balls	50	950	1	
	No. of Points	- 20	0		________
5.	No. of Balls	100	900	1	
	No. of Points	- 10	0		________
6.	No. of Balls	250	750	1	
	No. of Points	- 4	0		________

About 700 individuals took part in these experiments. Most were volunteer subjects recruited through advertisements in either the University of Oregon student paper or the general circulation local newspaper. All subjects were paid for their participation. They were typically between 20 and 25 years old, although the range of ages extended from 18 to 72. One exception to the above was a study in which members of the Eugene, Oregon League of Women Voters and their spouses served as subjects. This group was studied to determine whether the results obtained from the other, younger subjects, would generalize to a population of socially concerned homeowners responsible for making insurance decisions in their daily lives.

It has been our impression that the vast majority of our subjects take these sorts of experimental tasks seriously. Subjects' written reasons for their insurance-purchasing decisions indicated to us that the urn studies were no exception to this rule.

7.3.1 The Basic Experiment: Varying Probability Of Loss

The urn game presented in Table 7.1 systematically varies loss and probability of loss, the one increasing as the other decreases. Several different predictions may be derived on which insurance subjects will purchase policies for these six urns. Utility theory postulates a concave (negative) relationship between utility and loss; the disutility of a loss increases faster than does the loss. This concavity leads to the prediction that subjects will purchase insurance whenever the premium is equal to the expected loss.

However, it is not unreasonable to suppose that sometimes subjects will not purchase insurance, because of the time and effort required to process information or because of error in the subjective assessments of utility. When modified in some such way, utility theory would predict that subjects would be most likely to insure against low-probability, high-loss urns, because those situations yield the largest difference between the disutility of the premium and the expected disutility of the urn.

In contrast, the sequential model described in Chapter 3 hypothesizes that subjects will not buy insurance unless they view the hazard to be a problem worthy of concern. This may lead them, as a simplification measure, to ignore urns for which the probability of loss is too low to constitute a real threat. That is, there may be a threshold which must be passed before the probability becomes consequential and demanding of protective action. Presumably, such a threshold would vary over individuals. For some, it might lie between urns 1 and 2 (i.e. between P(L) =.001 and .005), for others, between urns 4 and 5, etc. If this hypothesis is correct, then we should find, over a group of subjects, a greater propensity to insure against high-probability, low-loss events.

7.3.2 Results Of The Urn Game

Figure 7.1 presents the pooled responses of 109 subjects presented the game in Table 7.1. Contrary to the predictions derived from utility theory, we found a strong preference for insuring against events which are likely to happen, but incur relatively minor losses. Whereas only about 20 percent of the subjects were willing to insure against the urn with P(L) = .001, over 80 percent insured against the urn with P(L) = .25.

Preference patterns of individual subjects were also examined. Each subject's responses were classified into one of six categories: (1) buy all; (2) buy none; (3) buy for some subset of least likely losses (i.e. urns 1; 1 and 2; 1,2, and 3; 1,2,3, and 4; or 1,2,3,4, and 5); (4) buy for some subset of most likely losses (i.e. urns 6; 5 and 6; 4,5, and 6; etc.); (5) buy for some subset of contiguous middle likelihood losses (i.e. urn 4 alone; 3 and 4; 2,3, and 4; 4 and 5; etc.); and (6) other, noncontiguous patterns (e.g. urns 3 and 5). The results of this analysis, shown in line 1 of Table 7.2, further demonstrate the strong preference for insuring against the most likely losses rather than against the least likely ones. Roughly one subject in five bought no insurance at all, while one in eight bought all available policies. Almost half of all subjects insured against some subset of the most likely losses compared with only 6.7 percent insuring against some subset of the least likely losses.

To extend the curve shown in Figure 7.1, the first experiment was repeated with two urns added, one at each end of the probability (or loss) continuum. One urn had P(L) = .0001, and a loss of 10,000; the other had P(L) = .50, and a loss of 2. The responses of 178 subjects to such an 8-urn game appear in Figure 7.2. The pattern found with 6 urns (repeated in Figure 7.2) is substantially replicated in the P(L) = .001 to .25 range. At the low end of the probability continuum, we find no further decline in insurance purchases with the P(L) = .0001 urn. Evidently, there are some individuals for whom large losses are worthy of concern, however low their probability (at least within the range studied).

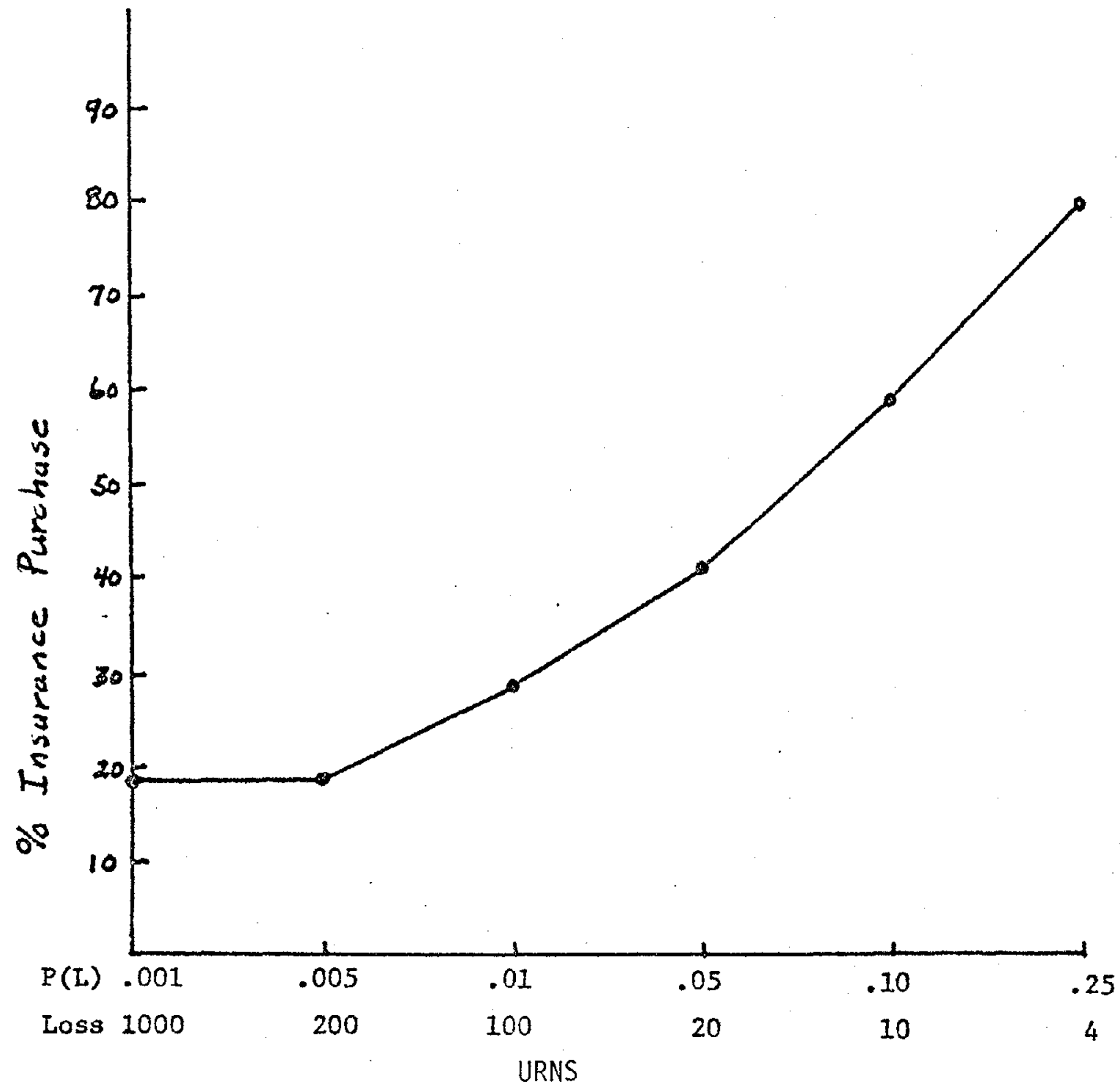


FIGURE 7.1

PERCENT OF SUBJECTS PURCHASING INSURANCE FOR SIX URNS
VARYING IN PROBABILITY AND AMOUNT OF LOSS

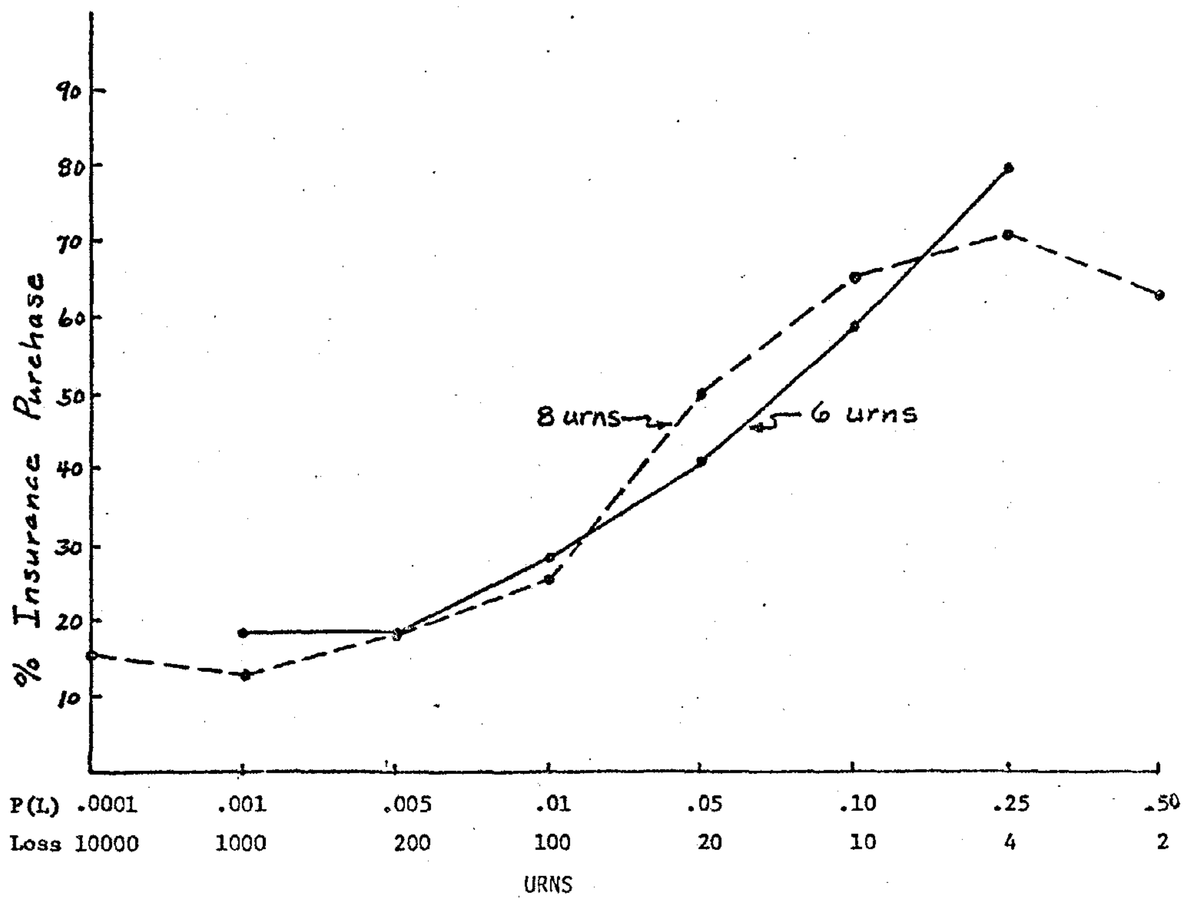


FIGURE 7.2

PERCENT OF SUBJECTS PURCHASING INSURANCE FOR URNS
VARYING IN PROBABILITY AND AMOUNT OF LOSS.
SIX- AND EIGHT-URN GAMES

TABLE 7.2

PATTERNS OF INSURANCE PURCHASE

	Buy All	Buy None	Least Likely Losses	Buy Some Subset of: Most Likely Losses	Middle Likelihood Losses	Other Patterns
6 Urns	12.6	19.6	6.7	46.0	3.7	11.4
8 Urns	6.7	9.6	5.3	48.4	16.6	14.4
Farm Game I	30.0	8.0	11.8	27.3	13.1	9.8
Farm Game II	33.3	9.4	17.2	24.7	7.7	7.7

NOTE: All entries show the percent of subjects exhibiting each purchasing pattern.

Again, almost half of the people insured against some subset of the most likely losses (Table 7.2, line 2, column 4). Nevertheless, there were limits to this tendency as shown by the decrease in insurance for the smallest loss with the largest probability (Figure 7.3).

7.3.3 Robustness Of The Probability Effect

However dramatic the results depicted in Figures 7.1 and 7.2, one might ask whether they are not, at least in part, an artifact of the particular subjects or the particular version of the urn game that we used. To believe in these results, one would like evidence showing that they are resilient enough to withstand changes in subject population and changes in experimental format.

Subjects. To test for the generality of results over changes in the subject population, we replicated the 8-urn study with members and spouses from the Eugene, Oregon League of Women Voters. Only individuals who participated in making insurance decisions for their household were studied (15 females; 7 males). The results (not shown) were quite similar to those obtained with the younger subjects, recruited via newspaper ads. Again, there was a sharp increase in insurance purchasing as probability of loss increased. Whereas only 27 percent said they would purchase insurance at P(L) = .0001, 65

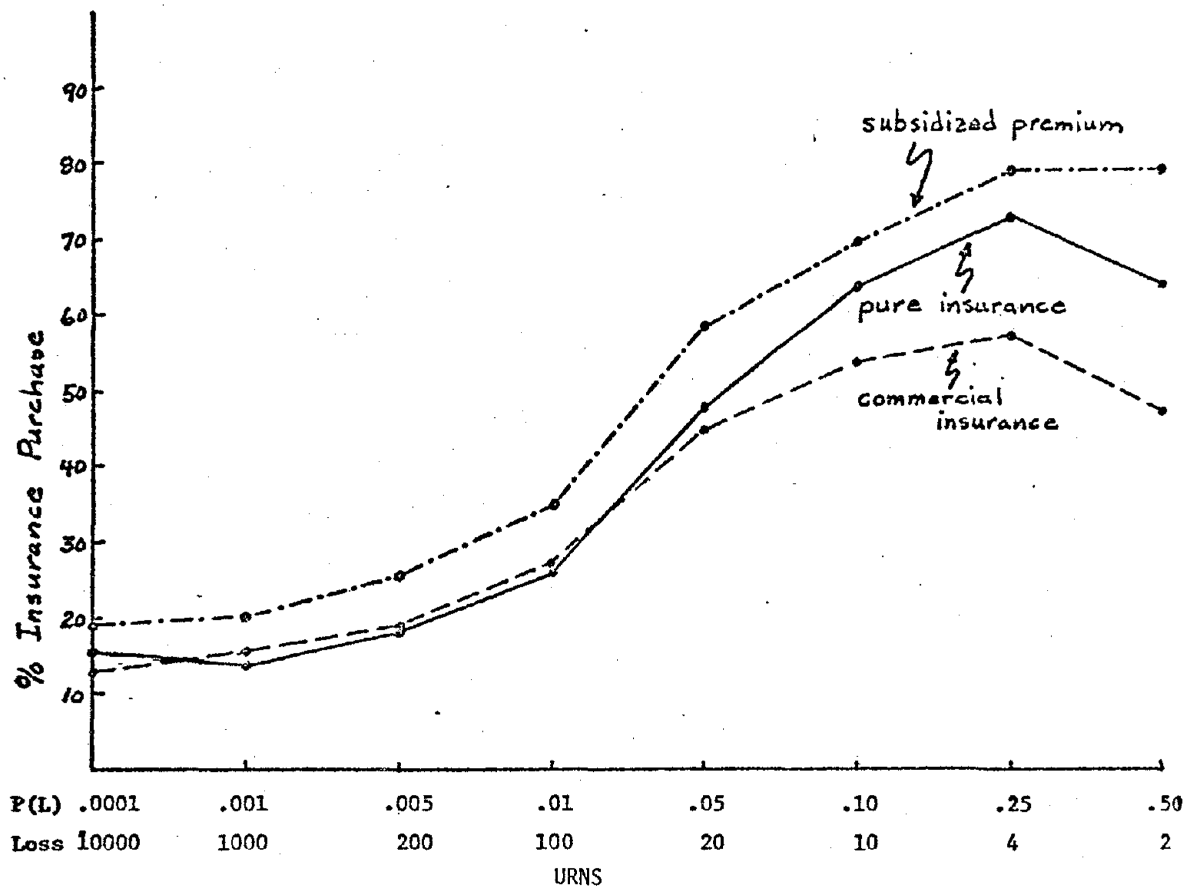


FIGURE 7.3

EFFECT OF VARYING THE RELATIONSHIP BETWEEN PREMIUM AND EXPECTED LOSS OF THE GAMBLE percent would purchase insurance at P(L) = .50.

Order of presentation. One possible biasing factor is the order in which the various urns were presented on the page. In the results reported above, subjects considered first those urns with the lowest P(L), as in Table 7.1. Perhaps they favored insuring against the most likely losses because of the experience accumulated while considering the least likely losses. To test this conjecture, we had 44 additional subjects consider the most likely losses first when making decisions about each of the eight urns. Although this change produced a slight, across-the-board increase in insurance buying (not shown), it had no effect on subjects' preference for insuring more often against the more likely losses.

Expected value manipulation. Another possibility is that these responses were atypical because subjects were considering actuarially fair insurance (whose premium equalled the expected value of the gamble), which is seldom encountered in real life. Figure 7.3 compares the results of offering 178 subjects insurance for which the expected loss of the gamble is greater than, less than, or equal to the premium. These represent subsidized, commercially offered, and pure insurance, respectively. The subsidized insurance variations were created in four different ways: by decreasing the premium by twenty percent or fifty percent, or by decreasing the loss by twenty percent or fifty percent. The commercially offered insurance was created by twenty percent or fifty percent increases in either premium or loss. The results of these variations, averaged across the four ways, are shown in Figure 7.3. Subjects did show some sensitivity to these expected-loss manipulations in the direction one would predict. A larger proportion were willing to buy subsidized insurance than pure or commercial coverage for each urn. However, the preference for insuring against high-probability, low-loss risks remained strong.

Simultaneous vs. separate urns. The data described above came from studies in which all urns were presented on the same page. One might argue that this simultaneous presentation might induce strategies that would differ from those that would occur if the urns were presented separately, one per page. A study was conducted to see whether presenting one urn per page would affect insurance preferences. Table 7.3 shows the results of presenting urns one per page as opposed to presenting them simultaneously on one page. The particular urns used here in this experiment were different from those used in the previous experiments; they were adopted from experimental work done by Amos Tversky and Daniel Kahneman at the Hebrew University of Jerusalem. We found that the preference for insuring likely losses was slightly reduced but by no means eliminated. Note that of the two urns for which P(L) = .25, subjects were less likely to insure against the urn with the highest loss and highest premium. This result, too, is inconsistent with concave utility functions.

TABLE 7.3

EFFECT OF SIMULTANEOUS VERSUS SEPARATE PRESENTATION OF URNS

Probability of Loss P(L)	Amount of Loss	Premium	Proportion Purchasing Insurance: Urns Presented on one Page N=134	Proportion Purchasing Insurance: Urns Presented Separate N=36
.001	5000	5	.13	.28
.01	200	2	.20	.25
.25	200	50	.57	.47
.25	5000	1250	.43	.42
.50	1000	500	.64	.53

7.3.4 Promoting Insurance Against Unlikely Calamities

How can one get people to insure against low-probability, high consequence events? One approach to this problem is to treat disaster insurance as an unmarketable commodity and search for ways to package it more effectively. For example, if what people really want is insurance against high-probability, low-loss events, perhaps they will also insure against unlikely disasters if such insurance is included in a package with insurance against likely losses, at a reasonable extra cost. Our first attempt to do this was by offering subjects a multi-risk policy, in which the only insurance available protected against all 8 urns (the urns in Figure 7.2) for a premium of 8 points. Of 35 subjects, only 11 bought this policy. Whereas in the previous studies offering insurance against 8 urns separately we "sold" an average of 3.3 points' worth of insurance per subject, here we sold only 2.5

points per subject. The proportion of subjects insuring against the least likely losses increased from about 1 in 6 to about 1 in 3 (11 of 35 subjects), at the cost of greatly reduced purchase of insurance against high and medium likelihood losses.

With the 8-urn multi-risk insurance policy, subjects were asked to buy over twice as much insurance as they ordinarily would (8 vs. 3.3 points). Perhaps greater success would be achieved with a package offering disaster insurance at not so much greater a cost. In a subsequent experiment, 151 new subjects were shown three urn games. One consisted of a single urn offering a high (.20) probability of losing 10 points. The insurance premium for this urn was 2 points. The second game also had one urn, carrying a .001 chance of losing 1000 points with a 1-point premium. The third game involved both of these urns and a combined (3 point) premium. In this compound situation, subjects had to draw once from each urn and could insure only against both. Subjects considered these three games in varying orders (none of which affected the results). The results appear in Table 7.4. Again, when considering each urn separately, subjects were twice as likely to insure against the high probability as against the low-probability loss. However, more people were willing to buy the compound insurance than either single-urn policy. As a result, over twice as many people were insured against the low-probability loss. Our subjects were willing to spend thirty percent more for compound insurance than the sum of their expenditures for the two single-urn policies. If it is in society's best interest to persuade people to insure themselves against unlikely calamities, then adding protection against a small but likely loss might be one way to accomplish this.

<u>Insurance as an investment</u>. Other approaches to marketing insurance are suggested by the notion that people view insurance as an investment; that is, they like to get something back for their premium. The probability effect could be due in part to this preference: insuring against high-probability, low-loss urns gives people a good chance of obtaining a monetary return (reimbursement of a loss). One way to provide the possibility of getting something back with low-probability losses is to offer to reimburse subjects if they make no claims. Of the many possible refund arrangements we adopted a multi-risk insurance plan (one premium for eight urns) which refunded all of a subject's premium if the subject made no claims, i.e. if no blue balls were drawn. Actuarially fair insurance offering this option must, of course, carry

TABLE 7.4

INSURANCE PURCHASES FOR SINGLE AND COMPOUND URNS

Urn Game	P(L)	L	Premium	Proportion Purchasing	Points Sold Per Subject
Low Probability	.001	1000	1	.24	.24
High Probability	.20	10	2	.47	.94
Compound	both of above		3	.51	1.53

a higher premium than insurance that reimburses only when losses occur. For the 8-urn situation, the fair premium is 11.7 points.

Each of the 35 subjects offered the multi-risk, no-refund insurance described above was subsequently offered the opportunity to purchase "money back if nothing goes wrong" insurance, for a 12 point (11.7 rounded upward) premium. Twenty-two subjects purchased this insurance, twice as many purchased the non-refund multi-risk. This amounted to 7.54 insurance points per subject or 62.8 percent of all insurance possible, compared with 31.4 percent of all multi-risk insurance possible and 41.3 percent of all non-multi-risk insurance purchased in earlier 8-urn games. This popularity emerged even though this insurance is a variant of the multi-risk insurance that proved rather unpopular, and though it was considered after the multi-risk package which carried a substantially smaller premium (8 versus 12 points). Examination of subjects' reasons for purchasing this policy showed that they felt they could not lose; either they would suffer a loss and be reimbursed or they would get all their premium back.

7.3.5 Limitations Of The Urn Paradigm

These studies have obviously not exhausted the possible variations using the urn design, whose abstractness and simplicity make experimental manipulations relatively easy and straightforward. Other variables, such as deductibles and premium amounts could be studied. None of these variations, however, pertain to the basic limitation of these urn studies, their abstract and hypothetical nature. Urn subjects consider well-defined insurance problems in isolation and without real stakes at risk. Our confidence in these results would be strengthened if they could be confirmed in a more realistic laboratory setting where insurance was not the sole object of attention. The farm game described below was an attempt to provide that experimental confirmation.

7.4 INTRODUCTION TO THE FARM GAME

Our solution to the realism problem was to devise a farm management game involving many decisions, including the purchase of insurance. Subjects were told:

> Farming is a business that requires decisions. In this game, the number of decisions has been considerably reduced from the number that must be made on a real farm; however, the principles are the same. The decisions you will make at the beginning of each play year are: (1) what crops you are going to plant; (2) what and how much fertilizer you will purchase and apply to those crops; and (3) what insurance you will buy, if any, against certain natural hazards.

Participants played the game for fifteen rounds; each round represented one year. Their income for each year was determined by the wisdom of their decisions, by random fluctuations in crop yield and market price, and by the randomly determined occurrences of the natural hazards. At the beginning of the game, they were given a 240 acre farm with a permanent concrete pipe irrigation system, a variety of farm equipment, and $80,000 of debt, leaving an initial net worth of about $200,000. The instructions, which took one to one and a half hours to complete, described the characteristics of the seven crops available (mean yield per acre, standard deviation of yield; mean and standard deviation of market price), the efficacy of two types of fertilizer for each crop, the fixed costs of growing each crop (machinery, labor and water), and the risks they faced.

For every round, the subjects' decisions were entered into a computer, which then prepared a year-end report. This report showed subjects' predecision financial situation, production results (yield and market price), hazards incurred, yearly expenses, and a year-end list of assets and debts.

The risks. Table 7.5 shows the natural hazards faced by subjects. The hazards were left unnamed, to render irrelevant any particular knowledge or beliefs subjects might have had about the probabilities or losses associated with real hazards such as hail or hurricanes. This afforded us control over the perceived probability of each hazard. The probability values were chosen to cover the range that had produced the greatest differences in insurance purchase propensity in our urn studies. Losses and premiums were established so that (a) the largest loss equalled or exceeded the value of the farm, thus ending the game; and (b) the cost of the premium would be non-negligible. The average subject's net earnings were approximately $6000 per year. Thus, the purchase of insurance, at $500 per hazard, was not an insignificant expense.

TABLE 7.5

FARM GAME HAZARDS

Hazard No.	Probability	Loss	Premium
1	.002	$247,500	$500
2	.01	49,500	500
3	.05	9,900	500
4	.10	4,950	500
5	.25	1,980	500

Thirty subjects were recruited through an advertisement in the local city newspaper offering $2.25 per hour for participation in a five-hour decision-making experiment. Applicants were screened to eliminate those uncomfortable or unfamiliar with working with numbers. There were nineteen males and eleven females, with a mean age of twenty-five.

Results. The clearest comparison between the farm game and the urn study is afforded by farm game subjects' first round responses. On that first round, they, like urn subjects, had no direct experience with the possible disasters, knowing them only in the abstract. Figure 7.4 shows that the first round responses of the farm game subjects were similar to the responses of urn game subjects in avoiding insurance against high-probability, high-loss hazards and preferring insurance against high-probability, low-loss hazards. Farm game subjects were much more willing to spend $500 to insure against a $1980 loss than to insure against the loss of their whole farm.

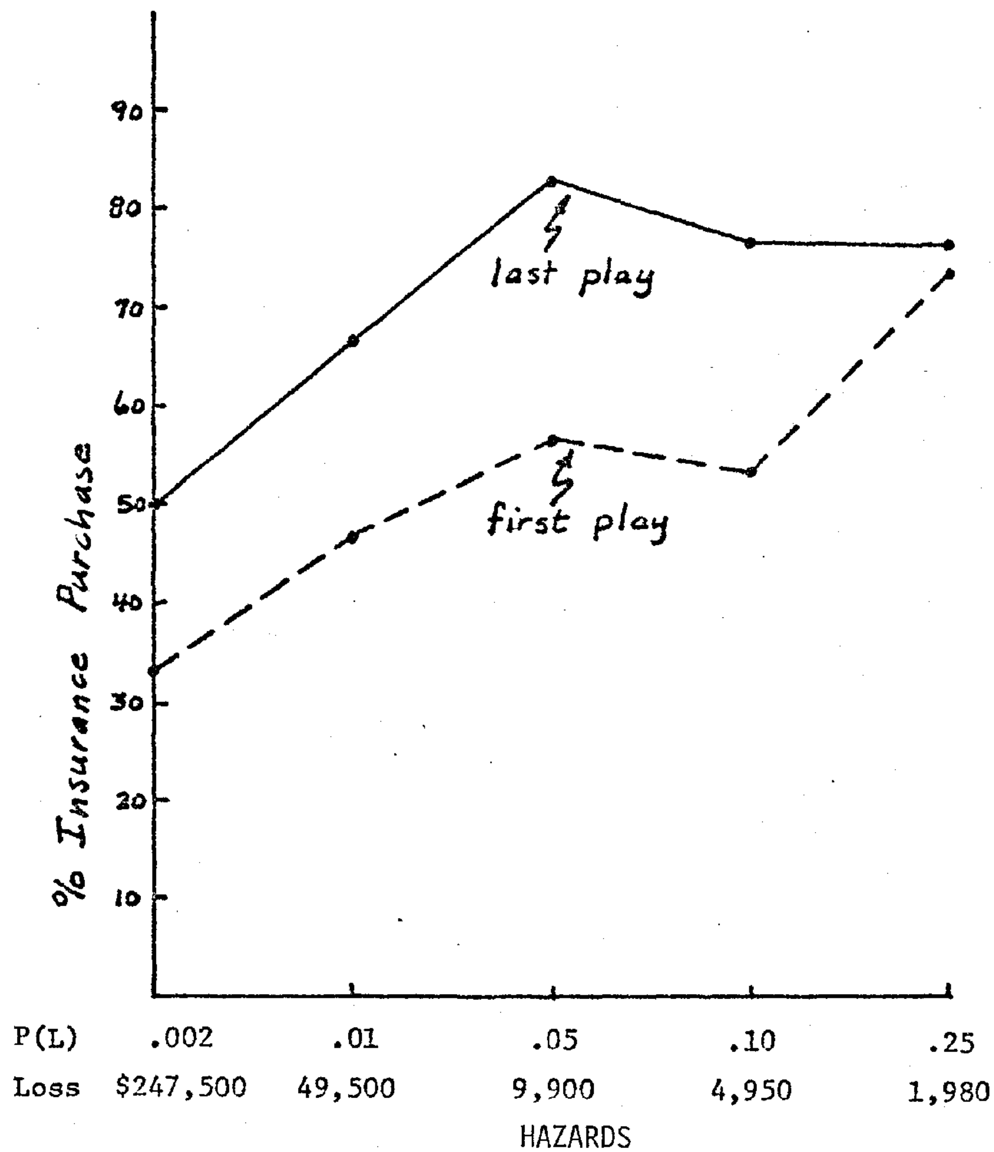


FIGURE 7.4

EFFECT OF PROBABILITY OF LOSS ON INSURANCE PURCHASING
IN THE FIRST FARM GAME

Figure 7.4 also shows subjects' reponses on the last (fifteenth) round of this game. Here, we find a marked increase in subjects' willingness to insure against all but the most likely losses, with the biggest increase for the middle likelihood losses (P(L) = .05 and .10). On the last round only one subject insured against the least likely loss who did not also insure against all other losses. There may be several reasons for increased purchase of insurance. Subjects may simply have become familiar with the game over time, and thus could devote more attention to insurance decisions rather than crop and fertilizer decisions. In addition, the farms were gaining in value over time; the subjects may have become more conservative, wishing to protect their greater assets. The differentially greater increase of purchase of low-probability insurance may have been due to the subjects' increasing belief that the low-probability disasters, which very rarely occurred, were "due to happen soon," while high-probability disasters, which occurred more frequently, had "already had their share" of occurrences. This interaction between the occurrence of disasters and purchase of insurance will be more closely examined in a later section of this chapter.

Over all rounds, farm game subjects bought much more insurance than urn subjects; 30 percent of the time they insured against all five disasters compared to 12.6 percent for the 8-urn games. Nevertheless, farm game subjects were still more than twice as likely to buy insurance against some subset of the most likely losses as against some subset of the least likely losses (see Table 7.2, row 3, columns 3 and 4).

7.4.1 Farm Game II

One possibly important difference between the farm game and real-life decisions is that subjects were not rewarded for managing their farm properly. Thus, although subjects appeared to be intrinsically motivated by the game, this type of motivation may have induced some strategy other than profit maximization (e.g. experimenting with different crop-fertilizer combinations to see what would happen). Our final experiment explored this possibility with thirty-one new subjects who were told that their earnings for participating in the experiment would depend upon their farm earnings. They were paid from $2.50 to $20, depending on their net worth at the end of Round fifteen.

Results. One distinct effect of the change in payoff mode was to increase subjects' mean earnings over the fifteen rounds from $85,000 to $100,000. Figure 7.5 shows first play and last play results. Hourly pay (Game I) and pay-by-farm-earnings (Game II) have produced remarkably similar patterns. In as realistic a context as may be possible in a laboratory experiment, where insurance is not the sole focus of the subjects' attention, we have found that subjects avoid insuring against low-probability, high-loss events. Although this aversion is weaker than with the urn games, it should be noted that even the present effect clearly violates the predictions of utility theory.

What effect did the occurrence of a disaster have upon insurance behavior on the next round of the game? The answer to this question is shown in Table 7.6, which analyzes the combined results from both farm games. In Table 7.6 the data are analyzed separately according to whether a hazard did or did not occur on the previous round. Looking at line 1, we see that when no hazard occurred on the previous round, only 9 percent of the decisions on the next round were changed. These changes were almost equally divided between buying a policy against a previously uninsured hazard (4.9 percent) and cancelling an existing policy (4.1 percent). Similar results were obtained for decisions made after a round on which a hazard did occur (line 2). There was only a slight, statistically insignificant, increase in purchases of policies for previously uninsured hazards. However, it is instructive to divide the data in line 2 into two categories-- decisions made for the same hazard that had just occurred (line 2a) and decisions for hazards other than the one that had just occurred (line 2b). When this is done, we see that there was a much greater rate of cancellation of existing policies for hazards that had just occurred (9 percent) than cancellation of other policies (2.5 percent). This suggests a belief that, since the hazard has just happened, it is unlikely to reappear soon. This belief, known as the "gambler's fallacy", has been found in laboratory studies as well as among residents of hazard areas (Slovic, Kunreuther, and White, 1974, pp. 192-193).

A slightly different way of looking at the effect of previous hazard experience is to examine the behavior of people who suffer an uninsured loss on a particular hazard. On the round following such a loss, 15.4 percent purchased insurance for that hazard. This is only slightly higher than the rate of new insurance on hazards other than the one that just occurred (14.5

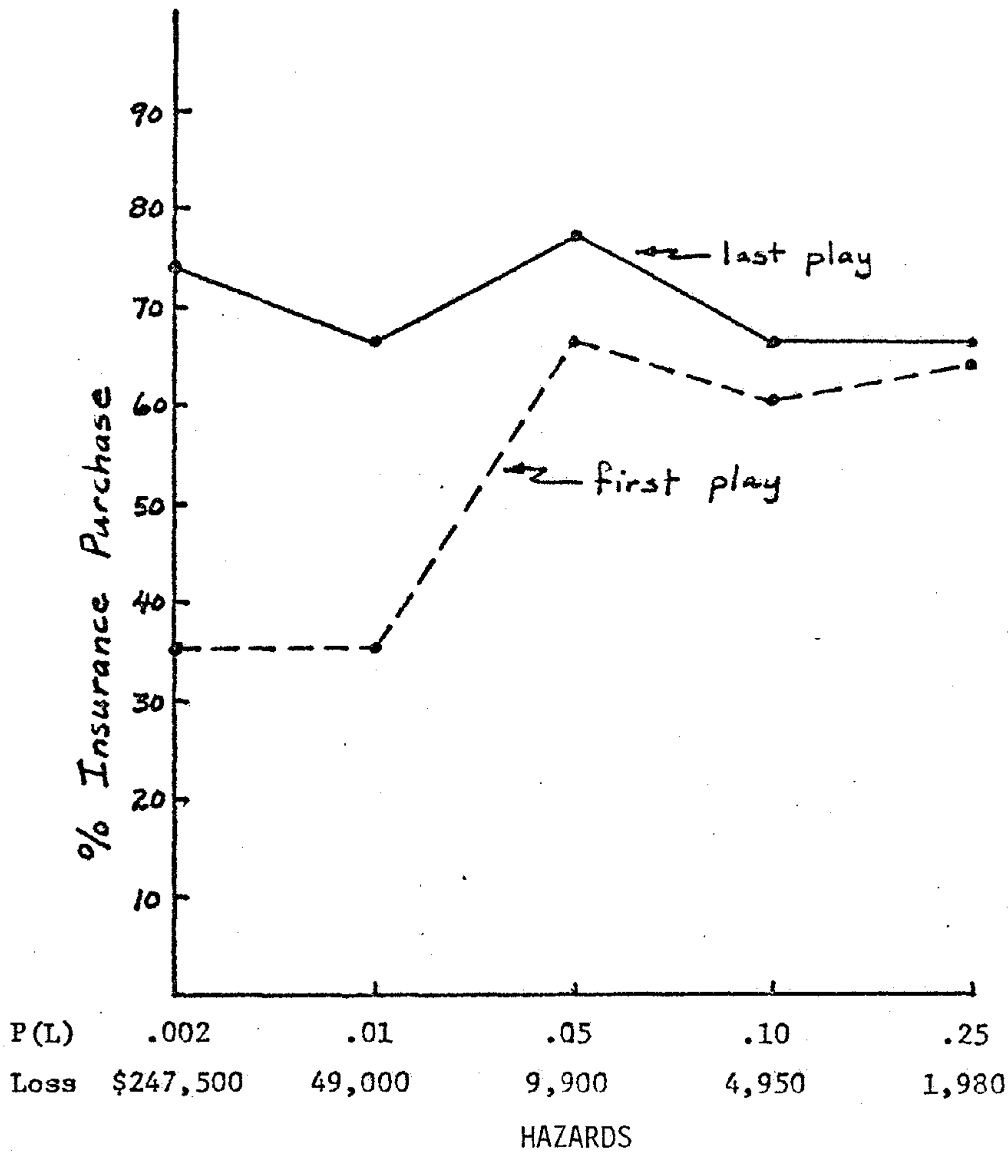


FIGURE 7.5

EFFECT OF PROBABILITY OF LOSS ON INSURANCE PURCHASING
IN THE SECOND FARM GAME

TABLE 7.6

EFFECT OF HAZARD EXPERIENCE ON ROUND N UPON DECISIONS FOR ROUND N + 1

Outcome on Round N	No. of Decisions	Decision on Round N + 1: Keep Existing Policy	Remain Uninsured	Buy a New Policy	Cancel Existing Policy
1. No Hazard	2485	58.0	33.0	4.9	4.1
2. Hazard Occurred	1840	57.0	33.5	5.8	3.8
2a. Hazard Occurred: Decision for same hazard	368	55.7	29.9	5.4	9.0
2b. Hazard Occurred: Decision for Different Hazards	1472	57.3	34.3	5.8	2.5

NOTE: Numbers are the percent of all decisions made on Round N + 1. These results are combined over both Farm Games.

percent) or the rate of new insurance on rounds that were not preceded by hazards (13.0 percent). Thus, these people did not markedly increase their insurance holdings after a hazard, a result that conflicts with observations of actual insurance behavior in the aftermath of a disaster (see, for example, Chapter 5). The reasons for this difference are not clear to us. One likely possibility is that the odds in the farm game are well defined and unchanging, whereas in the real world the occurrence of a disaster may greatly increase the perceived probability of such events.

7.5 EXPLAINING THE RESULTS

The major result of all the controlled experiments is that people buy more insurance against moderate or high-probability, low-loss events than against low-probability, high-loss events. The tendency to buy less insurance as the probability of loss decreases can be explained in terms of a probability threshold. It may be that people refuse to attend to or worry about losses whose probability is below some threshold, the level of which may vary from individual to individual and from situation to situation. Probabilities below the threshold are, essentially, treated as zero. The threshold concept makes good intuitive sense. There are only so many things in life one can worry about. Without some sort of threshold for concern, we would spend our entire lives protecting ourselves against a "Pandora's urn" of rare horrors.

When asked why they chose to buy or not to buy insurance the responses of a majority of our subjects typically referred to some sort of threshold notion. Some examples follow:

> Only in urns number 7 and 8 were the probabilities high enough to warrant buying insurance.

> I thought the odds of my coming up with a blue ball had grown sufficiently by urn number 4 to start taking insurance.

> I bought insurance only if the chance of selecting a blue ball was significant.

> In the first two, the chances of picking the blue ball are too small to worry about. The remainder caused increasing concern for me.

Actually, the threshold idea is not new to discussion of hazard insurance. Senator Robert Taft Jr. observed that:

> The most difficult obstacle for the flood insurance program to overcome, however, does not relate to the difficulties of certifying communities for insurance. Instead, it relates directly to the psychological outlook of individuals, homeowners, and businessmen in the flood plain areas. People just do not buy insurance. The probability that a flood will damage their property once in a hundred years is apparently not a matter of concern to most individuals. (Taft, 1972, p. 18)

7.5.1 Relation To The Survey Results

The notion of a probability threshold protecting a finite reservoir of concern improves our understanding of results from the field survey. First, it helps explain why many survey respondents showed little concern about floods or earthquakes and had little information about these hazards or about protective measures such as insurance. Second, it is compatible with the survey data showing that insured persons had greater perceived probabilities of loss than uninsured persons. It further suggests that greater perceived probability of loss actually determines insurance purchasing rather than being a rationalization after the fact (e.g. "I have insurance, therefore I must believe the hazard is likely"). Third, these laboratory results suggest that the strong effect of previous hazard experience shown in the survey is most likely due to increased subjective probability of the hazard rather than to greater appreciation of the magnitude of loss.

Finally, the threshold notion is compatible with the sequential model of choice shown in Figure 3.2. In essence, we placed our subjects in Stage 3 of the model by calling their attention to the hazard and giving them relevant information for decision making. They indicated that probability of loss was a major factor in decision making at this stage. However, the notion of a "finite reservoir of concern" that underlies the threshold concept could also play an important role in the initial stages of the model. It seems likely that unless the hazard appears probable, it will not be viewed as a problem and the individual will not even consider protective measures such as insurance.

The threshold concept also provides insight into other, often puzzling, observations outside the realm of the field survey. For example, the striking fact that premium subsidization does not facilitate purchase of flood insurance can be understood as a consequence of inattention to insurance due to the low perceived probabilities of these hazards. If the event isn't going to happen, it doesn't matter how cheap the insurance is. The crucial role of perceived probability may also explain the lack of consistency of individuals' insurance behavior across situations with differing probability of loss (Vaughn, 1971) and the inability to predict insurance decisions on the basis of risk aversion indices obtained from gambling preferences (Greene, 1963, 1964; Williams, 1966). The preference for insuring against relatively high-probability, low-loss events may also contribute to the popularity of low-deductible insurance plans (Pashigian, Schkade, and Menefee, 1966) and appliance service contracts.

7.6 SUMMARY AND CONCLUSIONS

To date, little experimental work has been done in studying the expected utility theory of insurance or, for that matter, any type of insurance decision. The controlled laboratory experiments were designed to complement the field survey analysis. The field survey traded control for realism, the laboratory experiments traded realism for control over several variables.

Two types of experiments were developed: the urn problem and the farm game. The urn problem posed insurance purchase decisions in the abstract; the farm game typified real-life insurance decisions made by farmers. In the urn problem subjects were given urns with varying probabilities of losing different amounts of imaginary points. The subjects were asked what they would do (purchase insurance or not) if they were to play the game for real. Over 700 subjects were involved in these games.

According to expected utility theory, risk-averse individuals should always prefer to insure themselves against events with a low-probability of occurrence but with a high loss. However, contrary to this theory, subjects showed a strong preference for insuring against high-probability, low-loss events. This result held, even when the game was modified. The modifications included: changing the number of urns, changing the order of presentation of the urns, manipulating the expected value of losing to simulate subsidized insurance, offering a multi-risk insurance policy against loss from all the urns, and offering a premium refund if the subject did not collect on his multi-risk policy. With respect to the last two modifications it was found that more people were willing to buy a multi-risk policy than single policies, even when the multi-risk policy cost thirty percent more than the sum of the single policies included. It was also found that twice as many subjects purchased policies with refunds than without.

In the farm game, individuals had to decide what crops they were going to plant, which fertilizer to use, and what insurance they would purchase against natural hazards. Subjects were twice as likely to buy insurance against some subset of the most likely losses as against some subset of the least likely losses. A second farm game was developed in which the compensation subjects received for participating in the experiments was not an hourly wage, but was dependent upon their performance. Successful farmers received higher pay for participating. Despite this difference, the two games produced remarkably similar results.

An explanation as to why people buy more insurance against moderate or high-probability, low-loss events than against low-probability, high-loss events emerges from these experiments and the analysis of field survey data. People refuse to attend to or worry about losses whose probabilty is below some threshold, the level of which may vary from individual to individual and from situation to situation. Probabilties below the threshold are essentially treated as zero. This theory helps explain why many survey respondents showed little concern about floods or earthquakes and why insured persons had greater perceived probabilities of loss than the uninsured.

CHAPTER 8

BEHAVIOR AND ATTITUDES TOWARD MITIGATION AND RELIEF PROGRAMS

8.1 INTRODUCTION

Previous chapters have analyzed the homeowner's behavior towards purchasing insurance. This chapter utilizes field survey data to indicate the types of loss and recovery experience homeowners have had. Our primary interest is in their knowledge, attitudes, and behavior towards aspects of the mitigation and relief processes other than insurance. Many of the aggregate measures relating to behavior, knowledge, and opinions vary among groups within the sample. In many cases it is interesting and insightful to dichotomize between the flood and earthquake surveys, between insured and uninsured homeowners, and between the coastal and riverine portions of the flood sample.

With respect to the decision process of individuals we hypothesize that past experience plays a key role. For this reason much of the analysis in this chapter will look for effects of this variable on knowledge, attitudes, and behavior by classifying homeowners into two groups: those that have suffered damage from past disasters (the "experienced" class) and those that have not (the "inexperienced" class). We have already shown in Chapters 5 and 6 that this variable plays a key role in sensitizing homeowners to the problems associated with the hazard and hence the need for insurance protection. The general conclusion that emerges from this chapter is that past experience plays a similar role by increasing homeowners' concern with hazard mitigation measures. Thus, the chances of an individual undertaking protective actions are relatively low until he has actually undergone a personal experience with a flood or earthquake. The implications of these findings for public policy will be discussed in Chapter 11.

8.2 PAST EXPERIENCE WITH DISASTERS

8.2.1 Frequency And Severity Of Damage

What actually happened to people as a result of floods and earthquakes? A series of questions enabled homeowners to provide quantitative and qualitative descriptions of their past experience with these disasters. Individuals had little difficulty in placing dollar values on the damage to their house and contents. Table 8.1 provides an overview of the data regarding losses suffered from floods and earthquakes. A significant proportion of the respondents have suffered damage at some time to a house they have lived in and owned: 29 percent in the flood sample and 21 percent in the earthquake sample. Most of these people had suffered at least one disaster to their present home. In fact, lightning often strikes twice for many of these homeowners: over 200 of the flood victims had two or more disasters to their present home. Only 38 earthquake victims had suffered the same fate at least twice to their present house, but surprisingly enough, 189 had experienced two or more quakes to some house that they had lived in and owned.

The magnitude of the losses provide an interesting contrast between the impact of these two types of disasters on our sample population. The bottom half of Table 8.1 details the per capita damage figures for those homeowners who were able to provide loss estimates. Floods have been much more costly to homeowners than earthquakes whether one aggregates over all disasters or looks at just the single worst event suffered by a homeowner. Thus, for the 462 able to report dollar losses from all floods, the per capita estimate is $9,539 compared to only $1,412 for the 168 earthquake victims who provided figures to the interviewers.

The distribution of the amounts of damage for the most serious disaster suffered by the respondent is shown in Table 8.2. There is no question that floods have wreaked more havoc to residential victims than earthquakes. One hundred sixty-seven homeowners suffered losses from floods totalling more than $5,000 while only eight earthquake victims had damage exceeding this figure. Only two homeowners in earthquake country suffered damage over $10,000, while 90 flood victims had losses above this amount.

TABLE 8.1

SUMMARY OF DISASTER EXPERIENCE

	Flood Survey		Earthquake Survey	
	Number	Percent of Sample	Number	Percent of Sample
Sample Size	2,055	(100)	1,006	(100)
Frequency of Experience:				
Number with damage in any house lived in and owned	551	(29)	206	(21)
Number with two or more experiences in any house lived in and owned	241	(12)	189	(19)
Number with damage in present house	456	(22)	152	(15)
Number with two or more experiences in present house	203	(10)	32	(3)
	Dollar Value	Number in Sample	Dollar Value	Number in Sample
Per Capita Damage (for those able to estimate damage):				
Damage for all reported disasters	$9,539	462	$1,412	168
Damage for most serious disaster	$7,446	452	$1,366	158

TABLE 8.2

DISTRIBUTION OF AMOUNTS OF DAMAGE IN MOST SERIOUS DISASTER

Flood Survey			Earthquake Survey		
Damage range (in $)	Number of Respondents	Percent	Damage range (in $)	Number of Respondents	Percent
No damage	1,504	73.2	No damage	800	79.4
1 - 500	100	4.9	1 - 100	44	4.4
501 - 1,000	45	2.2	101 - 500	50	5.0
1,001 - 2,500	65	3.2	501 - 1,000	12	1.2
2,501 - 5,000	75	3.6	1,001 - 2,500	22	2.2
5,001 - 10,000	77	3.7	2,501 - 5,000	22	2.2
10,001 - 20,000	51	2.5	above 5,000	8	0.8
above 20,000	39	1.9	Don't know damage	14	1.4
Don't know damage	44	2.1			
Don't know date of most serious disaster	55	2.3	Don't know date of most serious disaster	34	3.4

8.2.2 Looking At Worst Experiences--What Happened?

The cold figures cited above are a bit sterile and do not indicate the nature of the damage. Many respondents provided rather graphic descriptions of their losses. Consider one homeowner from New Braunfels, Texas who gave the following account of the damage he incurred in the May, 1972 flood:

> Everything was under water, cracked patio, discolored bricks, extensive furniture damage. Valuable books, paintings, wood carvings, statues, expensive cameras, tape recorders, and about 50 percent of the clothing all ruined by the water. All the trees were washed away. Had to replace disposal and air conditioning unit. Everything ruined.

A Minot, North Dakota resident reported suffering the following damage in the April, 1969 flood:

> All the ceiling went off the basement. The tile all came up. The walls all came off. We had to put all new walls upstairs in these two rooms. We had to nail down the hardwood floors and sand them. I've had to put a new bathtub in, and in the kitchen all the cupboard doors came off. There was eleven and one half inches of water in the main floor so all the walls were cracked. All the windows were broken out of the basement.... It is just like a nightmare when you think of it.

The first quote suggests that it is sometimes difficult to put a dollar value on damage due to the loss of irreplacable belongings. This may explain why some homeowners could not estimate their losses as shown by the "Don't know" figures in Table 8.2.

The types of damage incurred by respondents are classified in Table 8.3. In the flood sample there was considerable structural damage to the house and to major equipment such as furnaces, water heaters, air conditioners, and the plumbing and wiring systems. A large number of people described specific contents damaged. These included everything that one would expect to find in a house: furniture, draperies, carpets, appliances, and personal belongings such as clothing, tools, and hobby equipment.

In the earthquake sample, responses were less varied. One third of the homeowners cited structural damage to foundations, roofs, chimneys, and exterior walls. More than half of the respondents reported breakage of dishes, lamps, and similar objects. An equal number experienced cracked walls, ceilings, and fireplaces. Although one person lost his house in a fire resulting from a quake, most earthquake damage was minimal compared to the flood damage. Even in severe earthquakes such as the San Fernando earthquake of February, 1971, the vast majority of the responses were similar to the one

TABLE 8.3

NATURE OF DAMAGE FROM MOST SEVERE DISASTER

Description	Number of times mentioned
Flood (551 People Responding)	
Specific Responses	
Damage to Structures and Major Equipment	
Structural damage to floors, foundation, walls, or roof	199
Damage to walls, floors, ceilings requiring refinishing; windows	173
Major equipment (furnace, water heater, air conditioner, plumbing, wiring)	169
Contents Damage	
Furniture, appliances, and furnishings	295
Personal belongings (clothing, tools, hobby equipment)	178
Other specific damage (often mentioned were cars and landscaping)	23
Nonspecific Responses	
Basement flooded	17
Contents of house destroyed	12
Considerable damage or total destruction	37
Yard and/or garage damaged	14
Minimal damage	23
Other	5
Earthquake (206 People Responding)	
Specific Responses	
Damage to Structures and Major Equipment	
Structural damage to foundation, roof, exterior walls, chimney	66
Cracked plaster, damage to interior walls, ceilings, fireplace	113
Damage to plumbing or gas systems	16
Contents Damage	
Breakage of lamps, china and glass objects	113
Other specific damage	5
Nonspecific Responses	
Minimal damage	11

from a homeowner in Huntington Beach:

> We had minor cracks in the foundation. That's about it. Some small cracks and I guess some glass broke. The chandelier shook and the bed rolled around, but nothing serious.

Interestingly enough, a 79 year old Oakland respondent said the worst damage she suffered was in the 1906 earthquake which "knocked down the chimney".

8.2.3 The Aftermath--Results Of Recovery

Most people repair some of the damage from a flood or earthquake but the recovery process is imperfect at best. Table 8.4 provides insight into the aftermath of a disaster by summarizing the condition of the property after the homeowner had expended funds and labor to restore his damaged property.

Of the 551 flood victims all but 80 repaired at least some of the damage from their most serious disaster. In contrast, 81 of the 206 earthquake victims made no repairs. The difference between the two samples is directly related to the minimal losses that earthquake victims suffer compared to those in floods.

Many of those that suffered earthquake damage, like the Huntington Beach homeowner quoted above, did not make repairs. For the group that did make repairs their reasons for believing that their property was either better or worse after the disaster are summarized in Table 8.5. The following quotes add insight into the recovery process. An Alexandria, Virginia respondent who suffered considerable damage in the July 1972 flood, but felt his property was now in better shape than prior to the disaster, commented:

> The floors looked better, the kitchen cabinets, the stove looked better. The new rug, the new upholstery, the new paint--all the new things naturally looked better.

The two following examples illustrate why some victims have not fully recovered from their floods: A Louisiana homeowner, who had been "flooded out" by Hurricane Betsy in 1965, reported:

> The wall studding was warped, throwing walls and doors out of line. The quality of repair materials were not as good as the original. The Terrazzo floors are permanently stained. We replaced doors on the cabinets in the kitchen but should have replaced entire cabinets as they're falling apart now. Our replacement choice of stove and oven was a mistake--they're not good quality.

Another homeowner, a resident of Cranford, New Jersey, who had been flooded in

TABLE 8.4

CONDITION OF HOUSE AFTER RECOVERY FROM DISASTER

	Flood Survey		Earthquake Survey	
	Number	Percent	Number	Percent
Recovery Operations				
Homeowners making repairs	471	(85)	125	(61)
Homeowners not undertaking repairs	80	(15)	81	(39)
Number with Damage	551	(100)	206	(100)
Status of House Compared to Pre-Disaster Condition				
Better Condition	131	(24)	17	(8)
Same Condition	201	(36)	81	(39)
Worse Condition	219	(40)	108	(52)
Total	551	(100)	206	(100)

TABLE 8.5

REASONS FOR BELIEVING PROPERTY WAS BETTER OR WORSE THAN PRE-DISASTER CONDITION

	Number of Mentions
Flood Survey	
Reasons Better	
Took steps to reduce damage in the future	34
Replaced old furniture or equipment with new items/improved structural condition of house	102
Reasons Worse	
Lost belongings that could not be replaced	13
Could not restore to former condition	85
Have not restored for fear of future floods	7
Repairs not yet completed	14
Not sure that all damage has been repaired	15
Other reason given	7
Earthquake Survey	
Reasons Better	
Reinforced foundation	6
Replaced old objects with new ones	10
Painted house, installed new siding	2
Reasons Worse	
Structural damage to foundation, exterior walls, chimney	9
Interior walls continue to crack, plaster does not hold	6
Ground, driveway, sidewalks continue to crack	5
Other reason given	7

August 1973, stated:

> The soil washed away seeds and shrubs. We didn't fix up the grounds to be as good as before, for fear of future loss from floods.

8.3 SOURCES OF FUNDS FOR RECOVERY FROM PAST DISASTERS

Having seen what happens to homeowners as a result of floods and earthquakes let us examine the financial resources they employ in the recovery process. It is possible for us to contrast actual sources of relief by insured and uninsured victims for the flood survey since sixty-five homeowners claimed they had purchased flood coverage prior to the disaster. For the earthquake survey only four homeowners had earthquake insurance at the time they suffered losses and only three reported collecting on their policy, so it is meaningless for us to separate quake victims into insured and uninsured categories.

In order to provide a meaningful analysis of these data we have been selective in which respondents to include. Only those who could estimate the amount they received from <u>each</u> recovery source utilized were incorporated. For the flood sample only insured individuals who knew the approximate purchase date were eligible for inclusion since our interest was in making comparisons on the basis of whether or not individuals were insured at the time of their most serious disaster. We eliminated any flood victims whose losses were below $500 since a few people who had made substantial improvements would present a distorted picture of the recovery process for the low damage group. In the case of earthquakes, we eliminated only those with losses below $100 due to the large fraction of victims who were in the $101 to $500 damage range.

Table 8.6 provides a snapshot of the recovery process for three different damage ranges and four sources of relief (insurance, federal loans, personal savings, and bank loans). The damage ranges differ for the two disasters to reflect the more severe nature of flood losses in comparison to those from earthquake.

To understand the meaning of the figures in this table let us compare the insured and uninsured homeowners who suffered flood losses ranging from $500 to $2500 dollars. For those who did not have flood coverage, 91 percent of

TABLE 8.6

RECOVERY FROM PAST MOST SERIOUS DISASTER
FUNDS AS PERCENT OF DAMAGE
(Averaged over all Victims)

Flood

Range of Damage	$500- 2,500		$2,500- 10,000		More than $10,000	
Insurance Status Before Flood	Insured	Uninsured	Insured	Uninsured	Insured	Uninsured
Source of Recovery Funds						
Insurance	78	6	68	5	30	14
Government Loans	0	35	20	27	8	42
Savings	88	91	30	43	12	30
Bank Loans	3	8	6	3	1	5
Total	169	140	124	78	51	91
Sample Size	22	73	27	93	16	57

Earthquake

Range of Damage	$100-500	$501-2,500	More than $2,500
Source of Recovery Funds			
Insurance	0	8	0
Government Loans	0	13	34
Savings	27	29	21
Bank Loans	2	2	2
Total	29	52	56
Sample Size	48	32	22

their total damage was covered by savings and another 35 percent by government loans. On the average, insurance covered 6 percent of their damage, presumably due to wind losses (which are included in a homeowners policy) or vehicle damage (which is included in an automobile or marine policy). These uninsured homeowners received enough money from different sources so that recovery funds amounted to 140 percent of their damage. Hence their house should have been better off after the flood than before. Insured victims in the lowest damage class fared even better than their uninsured counterparts. Their primary source of recovery was also savings (88 percent of damage) with insurance running a close second (78 percent). This group estimated that they received funds totalling 169 percent of their average damage.

Looking across the damage ranges for flood victims one notes that uninsured homeowners did not receive enough money to fully recover if their losses were in the highest two ranges. Insured homeowners fared very well in the middle range but those who suffered the highest amount of damage received only enough funds to cover approximately half their losses. The low percent received from insurance (30 percent) undoubtedly reflects limits on their coverage at the time of the disaster. What is surprising is the little use this group made of other sources of funds including government loans.

On the average, earthquake victims do not expend sufficient funds to fully repair their damage whether it is high or low, as shown on the bottom portion of Table 8.6. For those with damage under $2500, savings were the primary sources of recovery. In the highest damage category government loans assumed primary importance, but the amount averaged only one third of the total losses for this group. These figures are consistent with the data in Table 8.4 showing that earthquake victims are much less prone to make repairs than those who suffered flood losses.

The picture of the recovery process would not be complete without indicating the percentage of homeowners in each damage category who actually utilized particular sources of funds and the average percentage of damage that these sources provided for such individuals. Table 8.7 provides this information. The proportion of uninsured homeowners who availed themselves of government loans to repair flood damage rose from 15 percent in the lowest damage class to 43 percent in the middle damage range to 70 percent in the highest group. A similar phenomenon exists for the earthquake victims: no one with less than $500 damage utilized the government loans, 12 percent of

TABLE 8. 7

RECOVERY FROM PAST MOST SERIOUS DISASTER
(Percent of Victims Using Various Sources)

Flood

Damage	$500- 2,500		$2,500- 10,000		More than $10,000	
Insurance Status before Flood	Insured	Uninsured	Insured	Uninsured	Insured	Uninsured
Source of Recovery Funds						
Insurance	82	10	93	15	81	44
Government Loans	0	15	22	43	25	70
Savings	68	82	74	82	81	77
Bank Loans	5	10	7	8	6	14
Some Source	95	88	100	97	82	97
Sample Size	22	73	27	93	16	57

Earthquake

Range of Damage	$100-500	$501-2,500	More than$2,500
Source of Recovery Funds			
Insurance	0	9	0
Government Loans	0	12	41
Savings	38	63	68
Bank Loans	2	3	5
Some Source	39	72	77
Sample Size	48	32	22

those with between $501 and $2500 damage relied on loans, while 41 percent of the victims suffering more than $2500 damage received disaster loans.

From Table 8.8 one gains a perspective on the relative importance of particular sources for those homeowners who used them. Thus we see that those uninsured flood victims in the lowest damage category who relied on federal relief took advantage of their losses to obtain loans averaging 233 percent of their damage. These percentages decrease somewhat for the higher damage groups, but they are still considerably above the corresponding figures displayed in Table 8.6.

What can one conclude about the recovery process of disaster victims on the basis of these three tables? With the appropriate cautionary note that our sample in each class is relatively small, the following suggestive differences can be gleaned from the data:

(1) Victims with flood insurance were able to cover most of their losses through claims payments except if their damage was in the highest category.

(2) In all three damage classes a smaller percentage of insured than uninsured homeowners availed themselves of government loans (Table 8.7). Furthermore, the percentage of damage covered by government loans is smaller for the insured than uninsured groups when averaged over all victims in each class (Table 8.6). These figures suggest that flood insurance reduced the demand for federal relief, as one would anticipate.

(3) Personal savings were used by most flood and earthquake victims (Table 8.6) but as seen from Table 8.8, the proportion of damage covered by such funds decreased significantly as the magnitude of the damage increased.

(4) Bank loans were used infrequently (Table 8.7) but those who availed themselves of this form of aid borrowed an amount which was a substantial fraction of their losses, particularly in the low-damage classes (Table 8.8).

8.4 EXPECTATIONS OF FUTURE DISASTERS

What type of damage do people expect to have from a future disaster and how do they expect to marshall financial resources to recover? Homeowners were asked to describe the effects of a future severe flood or earthquake and to estimate the dollar costs to repair the damage to the house and its

TABLE 8.8
RECOVERY FROM PAST MOST SERIOUS DISASTER
FUNDS AS PERCENT OF DAMAGE
(Average over Victims Using Source)

FLOOD

Range of Damage	$500-2,500		$2,500-10,000		More than $10,000	
Insurance Status Before Flood	Insured	Uninsured	Insured	Uninsured	Insured	Uninsured
Source of Recovery Funds						
Insurance	96	61	74	30	37	31
Government Loans	0	233	90	62	34	59
Savings	128	110	40	53	15	38
Bank Loans	62	88	83	35	11	36
Total	177	160	124	80	59	93
Number with Some Source	21	64	27	90	14	55

EARTHQUAKE

Range of Damage	$ 100-500	$ 501-2,500	More than $2,500
Source of Recovery Funds			
Insurance	-	185	0
Government Loans	-	107	83
Savings	69	47	30
Bank Loans	100	64	33
Total	74	73	73
Number with Some Source	19	23	17

contents. Table 8.9 depicts the distributions of such damage on the basis of whether or not a homeowner had experienced a previous flood or earthquake.

In the flood portion of the table only seven percent of the experienced respondents expect no damage from a future severe flood, while almost one-quarter of the inexperienced homeowners anticipate no loss if severe flooding occurred in their area. Almost all of the homeowners in the earthquake sample anticipate some damage. The really striking aspect of the distributions, as was pointed out in Chapter 5, is the generally large amounts of damage predicted from both hazards. For the earthquake hazard this result was surprising in view of the rather modest amounts of damage that respondents have actually experienced. For example, an Orange County homeowner who suffered "just a few cracks in the foundation and a few broken glasses" from the San Fernando earthquake, said a severe earthquake would:

> Destroy it! Completely destroy it, everything would be gone, completely destroyed, inside and out, nothing left!

It is worth noticing the distributions for the experienced and inexperienced earthquake respondents are almost identical. A Daly City homeowner with no earthquake experience said that in a severe earthquake his house "would crumble and fall. It would be a total loss...."

Table 8.10 shows how insured and uninsured respondents expect to recover from a future severe flood or earthquake based on their own dollar estimates of damage. The structure of this table resembles Table 8.6, except that a larger portfolio of possible sources of funds are now included. The insured/uninsured groupings reflect the respondent's current status.

The three most important sources of relief for uninsured homeowners in both flood and earthquake areas are bank loans, government loans, and personal savings in that order. Naturally policyholders expect to rely primarily on their insurance coverage to finance their recovery. In the flood areas, however, those expecting to suffer more than $30,000 damage felt that their insurance would only cover about half their losses, on the average, because of policy limits. Earthquake insured individuals expect to receive between seventy to eighty percent of their costs from a policy irrespective of damage. Those homeowners in the lowest damage category undoubtedly have no knowledge of the five percent deductible clause in their earthquake insurance policy.

TABLE 8.9

DISTRIBUTION OF EXPECTED DAMAGE TO PROPERTY FROM A FUTURE "SEVERE" DISASTER
(Percent of Respondents)

Damage Range (in dollars)	Flood Survey No Experience	Flood Survey Experience	Earthquake Survey No Experience	Earthquake Survey Experience
No damage	24	7	8	5
0 - 10,000	24	34	17	20
10,000 - 30,000	31	41	32	33
More than 30,000	21	18	43	43

TABLE 8.10

RECOVERY FROM FUTURE SERIOUS DISASTER
(Funds as a Percentage of Damage)
(Averaged over all victims)

FLOOD

Damage Range	$500-10,000		$10,000-30,000		More than $30,000	
Current Insurance Status	Insured	Uninsured	Insured	Uninsured	Insured	Uninsured
Sources of Recovery Funds						
Flood Insurance	94	4	72	8	53	5
Government Loans	4	20	10	25	10	22
Savings	7	19	7	10	9	8
Homeowner's Ins.	4	8	7	12	10	11
Bank Loans	8	38	3	30	8	20
Other (e.g., friends, relatives stocks)	2	7	2	5	1	4
Total Recovery Funds ÷ Damage Estimate	120	96	101	89	92	70
Sample Size	207	208	328	184	196	87

EARTHQUAKE

Damage Range	$500-10,000		$10,000-30,000		More than $30,000	
Current Insurance Status	Insured	Uninsured	Insured	Uninsured	Insured	Uninsured
Sources of Recovery Funds						
Earthquake Ins.	74	0	79	2	71	1
Government Loans	5	20	2	23	6	26
Savings	9	28	6	14	5	9
Homeowner's Ins.	8	18	7	10	8	6
Bank Loans	6	31	3	28	4	27
Other (e.g., friends, relatives stocks)	0	11	1	2	1	8
Total Recovery Funds ÷ Damage Estimate	101	108	98	79	94	77
Sample Size	45	86	119	127	165	134

For the insured groups in both the flood and earthquake samples the ratio of estimated total recovery funds to expected damage is close to one hundred percent whether damage is expected to be high or low. Uninsured homeowners would be forced to rely primarily on outside sources of funding or limited internal resources. Their average estimated ratio of recovery funds to damage is somewhat less than for the insured group and decreases as their estimated losses increase. Compared to past recovery experience it appears that most homeowners are overly optimistic about the amount of money they will utilize from all sources (except government relief) should a future disaster cause damage to their property.

What would happen if a homeowner's house were completely destroyed by a future flood or earthquake? Table 8.11 compares experienced to inexperienced homeowners and summarizes the responses to this question. In the flood survey, seventy percent of those who suffered damage in the past claimed that they would not rebuild on the same site if their house were destroyed; forty-five percent of homeowners without previous flood experience would not rebuild. In the earthquake sample, on the other hand, the difference between the two groups is slight, and most people would rebuild.

The major reason for wanting to rebuild on the same site relates to the desirability of the area: "It's a good neighborhood--close to everything", "I like the climate and the people who live around here", "I have no other place to go." The "no fear of recurrence" category is typified by the following responses by one of the homeowners in the survey: "Another flood wouldn't come again. They go in cycles." Another said: "A flood won't come back in a hundred years." An earthquake respondent said "chances of another severe earthquake would be slight." The financial reasons for rebuilding on the same site are related to the fact that the land is already owned. For example, one homeowner said: "At the present time there isn't anything else we can afford." Another said: "Land is getting too expensive to buy elsewhere."

A fear of recurrence is the dominant reason people would not rebuild on the same site. This factor is particularly important for homeowners on the flood plain who have already suffered personal losses, as typified by the following quotes:

> Psychologically and physically I don't think I could go through another flood. I still have nightmares about the last one. It's too costly to start over again buying furniture and repairing the house.

TABLE 8. 11

ATTITUDES TOWARD REBUILDING ON THE SAME SITE IF HOUSE WERE DESTROYED
(Percent of Responses)

	Flood Survey		Earthquake Survey	
	No Experience	Experience	No Experience	Experience
Would rebuild	55	30	65	61
Would not rebuild	45	70	35	39
Reasons would rebuild				
Desirable area	65	70	54	57
No fear of recurrence	14	8	18	17
Financial reasons	16	17	25	23
Other reasons	5	4	3	3
Reasons would not rebuild				
Fear recurrence	49	64	32	36
Other reasons	51	36	68	64

I have already built back after one flood, and if it happens again, I'll move somewhere else. The mental strain is too much.

8.5 AWARENESS OF GOVERNMENT LOAN PROGRAMS

Although some respondents mentioned government loans as a possible source of relief should they suffer damage from a severe flood or earthquake, these data do not indicate how much homeowners really know about the SBA Disaster Loan Program. A series of questions were designed to measure the extent of their knowledge. In analyzing the responses to these questions we have compared the "experienced" group with the "inexperienced" one.

Initially we asked homeowners "What help, if any, does the federal government currently provide to homeowners who suffer losses after a flood (earthquake)?" Those that volunteered government loans as one source of relief are classified as responding positively "without prompting". Individuals not mentioning loans were then prompted by being asked directly if the federal government provides such relief. Table 8.12 compares the percentage of respondents who volunteered loans with and without prompting.

In the flood-prone areas most homeowners are aware of the loan program. Those who had past damage were more likely to volunteer this type of relief without prompting than those who did not. In the case of earthquakes, the reverse is true, although the difference between the experienced and inexperienced groups is very small. Overall, approximately eighty percent of homeowners in flood-prone areas and two-thirds of those in earthquake-prone regions of California know that SBA loans exist.

Of those aware of the SBA program, most had limited knowledge of the terms of the loans. This is shown by Table 8.13 which displays the percentage of respondents who knew whether or not there was a forgiveness clause, and what the current interest rate is. At the time the questionnaire was administered there were no forgiveness grants, although that provision had been eliminated from the loan program only a little more than a year before. Therefore, it is understandable that more of the experienced respondents believed that there is still forgiveness today. Half of the inexperienced homeowners in flood- and earthquake-prone areas did not know whether or not there was a forgiveness clause.

TABLE 8.12

AWARENESS OF GOVERNMENT DISASTER LOANS

Percent of respondents indicating knowledge of SBA loans

	Flood Survey			Earthquake Survey		
Experience	Without Prompting	With Prompting	Total	Without Prompting	With Prompting	Total
None	48	30	78	48	20	68
Some	61	23	84	52	16	68

TABLE 8.13

KNOWLEDGE OF TERMS OF SBA LOANS
(Percentage of Sample)

	Foregiveness?			Interest Rate		
Experience	Yes	No	Don't Know	Up to 5%	More than 5%	Don't Know
			Flood Survey			
None	28	21	51	32	15	54
Some	50	18	31	43	8	49
			Earthquake Survey			
None	20	29	50	36	14	45
Some	52	12	34	43	14	44

Sample Size: Respondents aware of SBA loans:

Flood survey 1,636 individuals.
Earthquake survey 684 individuals.

The interest rate at the time of the survey was five percent, but until April, 1973 it had been below this figure. In evaluating the question on interest rate, we considered any estimate less than or equal to five percent to be correct. Here, also, there are many who cannot give an answer, but on the whole experienced homeowners were more accurate than inexperienced ones in both the flood and earthquake surveys.

How do homeowners feel about the government providing relief for long term recovery from disasters? Specifically, should recovery be a public or private responsibility? We attempted to gain some insight about homeowners' views by asking the question: "Suppose a flood (earthquake) damaged your home. Should the government pay for all, most, little, or none of your losses?" The responses are summarized in Table 8.14.

The experienced homeowners were generally more inclined to favor substantial government assistance than the inexperienced respondents. In the earthquake survey, for example, forty-two percent of the experienced group felt the government should be primarily responsible for covering losses while only nineteen percent of those not having suffered losses fell into this category. Although similar attitudes exist between the insured and uninsured homeowners in flood-prone areas, these two groups exhibit substantial differences within the earthquake sample. Only twelve percent of the earthquake policyholders feel the government should bear the brunt of the responsibility for covering losses compared to thirty-one percent in the uninsured group. A fair number of respondents in both surveys qualified their answers by remarking that aid should be given to members of disadvantaged groups such as the poor and elderly.

8.6 PERSONAL PROTECTIVE MEASURES

While the main thrust of our research has been directed at understanding the factors that influence the insurance purchase decision, it is of interest to gain insight into the behavior of homeowners with respect to other protective measures adopted in the pre-disaster period. To what degree do people protect themselves? What are their motivations? What are the reasons for not undertaking protective activities? The survey was designed to obtain information relating to these questions, and in this section we take a brief look at some of the results.

TABLE 8. 14

ATTITUDE TOWARD GOVERNMENT RESPONSIBILITY FOR PERSONAL LOSSES
(Percent of Respondents believing Federal Government should pay all/most or little/none of personal losses)

Group	Flood Survey Sample Size	Flood Survey All or Most	Flood Survey Little or None	Earthquake Survey Sample Size	Earthquake Survey All or Most	Earthquake Survey Little or None
Overall	2,055	31	67	1,006	23	77
Experience	456	43	55	152	42	57
No Experience	1,599	29	70	854	19	80
Insured	1,103	32	67	461	12	88
Uninsured	952	32	67	545	31	68

8.6.1 Measures Actually Adopted

Measures adopted by respondents are listed in Table 8.15. The most popular steps taken by those in flood-prone areas were structural in nature: building the house on a reinforced slab, putting fill in the yard and installing a retaining wall, pumps, or drains and ditches. In earthquake-prone areas, homeowners were primarily concerned with securing breakable objects rather than undertaking measures which would mitigate damage to the structure.

Table 8.16 presents data on the percentage of those adopting different measures and the average cost of preventive measures using several different classifications of the respondents. Twenty-seven percent of the flood respondents and twelve percent of the earthquake respondents described measures they have undertaken to reduce damage in a future disaster. A respondent was classified as an "adoptor" if he mentioned any action even if it was undertaken for reasons having nothing to do with the hazard in question. Jackson (1972) found in his survey of 302 residents of earthquake areas on the west coast of North America, that only five percent had taken protective measures of the kinds we have in mind, perhaps because Jackson had a more precise system for classifying acceptable adjustments.

One might expect the proportion of people adopting protective measures to be higher among those who have experienced a previous flood or earthquake than among those who have not. This is undoubtedly the reason homeowners residing in the high hazard zone (Zone A) were more likely to adopt protective measures than their counterparts in areas less subject to flooding (Zone B). Residents of riverine communities showed a higher propensity to take protective action than those in coastal areas.

In both the flood and earthquake surveys, there were greater proportions of people taking preventive actions among the insured groups than among the uninsured homeowners. There are at least two relationships between insurance and other protective measures which would affect the adoption of preventive measures. If one believes that insured individuals are more sensitive to the dangers of the hazard, then one could argue that these individuals are more likely to protect themselves in other ways. On the other hand, insurance may inhibit other protective activities as indicated by the following reaction: "I've got insurance, so why worry about it?" It is impossible to disentangle

TABLE 8.15

PROTECTIVE MEASURES ADOPTED BY HOMEOWNERS

Number Adopting Measure	Measures
	Flood Survey
99	Built house on reinforced or elevated slab.
87	Put fill in yard.
76	Installed or repaired retaining wall.
76	Installed a pump.
74	Installed or repaired drains, dug ditches.
66	Installed storm windows, shutters or doors.
43	Reinforced walls or foundation.
37	Moved contents of lower level to upper floor.
36	Waterproof basement or walls.
33	Elevated appliances, furniture or equipment.
31	Caulked or sealed around doors and windows.
30	Landscaped, planted trees or shrubbery.
12	Cleared out underbrush.
8	Plumbing improvements.
87	Other actions not classified above.
795	Total number of adoptions.
	Earthquake Survey
83	Remove or secure objects that might fall, eliminate or replace breakable items (e.g., plastic dishes).
18	Structural reinforcement to basement and foundation.
7	Secure hot water heater.
7	Eliminate plaster inside house.
7	Install shut off system for utilities.
6	Built house to be earthquake proof.
6	Install new wiring.
55	Other actions not classified above.
189	Total number of adoptions.

these two conflicting incentives.

The data on adoption costs in Table 8.16 is an indication of the resources that people are willing to devote to protective measures. In the flood survey, more than one quarter of the adoptors did not know the costs. For the earthquake sample nearly half of the respondents didn't know the costs. We believe this is because many of the actions were undertaken, at least partly, by the homeowners themselves, and these people frequently could not estimate the actual cost incurred. For those that could give figures on the amount expended on personal protective activities, the per capita costs for the subgroups in Table 8.17 range from $1030 (riverine) to $2140 (earthquake-uninsured).

What were the reasons for undertaking preventive measures? The primary motivations are listed in Table 8.17. Among the adopters of flood-mitigation measures, the first three reasons, totalling seventy-eight percent of the responses, show a direct concern for the hazard. The most frequent response "to take care of minor flooding that occurs in heavy rains," relates to an existing problem, not some hypothetical future danger. This rationale is directly related to past experience and may explain why a larger proportion of flood area residents take action than do earthquake-prone homeowners. In fact, many earthquake-mitigation adopters indicated that the primary reason for adopting the action had little to do with the hazard itself.

8.6.2 Measures Not Adopted

We also were curious as to why people have not adopted personal protective measures. The respondents were asked what (else) they could do to their property, house, or possessions to reduce the possibility of damage. The interviewer then probed as to why they had not chosen to undertake such activities. The numbers of people mentioning possible measures was disappointingly small. This suggests that most homeowners in hazard prone areas have not been concerned with ways to reduce future disaster losses.

The percentage of people responding are given at the bottom of Table 8.18. Their reasons are tabulated for both the experienced and inexperienced groups. Among those that had suffered previous damage from a disaster, expense was the dominant reason for not undertaking a particular protective action. A relatively small number in this group failed to adopt measures

TABLE 8.16

ADOPTION OF PROTECTIVE MEASURES BY HOMEOWNERS

Flood Survey

	Overall	No Experience	Some Experience	Insured	Uninsured	Zone A	Zone B	Coastal	Riverine
Sample Size	2,055	1599	456	1103	952	1056	999	1413	642
Percent of respondents taking action	27	23	40	31	22	28	23	22	36
Percent of respondents knowing cost of action	19	17	30	23	15	21	16	16	26
Average amount spent per respondent taking action	$1,370	1,500	1,110	1,460	1,210	1,430	1,200	1,615	1,030

Earthquake Survey

	Overall	No Experience	Some Experience	Insured	Uninsured
Sample Size	1,006	854	152	461	545
Percent of respondents taking action	12	11	15	18	7
Percent of respondents knowing cost of action	6	6	9	9	4
Average amount spent per respondent taking action	$1,460	1,380	1,750	1070	2140

TABLE 8.17

REASONS FOR ADOPTING PROTECTIVE MEASURES BY HOMEOWNERS

Number of Times Mentioned	
	Flood Survey
258	To prevent or reduce damage from floods.
46	To prevent hurricane damage.
316	To take care of minor flooding that occurs in heavy rains.
36	To maintain or improve property.
54	Advice or requirement by some authorative source (e.g., building inspector, architect, insurance agent, flood control information provided by the media.)
58	Other reason given.
27	No reason, don't know.
795	Total reasons.
	Earthquake Survey
56	Because of previous experience with earthquakes.
47	Advice given in news media on how to lessen earthquake damage.
74	Protection against earthquake damage was not the primary reason.
5	Satisfying a local requirement (e.g., required by building inspector).
3	Other reason.
4	No reason, don't know.
189	Total reasons.

TABLE 8.18

REASONS FOR NOT UNDERTAKING PROTECTIVE ACTIVITIES BY THOSE MENTIONING POSSIBLE ACTIONS
(Percent of Reasons Given for not Adopting)

	Flood Survey		Earthquake Survey	
Reason	No Experience	Some Experience	No Experience	Some Experience
Too expensive	28	53	23	40
Futility ("Really won't help anyway.")	7	9	5	4
Procrastination ("No time." "Never got around to it.")	20	13	39	24
Unnecessary. ("Don't need to, not much likelihood of a disaster.")	11	1	13	2
Other	33	23	19	29
Percent of people mentioning possible actions	15	24	18	19

because of the small likelihood of a future disaster. For inexperienced homeowners, expense is still important, but not nearly as much as for the experienced group. For them procrastination (or similar reasons) and lack of necessity were mentioned with some frequency. The "other" category includes a variety of reasons related to practicality which were difficult to group under specific headings. For example, "You can't have bare walls, that isn't practical." Or consider the earthquake area homeowner in California who decided not to "eliminate our water bed because we like it too much." Some of the responses in the "other" category were, "I just thought of it now." This response implies that earlier discussion of the flood or earthquake problem in the interview led some homeowners to think about mitigating future losses for the first time.

8.6.3 Attitude Toward Disaster Proofing

In Table 8.16, we saw that homeowners who took personal protective measures spent, on the average, $1370. In the last section we noted that expense was a very important barrier to adopting mitigation measures, particularly among experienced homeowners. While it was not practical to attempt a detailed measurement of the inhibiting effect of costs on actions, the respondents were asked the following question:

> Suppose you were buying another house identical to your own in this neighborhood and could spend an extra thousand dollars to make the house flood (earthquake) resistant. Would you spend the money?

This question was followed by one asking why they responded as they did. As shown in Table 8.19, approximately three-quarters of the respondents in both surveys agreed that they would make the additional investment primarily for their security ("to feel safe"). In the flood survey, half of the inexperienced people who would not spend the money felt it was an unattractive investment because there was no danger. As one person said "In this area I don't think it would be necessary. I wouldn't buy [a house] in an area where it was necessary." Only a very small number of experienced homeowners claimed "no danger" as a reason for not spending the money.

Do homeowners feel that the expenses associated with measures to reduce structural losses should be borne primarily by themselves or the government? A question on the subject, structured in a fashion similar to the one on the government responsibility for disaster relief (see Section 8.5), was asked of

TABLE 8.19

WILLINGNESS TO SPEND $1,000 FOR A DISASTER RESISTANT HOUSE
(Percent of Responses)

	Flood Survey		Earthquake Survey	
	No Experience	Experience	No Experience	Experience
Would spend money	70	74	78	73
Would not spend money	30	26	22	27
Reasons Would				
To feel safe	71	70	61	68
To protect investment	25	23	33	30
Other	4	8	6	2
Reasons Would Not				
Unnecessary, no risk	50	5	16	11
Can't make a house disaster proof (for $1,000)	24	49	50	46
Wouldn't move to another house in this area	10	26	8	11
Other	16	20	25	32

all respondents. The results summarized in Table 8.20 are similar to those with respect to government responsibility for bearing losses (Table 8.14): Homeowners with some flood or earthquake experience are more likely than those with no experience to want the government to assume most of the financial burden associated with structural improvements. Although there was no difference in attitudes between insured and uninsured individuals in flood-prone areas, thirty percent of the insured homeowners in the earthquake sample felt the government should assume all or most of the financial responsibility for making structures more quake resistant compared to only thirteen percent of the insured group who felt this way.

8.7 AWARENESS OF LAND-USE REGULATIONS AND BUILDING CODES

Land-use regulations and building codes are important means used by governmental bodies to mitigate the effects of disasters. These measures place restrictions on where and how property can be developed. How aware are homeowners of governmental disaster mitigation measures? The following open-ended question was used in the survey:

> What has been done or is being done by the federal, state, or local government to reduce flood (earthquake) damages to homeowners in this area?

The answers are tabulated in Table 8.21. Since the respondents could give as many answers as they wished, the sums can add up to more than one hundred percent. Relatively few respondents in flood-prone areas were aware of land-use regulations and building codes even though the survey was carried out in communities participating in the regular part of the National Flood Insurance Program and hence, were presumably complying with the regulations cited in Chapter 2. It is not surprising that the most popular response in the earthquake survey was building codes while in the flood survey it was engineering works (e.g. dams, levees). Building codes are often discussed in California as a means of mitigating earthquake damage, particularly to school buildings and hospitals. Dams and levees are often visible to residents of flood-prone areas. It is worth noting that engineering works were cited more frequently by homeowners in riverine areas than in coastal regions.

Land-use regulations and building codes were then briefly defined. All respondents were asked whether they knew of any such measures which had been adopted in their area. Another set of questions probed as to what land-use

TABLE 8. 20

ATTITUDES TOWARD GOVERNMENTAL FINANCIAL RESPONSIBILITY IN MAKING BUILDING IMPROVEMENTS FOR DISASTER RESISTANCE
(Percent of Respondents Believing Government Should Pay all/most or little/none of cost)

	Flood Survey		Earthquake Survey	
Group	All or Most	Little or None	All or Most	Little or None
Overall	29	69	23	77
No experience	25	73	21	78
Some experience	41	57	34	66
Uninsured	29	70	30	69
Insured	29	69	13	86
Coastal	25	73	-	-
Riverine	38	61	-	-

TABLE 8.21

AWARENESS OF GOVERNMENT MITIGATION MEASURES
(Percent of Respondents Mentioning Measure Without Prompting)

Measure	Flood Survey	Earthquake Survey
Building codes	12	28
Land use regulations	8	6
Engineering works	46	-
Better school construction	-	13
Warning systems	1	-
Public education	-	2
Research	-	7
Insurance programs	1	1
Non-specific response	6	1
Not aware of any measure	24	33
Don't know	15	25

regulations or building codes should exist. These results are summarized in Table 8.22. In this table, the "positive response" columns include homeowners who mentioned anything at all. In the "What should exist" side of the table, "none" refers to the "there should not be any more, we have enough already" type of answer.

The leftmost columns of the table supports the hypothesis that people are not aware of land use regulations or building codes. Even with prompting, the number of positive responses is relativey low. There were many more positive responses to the "what should exist" questions than there were to the "what now exist" ones. This probably reflects a basic quality of human nature that people who are poorly informed on a subject, are willing to give an opinion as to ways of improving conditions.

Persons responsible for formulating and implementing public policy might find our respondents' proposals for land-use regulations and building codes to be of interest. These are tabulated in Tables 8.23 and 8.24 without editorial comment.

8.8 WARNINGS

Although the subject of disaster warning systems is not in the mainstream of issues addressed in this project, they are of great interest to many people concerned with natural hazards. The field survey offered an opportunity to obtain data on the role played by warnings in flood situations, and on perceptions concerning the potential savings from an earthquake prediction.

8.8.1 Flood Warnings

How effective have warnings been in reducing flood damages? The respondents in the flood survey that had suffered damage were asked a series of questions regarding warnings in connection with their most serious experience. The results are shown in Table 8.25 where we see that only 141 of the 554 disaster victims actually heard warnings. One hundred and five of these people heeded the warnings and sixty-four realized dollar savings, in some cases, substantial amounts. Table 8.26 summarize the actions taken by those who heeded the warnings.

TABLE 8.22

ATTITUDES TOWARD LAND USE REGULATIONS AND BUILDING CODES

Percent of Respondents

	What now exist?			What should exist?		
	Positive Response	None	Don't Know	Positive Response	None	Don't Know
	Flood Survey					
Land use regulations	25	33	42	56	20	34
Building codes	25	29	45	39	23	38
	Earthquake Survey					
Land use regulations	21	32	47	52	15	33
Building codes	34	7	59	49	9	42

TABLE 8.23

SUGGESTED LAND USE REGULATIONS

	Number of Times Mentioned
Flood Survey	
Description of Measure	
Limit occupancy of the flood plain	435
Specific rules controlling building construction	163
Require adequate drainage (not clear this is a land use regulation)	147
Measures to preserve watershed, control runoff	106
Provide information to home buyers	12
Engineering works	9
Other	39
None, have adequate codes now	418
Don't know	726
Earthquake Survey	
Description of Measure	
Prohibit building on faults, hillsides, unsafe soils	383
Conduct geological surveys to determine safe area for building	61
Special regulations for locating schools, public buildings, atomic energy plants	31
Prohibit high rise buildings	28
Response pertains to construction and not land use	15
Other	8
None	152
Don't know	328

TABLE 8.24

SUGGESTED BUILDING CODES

	Number of Times Mentioned
Flood Survey	
Description of Measure	
Require houses to be elevated	196
Prohibit building on low lands, swamps, close to sea, river	184
Require builders to provide adequate drainage, sewers	102
Regulate size and height of buildings, size of lots	94
Better enforcement, uniformity of codes	14
Other (e.g., no basements, sump pumps, water-proofing)	200
None	473
Don't know	793
Earthquake Survey	
Description of Measure	
Requirements for construction materials	151
Require better, more solid construction	131
Limit height of buildings, stringent regulations for multi-story buildings	58
Restrict where houses are built	43
Stricter enforcement of existing regulations	43
Reduce risk of fire through requirements on utility connections	21
Other	47
None	91
Don't know	421

TABLE 8.25

REACTION TO FLOOD WARNINGS

Based on Respondent's Worst Experience	Number of Respondents
Had an experience	554
Heard warnings	141
Believed warnings	96
Took some action	105
Realized some dollar saving	64
Median saving	$1,000

TABLE 8.26

ACTIONS TAKEN IN RESPONSE TO FLOOD WARNINGS

	Number of Respondents Taking Action
Moved furnishings to upper floors, elevated furnishings or equipment	34
Evacuated house	41
Other protective measures such as placing sandbags around house, boarding windows	30
Stocked supplies	3
Went to Coast Guard	3

These data suggest that warnings can be an effective means of reducing property damage. For a variety of reasons many disaster victims did not receive advance notice of floods. This is not meant to be a criticism of our warning systems or of any of the agencies involved; we have no information about the circumstances of the floods nor on whether or not a warning was actually issued.

8.8.2 Earthquake Predictions

Homeowners in the earthquake sample were asked how likely it is that "scientists will be able to accurately predict earthquakes in California in the next five years?" Table 8.27 gives the distribution of responses to this question from which we would conclude that confidence is not particularly high. The respondents were then asked to rank in importance the three components of a prediction: location, severity, and likelihood. As Table 8.28 shows, the overall rankings came out in that order. These results might be rationalized in the following way. A person first wants to know if he will be affected by an earthquake. Then he wants to know if it will be serious enough for him to be concerned about its consequences. The likelihood of the earthquake comes last because uncertainty is the most difficult of the three concepts for a person to deal with.

What action would homeowners take with respect to their house and property if a severe earthquake were predicted to occur in the next week? Table 8.29 shows how respondents answered this question. The most frequently mentioned actions were evacuation and the securing of breakables. Evacuation responses were on the order of "I'd go far away from here" and "I'd lock up the house and leave." A Long Beach resident said "I'd put away everything that might get broken -- pictures, lamps, dishes. Also, I'd pray a lot." One fifth of the respondents said they would do nothing because "there is no action I could take." Whether or not they would feel this way if an earthquake prediction were actually announced for their community is another question.

TABLE 8. 27

BELIEF IN THE ABILITY TO ACCURATELY PREDICT EARTHQUAKES WITHIN THE NEXT FIVE YEARS

Response	Percent of Respondents
Definitely will	6
Probably will	38
Probably will not	40
Definitely will not	16

TABLE 8. 28

ATTITUDES TOWARD ASPECTS OF EARTHQUAKE PREDICTION

	Percent of Respondents	
Characteristic	Most Important	Least Important
Location	48	15
Severity	26	37
Likelihood	25	48

TABLE 8.29

ACTIONS BASED ON AN EARTHQUAKE PREDICTION

Action	Number of Mentions
Evacuate	402
Secure breakables and objects that might fall	378
Turn off utilities	182
Stock up with emergency supplies	53
Buy earthquake insurance	19
Temporarily brace house	4
Other	11
Take no action	197
Don't know	84

8.9 SUMMARY AND CONCLUSIONS

This chapter has examined homeowners' past experiences with floods and earthquakes, as well as their knowledge and attitudes towards hazard mitigation measures. A large number of tables have illustrated the field survey findings. In particular, we have looked at homeowners' past damage, their recovery from past disasters, their expected recovery from a future disaster and their awareness and attitudes towards government relief programs. We have also focused on the personal protective measures homeowners have (or could have) adopted, their knowledge and attitudes toward land-use regulations and building codes, and their behavior with respect to flood warnings and earthquake predictions.

The emphasis has been on past experience because such experience increases awareness of the hazard and points out the need for insurance protection or other mitigation measures. Hence, it plays a key role in the decision to protect oneself against low probability, high loss events.

CHAPTER 9

CHARACTERISTICS OF HAZARD PRONE REGIONS AND COMMUNITIES

9.1 INTRODUCTION

Communities and hazard prone areas vary in ways that should be considered in formulating policies dealing with natural hazards. In this chapter, we touch on some of these differences using data from the field survey, Census data, and a sample of loan recipients from the SBA disaster loan files.

All figures describing the characteristics of communities were developed using weighting factors corresponding to the objective probability of selection from the sample universe[1]. Hence, the data presented in the chapter represents population characteristics rather than simple averages of the field survey responses.

9.2 AVERAGE CHARACTERISTICS OF HAZARD PRONE AREAS

9.2.1 Differences In House Construction

According to the Federal Insurance Administration depth-damage curves, differences in house construction affect the structures's potential for flood damage. These curves, developed from a large body of experience, specify the average percentage of value destroyed as a function of water height, type of house, and location of contents (which can be inferred from the type of house). Examination of these curves leads to the following two generalizations, which are true for both structural and contents damage:

a) Houses with basements are more susceptible to damage than houses without basements if they are similarly situated on the flood plain.

b) Damage potential for homes in similar hazard prone areas decreases as the number of stories increases: single story houses are worse than split level houses, which are worse than two story houses.

These results make intuitive sense: the greater the proportion of a house that is located above flood level, the less vulnerable the entire structure is to severe flood damage.

Table 9.1 provides aggregate statistics on the size and configuration of houses in the four areas under consideration. Many coastal houses have only one floor and hence are susceptble to considerable damage should a severe flood occur. On the other hand, few have basements and hence are subject to little damage from minor flooding. Riverine houses tend to be larger than coastal structures and a large proportion have basements. On balance, we cannot say which hazardous areas have the more susceptible houses, but there are differences that have an effect on the type and amount of damage.

Homes in earthquake-prone communities in California tend to resemble property located in coastal Zone A regions. Many earthquake communities are in warm climates where styles tend to be similar to those found in the areas in our survey directly on the shore. Susceptibility to earthquake damage is a function of the type of construction of the house, not its size. Wood-frame houses, which comprise nearly all those in our earthquake sample, are least likely to sustain damage. Contents damage from quakes is also likely to be minor as long as the house does not totally collapse.

9.2.2 Development Of Hazard Prone Areas

Data from the field survey presented in Table 9.2 supports the hypothesis that development of flood hazard areas does not reflect great concern for the hazard. Thus we see that the Zone A houses in riverine areas are much newer than those in Zone B, indicating that recent developments have been in areas which are likely to flood. Current market values of property, however, are higher in Zone B than Zone A of the riverine communities.

In the coastal regions, there are similarities between the two hazard zones with respect to size and age of the houses, but property values today are significantly higher in Zone A than Zone B. In addition, the average appreciation rate (which was computed for each structure by dividing the difference between current market value and purchase price by the number of years since purchase) is higher in Zone A than Zone B[2]. The original purchase price in coastal Zone A was higher than in coastal Zone B, but the ratio of appreciation rate to purchase price in coastal Zone A has been 0.20 and only 0.14 in coastal Zone B. These differences suggest that in coastal areas, properties in the highest hazard zones are most desirable. Burton and Kates (1964) suggest an explanation for this phenomenon by stating:

TABLE 9.1

PHYSICAL CHARACTERISTICS OF HOUSES BY AREA

	Coastal Zone A	Coastal Zone B	Riverine Zone A	Riverine Zone B	Earthquake
Average number of stories	1.42	1.67	2.19	3.14	1.40
Average number of rooms	6.47	6.17	6.92	7.91	6.40
Percent with basement	16	26	54	92	18
Percent split level	9	15	9	17	10

TABLE 9.2

FACTORS RELATING TO DEVELOPMENT OF AREAS

	Coastal Zone A	Coastal Zone B	Riverine Zone A	Riverine Zone B	Earth-quake
Average year of construction	1954	1952	1954	1937	1949
Average year of purchase	1962	1963	1965	1962	1962
Average purchase price ($1,000)	23.2	18.7	25.3	25.9	27.9
Average value of land ($1,000)	14.1	9.9	10.5	11.3	14.4
Average current market value of house ($1,000)	39.7	33.1	40.7	44.6	44.2
Average yearly appreciation rate ($1000/year)	4.63	2.65	7.58	3.42	3.60

> Undoubtedly the main attraction of coastal areas today lies in their opportunities for recreational use. This is a relatively minor factor in riverine situations, but on the coast it is the dominant reason for the rapid expansion of settlement in the past decade. An important aspect in the recreational amenity is proximity to the sea. The most favored sites overlook a fine sandy beach, with easy access to warm, calm water. (p. 384)

Table 9.2 also shows that land values and property values are higher in earthquake-prone areas than in the flood-prone communities. This probably reflects both the desirability of residing in California and its overall high cost of living.

9.2.3 Mobility Of Homeowners

Table 9.3 presents three factors relating to the mobility of the respondents: average length of time in the neighborhood, the likelihood of moving in the next five years, and the likelihood of rebuilding on the same site if the respondent's house were destroyed in a disaster. The table indicates that on the average, coastal residents have been in their neighborhood longer than riverine residents and are not likely to move in the next five years, particularly those living in Zone A. Should a disaster destroy their homes, residents in coastal communities are more likely to rebuild on the same site than are riverine dwellers. Their desire to remain in the area implies that they have taken into account the risk of flooding when they located there. Those in riverine communities may not have been aware of the hazard when they decided to move into their current house and may still be insensitive to it today. A severe flood would thus come as an unexpected shock and lead them to pull up stakes. In their report on the occupance of the flood plain and seashore Burton and Kates (1964) note that:

> Our impression, after interviews with a number of managers of coastal property, is that they... have a greater awareness of the hazards of storms than is common among city dwellers on river flood plains.... The city floodplain dweller with no knowledge of flood hazards is common. The coast dweller without a little knowledge of storm potential has not been found.

9.2.4 Magnitude Of Damage

Table 9.4 compares structural and contents damage figures for the different hazard prone areas. The variable "per capita structural damage given damage" refers to average damage in thousands of dollars for those

TABLE 9.3

FACTORS RELATING TO MOBILITY OF AREA RESIDENTS

	Coastal Zone A	Coastal Zone B	Riverine Zone A	Riverine Zone B	Earth-quake
Average years in neighborhood	13.2	13.6	10.1	13.1	13.3
Liklihood of moving in 5 years*	3.3	3.1	2.8	2.7	2.9
Percent who would rebuild if house were destroyed	60	55	39	32	60

*Average of responses: 1 = definitely, 2 = probably, 3 = probably not, 4 = definitely not.

TABLE 9.4

MAGNITUDE OF DAMAGE BY AREA

	Flood	Coastal Zone A	Coastal Zone B	Riverine Zone A	Riverine Zone B	Earth-quake
Percent with structural damage	12.0	20.4	4.2	16.3	3.6	15.0
Per capita structural damage; given damage ($1,000)	5.9	7.1	3.1	4.1	1.2	1.2
Percent with contents damage	14.1	20.4	5.1	20.5	10.0	13.0
Per capita contents damage; given damage ($1,000)	5.2	7.3	2.9	2.3	0.8	0.5
Per capita total damage; given damage ($1,000)	9.1	12.3	4.5	5.4	1.2	1.4

actually suffering losses. A similar interpretation holds for contents damage. Thus, in flood-prone areas, average property damage was $5940 based on the twelve percent that experienced losses, while average contents damage was $5190 for the 14.1 percent that experienced such losses. The "per capita total damage given damage" row of the table shows that coastal high and low-hazard areas incur considerably higher average losses than their counterparts in riverine communities or in California earthquake-prone areas. Burton, Kates and Snead (1969) offer an explanation for this difference:

> Associated with recreational development that places a high premium on adjacency to (the ocean) are two land-using practices that exacerbate natural hazards: inadequate filling of tidal marshes and the leveling of sand dunes. Thus, unchecked, the rate of growth of recreational activity and the land-use practices encouraged in private recreational development sets in motion a process leading to growth in damage potential considerably higher than the general growth of the nation and its economy. (p. 180)

In coastal communities, the average amount of damage to contents is roughly equal in magnitude to the damage to the house. In riverine areas, the average amount of damage to contents is considerably less than the damage to the structure due to a prevalence of multi-story houses. For example, a Minot, North Dakota resident owning a two story house with a basement incurred $4000 worth of structural damage, but only $2000 worth of contents damage in the April 1969 flood.

Earthquake damage was generally minor for homeowners in our survey. About fifteen percent suffered some structural losses, however the average was only $1240. Average contents damage was approximately $500 for the thirteen percent in this category. These low figures are largely due to the ability of wood-frame structures to absorb earth tremors.

9.3 DIFFERENCES IN DAMAGE BY SOCIO-ECONOMIC GROUPS

From a social welfare viewpoint it is important to examine the socio-economic characteristics of families who have incurred losses from natural hazards. In this section we will provide summary statistics on the age, income, and house value distributions of the victims of floods and earthquakes. The figures must be interpreted with caution due to the relatively small samples in some of the groups. A few large losses can substantially affect the averages. For this reason we have indicated both the percentage in each group who have suffered damage as well as the per capita losses for the disaster victims.

9.3.1 Damage By Age Groupings

In Table 9.5 we investigate the differences in damage by age groups for the five hazard prone areas comprising our sample universe. A relatively small proportion of homeowners that are forty-five years old and under have suffered damage from floods or earthquakes compared to the two older groups. This difference is particularly striking in Zone A for both coastal and riverine areas where a surprisingly large proportion of elderly people have suffered flood damage. For example, more than twenty-five percent of the homeowners over age sixty-five residing in coastal Zone A incurred losses.

The picture is considerably different if one compares the per capita damage incurred by each of the different age groups. In all the flood-prone areas the youngest homeowners have the highest average damage when compared to the other two age groups. The most noticeable single statistic is the per capita figure of $22,900 for the forty-five and under population residing in Zone A of the coastal regions. This unusually high loss is due to a small number of people in the sample who suffered very severe damage from hurricanes. The average damage from earthquakes is relatively small for all age groups.

9.3.2 Damage By Income Groupings

The damage pattern with respect to income, displayed in Table 9.6, is not as clearcut as that for age. In general, one can say that a substantial proportion of low income residents suffer damage in Zone A as well as in earthquake-prone areas of California. On the other hand, the per capita damage figures indicate that the losses to low income homes are not likely to be as large as for the other two income groups. For example, in riverine Zone A areas, the average low income homeowner has suffered $1,700 in losses compared to an $8,000 average for high income victims. The actual losses experienced by the low income group, however, are still likely to be high in relation to their earnings.

TABLE 9.5

DAMAGE BY AGE GROUP AND HAZARD AREA

Age	Coastal Zone A	Coastal Zone B	Riverine Zone A	Riverine Zone B	Earthquake
			Percent With Damage		
Up to 45	11	4	14	4	14
46 to 64	29	10	32	12	24
Over 64	26	3	20	8	12
		Per Capita Total Damage for Homeowners Having Suffered Damage (in $1,000)			
Up to 45	22.9	5.2	5.9	2.2	1.1
46 to 64	5.2	3.5	3.2	.6	1.6
Over 64	2.6	5.6	3.5	1.2	.7

TABLE 9.6

DAMAGE BY INCOME GROUP AND HAZARD AREA

Income	Coastal Zone A	Coastal Zone B	Riverine Zone A	Riverine Zone B	Earthquake
			Percent With Damage		
Up to $10,000	33	4	19	13	23
$10,000 to $25,000	16	7	20	6	16
Over $25,000	11	5	25	7	18
			Per Capita Total Damage for Homeowners Having Suffered Damage in $1,000		
Up to $10,000	5.8	4.9	1.7	.3	.7
$10,000 to $25,000	12.7	3.2	2.4	1.0	1.4
Over $25,000	5.3	8.9	8.1	1.9	1.8

9.3.3 Damage By House Value Groupings

Table 9.7 displays damage by house values and hazard areas. The most interesting comparison, with respect to the proportion of homes suffering damage is between coastal and riverine Zone A areas. In the coastal group over one third of the houses with values under $30,000 suffered damage and approximately eleven percent of the highest valued residences (over $50,000) incurred losses. The reverse is true for the riverine Zone A areas: only seventeen percent of the lower valued houses had losses and over forty percent of the high valued homes were damaged by floods. Relatively few homes suffered damage in the less hazardous parts of coastal and riverine areas (Zone B). In earthquake-prone regions a larger proportion of lower valued homes had damage than those in the other two groups.

With the exception of coastal Zone B, the largest per capita damage for homes were in the highest value category. Thus, in coastal Zone A, the per capita damage for homes over $50,000 was $13,500 compared to $6,000 for the lowest valued homes. In coastal Zone B, the highest valued homes had only $1,500 per capita damage compared with between $4,500 and $5,000 for the lower valued groups. Earthquake damage was relatively low for all house value groupings.

9.4 SMALL BUSINESS ADMINISTRATION DISASTER HOME LOAN DATA

Since 1953, victims of disasters have had the option of utilizing low interest disaster loans from the Small Business Administration (SBA) to restore their homes and businesses to pre-disaster condition. Practically anyone suffering uninsured damage in a disaster area qualifies for a loan if there is reasonable indication that he will be able to repay it.

To supplement the field survey we collected detailed data on disaster victims who obtained aid from the SBA. Although extensive data from SBA home loan files have been collected[3], we will focus here on one example from each of the three types of disasters relevant to our field survey: riverine flooding, hurricane flooding, and earthquakes, and only on two of the loan recipients' socio-economic variables: age and annual income. The three disasters are the Alaska earthquake of 1964, the California floods of 1969, and Hurricane Camille of 1969. Table 9.8 contrasts the size of our sample with the total number of SBA loans given in each of these disasters.

TABLE 9.7

DAMAGE BY HOUSE VALUE AND HAZARD AREA

House Value	Coastal Zone A	Coastal Zone B	Riverine Zone A	Riverine Zone B	Earthquake
	Percent With Damage				
up to $30,000	35	4	17	6	24
$30,000 to $50,000	17	7	15	11	15
over $50,000	11	15	41	3	16
	Per Capita Total Damage for Homeowners Having Suffered Damage (in $1,000)				
up to $30,000	6.0	4.6	2.8	1.2	.9
$30,000 to $50,000	4.8	5.0	2.1	.4	1.7
over $50,000	13.5	1.5	6.7	4.7	1.4

TABLE 9.8

DISASTER AND SAMPLE SIZE FOR LOAN DATA

Date	Disaster	Sample Size	Total Number of Loans
3/64	Alaska Earthquake	104	864
1/69	California Floods	200	733
8/69	Hurricane Camille	209	14,260

SOURCE: SBA loan files.

Table 9.9 groups the data according to income level, while Table 9.10 is arranged by age. The tables show per capita verified loss, distribution of the sample, and the comparable distribution using Census data for the states in which the disasters took place.

Table 9.9 shows that losses for which loans were given generally increased with income. This finding is consistent with the analysis of field survey data on income and damage discussed in the previous section. Table 9.9 also indicates that for the Alaska earthquake and the California floods relatively few low income people received loans compared to the percentage in these categories based on Census figures.

Looking at Table 9.10 we see that in all three disasters relatively few older people received loans. In Alaska there were no loan recipients in the sample over sixty-five, and in the California flood fewer than four percent of the sample were in this category even though the Census figures reveal that 11.6 percent of the population in the state was over sixty-five. Data from Hurricane Camille reflects a similar pattern.

We do not know why the younger and higher income groups dominated the loan sample. They may have been more likely to suffer damage or more willing to apply for loans than the older and lower income people. The field survey, which was carried out over a much broader geographic area and included victims from many disasters, suggests that the latter factor is more important. The data show that a large proportion of lower income and elderly people have suffered flood and earthquake damage.

Evidence from other studies lends support to the hypothesis that low income individuals and elderly people are unlikely to obtain disaster relief from government sources. An American Friends Service Committee study on the distribution of aid to disaster victims cited in Cochrane (1975) reports that:

> During our interviews we became concerned over the loan policy for the elderly... we felt that while older people were not actually being denied loans, some were being given terms they could not afford.

Cochrane also cites a study by Mileti (1974) in which Rapid City disaster victims were interviewed. Mileti found that:

> Of the 187 individual households interviewed, the lower income groups were more reluctant to seek aid (or were prevented from seeking aid) from a Federal source, the SBA in particular, than the upper income groups.

TABLE 9.9

AVERAGE VERIFIED LOSSES BY INCOME FOR SAMPLES FROM SBA LOAN FILES FOR THREE DISASTERS

	Alaska Earthquake			California Floods			Hurricane Camille		
Income	Average Verified Loss (in $1,000)	Percent of Sample (81 cases) **	Income Distribution for State of Alaska	Average Verified Loss (in $1,000)	Percent of Sample (160 cases) **	Income Distribution for State of California	Average Verified Loss (in $1,000)	Percent of Sample (181 cases) **	Income Distribution for State of Louisiana and Mississippi*
Up to $10,000	11.5	23.5%	38.0%	8.7	25.0%	45.4%	5.5	69.1%	73.2%
$10,000 - $25,000	18.0	69.1%	52.3%	13.1	58.7%	48.5%	20.6	28.7%	24.7%
Over $25,000	26.7	7.4%	9.7%	12.6	16.3%	6.1%	30.8	2.2%	2.1%

SOURCES: SBA loan files
Income distribution for families from 1970 Census table #68

*Figures in this column are a weighted average of the income distribution for the two states: Louisiana and Mississippi. The weights reflect the relative breakdown of the loan sample for each state.

**The number of cases is less than the sample size for each disaster cited in Table 9.8 because some samples in the SBA loan files did not contain income data.

Furthermore, Kunreuther (1973) reported that:

> Data from the San Fernando earthquake show that the SBA disaster loan policy currently looks at the income of individuals suffering damage only insofar as it affects their ability to repay the loan. In fact, if anything, the policy discriminates against the low income family that may not be able to afford a large loan.

9.5 COMMUNITY COMPARISONS USING FIELD SURVEY AND U.S. CENSUS DATA

The field survey covers forty-three flood-prone sites in thirteen different states and eighteen earthquake-prone areas in the state of California. Table 9.11 presents summary statistics on key variables for each of the communities in the field survey. The left hand side of the table is devoted to field survey data; the right hand side to Census data. It is important to keep in mind that comparisons in the table should be made between communities, not between the field survey data and Census data for one particular community. Differences exist between these data sources: the Census covered all the residents in the community, while the field survey was restricted to homeowners in hazard prone areas.

To illustrate a comparison between two communities using Table 9.11 consider the first coastal community listed, Ft. Lauderdale, and the first riverine community, Los Angeles County. One can see that the seventy-seven homeowners interviewed in Ft. Lauderdale have lived in their neighborhood for an average of 10.8 years compared to only seven years for the twenty-seven Los Angeles County respondents. The per capita damage suffered by Ft. Lauderdale respondents is $135 compared to $244 for those in Los Angeles County. Note that these figures are averages over all respondents in each community, including those that have not suffered any damage. The average annual income and educational level is higher for the Los Angeles County respondents: $23,300 and fourteen years of schooling, as opposed to $18,400 and thirteen years of schooling for Ft. Lauderdale respondents. The purchase price and current value of the respondents' homes are almost equal, however, the average age of the household head is greater in Ft. Lauderdale: fifty-seven years vs. forty-one years.

On the Census data side of the table, the total population of the Census tracts or enumeration districts in which interviews took place is indicated in the column marked "Population". This figure is not necessarily the population of the entire community, but simply the number of inhabitants in those areas

TABLE 9.10

AVERAGE VERIFIED LOSSES BY AGE FOR SAMPLES FROM SBA LOAN FILES FOR THREE DISASTERS

	Alaska Earthquake			California Floods			Hurricane Camille		
AGE	Average Verified Loss (in $1,000)	Percent of Sample (87 cases) **	Age Distribution for State of Alaska	Average Verified Loss (in $1,000)	Percent of Sample (159 cases) **	Age Distribution for State of California	Average Verified Loss (in $1,000)	Percent of Sample (181 cases) **	Age Distribution for States of La. and Miss.*
Up to 45	15.2	49.4%	68.4%	10.9	40.2%	51.8%	10.7	63.0%	47.6%
46 - 64	20.6	50.6%	28.1%	12.8	56.0%	36.6%	12.6	29.8%	36.8%
over 64	0.0	0.0%	3.5%	5.5	3.8%	11.6%	12.4	7.2%	15.6%

SOURCES: SBA Loan Files
Age distribution for families from 1970 Census table #156.

*Figures in this column are a weighted average of the age distribution for the two states: Louisiana and Mississippi. The weights reflect the relative breakdown of the loan sample for each state.

**The number of cases is less than the sample size for each disaster cited in Table 9.8 because some samples in the SBA loan files did not contain age data.

TABLE 9.11

COMMUNITIES FOR FIELD SURVEY

Communities	Survey Data: Number of Interviews	Years in Neighbor-hood (Years)	Average Damage Worst Flood ($)	Annual Family Income ($1,000)	Educa-tion Level	Purchase Price of House ($1,000)	Current Value of House ($1,000)	Age of House Head (Years)	U. S. Census Data: Popula-tion	Annual Family Income	Educa-tion Level	Current Value of House	Average Age of Population
Coastal													
1. Ft. Lauderdale	77	10.8	135	18.4	13.0	27.3	43.6	57	93,895	9.9	12.6	33.5	47.3
2. Hollywood	47	11.8	114	18.2	13.1	27.2	51.0	64	102,988	8.0	11.4	14.6	45.3
3. Dade County	19	14.7	594	24.5	14.7	39.6	62.3	60	137,896	6.8	11.5	26.6	42.7
4. Monroe County	24	10.0	625	24	12.9	17.7	41.6	60	3,308	NA	NA	23.7	38.0
5. Indian Rocks Beach	92	10.0	9	18.5	13.3	29.7	57.1	61	30,762	9.2	12.7	25.6	48.2
6. Redington Beach	37	12.6	581	17.1	12.7	20.8	41.3	61	22,224	6.2	12.2	19.0	50.4
7. St. Petersburg	77	10.2	32	23.1	13.7	29.5	47.1	57	108,765	8.2	12.3	12.5	43.3
8. Treasure Island	53	9.4	66	22.9	14.0	33.9	58.2	59	45,202	7.6	12.4	23.7	48.7
9. Ocean Ridge	22	9.4	622	41.1	14.9	53.2	90.0	59	13,872	11.0	12.8	44.5	56.9
10. Sarasota County	20	5.8	0	14.4	11.7	25.5	42.6	59	6,869	NA	NA	18.5	43.2
11. Venice	33	6.8	54	19.8	14.1	26.6	47.3	64	13,446	NA	NA	20.8	48.3
12. Jefferson P.	201	12.3	161	17.2	12.2	26.3	36.0	47	196,576	10.6	12.0	23.9	29.1
13. New Orleans	144	15.3	930	13.8	11.9	20.7	33.7	51	174,339	9.1	11.9	23.1	39.4
14. St. Bernard P.	72	16.2	7,345	16.6	11.8	24.5	32.8	47	80,448	9.8	11.4	21.3	28.6
15. Marion	16	15.4	212	25.7	13.9	27.7	62.8	57	10,398	9.7	12.3	22.7	33.9
16. Wareham	36	17.0	234	18.4	13.5	13.7	32.0	56	2,035	NA	NA	NA	NA
17. Hancock County	75	27.1	1,301	7.4	9.1	9.2	17.5	54	1,551	NA	NA	NA	NA
18. Waveland	23	18.9	13,160	14.9	12.6	18.0	33.4	62	2,270	NA	NA	NA	NA
19. Harrison County	35	35.1	5,390	9.8	10.2	17.0	38.6	54	5,942	5.7	11.0	18.0	25.6
20. Long Beach	6	8.8	15,252	19.0	15.3	20.3	28.9	48	6,010	6.7	12.5	18.0	35.2
21. Atlantic City	11	26.1	938	5.9	10.0	13.2	16.4	65	4,197	6.5	10.9	13.8	39.8
22. Islip	70	14.3	2	19.2	12.7	20.3	39.4	43	9,631	9.7	12.4	23.6	34.8
23. Charleston	17	9.0	117	22.6	13.5	23.3	49.1	51	61,930	8.8	12.4	20.7	29.5
24. Isle of Palms	11	8.3	0	16.8	15.6	27.3	52.1	53	5,374	10.5	12.8	18.5	28.6
25. Galveston	120	12.7	893	16.5	12.1	17.6	25.4	46	67,442	1.0	12.0	17.1	30.4
26. Matagorda County	9	16.0	1,778	24.2	13.1	15.6	31.2	59	387	NA	NA	10.8	37.3
27. Aransas Pass	21	14.9	6,339	14.7	10.2	17.8	26.6	54	4,390	NA	NA	7.1	36.1
28. Sinton	45	18.6	4,548	17.7	11.1	17.2	24.5	55	5,563	NA	NA	NA	NA
Riverine													
29. Los Angeles County	27	7.0	244	23.3	14.1	30.9	39.5	41	9,964	13.1	13.6	34.3	34.4
30. La Puente	26	8.8	42	13.6	11.3	19.1	22.6	47	58,719	9.6	11.8	18.2	24.7
31. Prince Georges C.	21	11.6	254	21.7	13.1	21.5	43.1	49	26,445	10.6	12.4	23.3	30.9
32. Pompton Lakes	41	11.2	1,600	17.5	13.1	23.2	43.2	44	79,779	12.4	12.1	26.9	31.8
33. Wayne Twp.	44	13.0	391	17.9	12.0	22.2	43.0	47	44,389	13.3	12.3	28.4	31.6
34. Clark Twp.	30	10.5	2,513	29.6	14.2	38.0	65.1	48	39,745	14.4	12.3	32.6	31.5
35. Cranford Twp.	76	14.3	4,400	21.4	14.2	29.0	51.0	47	82,404	15.6	12.8	33.1	33.5
36. Elizabeth	72	19.9	2,100	14.7	11.5	19.2	36.4	52	59,540	9.3	11.1	22.4	36.1
37. Plainfield	70	13.5	2,496	18.5	12.9	23.3	37.6	48	45,057	9.9	11.6	21.7	33.6
38. Minot	82	10.4	689	14.7	12.0	18.1	25.1	46	19,110	NA	NA	16.2	27.4
39. Clackamas C.	16	15.6	650	16.1	13.8	25.3	36.2	52	18,662	8.1	12.3	16.6	35.6
40. Josephine C.	21	15.4	2,360	13.8	12.5	19.7	35.5	57	4,906	NA	NA	NA	NA
41. New Braunfels	20	24.2	21,776	15.4	11.0	12.4	27.6	53	3,326	NA	NA	11.1	29.6
42. Abilene	31	11.0	48	18.2	13.5	17.8	28.4	51	48,587	8.8	12.5	12.1	29.8
43. Alexandria	65	12.8	1,430	25.5	14.8	27.5	37.3	46	25,214	8.3	12.8	33.2	30.2
Average		13.8	1,667	18.0	12.8	23.4	39.3	52					

TABLE 9.11--Continued

Communities	Survey Data: Number of Interviews	Survey Data: Years in Neighborhood (Years)	Survey Data: Average Damage Worst Flood ($)	Survey Data: Annual Family Income ($1,000)	Survey Data: Education Level	Survey Data: Purchase Price of House ($1,000)	Survey Data: Current Value of House ($1,000)	Survey Data: Age of House Head (Years)	U. S. Census Data: Population	U. S. Census Data: Annual Family Income	U. S. Census Data: Education Level	U. S. Census Data: Current Value of House	U. S. Census Data: Average Age of Population
Earthquake													
1. Walnut Creek	80	6.9	111	28	15.9	49	71	44	19,892	18.3	15.0	43.5	28.1
2. San Raphael	14	15.0	14	27	14.3	40	76	53	15,778	11.4	12.8	38.5	35.2
3. Daly City	28	12.0	142	19	13.1	23	40	53	12,714	12.6	12.5	NA	32.4
4. San Bruno	31	13.6	306	14	10.4	18	34	50	7,048	9.1	11.8	22.5	27.0
5. San Mateo	33	9.0	15	20	14.0	30	55	50	7,934	13.7	12.5	NA	27.1
6. Palo Alto	29	14.3	13	25	15.0	30	55	50	11,272	15.5	16.0	34.6	28.2
7. San Jose	112	12.4	31	19	14.0	25	40	49	20,754	9.9	12.5	25.0	38.6
8. Sunnyvale	37	9.5	0	21	13.4	25	44	43	15,170	13.3	12.8	29.6	28.8
9. Fremont	27	8.2	0	20	12.9	23	35	39	6,294	12.3	12.5	NA	23.2
10. San Leandro	30	13.6	3	20	11.3	19	32	49	10,108	10.3	12.1	23.1	30.5
11. Oakland	49	19.0	35	21	12.8	29	45	52	20,010	9.2	12.6	30.7	40.3
12. San Francisco	42	17.0	11	16	13.8	25	44	56	6,284	10.5	12.9	35.0	35.5
13. Los Angeles	174	15.5	700	19	13.1	28	44	53	47,772	9.9	12.2	29.1	32.8
14. Long Beach	32	20.0	4	18	11.6	21	36	52	10,226	8.9	12.2	20.1	29.3
15. Huntington	16	4.9	35	25	15.6	36	54	40	9,284	13.4	13.0	32.3	23.5
16. San Bernadino	34	12.4	38	11	11.1	13	20	54	19,218	6.2	10.9	12.3	26.0
17. Miscellaneous	234	10.1	275	23	14.4	31	47	47	NA	NA	NA	NA	NA
Average		12.4	217	21	13.4	29	45	49					

NA = Not Available

from which the sample was drawn. The figures in the remaining columns are based on this subgroup. Hence, for Ft. Lauderdale, the population is 93,895 compared to 9,964 for Los Angeles County.

We also see for Ft. Lauderdale that the average annual income is $9,900, the average educational level attained by those in the population over twenty-five is 12.6 years of school, the current house value (as of 1970, the year of the Census) is $33,500, and the average age of the population is forty-seven years. For Los Angeles County these figures are respectively: $13,100 per year, 13.6 years of school, $34,300 for the current value of the house, and the average age is thirty-four years. Although it is not always the case, we see that the trends that existed in the comparison of the field survey data for the two communities is upheld by the Census data. The reader is encouraged to make further comparisons between the communities.

9.6 SUMMARY AND CONCLUSIONS

This chapter has used field survey data to draw contrasts among the five types of hazard areas surveyed. These contrasts dealt with physical aspects of property, development of hazard prone areas, and mobility of homeowners. An analysis of damage by area, age, income, and house value was made. A sample from the SBA loan files, for three different disasters, were examined to give insight into who are the recipients of disaster loans. Summary statistics were presented from both field survey and Census data for each surveyed community in order to compare communities. The kind of information contained in this chapter can play an important role in the further development and use of the community flood and earthquake model outlined in Chapter 10.

FOOTNOTES

[1] Appendix A.1 contains a discussion of the weighting procedure and the use of such data in making inferences about the entire homeowner population in the flood and earthquake communities.

[2] The same is true between the two hazard zones in the riverine communities, but the large difference in average year of purchase makes such a comparison meaningless because of inflation.

[3] A more detailed discussion of the data collection methods and the specific information tabulated appears in Faier (1975).

CHAPTER 10
A COMMUNITY FLOOD MODEL FOR POLICY ANALYSIS

10.1 INTRODUCTION

A preliminary version of a community flood model has been developed for the dual purpose of integrating data from the field survey, the laboratory experiments, and the SBA disaster loan file sample; and then evaluating the relative performance of alternative hazard mitigation and disaster relief programs. This chapter outlines the purposes and uses of the community flood model (Section 10.2) and then describes the results of a pilot study that compares the costs of alternative hazard mitigation and disaster relief programs to homeowners and the federal government (Section 10.3). Appendix A.2 provides the details on the model effort and completed pilot study.

10.2 PURPOSES AND USES OF WHARTON COMMUNITY FLOOD MODEL

Eventually the Wharton community flood model will integrate findings from the field survey and controlled experiments with data on flooding phenomena. The principle purpose of the model is to assess benefits and costs of alternative hazard mitigation and disaster relief programs. The model serves three complementary purposes:

Integration. It permits us to combine diverse data and submodels developed in other portions of the project. The field survey and laboratory experiments complement each other in providing descriptive models of individual behavior with respect to adjustments in the pre-disaster period. In addition, the field survey offers a source of information on socio-economic characteristics of individuals and a description of their properties. Data from the SBA disaster loan files and the field survey provide a detailed picture of the post-disaster recovery process for individuals who suffered losses. By developing pre- and post-disaster policies related to insurance protection, building codes, land-use regulations, and federal aid we can determine the effect of floods of different magnitudes on individuals in the community. The community flood model will thus enable us to integrate three components: individual behavior, alternative policies, and disaster-related damage so that their interactions can be studied and evaluated.

Costs of alternatives. The model will serve as a first step in enabling one to estimate costs to individuals in a community, governmental agencies, and the insurance industry for various public policy alternatives. In the next section we will describe a pilot study which indicates the types of costs that can be estimated from the model.

Policy evaluation. The function of integration and cost analysis are subsidiary, but necessary goals to policy evaluation. The ultimate use of the flood model is to provide guidance for choosing among alternative hazard mitigation and disaster relief policies. Specifically, the model will provide data on differential cost effects of alternative policies such as the ones evaluated in the pilot study described below.

10.3 A PILOT STUDY USING WHARTON COMMUNITY FLOOD MODEL

A preliminary version of the Wharton community flood model has been completed for evaluating costs to homeowners and the federal government under representative hazard mitigation and disaster relief programs.

10.3.1 Constructing A Community

The comparisons have been made by constructing a community consisting of 238 individual homeowners in flood-prone areas with the following attributes derived from field survey data:

Socio-economic Characteristics:

1. Age of Household Head
2. Annual Income
3. Education Level of Household Head

Property Characteristics:

1. Residence Value
2. Contents Value
3. Type of House

4. Elevation (in relation to 100 year flood)
5. Flood Insurance Coverage

Appendix A.2 provides a description of the modeling effort and the marginal distribution for each of these input variables.

10.3.2 Developing Alternative Disaster Programs

The alternative disaster programs analyzed by the community flood model consist of a policy with respect to each of the following three dimensions:

1. Insurance and Government Loans
2. Land-Use Regulations
3. Flood Proofing Measures

The following policy options were tested for each of these dimensions:

1. Insurance and Government Loans
   a. Current policy case: Actual flood insurance coverage plus current SBA disaster loan policy (20 year loans at 5 percent annual interest rate and no forgiveness grants). This policy was in effect at the time the field survey was undertaken.
   b. Compulsory flood insurance and current SBA loan policy to cover losses in excess of maximum insurance limits ($35,000 for the structure - $10,000 for contents).
   c. Compulsory flood insurance with no SBA loans available.
   d. No flood insurance and current SBA loan policy.

2. Land-Use Regulations
   a. No land-use regulations.
   b. Elimination of residential homes from portion of flood plain where water height exceeds five feet in a 100 year flood.

3. Flood Proofing
   a. No flood proofing.
   b. Flood proofing all homes to two feet above ground level.

All policies with SBA loan components (1a, 1b, 1d) are applied under the assumption that all homeowners are eligible for loans by virtue of the amount of their losses receive loans. An example of a disaster program for this hypothetical community would be:

Current policy case (1a)

No land-use regulations (2a)

No flood proofing (3a)

This program, henceforth designated as Program I, has policy components 1a, 2a, 3a. Program I will be the focal point for comparison with the following other programs:

Program	Policy Components	Principal Difference from Program
II	(1b, 2a, 3a)	Compulsory Flood Insurance
III	(1c, 2a, 3a)	Compulsory Flood Insurance and no SBA loans
IV	(1d, 2a, 3a)	No Flood Insurance
V	(1a, 2b, 3a)	Land-use Regulations
VI	(1a, 2a, 3b)	Flood Proofing

For example, suppose one wanted to determine the impact of a disaster program with compulsory flood insurance and no SBA loans. Comparisons are then made between Program I and Program III. The effect of land use regulations is evaluated by comparing Program I with Program VI.

10.3.3 Generating Data To Evaluate Alternative Programs

The community flood model has generated the following data for comparing flood damage, recovery funds, and costs of alternative programs:

Flood Damage
- To house
- To contents
- Total

Recovery Funds
- From insurance claims
- From SBA loans
- Unrecovered losses (because of deductible)

Loan Cost in Present Value Terms to
- Homeowner: Present value of his payments (for 5 percent, 20 year loan) based on homeowner's borrowing rate (i.e. 10 percent)
- Government: Amount of loan minus the present value of the homeowner's payment discounted by Government borrowing rate (i.e. 7 percent)

Total Cost To Homeowner

10.3.4 Comparing Alternative Disaster Programs

Flood damage, recovery funds, and costs of a disaster are affected by the following inputs to the community flood model:

Socio-Economic and Property Characteristics of Individuals
- flood insurance status
- type of house
- elevation of house in relation to 100 year flood
- property value
- contents value

Water Height from Flood

Disaster Program (e.g. Program I)

Sensitivity analyses are illustrated by determining how variation in water height affects damage and recovery. Unless specifically stated, comparisons of the relative performance of Programs II through VI with Program I have been made under the assumption that the representative community has suffered damage from a 100 year flood.

Sensitivity of Program I to Changes in Water Height

The effect of changing the magnitude of flooding was examined by varying the water height from five feet below the 100 year flood to five feet above. Program I was in effect for all trials. The effect of variation in water height on damage, recovery funds, and costs are detailed in the tables below.

Damage, insurance claims and SBA loan amounts are highly sensitive to the height of the water as seen from the table. For example, in comparison with the 100 year flood, a flood five feet lower reduces damage by almost sixty percent; a flood five feet higher causes nearly three times as much dollar damage. Sixty-nine percent of the houses are damaged in the 100 year flood; this percentage drops to 21 percent if the water is five feet lower. A flood two feet above the 100 year flood damages 99 percent of the houses, and a flood five feet above the 100 year flood damages all of them.

The damage and costs increase dramatically with small increments in water level (e.g. from 0 to 1) because of the nature of the depth-damage relationship: damage often begins before the water reaches the first floor level, and then increases rapidly as the water rises.

Damage and Recovery Funds (In Thousands of Dollars)

Water Height*	Damage		Insurance Claims		SBA Loans		Homeowners' Unrecovered Losses
	Total	% of Houses	Total	% of Houses	Total	% of Houses	
-5 ft.	459	21	301	15	143	10	15
-2	712	36	447	24	242	17	24
0	1049	69	656	43	351	34	41
+1	1385	90	867	59	461	44	56
+2	1743	99	1096	60	583	50	64
+3	2142	99	1346	64	731	55	65
+5	3030	100	1814	65	1148	62	68

Cost (In Thousands of Dollars)

Water Height*	Homeowners' Loan Cost	Government Loan Cost	Homeowners' Total Cost
-5 ft.	98	21	113
-2	165	36	189
0	240	52	281
+1	315	69	372
+2	399	87	462
+3	500	108	565
+5	785	171	853

* In relation to 100 year flood level.

Compulsory Flood Insurance and Current SBA Loan Policy (Program II)

In Program I, 65 percent of all homeowners were insured, but did not necessarily have full coverage. To test the effect of compulsory insurance, all houses were assumed to have coverage up to the value of the house and its contents or up to maximum coverage limits, whichever was smaller (Program II). Comparisons of Program II and Program I were made for both the 100 year flood and for one five feet higher. The results are shown in the two tables below.

Damage and Recovery Funds (In Thousands of Dollars)

		Damage		Insurance Claims		SBA Loans		
Program	Water Height	Total	% of Houses	Total	% of Houses	Total	% of Houses	Homeowners' Unrecovered Losses
I	0	1049	69	656	43	351	34	41
II	0	1049	69	985	69	2	1	62
I	+5	3030	100	1814	65	1148	62	68
II	+5	3030	100	2923	100	4	2	103

Costs (In Thousands of Dollars)

Program	Water Height	Homeowners' Loan Cost	Government Loan Cost	Homeowners' Total Cost
I	0	240	52	281
II	0	1	0.3	63
I	5	785	171	853
II	5	3	0.6	106

Under Program II, both the homeowners' and government's costs are significantly reduced due to increased insurance claims. As can be seen from the table, even when the water level was 5 feet above the 100 year flood, only 2 percent of the homeowners required SBA loans for losses in excess of their insurance coverage. Homeowners' unrecovered losses increase under Program II because more people in the community are now insured and hence incur a deductible before collecting on their policy. Deductible amounts were not included in SBA loans.

A program with compulsory insurance having coverage limited to 80 percent of value was also tried but yielded no significant differences compared to the full coverage case. This is because the depth damage curves restrict damage to no more than 60 percent of real property value. These curves are averages and do not reflect the extreme losses that would require high levels of insurance coverage for full compensation.

Compulsory Flood Insurance and No SBA Loans (Program III)

A comparison of Program III and Program I was made for the case where the representative community suffers damage from a 100 year flood. The results are detailed in the following two tables below. Program III yields results similar to Program II. Specifically, full insurance coverage increases insurance claims, and reduces both the homeowner's loss and government loan cost over Program I.

Damage and Recovery Funds (In Thousands of Dollars)

	Damage		Insurance Claims		SBA Loan		
Program	Total	% of Houses	Total	% of Houses	Total	% of Houses	Homeowners' Unrecovered Losses
I	1049	69	656	43	351	34	41
III	1049	69	985	68	--	--	64

Costs (In Thousands of Dollars)

Program	Homeowners' Loan Cost	Government Loan Cost	Homeowners' Total Cost
I	240	52	281
III	--	--	64

No Flood Insurance and Current SBA Loan Policy (Program IV)

Under Program IV, the community would not be in the National Flood Insurance Program and homeowners would have to rely solely on SBA loans at a 5 percent annual interest rate. The comparisons with Program I are detailed below.

A policy of no flood insurance coverage (Program IV) is extremely costly to both the government and homeowners. The only available funds for recovery are SBA loans at an annual 5 percent interest rate. The government's loan costs tripled over its expenditures under Program I. Homeowners' total cost is 2.55 times what it was under Program I.

Damage and Recovery Funds (In Thousands of Dollars)

	Damage		Insurance Claims		SBA Loans		
Program	Total	% of Houses	Total	% of Houses	Total	% of Houses	Homeowners' Unrecovered Losses
I	1049	69	656	43	351	34	41
IV	1049	69	--	--	1049	69	0

Costs (In Thousands of Dollars)

Program	Homeowners' Loan Cost	Government Loan Cost	Homeowners' Total Cost
I	240	52	281
II	717	156	717

Land-Use Regulations (Program V)

To measure the effect of land-use regulations on damage and costs, all homes where the water level from a 100 year flood was at least 5 feet were removed from the community. Otherwise, the policy components of Program V are identical to Program I. The comparisons between the two programs are indicated below.

Damage and Recovery Funds (In Thousands of Dollars)

	Damage		Insurance Claims		SBA Loans		
Program	Total	% of Houses	Total	% of Houses	Total	% of Houses	Homeowners' Unrecovered Losses
I	1049	69	656	43	351	34	41
V	452	54	297	33	126	25	28

Costs (In Thousands of Dollars)

Program	Homeowners' Loan Cost	Government Loan Cost	Homeowners' Total Cost
I	240	52	281
V	86	18	115

The introduction of land-use regulations removed 15 percent of the houses from the community thereby reducing damage by 57 percent from what it was without land-use regulations. The reduction in government loan cost and homeowners' total cost were even greater, decreasing by 65 percent and 60 percent respectively.

Flood Proofing All Homes (Program VI)

Program VI is identical to Program I except that all homes are now flood proofed to two feet above ground level. The assumption was that water levels up to two feet with respect to first floor elevation do no damage, while water above two feet causes the same amount of damage as there would have been without flood proofing. Comparisons are made below for the 100 year flood and one where the water rises an additional five feet.

Damage and Recovery Costs (In Thousands of Dollars)

Program	Water Height	Damage Total	Damage % of Houses	Insurance Claims Total	Insurance Claims % of Houses	SBA Loans Total	SBA Loans % of Houses	Homeowners' Unrecovered Losses
I	0	1049	69	656	43	351	34	41
VI	0	813	26	498	18	296	14	20
I	5	3030	100	1814	65	1148	62	68
VI	5	2872	91	1727	60	1081	56	63

Costs (In Thousands of Dollars)

Program	Water Height	Homeowners' Loan Cost	Government Loan Cost	Homeowners Total Cost
I	0	240	52	281
VI	0	202	44	222
I	5	785	171	853
VI	5	739	161	803

Flood proofing homes has a much greater impact for smaller floods than for larger ones. In the 100 year flood, damage was reduced by $236,000, while in the higher flood it was reduced by $158,000. This can also be seen by comparing changes in the percentage of houses affected. Flood proofing saved an additional 43 percent of the houses from damage in the 100 year flood, but only 9 percent of the houses in the higher flood. The percentage reductions in the government's and homeowners' costs were considerably greater for the 100 year flood than for one five feet higher.

10.4 CONCLUSIONS

The Wharton community flood model has been utilized to evaluate alternative disaster programs by constructing a community from survey data and subjecting it to floods of varying magnitudes. The sensitivity analyses and comparisons of programs indicate the flexibility of the model and its usefulness for making public policy recommendations. The analyses based on this community are suggestive of the types of comparisons which can be made. The results can be summarized as follows:

(1) Damage and hence recovery costs are highly sensitive to small changes in the water level associated with flooding because of the nature of the depth-damage relationship postulated by the FIA damage curves.

(2) A program where all homeowners have flood insurance significantly reduces government loan costs and homeowners' total costs over the current disaster program. Insurance claims significantly increase, and this cost in relation to premiums collected must be incorporated in the overall evaluation of Program II or III.

(3) A program where no homeowners have flood insurance (Program IV) greatly increases government loans and homeowners' costs.

(4) Land-use regulations (Program V) and flood proofing (Program VI) significantly reduce damage from floods and therefore, mitigate losses to the homeowners, government, and insurance industry.

CHAPTER 11

SIGNIFICANT FINDINGS AND IMPLICATIONS FOR PUBLIC POLICY

11.1 INTRODUCTION

The field survey and laboratory experiments have provided us with considerable insight into the decision processes utilized by homeowners in coping with hazards which have a relatively low probability of occurrence, but may result in some loss, possibly severe, to their property. This chapter summarizes the principal findings of the study and then indicate their implications for public policy. The concluding section proposes directions for future research.

11.2 SIGNIFICANT FINDINGS

The analysis of field survey data has revealed the limited knowledge that most homeowners residing in hazard prone areas have regarding alternative mitigation measures and relief programs. Furthermore the data demonstrate that a relatively small portion of the homeowners have personally protected themselves against potential damage from floods and earthquakes. The laboratory experiments on insurance have provided us with a better understanding of why individuals know and do so little about these hazards. The results suggest that people refuse to attend to or worry about events whose probability is below some threshold, the level of which may vary from individual to individual and from situation to situation. These general conclusions can be illustrated with a number of specific results.

11.2.1 Knowledge Of Insurance

Most respondents in the field survey were aware that flood and earthquake insurance existed, but over sixty percent of the uninsured homeowners residing in hazard prone areas were unaware that they were eligible to purchase coverage.

Of those individuals who were aware that they were eligible to buy this insurance, many had limited information on the terms of a policy. For example, the flood insurance premium on existing homes is subsidized by the federal government, yet one quarter of the insured and half of the uninsured respondents were unaware of this fact. Approximately twenty-five percent of the uninsured in both the flood and earthquake surveys were unable to estimate the premium, even when prodded by the interviewer to offer their best guess. While most policyholders could provide some estimate of their own premium, almost half of those in flood-prone areas and more than one third of those in the earthquake sample substantially misestimated the amount they pay.

A similar finding holds for people's knowledge of the deductible. As one might expect, most uninsured individuals did not know if there is a deductible on a flood or earthquake insurance policy. A substantial number of insured homeowners were also unable to estimate this amount, or assumed that they were covered against total damage. Earthquake policyholders, in particular, will be disappointed to find that there is a five percent deductible on the actual cash value of their policies; they will collect nothing if their losses are relatively small.

11.2.2 Knowledge Of The Hazard

Turning now to the hazards themselves, the field survey revealed that over ninety percent of the homeowners are able to provide estimates of the anticipated losses from a future severe flood or earthquake. Insured homeowners expect more damage from these disasters than do the uninsured group. However, over thirty-five percent of the nonpolicyholders in the flood sample and over sixty percent of the uninsured in the earthquake group estimate more than $10,000 damage to their property if a severe disaster occurs. In the case of the earthquake sample such estimates are likely to be on the high side, since practically all the homes in California are wood-frame structures which normally withstand severe shaking without much damage.

Homeowners were also asked to estimate the chances of a severe flood or earthquake next year causing damage to their property. This probability was based on the respondent's earlier estimates of damage. Approximately fifteen percent of the flood respondents and eight percent of the earthquake group were unable to provide such a figure. The insured homeowners generally have higher estimates of the chances of a severe flood or earthquake than did the nonpolicyholders. Still there are some insured individuals who feel that a severe flood causing damage to their property is almost impossible (1 out of 100,000 or less), while there are some uninsured homeowners who estimate the probability to be quite high (1 out of 10 or more). It is not clear from the field survey data how well people understand the concept of probability and whether or not they have thought about the chances of relatively low-probability events occurring.

11.2.3 Importance Of Federal Aid

One possible way to explain the lack of thought given to either the hazard or the insurance option is an expectation by homeowners that the federal government will provide them with liberal disaster relief should they suffer losses. The data from the field survey do not support this hypothesis. Although most homeowners are aware that the Small Business Administration provides aid to victims, the respondents generally have little knowledge of the loan terms or whether they can receive forgiveness grants from SBA.

Even more important, most homeowners do not anticipate turning to the federal government for aid should they suffer losses in the future from a severe earthquake or flood. Insured individuals may have little need for such relief but uninsured victims are forced to rely on their own resources or those of others for recovery. Yet, approximately three quarters of the flood and earthquake nonpolicyholders who estimate their losses to be $10,000 or less anticipate no aid from the federal government. Even for uninsured homeowners who expect losses in excess of $10,000, the majority do not anticipate turning to the federal government for any relief.

Based on these results, we hypothesize that most homeowners in hazard prone areas have not even considered how they would recover should they suffer flood or earthquake damage. Rather, they treat such events as having a probability of occurrence sufficiently low to permit them to ignore the consequences.

Even following a disaster many victims have not utilized the federal loan program to the extent possible. To illustrate, consider those victims who had flood insurance at the time they suffered a disaster. The group that had losses over $10,000 only collected insurance claims totaling thirty percent of their damage. Only one quarter of these individuals obtained an SBA loan. Funds from this source averaged less than ten percent of total damage. As a result these homeowners only recovered, on the average, approximately half their losses. Similar behavior was observed for the uninsured victims of floods and earthquakes.

We are unable to determine why homeowners did not rely more on the federal government for relief. Some families may have had negative feelings toward incurring large debts while others may have had their loan size limited by the SBA because the agency felt they could not afford to repay the loan. Whatever the reason, this self-reliance has resulted in many victims not recovering completely from the disaster. The field survey data revealed that fifteen percent of those who suffered flood damage and forty percent of those with earthquake damage did not make any repairs at all to their house. Over one-third of the flood victims felt their house was in worse condition after repairs had been made than it had been before the disaster. The majority of the earthquake victims did not consider their house to be restored to its pre-disaster condition.

Homeowners' attitudes towards government responsibility for personal losses is consistent with this lack of interest in relief. Almost seventy percent of both insured and uninsured homeowners in the flood sample felt that the government should pay for little or none of the losses suffered from a future disaster. In the earthquake sample, seven out of eight insured homeowners felt the government should pay for little or none of the losses while approximately two out of three uninsured respondents exhibited this attitude.

11.2.4 Knowledge Of Mitigation Measures

The field survey data also revealed a lack of awareness by respondents about measures which could mitigate losses from future disasters. Relatively few homeowners have adopted protective activities to reduce physical damange from a flood or earthquake. Insured homeowners were more likely to have taken such steps than their uninsured counterparts, but even this group has not shown much interest.

In flood prone areas for example, slightly more than thirty percent of the policyholders and twenty percent of the nonpolicyholders had taken such action. In the earthquake sample less than twenty percent of the insured and seven percent of the uninsured homeowners adopted protective actions, often for reasons having little to do with the hazard itself. A relatively small proportion of the respondents had even thought about other protective measures which they could adopt in the future.

There was also a general lack of knowledge as to what governmental regulations were currently in force to reduce losses from future disasters. For example, only one quarter of the homeowners in the flood survey responded positively when asked if their community had adopted any land-use regulations for reducing flood losses, even though all communities in the sample were required to enact such meausres as a condition for participating in the regular National Flood Insurance Program. A similar number of respondents were aware of codes regulating the construction of homes. In earthquake-prone areas there was also a limited knowledge of such measures: only one out of five knew of any land-use regulations and one out of three were aware of building codes in their area.

Flood warning systems were found to have some value in preventing losses. Of the 141 respondents who had suffered damage and heard warnings, 105 took some protective action with 64 realizing some dollar savings. However, it must be noted that the 141 victims represent less than a third of the homeowners with flood experience.

11.2.5 Development Of Hazard Prone Regions

The picture emerging from the analysis of the field survey data is one of benign neglect. Individuals are reluctant to collect information on the possible adjustments related to natural hazards because they have more pressing things on their mind. The many decisions that have to be made during their daily routine tend to push these low probability events near the bottom of a long list. Hence, they are not likely to receive any attention.

This lack of concern with the consequences of the hazard may explain the recent growth of coastal and riverine areas as well as earthquake-prone regions. Homeowners who have chosen to locate in these regions may have done so primarily for reasons such as recreation and scenic beauty, without attending to the potential consequences of a future disaster.

The field survey data revealed that housing values appreciated faster in the high hazard coastal and riverine areas (Zone A) than in the less hazardous regions (Zone B). Riverine communites tend to have their lower valued houses close to the river, presumably because their market price reflects the higher flood risk. However, the reverse is true in the coastal areas: the most expensive homes are in the highest hazard zone.

The data also reveals that residents in earthquake-prone and coastal communities have resided in their neighborhood longer than those in riverine areas and are less likely to move in the next five years. When asked what they would do if a disaster should destroy their homes, the riverine dwellers were the ones least likely to rebuild on the same site. For the other two groups, the desire to remain in the area has led them either to accept the risk associated with the hazard or to assume that they would not have another severe disaster in their lifetime.

11.2.6 Accuracy Of Expected Utility Model

Taken together, the above findings suggest that most individuals do not collect enough data to evaluate the costs and benefits of alternative courses of action regarding protection and recovery against low probability events.

In particular, the analysis of the field survey data reveals that the expected utility model is an inadequate description of the choice process regarding insurance purchases. Many individuals have insufficient knowledge of the availability or terms of insurance and/or the consequences of the hazard for this approach to be applicable to them. Furthermore, a substantial number of those who have sufficient information for making decisions on the basis of the expected utility model frequently behave in a manner inconsistent with what would be predicted by the theory.

The laboratory experiments provide further evidence on the inadequacy of utility theory in explaining behavior. In a series of studies in the form of urn experiments and a farm simulation, subjects were exposed to a variety of hazards which had different losses and probabilities associated with them. By keeping the premium constant for all hazards and varying the losses and probabilities in such a way that the expected loss (loss multiplied by probability) was the same, it was possible to test the adequacy of utility theory in explaining insurance behavior.

According to this theory, individuals should prefer to insure themselves against events having a low probability of occurrence but a high loss rather than against those having a high probability and low loss. The reverse was found to be true for a variety of experimental formats. These results suggest that if the chances of an event are sufficiently low, then people will treat the probability of occurrence as zero and not even consider the consequences. In this case there is no need to concern oneself with protective mechanisms such as insurance.

11.2.7 Accuracy Of Sequential Model Of Choice

These human limitations in collecting information and making computations are consistent with the concepts of bounded rationality. Specifically, the time and effort required to gather and process data force individuals to construct a simplified model of the world. Using these ideas, we hypothesized that the decision process regarding the adoption of protective activities is a sequential one: if the individual perceives the hazard to be a problem (Stage 1) then he is likely to search for ways to mitigate future losses including the purchase of insurance (Stage 2). His final decision on whether or not to buy coverage (Stage 3) will be based on simpler criteria than those implied by the expected utility model.

Statistical analysis of the field survey data reveals that the variables which are most important in differentiating insured from uninsured homeowners are consistent with such a sequential model of choice. By constructing multi-dimensional contingency tables we found that the two most important factors in predicting the insurance purchase decision are whether the hazard is considered to be a serious problem, and whether one knows someone who has purchased coverage. Furthermore, these two variables strongly interact.

This implies that if someone thinks the hazard is a serious problem and also knows someone else with insurance coverage, he is more likely to purchase insurance than these variables taken separately would imply. In quantitative terms, logit regression equations indicate that there is a fifty-five percent difference in the probability of having insurance between those who know someone and think the flood or earthquake hazard is a serious problem and individuals who do not know someone and feel the problem is unimportant.

The statistical analysis of the field survey data also indicated that past experience was the most important factor in alerting homeowners to the seriousness of the hazard. This variable was particlarly important in those areas where damage from flooding could be severe. Those aware of the potential for floods or earthquakes in their neighborhood before moving there were also more likely to treat the hazard as a serious problem than individuals who were unaware of these risks at the time they bought their homes.

11.2.8 Role Of Socio-Economic Variables

Interestingly enough, socio-economic variables played a relatively unimportant role in the decision to purchase insurance or in how people viewed the seriousness of the hazard. Income and education were both statistically significant in discriminating between policyholders and nonpolicyholders, but neither variable had a large effect on the probability that a person would have coverage. We found that as income increased the chances of having an insurance policy also increased, but only by a small difference between the lowest class (under $10,000) and the highest class (over $25,000). Those with at least a high school education had a higher probability of buying insurance than those who had not completed high school. Neither income nor education levels had any explanatory power in determining homeowners' perception of the hazard.

Older people were more likely to buy insurance than their younger counterparts, but the longer one lived in the neighborhood, the smaller the chance became that one actually would have coverage. There was also a significant interaction effect between the length of time one lived in different hazard prone areas and one's perception of the problem. Thus, homeowners in the most hazardous parts of the coastal area or in earthquake-prone regions were more likely to view the hazard as a serious problem if they had just moved there than if they had lived in the community for some time. Those residing in areas most susceptible to riverine flooding followed the reverse pattern --- the longer the person resided in the area the greater the likelihood that he would view the flood hazard to be a serious problem. The field survey data do not enable us to determine why these differences between regions exist.

11.2.9 Relationship To Other Studies

In summary, the data from the field survey are consistent with empirical evidence from other studies on decision making under uncertainty. They also stress the importance of past experience as a stimulus for taking action. The process of searching for information on insurance is likely to be similar to the one followed by individuals who are considering the adoption of a new innovation. Information is a scarce commodity and its diffusion takes time. Friends and neighbors are thus likely to play an important role in influencing the decision process. They are viewed as accessible and reliable sources of information on the availablity of insurance and terms of a policy.

11.2.10 Synthesis Of Lab Experiments With Field Survey

The results of the laboratory experiments further increase our understanding of the field survey analyses. The idea of a probability threshold protecting a reservoir of concern helps explain why many survey respondents showed little concern for floods or earthquakes and had little information about these hazards or about protective measures such as insurance.

This concept is compatible with the finding from the survey that insured persons had greater perceived probabilities of loss than uninsured persons. The laboratory experiments suggest that a high probability of loss actually influences the decision to purchase insurance rather than being a rationalization after the fact (e.g. "I have insurance, therefore I must believe the hazard is likely"). These experiments also imply that the strong effect of previous hazard experience on insurance puchase observed in the survey data is most likely due to an increased subjective probability of the hazard rather than to a greater appreciation of the magnitude of loss.

Finally, the threshold notion is compatible with the sequential model of choice. In essence, the laboratory experiments were examining Stage 3 of the model in which the subject's attention was directed to the hazard and the insurance option. People indicated that probability of loss was a major factor in their decision-making process at this stage. However, the notion of a "finite reservoir of concern" that underlies the threshold concept could also play an important role in the initial stages of the model. It seems likely that unless the hazard appears probable, it will not be viewed as a problem and the individual will not consider protective measures such as insurance.

11.3 IMPLICATIONS FOR PUBLIC POLICY

The policy maker has quite a different perspective on the hazards and insurance than the individual homeowner. He must look at risks aggregated over many residents in numerous locations or in one place over a period of time (e.g. the risk of a major earthquake occuring in California within the next twenty-five years). From this vantage point the probability of disaster becomes high enough to cause him to view these events as a problem and hence feel the need for widespread adoption of insurance and other protective activities. The resident of the hazard area, however, with less concern for the community and with a shorter time horizon, feels unthreatened. Here we obviously have a formula for conflict and mutual frustration between the policy makers and individual members of society.

Society has long recognized a need for enabling individuals to protect themselves against some of the risks to which they are exposed. In fact, the development of insurance markets is the prime example of ways in which losses from uncertain events are shifted from an individual or business to a risk bearing institution. Our study is concerned with the relative performance of different social institutions in shifting the burden of risk from those who live in hazard prone areas to others.

After looking at an idealized theory of insurance we will indicate the problems companies have faced in offering widespread coverage to the public. These practical difficulties are illustrated by focusing on the flood and earthquake risks. Social institutions have emerged in recent years to cope with these problems. Hence, flood and earthquake policies are now readily available to homeowners residing in hazard prone areas. Yet insurance has not been a successful protective mechanism because residents have not had much interest in coverage.

The inescapable conclusion from our study is that the consumer is the source of market failure. It thus may be necessary to substitute other institutional mechanisms for the free market if one would like individuals to be protected against the consequences of low probability-high loss events.

11.3.1 Reasons For Limited Markets For Insurance

In Chapter 3 we sketched the elements of an ideal theory of insurance from the consumer's point of view. Essentially an individual is assumed to maximize his expected utility by collecting information on the probabilities and potential losses from a hazard and the terms of alternative insurance contracts. He then chooses the coverage which maximizes his expected utility.

From the insurance company point of view the price charged will be determined by the risk. The actual rate will normally be higher than the pure loss premium for several reasons. For one thing there are administrative costs associated with running the company which include overhead, marketing expenses, and profit. These additional costs may be partially offset by the interest earned on premiums if insurance is based on some prepayment plan. If risks are interdependent, as they are likely to be in the case of a natural hazard, then an additional premium will be charged to reflect the potentially high loss from a major disaster. This surcharge will cover the cost of reinsurance or the possible risk of bankruptcy. A further source of additional costs is the degree of uncertainty on the probability distribution and losses associated with the risk.

11.3.2 Problems Of Marketing Insurance

Insurance companies have faced practical problems which have forced them to deviate from the above theoretical principles. As noted in Chapter 2, the principal difficulty facing the industry when they initially tried to market flood insurance was <u>adverse selection</u>. Since the demand for coverage was concentrated in relatively few areas, the companies marketing policies went bankrupt due to severe flooding in these communities. This naturally discouraged other firms from marketing coverage and flood insurance was not offered again on fixed residential property until the National Flood Insurance Program was initiated in 1968.

Another problem which has limited the supply of insurance is one labeled moral hazard. This refers to the difficulty that insurance companies have in distinguishing between unavoidable and avoidable risks in drawing up their insurance contracts. For example, it is impossible for an insurance company to make the distinction between a fire which was caused by deliberate or negligent actions on the part of the insured homeowner and one that was due to natural causes. As an example of a moral hazard problem involving flood, a policyholder might take advantage of flood warnings to move his old appliances down to the basement so that he can replace damaged equipment with new items. In the case of earthquakes, an insured victim might claim that plaster cracking was due to the shaking of the house even though it had been caused by the normal settling process. To eliminate this moral hazard problem there is a five percent deductible on the actual cash value of the policy.

Infrequent events such as floods and earthquakes yield limited statistical data for determining the probabilities and losses associated with the hazard. Even if one had detailed figures from past experience upon which to base rates, there is a substantial transaction cost in developing customized premiums. For example, the elevation of each house on the flood plain has to be measured in relation to the river to determine individualized differences. Furthermore, rates have to reflect differences in structures and the type of construction. Property also has to be inspected to ascertain the location of contents in different parts of the house. Not only would it be costly to develop premiums that differentiate between these factors, but the complexity of the rate schedule would be very confusing to the agent or homeowner.

One last problem faced by insurance companies in setting flood insurnace rates is the problem of externalities. Specifically we mean the effect that the location of structures in one part of the flood plain have on damage to other parts. An example of this problem would be the construction of some new facilities on an upstream portion of a river which might increase water run-off and debris, thus exacerbating damage to villages downstream. If insurance were marketed to new homes and businesses in the upstream community, then rates should reflect the potential damage to the existing structures downstream. The costs of determining this damage and the necessary transfer payments to reflect such a rate structure would make this an administrative nightmare.

11.3.3 Social Institutions For Coping With Market Failure

The above factors explain why the economic system has not developed a more adequate set of markets for risk-bearing and insurance. Arrow (1963) has suggested that:

> ...when the market fails to achieve an optimal state, society will, to some extent at least, recognize the gap, and nonmarket social institutions will arise attempting to bridge it. (p. 947)

In the case of natural hazards, we noted in the introductory chapter, that until recently the government had assumed this institutional role entirely by providing low interest loans and forgiveness grants to uninsured victims of natural disasters. However, the increasing costs of these programs to the general taxpayers together with demands by homeowners in flood-prone areas for insurance to cover their losses led to the establishment of the National Flood Insurance Program in 1968. This program was aimed at obviating the need for substantial federal disaster relief in future years.

The flood program is an excellent example of how social institutions have developed to overcome the sources of market failure outlined above. By having the federal government subsidize rates people are able to buy coverage at attractive prices. The subsidized rates eliminate the high transaction costs which would otherwise be required in setting customized rates for all existing structures on the flood plain. Rates on new property reflect the degree of flood risk; the property owner bears the costs of determining the appropriate elevation of the house which forms the basis of his premium. A government reinsurance program protects the NFIA and all participating companies against catastrophic losses caused by the problem of adverse selection. Land-use regulations and building codes reduce the externalities associated with upstream development.

Even though subsidized flood insurance has been readily available from licensed agents and brokers in eligible communities, few individuals have been interested in purchasing coverage on a voluntary basis. As a result Congress passed the Flood Disaster Protection Act of 1973 which increased the incentives for flood-prone communities to participate in the program and for residents of these areas to purchase flood insurance. Today an identified flood-prone community has the choice of participating in the program or forfeiting most federally-related financing for projects that would be located in flood-prone areas as well as most mortage money for property. If a community becomes eligible, homes and businesses in high-hazard areas (Zone A) are required to purchase flood insurance as a prerequisite for receiving any type of federally-related financial assistance for new acquisition or construction purposes. Thus, what was a voluntary program has now essentially become a required one.

Earthquake insurance is privately marketed, yet there is little incentive for individuals to purchase it if they have accurate information on the terms of the policy and potential losses from a disaster. The five percent deductible clause together with the relatively minor damage to wood-frame structures caused by severe quakes makes such coverage unattractive. Low interest disaster loans and forgiveness grants have also been offered in the past to uninsured homeowners suffering damage from quakes, thus further reducing the cost of being uninsured.

Yet the analyses of the field survey data indicate that uninsured homeowners have <u>not</u> based their decision on such objective information. Most nonpolicyholders are unaware of the deductible amount nor do they have accurate estimates of the cost of coverage. Furthermore, many estimate unusually high damage to their wood-frame house from a severe quake and do not anticipate federal aid to cover their losses. Given these subjective estimates, one would have expected the majority of California residents to carry earthquake insurance. Yet less than five percent of the homes in the state have such coverage today.

The lack of interest in flood and earthquake insurance by individuals is consistent with the view of George Bernstein, former head of the Federal Insurance Administration. In testimony before a U.S. Senate Subcommittee he noted that:

> ...most property owners simply do not buy insurance voluntarily, regardless of the amount of equity they have at stake. It was not until banks and other lending institutions united in requiring fire insurance from their mortgagers that most people got around to purchasing it. It was also many years after its introduction that the now popular homeowners insurance caught on. At one time, too, insurers could not give away crime insurance, and we just need look at our automobile insurance laws to recognize that unless we force that insurance down the throats of the drivers, many, many thousands of people would be unprotected on the highways. People do not buy insurance voluntarily unless there is pressure on them from one source or another. (Bernstein, 1972, p. 23)

11.3.4 The Consumer As The Source Of Market Failure

This brings us to a key finding of our study. The principal reason for a failure of the market is that most individuals do not use insurance as a means of transferring risk from themselves to others. This behavior is due to people's refusal to worry about losses whose probability is below some threshold. Consequently they have no interest in protecting themselves with insurance. If insurance is brought to their attention, people may view it as a poor investment rather than as a meaningful protective mechanism. One reason people do not buy coverage is because they feel they are unlikely to receive anything back on their cash outlays.

On the other hand, suppose the individual views the probability of a disaster to be high enough for him to consider the hazard to be a serious problem. In this case the potential consequences become important. Then the insurance premium is likely to appear to be an excellent investment against the potentially large loss from a future disaster.

An additional factor which has inhibited the voluntary purchase of flood and earthquake insurance is the long dissemination process regarding information on availability of coverage and terms of a policy. Studies on adoption of innovations point to the role of interpersonal contact which is perceived to be a convenient and reliable source of information and is often an important element in triggering the final purchase decision. The field survey data analyses reinforce these findings. In particular, the variable "knowing someone else with insurance" is tremendously important in differentiating policyholders from nonpolicyholders.

In summary, our findings suggest that in developing institutional mechanisms for shifting risks involving low-probability events, considerably more emphasis must be placed on the demand side of the market. We know a great deal about why markets fail due to imperfections affecting the supply side (the insurance companies) but we are only beginning to learn about the imperfections of individuals in processing information and making decisions.

11.4 MECHANISMS FOR ALLEVIATING MARKET FAILURE

It is axiomatic in the insurance industry that policies are "sold not bought". The use of insurance to guard against rare losses is not always compatible with the individual's need to preserve some segment of his attentional capacity for thinking of things other than protection. If this study points up the fundamental difficulty in protecting individuals against the hazards they face, it also suggests ways of ameliorating the situation.

11.4.1 Creating Concern For The Hazard

The results of the field survey and controlled experiments suggest that persons will only consider insuring themselves against low-probability-high consequence events if they are convinced that the chances of these hazards are, in fact, high enough to warrant concern. We know that the probability of an event is determined, in part, by the ease with which relevant instances are imagined or by the number of such instances that are remembered (Tversky and Kahneman, 1973). Hence the way to increase the concern with a future disaster is to use media publicity, vivid films, or visual displays such as the practice employed by TVA of plotting flood heights on photographs of familiar buildings (Kates, 1962). Presenting information in such graphic forms may increase memorability and imaginability so that the subjective probability of the event is above the person's critical threshold.

Another way to increase concern with the hazard is to present information on the probability of a disaster on a different time interval than the traditional one year period. Thus, in describing the chances of a one hundred year flood one could note that if you lived in this house for twenty-five years the chance of suffering damage a least once will be .22. By stretching the time horizon in this way the individual may then view the probability of loss to be high enough to warrant interest in insurance.

11.4.2 Role Of The Insurance Agent

The insurance agent may serve a very important and useful function in triggering interest in coverage. He can improve the awareness of the hazard and insurance by initiating contact with individuals who have purchased other policies with him. He can emphasize the probability that the hazard will occur in the future and note the potential losses which may result. He can provide information on the availability of flood or earthquake insurance, the rate schedule, and the stated deductible. In the case of flood insurance, he should indicate that premiums are subsidized by the federal government on all existing homes and that rates are uniform so a search for the best price is unnecessary.

The agent can also help individuals comprehend the "fine print" of an insurance policy. The insurance industry views a policy as a legal document and thus feels it must protect itself by expressing in writing all possible occurrences. Recently efforts have been made by some companies to rewrite automobile and homeowner policies in simple English, to define explicitly all the appropriate terms, and to print the document in much larger type. Such policies are now considerably easier to read but they are still lengthy and require some help in understanding the conditions.

If most individuals treat insurance as an investment, then one of the principal functions of the agent should be to educate his clients that the biggest return on their coverage is not to have any return at all. Unless the homeowner adopts this point of view he is likely to purchase a flood or earthquake policy only after suffering damage and may then cancel his coverage a few years later if he has not received a return on his premium. Such a process of education requires the agent to play an active role.

Today the agent has a limited economic incentive to initiate personal contact with his clients. Commissions are based on an amount proportional to the total premium which, in the case of earthquake and flood insurance, is usually a small amount. In their study of the impact of the flood insurance program on ten New York communities in the Susquehanna River Basin, Preston, Moore and Cornick (1975) found that many insurance agents expressed little interest in the flood program. The agent felt that there would be little money in marketing coverage because the volume of business would be low and because they did not expect to pick up very much other business as a result of developing new contacts. One way to increase the agent's interest would be to raise commission rates on the sale of new policies. The agent may then be willing to invest more time and effort into trying to convince potential clients of the attractiveness of such insurance.

11.4.3 Difficulties In Marketing New Coverage

Even if residents in hazard prone areas were provided with better information on the hazard and insurance, the impact on sales of new policies is not likely to be very large. For one thing, there will generally be selective exposure to data, which partially explains the general failure of mass communication efforts (Hovland 1959). From an information processing viewpoint this implies that people who are most in need of the information--the low income class--are most likely to ignore it. Faced with stringent budget constraints, this group will have no interest in insurance coverage as they feel they cannot afford it.

Another factor inhibiting the voluntary adoption of insurance is the extensive mobility of our population. New residents locating in hazard prone areas are likely to view the chances of a future flood or earthquake to be sufficiently small so that they will not be concerned with potential losses. Even if they are sensitive to the hazard they may not know about flood or earthquake insurance because the diffusion of such information takes time.

Community officials in hazard prone areas may be able to alleviate this problem somewhat by informing all residents of the nature of the hazard facing them. Preston, Moore and Cornick noted that local officials in the Susquehanna Basin had a limited understanding of the National Flood Insurance Program and hence were primarily interested in minimal compliance with the regulations rather than active participation. The authors suggest more coordination between federal, state, and local organizations to facilitate an interest by communities in promoting the program and disseminating information on hazard mitigation measures and insurance availability to residents.

11.4.4 The Role Of Financial Institutions

If voluntary methods of promoting insurance are viewed as too costly and time-consuming then financial institutions may be able to play a key role in filling the gap created by a failure of the market. As a means of protecting their own investments they may want to require flood or earthquake coverage as a condition for a new mortgage on residential property. One way to do this would be to include such added protection as part of a comprehensive homeowners coverage for new residents locating in these hazard prone areas[1].

In fact, the Federal Disaster Protection Act of 1973 makes flood insurance a requirement on practically all new mortgages. In the case of earthquake insurance, coverage today is normally written as an endorsement on a homeowner's policy for those who voluntarily desire coverage. Should banks require coverage on all new mortgages in California it may be necessary to institute some form of federal reinsurance against catastrophic losses. Such government involvement is an answer to the concern of the insurance industry that there is not enough private reinsurance capacity to absorb the probable maximum loss which would result from a damaging quake in a populated part of the state.

Results from our field survey indicate that over three-quarters of the respondents in flood-prone areas and over half of those in earthquake-prone regions feel it would be fair for banks and financial institutions to require flood or earthquake coverage as a condition for a loan. Similar findings were reported by Cummins et. al. (1974) in their study of consumer attitudes toward insurance. In asking the question "Would you favor or oppose a law which required all people who live in flood and earthquake zones to have flood and earthquake insurance?" almost sixty percent of the respondents in their survey were in favor of such a regulation and only thirty percent were opposed to it. The rest did not have an opinion one way or the other.

11.4.5 Role Of Disaster Relief

One reason for suggesting new approaches for promoting the sale of flood and earthquake insurance is that individuals today are not adequately prepared to cope financially with the consequences of natural disasters. The data from the field survey clearly revealed that the majority of uninsured homeowners do not anticipate turning to the federal government for aid should they suffer losses in the future from a severe flood or earthquake. In fact, it is likely that they have not even thought about the consequences of a disaster prior to its occurrence.

Even if flood and earthquake insurance were required tomorrow as a condition for a new mortgage, there will still be victims from future disasters who will be hurt financially. Some of them will be long-term residents who were not required to have insurance and had not voluntarily purchased coverage. Some families who are renting property will not have insurance against contents damage from floods or earthquakes. It is likely that a large proportion of this uninsured group will be in the low-income bracket either because they could not afford coverage or because they did not have sufficient information on the availability and terms of a policy. The field survey data also suggest that many of the insured victims will only have sufficient coverage to restore a portion of their losses.

A disaster relief program may be desirable for assisting these groups in their recovery efforts. In the past many of the victims have not taken full advantage of existing loan programs and other sources of aid, so their property was in worse shape after repairs had been made than it was before the disaster. If governmental aid is deemed desirable, then a concerted effort should be made to disseminate information to the affected population, so that residents can understand what relief is available to them and how they can obtain different forms of assistance. A special effort should be made to provide this information to low-income residents, the group least likely to be aware of such programs and most in need of relief.

11.4.6 Coordination Of Insurance With Other Adjustments

White (1966) has stressed the importance of providing residents of hazard prone areas with data on the choice of measures open to them. Insurance offers the potential of coordinating several hazard mitigation and disaster relief adjustments through an explicit set of economic incentives. For example, both the federal government and the insurance industry could now encourage residents of flood-prone areas to undertake preventive actions such as installing a reinforced wall to reduce losses from future flooding. Pamphlets could be sent to all currently insured homeowners with information on such possible measures and the actual reduction in their annual premiums should they choose to adopt one or more flood proofing options. Since the federal government is paying a large fraction of the claims for water damage, it could provide homeowners with low-interest home-improvement loans to encourage them to undertake such adjustments. In fact, if the benefits of the protective measure exceed the costs, then the reduction in premiums may more than offset the loan charges.

A recent U.S. Water Resources Council report (1976) has proposed a conceptual framework to mitigate losses from future flooding in the United States. The report indicates that one of the most serious problems associated with flood plain management is the fragmented and uncoordinated responsibility for different programs. There is a need to coordinate land-use regulations, flood proofing, flood warning systems and insurance as part of a unified national program of flood plain management. The report thus supports the need for coordinating insurance with other adjustments.

11.5 SUGGESTIONS FOR FUTURE RESEARCH

This study has only scratched the surface in our understanding of the insurance decision process and the ways in which society can mitigate losses resulting from low probability events such as flood and earthquakes. The need for additional research is highlighted by the survey results which show that not all people who felt floods or earthquakes were highly probable carried insurance and that many people who had purchased coverage felt the chances of a disaster were very low. This section briefly discusses fruitful areas for additional research.

One result which was highlighted by the survey and about which we need to learn more, is the influence of communication with friends and neighbors upon insurance decisions. Some individuals may tend to follow societal norms by conforming to others without giving the matter much thought while others purchase insurance because they have been given useful information through personal contact.

Other controlled experiments could be undertaken using the urn paradigm and farm game to study the influence of such factors as premiums and deductibles, refund policies, cost of information about losses, and a host of other situational and psychological considerations that might affect insurance purchases. A program of research on these problems is outlined by Slovic (1975).

Further field work should be undertaken to understand more clearly what motivates individuals to locate in hazard prone areas and to determine the extent of their knowledge on the potential losses and chances of future disasters. From the field survey we know that people who are aware of the dangers of living in an area are much more likely to consider the hazard to be a serious problem than those unaware, and hence may be attuned to insurance and other mitigation measures. We need to learn what factors led these people to collect information on the hazard before they located in a given area.

A more detailed analysis of our field survey responses could be undertaken to determine whether certain socio-economic groups are unaware of the hazard mitigation measures open to them, the availability of insurance, or the existence of the SBA disaster loan program. Ferber (1956) has analyzed individuals' awareness of selected economic data (e.g. the current minimum wage). He concluded that there was considerable variation between population groups in their degree of knowledge. By understanding which groups are uninformed or misinformed on available hazard mitigation and recovery options, one may be able to develop policies for providing specialized information to these selective groups to increase their awareness.

It would be interesting to reinterview a small sample of the homeowners to determine whether or not their participation in the field survey changed their behavior. For example, did some of the nonpolicyholders investigate insurance after the interview and decide to buy coverage because they were now sensitized to the hazard problems facing them? A sample could be chosen in such a way that some homeowners would be located in communities which have experienced a disaster since they were interviewed. These data would enable one to determine what effect a recent disaster has had on changes in subjective damage and probability estimates and in attitudes regarding alternative hazard mitigation and disaster relief policies.

A future study could investigate why most low income individuals do not protect themselves against disaster losses. The recent Disaster Relief Act Amendments of 1974 offer an unusual opportunity to determine the relative importance of the following two factors which appear to limit insurance purchase by this group: lack of information and budget constraints. Under Section 408 disaster victims are eligible for grants to cover part of their losses. A portion of this grant is normally used to provide flood victims with insurance for the next year. If these individuals renew their policies then it is likely that their original lack of interest in coverage was due to their limited knowledge of flood insurance. On the other hand, if they let their policies lapse then it is likely that they were uninsured prior to a disaster primarily because they could not afford coverage.

Considerably more work should be done to determine how well people understand the concept of probability and what methods they use in assessing risk. More experimentation is needed on how one can present information about probabilities most effectively to individuals. Kates (1975) provides a comprehensive summary of work that has currently been completed in the area of risk assessment and probability estimation.

It would also be interesting to undertake field research on other protective activities to determine similarities and differences between actions which affect property losses and those which affect life or health. The fact that flight insurance is relatively popular and earthquake insurance is not, despite a lower probability of a plane crash than a severe quake, implies that individuals may behave differently when their life rather than their property is at stake. Yet at the same time we know that seat belts are not worn by large numbers of people and that many smokers have no intention of giving up the habit even though their health and life are affected by these actions.

The results of this study may also provide insight into consumer behavior with respect to other types of insurance. For example, there is currently a large-scale social experiment on health insurance underway at RAND (Newhouse, 1974) which is examining the effects of alternative insurance plans upon the demand for medical service. Further research should be undertaken to see whether our findings are borne out by the data collected by the RAND project. For example, one innovative type of insurance being studied in the health insurance project is a plan whereby outpatient care is free but inpatient care is subject to deductibles. Such a plan provides a positive incentive to obtain preventive care. Our findings suggest that little protection will be undertaken for illnesses which are perceived to occur with a small probability. Methods other than free outpatient care may be required to induce protective behavior.

In both the medical and dental areas there is a growing interest in ways to induce individuals to protect themselves from potentially severe consequences. Dr. John Knowles, president of the Rockefeller Foundation, recently commented that:

> The individual must realize that a perpetuation of the present system of high-cost after-the-fact medicine will only result in higher costs and more frustration. The next major advance in the health of the American people will result only from what the individual is willing to do for himself. (Wall Street Journal, March 22, 1976, p. 1)

With respect to public policy implications of our findings, further work is currently underway to extend the community flood model (Kunreuther and Wilson, 1976). This study will enable interested parties to evaluate the relative performance of alternative hazard mitigation and relief programs on homeowners, businesses, and the government.

More research is also needed to determine differences between the way consumers and firms process information and the types of social institutions which are best suited for coping with market failure. For example, why did banks and financial institutions not require flood insurance on their own as a conditon for a new mortgage during the first four years of the National Flood Insurance Program? Why have banks not been more interested in requiring California homeowners to purchase earthquake insurance today as a condition for obtaining a mortgage?

All of these questions are worthy of investigation as they promise to increase our understanding of how individuals and instututions operate in an uncertain world where information is a scarce commodity.

FOOTNOTES

[1] Critical analyses of the feasibility of alternative forms of hazard insurance appears in Cornelius (1974); Hall (1973); and Levin, Griffin and Tierney (1973).

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SAMPLING REPORT FOR STUDY OF SELECTED NATURAL HAZARDS

1. Rationale for Sample Design

This study is an investigation of the determinants of the decision on whether to buy insurance against selected natural hazards. The universe was homeowners living in areas thought to be particularly prone to these hazards. These were riverine and hurricane flood prone areas designated by a federally subsidized insurance program and an earthquake prone area of California. The critical study variable was whether or not an insurance policy had been bought. Because of variations in the relevant natural factors, there was particular interest in whether or not buying behavior differed among areas prone to hurricane floods, riverine floods, or earthquakes. Because the critical comparisons were to be between policyholders and nonpolicyholders, it was decided to interview equal numbers of both groups in each of the three types of areas.

In each case, policyholders were selected with equal probability. Flood insurance policyholders were selected from the files of the National Flood Insurance Association. Earthquake policyholders were selected from the files of private companies selling earthquake insurance in California who agreed to cooperate with the study. The critical decision with regard to study design was the delineation of the proper comparison group of nonpolicyholders. There were two important, but conflicting criteria underlying the specification of the comparison group. One was that the selected nonpolicyholders should be representative of all those homeowners eligible to buy insurance who chose not to do so. The second criterion was that the nonpolicyholders should be comparable to the policyholders. A sample designed to satisfy the first criterion only would have included many homeowners living in those areas least likely to experience a disaster. Few policyholders lived in such areas. A sample designed to satisfy the second criterion only would have included those nonpolicyholders most like the policyholders. This could have obscured important factors underlying the decision to buy insurance. Three competing sampling plans were considered and rejected before a final compromise was decided upon. These plans were:

a. to study six subjectively selected communites, two each in earthquake, hurricane flood prone, and riverine flood prone areas, of which one had suffered a recent disaster and the other had not,

b. to take a national equal probability sample of policyholders, and then to select an equal probability sample of nonpolicyholders from the same communities from which the policyholders had been selected, and

c. to select an equal probability sample of policyholders, and then to select a matched sample of nonpolicyholders, such as next door neighbors.

These plans will be discussed in turn.

The main advantage of the first plan was that it would have been possible to isolate two important variables, the type of natural hazard and the recency of a disaster. There were two major drawbacks, however. One was that the two subjectively selected communities within a pair would have been quite likely to differ on important variables other than recency of a disaster, confounding the influence of this variable in data analysis. The second drawback was that it would not have been possible to make the necessary inferences for national policy making. Generalizations from the six communities would have been limited to these communities only, which could not be expected to reflect the characteristics and the variations in the characteristics of the national populations of policyholders and eligible nonpolicyholders.

The second plan would have avoided the difficulties inherent in subjectively selecting communities, and would have provided representative national samples of policyholders and nonpolicyholders. However, within selected communities, the policyholders and nonpolicyholders would have differed to such a great extent on some important variables that it would not have been possible to assess the effects of other important variables. For example, within a flood prone community, the policyholders would have been likely to live in the low areas near the river or ocean while the nonpolicyholders would have been likely to live in the higher areas further back. Secondly, the concentrations of nonpolicyholders would have occurred in communities where the rates of policy buying were low, whereas the concentrations of policyholders would have been in a different set of communities where rates were high.

The third plan had the attractive features of permitting generalizations to a national universe while minimizing the differences between policyholders and nonpolicyholders on relevant study variables such as objective risk, value of property and income. This maximized the opportunity to concentrate on other relevant determinants of the decision-making process. This sampling plan would have made it difficult, however, to study the interactions among risk, value, income, and these other factors. Controlling for risk and value in this manner would have biased the analysis of the data in the direction of overemphasizing the importance of other, less rational factors which contribute to the decision of whether or not to buy disaster insurance. Because risk, value, and income are correlated with the likelihood of buying a policy, the matching plan would have exaggerated the effects of the other variables. For example, a nonpolicyholder in a particularly high risk area or a policyholder in a particularly low risk area could quite likely have less rational utility functions than other eligible respondents.

The final compromise incorporated features of all three plans. We retained the ability to generalize to the national population, albeit at a somewhat higher variance, but improved the comparability between policyholders and nonpolicyholders by oversampling nonpolicyholders in high risk areas. All homeowning nonpolicyholders were given an objective probability of selection, which permits the generalizations to the national universe.

2. Sampling Policyholders

The desired total number of interviews was 3,000, 1,500 each with policyholders and nonpolicyholders. Of these, 625 interviews each with policyholders and nonpolicyholders were to be conducted in hurricane flood prone areas, 375 of each were to be conducted in riverine flood prone areas, and 500 of each were to be conducted in earthquake prone areas. Because the rate of policy buying was much less in riverine flood prone areas than in hurricane flood prone areas, it was necessary to select policyholders at a much higher rate in the riverine areas than in the hurricane areas. Within each of the three types of areas, however, policyholders were selected with equal probability.

The following definitions of eligible respondents were used:

Flood areas: These were policyholders included in the regular program of the National Flood Insurance Association as of August 31, 1973, who lived in a county where there were at least 25 policyholders, and the majority of housing units were not enumerated in the 1970 Census as being occupied on a seasonal basis.

Earthquake areas: These were policyholders paying premiums in the period August 1, 1972, through July 31, 1973, to one of eight insurance companies cooperating with the study, who lived in the earthquake prone area of California. The definition of the area boundaries are given later in this section. The names of the eight companies are:

1. Insurance Company of North America
2. Hartford Insurance Company
3. Fireman's Fund American Insurance Company
4. Kemper Insurance Company
5. Allstate Insurance Company
6. Transamerica Insurance Company
7. Travelers Insurance Companies
8. State Farm Insurance Company

The reason for only including flood area policyholders living in counties where there were at least 25 policyholders was to insure that interviewing would be sufficiently clustered geographically so that interviewing costs would not be too high.

All counties including at least 25 flood insurance policies were listed and sorted into the hurricane or riverine flood prone strata. The hurricane flood stratum included all counties bordering either the Atlantic or Gulf Coasts in a belt stretching from New England through southern Texas. All other counties were placed in the riverine stratum. The policyholders were then separately ordered in a cumulative list by county for the two strata. There were 109,345 policyholders in the hurricane flood prone stratum and 14,304 in the riverine flood prone stratum. It was decided that an average of 25 interviews each with policyholders and nonpolicyholders, enough work for two interviewers, would constitute a "hit", so that for each county selected, at least 50 interviews could be expected. For large counties with many policyholders, more hits and interviews would be expected. We therefore made 25 selections, or hits, in the hurricane flood prone stratum and 15 in the riverine flood prone stratum. For each county selection, two communities were selected within the county. The sampling interval for counties was 109,345/25 = 4,374 and the expected number of times a given county was selected was equal to the ratio, (number of policyholders in county/4,374) in the hurricane stratum. In the riverine stratum the expected number of times a given county was selected was equal to (number of policyholders in county/954). Two community selections were made for each county selection. For a given community, the expected number of selections was (number of policyholders in community/2,187) in the hurricane stratum and (number of policyholders/477) in the riverine stratum.

Within the selected communities, the policyholders were grouped into geographic clusters. The average size of the clusters was about ten policyholders. These were then selected within communities at rates inversely proportional to the probabilities of the communities being selected. The overall probabilities of selection were 1/74.0 for policyholders in the hurricane flood prone stratum, and 1/19.1 for policyholders in the riverine flood prone stratum.

It was later found that many of the selected policyholders did not meet the eligibility requirements for this study. This was usually because the policy was for a business, or because the policyholder did not live at the address for which the policy had been bought. In addition, there were other selected addresses which could not be found on a map and for which directions could not be given to an interviewer. Both ineligible selections and addresses which could not be found were eliminated from the sample. An example of an address which could not be found was, "Box 290, Biloxi, Mississippi". After eliminating the ineligibles and those that could not be found, the final number of selected hurricane flood-prone policyholders was 1,205 and the number of riverine flood prone respondents was 630.

The holders of earthquake insurance policies were selected in an analogous manner. Two months in the period, August, 1972, through July, 1973, were selected randomly and separately for each of the eight companies, one from the first six months of the period and one from the second six months. All policyholders paying premiums in one of the selected months were listed and sent to us by the companies. Altogether, about 6,000 names were selected by the companies in this manner. We then grouped these names by county and estimated the rates at which homeowners had bought insurance in each county. Only those counties where the rates of buying were sufficiently high were included in the study. These were:

County	Rate at Which Homeowners Bought Insurance (%)
San Mateo	5.10
Santa Clara	3.51
Marin	1.98
Ventura	1.94
Sonoma	1.68
Alameda	1.65
San Francisco	1.56
San Bernadino	1.25
Los Angeles	1.02
Contra Costa	1.01
Orange	.79

The counties excluded from the study which had the next highest rates of buying were Riverside, with a rate of 0.57 percent, Kern, with 0.36 percent, and Santa Barbara, with 0.24 percent. Two counties with higher rates of buying were excluded because of their isolated locations and small populations. These were Del Norte, where the rate was 1.21 percent, and Santa Cruz, where the rate was 0.93 percent.

The 6,000 names were grouped into pages which were subselected at the rate of 8 in 25. The names on the selected pages were then grouped geographically, just as the selected names in the flood samples had been, and then clusters were then subselected at the rate of 1 in 2. The overall sampling fraction for the earthquake policyholders was therefore

$$2/12 \times 8/25 \times 1/2 = 1/37.5.$$

In analyzing the data for flood and earthquake insurance policyholders, it should be kept in mind that eligibility was defined for a given period and that the status of the person living in the house for which the policy was bought could have changed since August, 1973, for the flood sample and July, 1973, for the earthquake sample. The unit of observation was the address. In the event that the owner no longer lived at the address, and the home was now a rental unit, the persons living there were not eligible for interviewing. If the home was now owned and lived in by another person, an interview was conducted whether the new homeowner owned a policy or not. The actual definition of whether a respondent is a policyholder, for the purposes of analysis, should therefore be taken from the appropriate response on the questionnaire. We should also note that some of the addresses selected in our sample of nonpolicyholders which did not appear on our list of policyholders turned out to have policyholders in them, either because they had only recently bought a policy or because of an error in the listing supplied by the NFIA. In addition, care in analysis should also be made concerning the somewhat arbitrary definition of our sample. We have no idea what the characteristics of earthquake policyholders doing business with other companies or outside our 11 county area are, nor do we know what are the characteristics of flood insurance policyholders living either at the addresses we could not find or in counties with less than 25 policyholders.

3. Sampling Nonpolicyholders

The universe of nonpolicyholders in the flood areas included all persons not holding flood insurance policies who owned the home in which they were living and whose home was in a flood prone area recognized by the National Flood Insurance Administration. The specific rules for inclusion were as follows:

a. the person owning the home lived in it,

b. the home was in the list of counties obtained from the NFIA list including at least 25 policyholders,

c. the homeowner was not included in the NFIA list, and

d. the area in which the homeowner was living had been rated by a hydrographic survey as having a recognizable non-zero probability of flood damage.

The first stage of selection for the flood nonpolicyholders was the selection of communities described in Section 2 for the policyholders. Differential sampling was used in the second stage of selecting nonpolicyholders in order to increase their comparability with the policyholders. Nonpolicyholders living in areas where policyholders were thought to be concentrated were selected at higher rates than nonpolicyholders living in other areas. This oversampling was accomplished by stratifying areas within the selected communites on the basis of the objective probability of flood damage assessed by the hydrographic survey and by stratifying communities on the basis of the overall rate of policy buying. Within each of the hurricane and riverine flood prone strata, communities were sorted into three categories depending on the overall rate of buying. Areas within each community were sorted into two cells depending on the probability of flood damage, giving a total of six cells within each stratum.

Hydrographic surveys had been carried out in each of the communities participating in the NFIA program and geographic zones were delineated on the basis of the objective probabilities of flood damage assessed on the basis of the survey data. Areas where the probabilities were highest were labeled either Zone A or Zone V. According to estimates of the National Flood Administration, about 64 percent of all policyholders live in such areas. Areas where there was no perceptible probability of damage, Zone D, included about 6% of all policyholders and were excluded from the universe of nonpolicyholders. The areas of moderate probability, labeled Zones B and C included the remaining 30 percent of policyholders. The six cells into which nonpolicyholders were stratified for the two samples of nonpolicyholders are shown along with the sampling intervals below:

		Estimated Percentage of Owner-Occupied Homes with Policies in Community	Interval (in Housing Units) of Selecting Areas within Communities	
			Zones A and V	Zones B and C
Hurricane	1	5 percent or less	2,536	11,664
	2	6 to 15 percent	1,903	5,293
	3	16 percent and over	713	1,984
Riverine	1	1 percent or less	544	12,444
	2	2 to 10 percent	544	4,148
	3	11 percent and over	272	2,074

About 10 interviews were expected for each area selection.

Within each of the 12 community-zone cells, census tracts in metropolitan areas and enumeration districts in nonmetropolitan areas were ordered in a list, the numbers of owner-occupied housing units in each area as of the 1970 Census were cumulated, and the tracts and enumeration districts were selected systematically using the intervals given in the table. Within the selected tracts or enumeration districts, two listing areas, blocks or clusters of blocks including 10 or more owner-occupied housing units, were selected by the same process. The numbers of owner-occupied housing units for individual blocks were given for census tracts by the 1970 Census, but it was necessary to estimate the distribution of owner-occupied housing units within the enumeration districts using only a map of the area. The overall probability of a Listing Area being selected was therefore proportional to its size within its community-zone cell. This probability can be written as a product of several terms as shown below:

Pr (Listing Area i Selected) = $P_i = A_i \times B_i \times C_i \times D_i$, where

A_i = (number of policyholders in community)/I_1, where I_1 = 2187 in the hurricane flood-prone stratum and 477 in the riverine flood-prone stratum,

B_i = (number of owner-occupied housing units in community)/I_{2c}, where I_{2c} is the interval for the community-zone cell c given in the previous table,

C_i = (number of owner-occupied housing units in tract or ED)/ (number of owner-occupied housing units in the community), and

D_i = 2 x (number of owner-occupied housing units in Listing Area)/(number of owner-occupied housing units in the census tract or enumeration district).

The selected Listing Areas were then sent to ISR's Field Department and all housing units were listed in the field by an interviewer. These listings were returned to the Sampling Department, and the listed housing units were subselected at a rate $1/f_i$, which equalized the probabilities of selection within a community-zone cell, i.e., within each of the 12 cells the probability of selection was $P_i/f_i = K_c$.

There were some Listing Areas where the actual number of listings was unexpectedly large, either due to a high rate of growth since 1970 or errors in the estimated distribution of housing within a selected enumeration district. In order to reduce the increase in variance due to such a large amount of clustering, listings were subselected at a lower rate than for other sample Listing Areas in the same community-zone stratum. The weights which will be necessary to use in analysis of the data include adjustments for variations in the rates of sampling. These weights are listed in Appendix A.

Turning now to the earthquake nonpolicyholders, the sampling proceeded in a similar manner. Although there was no analogy to the hydrographic surveys carried out in the flood-prone areas, we observed considerable clustering of earthquake policyholders within the 11 county area delineated for the sample of earthquake policyholders. We therefore grouped the policyholders supplied by the insurance companies into communities and estimated the rate of policy buying in each. All nonpolicyholding homeowners living in communities where there were at least five policyholders from the sample of 6,000 names supplied by the insurance companies were included in the universe. The remaining areas were omitted from the universe just as Zone D was eliminated in the flood-prone communities. We estimate that the communities included in our universe include 96 percent of all policyholders in the 11 county area.

The rate of policyholding was higher in northern California communities outside of San Francisco and Oakland than it was in those cities and in southern California. The rate in these northern communities, or "Group A," was about twice what it was in the remaining communities, which we labeled "Group B." About 44 percent of all policyholders lived in Group A. We therefore oversampled nonpolicyholders in Group A so that about 44 percent of all selected nonpolicyholders also lived in these communities. Communities, census tracts, and Listing Areas were selected in the manner described for the flood sample. The probability of selection of a given Listing Area in Group A was equal to the number of owner-occupied units divided by 17454.5 and in Group B, the denominator was 29714.5. The houses in selected Listing Areas were enumerated by Field Department interviewers and these listings were subselected at rates inversely proportional to the probability of selection of the Listing Area. Multiplying these two sampling rates together, the overall probability of selection of a housing unit in Group A was 1/164 and in Group B, the rate was 1/278.

Within a selected household, in both the flood and earthquake samples, all persons who considered themselves to be knowledgeable about financial decision-making within the household were listed on the Call Report Form and one of them was selected randomly. Because the unit of observation was the household rather than individuals within the household, the number of such eligible respondents in a particular household is not relevant to the sampling procedure and will therefore not be included in the weighting scheme presented in Appendix A.

4. Expanding the Sample

After interviewing had begun, it became necessary to increase the size of the sample beyond what had originally been selected. This was due to lower eligibility and completion rates than had been anticipated prior to the start of interviewing. The sample of policyholders was expanded simply by selecting more clusters. This expansion was included in the final sampling fractions given in Section 2 and the weights given there are the ones that should be used in analyzing the data. For the nonpolicyholders, a slightly more complicated procedure was followed.

Because of costs, we were not able to select and list additional Listing Areas. To expand the sample, we reselected a subset of the previously selected Listing Areas and selected previously unselected housing units within them. In reselected Listing Areas where fewer than 40 percent of the listings had already been selected, we simply doubled the sample. In other cases, we simply included all remaining households in the sample. The probabilities of selection thus depended on the size of the original within Listing Area sampling interval, f_i, which in turn depended upon the probability of selection of the Listing Area, P_i. The final probabilities of selection of households in the samples of non-policyholders were as follows:

Stratum	Proportion of LAs Reselected	Overall Sampling Rates $f_i \geq 2.5$	Overall Sampling Rates $f_i < 2.5$
Hurricane flood	80%	$1.8P_i/f_i$	$(.2/f_i + .8)P_i$
Riverine flood	15%	$1.15P_i/f_i$	$(.85/f_i + .15)P_i$
Earthquake	20%	$1.2P_i/f_i$	$(.8/f_i + .2)P_i$

To illustrate with an example, suppose that f_i for an LA in the hurricane flood prone stratum was 4.0. Then the overall probability of selection of a given house in that LA would have been P_h, where

$$P_h = P_i/4 + (.8)(3/4)(P_i/3) = 1.8P_i/4.$$

Had the value of f_i been a smaller number, say 1.8, P_h would have been been

$$P_h = P_i/1.8 + (.8)(.8/1.8)(1 \times P_i) = 1.64P_i/1.8$$

$$\text{or}((.20 + 1.44)/P_i)/1.8 = (.2/1.8 + .8)P_i.$$

The complete list of weights or inverses of the probabilities of selection are given in Appendix A.

5. Sampling Errors, Weights, and Other Implications of Statistical Design

Many statistical techniques commonly used in the analysis of social science data depend on assumptions not commonly met by the design of a household survey. Among these are the assumptions of simple random sampling, equal probabilities of selection, and a non-zero probability of selection of every element in the universe. All three of these assumptions were violated in this survey. The implications of these violations are to be discussed below.

The statistical model of simple random sampling assumes that all selections are made independently of one another. If this model were used in survey sampling, it would mean that respondents were distributed evenly across the country maximizing the distance between them and the cost per interview. We could not have afforded to carry out such a survey, so we clustered our interviews by county, community, census tract or enumeration district, and Listing Area. The main consequence of this clustering, and loss of independence among observations, is for significance testing.

The decision to accept or reject a null hypothesis in significance testing depends in part on the number of degrees of freedom provided by the data. In most tests based on a model of simple random sampling the number of degrees of freedom is close to the actual number of observations. In cluster sampling, the number of independent observations is equal to the number of primary selections, counties in the flood sample and communities and clusters in the earthquake sample. The equivalent degrees of freedom is an empirical question, depending on the amount of homogeneity within the primary selections. The computation of the equivalent sample size under a simple random sampling model, or "effective n" is somewhat complex in the simplest situations and intractable for more complex statistics. The strategy for dealing with this problem in analysis is to use statistics where sampling errors can be computed taking the clustering into account. Examples of such statistics are proportions, differences between proportions, and regression coefficients. Instructions for computing sampling errors for proportions and differences between proportions are given below. Sampling errors of regression coefficients can be computed using a computer program available at the Survey Research Center, University of Michigan. A second category of statistics should simply not be computed because their underlying assumptions are violated by our design. A leading member of this category is the chi-square statistic. A third category of statistics is those which either do not depend upon significance testing or where the assumptions are sufficiently robust that our use of cluster sampling has only a small or negligible effect. This is a gray area between mathematics and practicality where statisticians prefer not to tread but which we should investigate should the analytical need arise.

The recommended technique for computing standard errors of proportions or differences between proportions, known as the method of "successive differences", involves the successive comparisons of differences between proportions found in successively selected primary sampling units and the computations of the average difference to what would have been obtained using simple random sampling (srs). This can also be done for subgroups or for differences between two subgroups irrespective of whether the subgroups are found in the same primary sampling units. The ratio of the average of the successive differences and the srs variance is known as the "design effect", an estimate of the increase in error due to the use of cluster sampling. The variance of an estimate of the design effect for an individual variable is sizable and it is recommended that design effects be computed for categories of variables and an average value be used for all of the variables in a given category. Because the sampling plan involved the delineation of three geographic subgroups, homeowners living in hurricane flood prone, riverine flood prone, and earthquake prone areas, it is recommended that separate design effects be computed for each group which can later be combined if necessary. The procedure of successive differences is as follows:

Define the following terms:

$X = \sum_{i=1}^{m} x_i$, where x_i is the weighted sum of observations for primary selection i, and m is the number of primary sampling units,

$Y = \sum_{i=1}^{m} y_i$, where y_i is the weighted sum of observations for primary selection i, for a study variable,

$R = Y/X$, the proportion for which the sampling error estimate is desired,

$A = \sum_{i=1}^{m-1} (y_i - y_{i+1})^2$, $B = \sum_{i=1}^{m-1} (x_i - x_{i+1})^2$,

$C = \sum_{i=1}^{m-1} (y_i - y_{i+1})(x_i - x_{i+1})$,

$VAR = (1/X^2)(m/2(m-1))(A + R^2B - 2RC)$, the estimated variance of the proportion R,

SRV = the simple random variance(weighted), which would have been computed with the same number of cases, and

DEFF = VAR/SRV.

The weighted value of SRV can be obtained by computing the simple random variance without weights and multiplying this value by the ratio

$$\frac{(\Sigma n_h)(\Sigma n_h k_h 2)}{(\Sigma n_h k_h)^2}$$ where k_h= weight assigned to subgroup h, and n_h= number of elements assigned to subgroup h

While VAR could be taken as an estimate of the variance for the individual proportion R, it is recommended that the average value of DEFF be computed for categories of variables. The actual variance to be used for computing confidence intervals for all variables in a given category would then be (SRV)(DEFF) where SRV is computed for each variable and DEFF applies to all variables in the category. It is important in using the successive differences procedure to order the primary selections in the order in which they were selected. This ordering for the three subgroups is given in Appendix B.

The need to use weighted data is necessitated by the use of differential sampling fractions in selecting representative samples of our six groups. The weights, or inverses of the sampling fractions used are given in Appendix A by Listing Area for nonpolicyholders and for the total groups of policyholders. The main problems of using weighted data are (1) that the variances of sample statistics are increased, (2) certain statistical procedures involving significance testing are complicated, and (3) it is difficult to use some statistical packaged computer programs.

Using these weights, it will be possible to make inferences to the entire homeowning populations in our flood and earthquake communities. Because there are so many more nonpolicyholders in the populations, these will overwhelm the policyholders in the analyses using weighted data. Nonpolicyholders in areas where the rates of buying policies are low have particularly large weights. The philosophical question of what types of inferences are to be made should be discussed at some length. For analyses where geographical location is important it may be desired to use the weighted data as given. For other analyses, however, it may be more desirable to reduce the sampling variation by using unweighted data for samples of policyholders and nonpolicyholders which are geographically similar. This will raise basic questions about the nature of the universe for which inferences are desired, because the sample will not be representative of any known universe. However, when considering this question, it should be realized that there are also problems with using the weighted data. Among these are the following:

a. There is possibly a sizeable bias due to nonresponse. This will be discussed in Section 6.

b. The set of communities now in the flood control program may be very different from the set of communities where the national policy would be applied.

c. There were some communities or sections of communities within the flood prone population which were eliminated from the study either because we could not locate the address on a map or because there was a large concentration of seasonal units in the area.

d. Earthquake insurance policyholders doing business with companies not cooperating with the study were also excluded.

e. It may be necessary to control for geographical location in comparing policy and nonpolicyholders on other variables, if geographical location is an important determinant of buying behavior. Dropping the weights will produce groups of policyholders and nonpolicyholders which are more comparable geographically.

The issue of weighting is a difficult philosophical issue for which no recommendation can be made without further discussion of substantive and statistical issues.

WEIGHTS TO BE ASSIGNED TO FLOOD NONPOLICYHOLDERS BY LISTING AREA

LISTING AREA	WEIGHT	LISTING AREA	WEIGHT	LISTING AREA	WEIGHT
111	560	1416	370	3431	320
121	260	1421	620	3432	320
122	330	1422	480	3433	310
123	840	1423	590	3541	2690
221	2530	1424	430	3631	320
311	510	1425	500	3641	1340
312	500	1511	140	3731	340
313	660	1512	280	3732	320
314	280	1513	140	3733	320
315	980	1521	280	3734	320
316	500	1711	750	3741	1310
411	140	1721	610	3742	1380
412	150	1811	540	3743	1330
511	560	1921	1460	3831	330
611	560	2011	2060	3841	2600
711	280	2211	2460	3842	2710
721	2370	2311	2610	3843	2700
722	1670	2321	2000	3931	50
811	140	2322	940	3932	40
911	1990	2411	1140	3933	50
1011	900	2412	750	3934	40
1111	2370	2611	500	3941	180
1211	130	2612	350	4031	360
1212	280	2613	500	4241	1350
1213	230	2614	280	4331	340
1214	160	2615	300	4332	320
1215	560	2621	300	4333	460
1221	500	2622	560	4334	320
1222	280	2911	620	4431	310
1223	290	3031	320	4432	30
1224	280	3032	1790	4433	360
1225	290	3231	320	4434	320
1226	330	3232	360	4441	1970
1411	270	3233	340	4442	1380
1412	280	3241	1450	4443	1510
1413	230	3242	1430	4444	1370
1414	350	3331	320	4445	1510
1415	440	3341	1330	4446	1330

Weights for hurricane flood policyholders (first 2 digits of Listing Area 01 through 29) are 74; for riverine flood policyholders (first 2 digits of Listing Area 30 through 44), 19.

WEIGHTS TO BE ASSIGNED TO EARTHQUAKE NONPOLICYHOLDERS BY LISTING AREA

LA	WEIGHT	LA	WEIGHT	LA	WEIGHT	LA	WEIGHT	LA	WEIGHT
50901	137	55901	128	59901	137	63901	214	63911	232
50902	137	55902	137	59902	126	63902	232	63912	232
51901	137	56901	146	60901	232	63903	232	63913	232
51902	137	56902	137	60902	228	63904	232	63914	232
52901	137	56903	126	60903	232	63905	232	64901	232
52902	137	56904	144	60904	232	63906	232	64902	232
53901	144	57901	137	61901	232	63907	232	65901	232
53902	137	57902	149	61902	232	63908	236	65902	221
54901	128	58901	137	62901	221	63909	232	66901	236
54902	137	58902	137	62902	217	63910	232	66902	244

Weights for earthquake policyholders are 37.5.

APPENDIX B

ORDERING OF SELECTIONS (BY LISTING AREA NUMBER)

EARTHQUAKE POLICYHOLDERS (full five-digit numbers)

1.	63001	17.	74001	33.	82001	49.	94001	65.	98001
2.	63002	18.	75001	34.	83001	50.	57001	66.	96002
3.	63003	19.	63009	35.	66001	51.	57002	67.	98002
4.	63004	20.	76001	36.	84001	52.	95001	68.	98003
5.	63005	21.	63010	37.	85001	53.	53001	69.	59001
6.	63006	22.	63011	38.	86001	54.	55001	70.	99001
7.	63007	23.	63012	39.	87001	55.	54001	71.	56001
8.	63008	24.	63013	40.	88001	56.	54002	72.	78001
9.	67001	25.	63014	41.	89001	57.	61001	73.	79001
10.	64001	26.	77001	42.	90001	58.	61002	74.	73001
11.	68001	27.	77002	43.	91001	59.	61003	75.	56002
12.	69001	28.	77003	44.	52001	60.	60001	76.	56003
13.	70001	29.	76002	45.	52002	61.	60002	77.	56004
14.	71001	30.	80001	46.	92001	62.	50001	78.	56005
15.	72001	31.	63015	47.	93001	63.	96001	79.	56006
16.	72002	32.	81001	48.	93002	64.	97001	80.	56007

EARTHQUAKE NONPOLICYHOLDERS
(first 2 digits of five-digit number--third digit is always 9)

1.	58	6.	54	10.	55	14.	63
2.	59	7.	53	11.	61	15.	64
3.	50	8.	57	12.	60	16.	65
4.	51	9.	56	13.	62	17.	66
5.	52						

FLOOD POLICY AND NONPOLICYHOLDERS (first 2 digits of four-digit number)

1.	04	7.	18,19	13.	28,29	19.	30,31	25.	32
2.	05,06, 07,08	8.	20,21	14.	26	20.	40	26.	44
3.	10,11	9.	12,13	15.	24,25	21.	41	27.	45
4.	01,02	10.	14	16.	22	22.	35,36, 37,38	28.	42
5.	09	11.	15	17.	23	23.	33,34	29.	43
6.	03	12.	27	18.	16,17	24.	39		

Appendix A.2

Development of the Wharton Community Disaster Model

Work is progressing on the development of a community flood and earthquake disaster model as a tool for comparing costs to individuals, the insurance industry, and relevant government agencies under alternative hazard mitigation and disaster relief programs.

Comparisons are made using a computer program in which individual homeowners are represented in considerable detail with respect to their socioeconomic characteristics (e.g. age, income and education) and characteristics of their properties (e.g. value of house, type of construction, location in flood plain) in the pre-disaster period. These variables interact with policies and events in the pre-disaster period, the disaster itself, and disaster relief policies, all inputs to the computer program. This highly disaggregated view is consistent with the research objectives of the overall project. It permits us to integrate data on flooding or earthquake phenomena with data on individual behavior obtained from the survey for the purpose of policy evaluation. This Appendix describes the modeling effort and a pilot study based on constructing a representative community from field survey data.

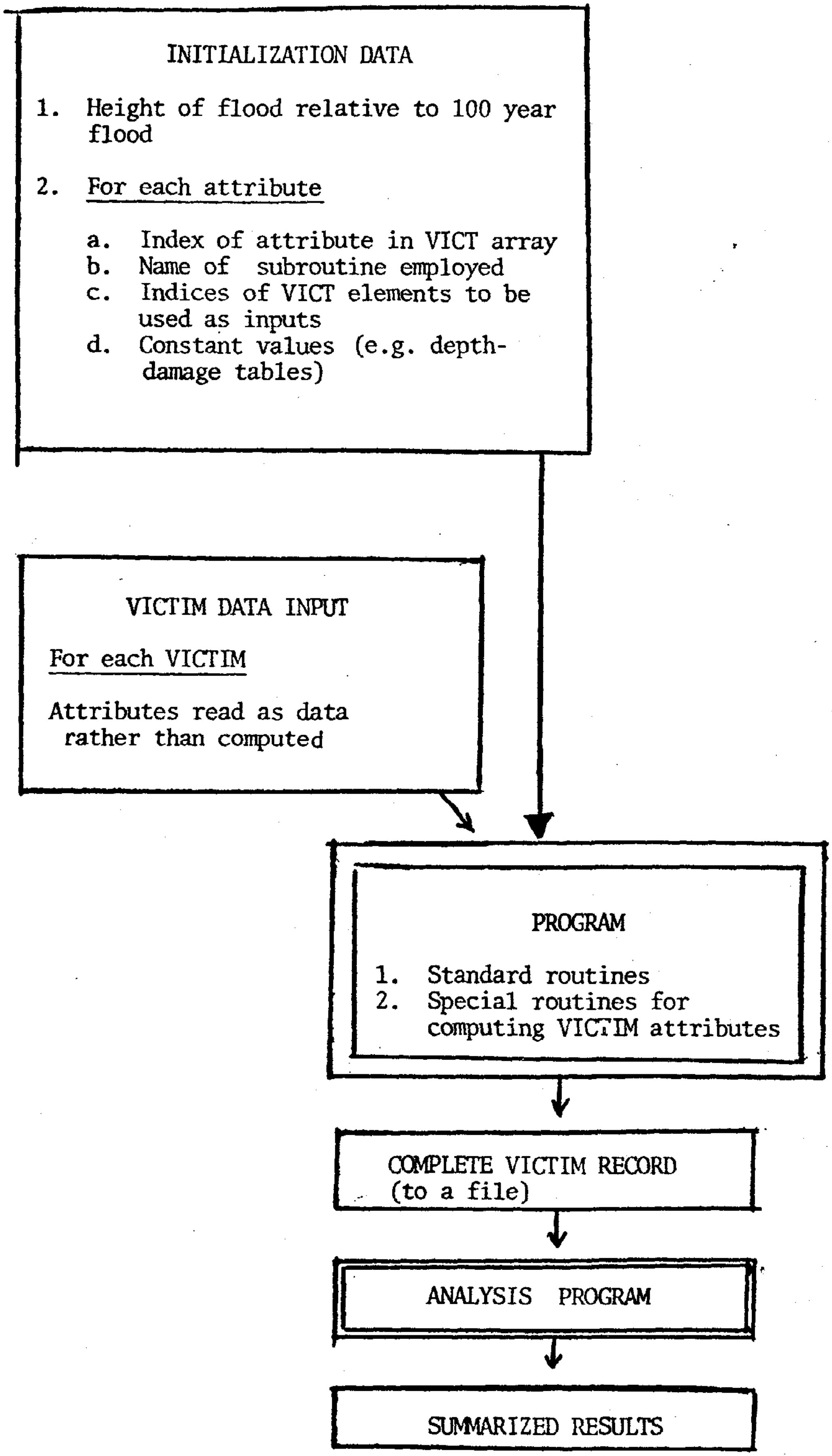
1. Modeling Concepts

Over the past year we have developed concepts of model structure that permit a high degree of flexibility so that it is relatively easy to change data requirements, internal relationships, and outputs. This is important because it will enable us to modify model structure and incorporate additional variables as the need arises. For example, we can incorporate relationships uncovered in the analysis of the survey data, examine alternative disaster relief programs suggested by federal agencies or new legislation, and utilize more refined depth-damage relationships without having to undertake a whole new programming effort. The only condition for incorporating these new factors will be a clear definition of relationships and availability of relevant data.

At the risk of being a bit technical, it may help to describe briefly the basic ideas employed to achieve flexibility for the flood model. A similar model will be developed for studying homeowners in our earthquake-prine areas. Figure 1 is an overview of how the model is organized. Central to the scheme is a representation of each individual (referred to as a "victim") as an array of numbers called VICT. For each victim, there is an input record containing some basic attributes such as ground floor elevation, house value, house type, income and amount of insurance. Every attirbute of a victim is assigned one position in the array, e.g. attribute 4 of VICT may contain estimated annual income. The remaining attributes are computed sequentially on the basis of their assigned positions in the VICT array; any attribute that has already been computed can be used as data in the computation of another attribute.

As part of the initialization process (processing that occurs before any computations relating to individuals are made), data is read indicating for each position in VICT (i.e. victim attribute) the name of the subroutine used to compute the attribute, lists of other attributes used in the computation, and constant values (e.g., depth-damage tables, percent deductible, interest rate on SBA loans, etc.) required to compute relevant post-disaster positions. (e.g. property damage from a 100 year flood, insurance collected, and SBA loan size).

Figure 1. Processing Scheme Employed by WCFDM



After all attributes of a victim have been computed, his record is written into a file and the next victim is processed. Subsequently, the file is read by an analysis program to summarize the results.

This scheme results in a computer program that is highly modular, consisting of a large number of small easily written routines that are easily replaced. In addition the data base is organized so that its structure is determined by data elements instead of being inflexibly set in the course of writing the computer program.

Using this structure, it is quite easy to run the model. Table 1 indicates the victim attributes and the interrelationships which were used in our pilot study.

2. Application of Modeling Concepts to Pilot Study

a. Basic Assumptions

The community consists of 238 homeowners with attributes derived from the field survey. Each household is represented by: Residence value, value of contents, type of house, elevation with respect to 100 year flood, age, income, education level, and amount of flood insurance in force. A sample of respondents from the field survey has been combined to manufacture the hypothetical community. The following assumptions have been made with respect to the property and socio-economic characteristics of homeowners in the community:

Residence Value. Derived from data on the purchase price of the house (Q.195) current value of house (Q.196), purchase date of house (Q.193) and date of most severe flood (Q.72).

Contents value. The contents value is related to residence value (r.v.) in the following manner:

Table 1

Attributes of Representative Community and Data Sources

Number	Attribute	Data Sources
1	Victim Identification Number	----
2	Annual Income	Field Survey (Q. 218,220)
3	Age of household head	Field Survey (Q. C4 of screening form)
4	Education level	Field Survey (Q.207,213)
5	Flood Insurance Status (1=insured; 0=uninsured)	Field Survey (Q. 76)
6	Insurance coverage on house	Field Survey (Q. 54)
7	Insurance coverage on contents	Field Survey (Q. 54)
8	Type of house	Field Survey (Q. 101, 106, 107)
9	Location of contents	Inferred from Attribute 8
10	Elevation of house in relation to 100 year flood	Field Survey (Q.68) and FIA Depth Damage Curves
11	Property value	Field Survey. Interpolated value-based on purchase price, current value, purchase data and date of worst flood (Q.195, 196, 193, 72)
12	Contents value	Derived from Attribute 12
13	Property damage	Computed from Attributes 8, 10 and 11 using FIA depth damage curves
14	Contents damage	Computed from Attributes 9 , 10 and 12 using FIA depth damage curve
15	Total damage	Sum of Attributes 13 and 14
16	Property insurance coverage	Program IV--0 coverage Programs I,V and VI -- Attribute 6 Programs II and III--Maximum of property value and insurance limit

Table 1 (Continued)

Number	Attribute	Data Source
17	Contents insurance coverage	Program IV--0 coverage Programs I,V and VI--Attribute 7 Programs II and III--Maximum of contents value and insurance limit
18	Deductible	Maximum of $200 or 2 per cent of loss for property and contents damage taken separately
19	Insurance claim	Minimum of insurance coverage or damage less deductible for property and contents taken separately
20	SBA disaster loan (Annual interest rate -5% Length -- 20 years)	Total damage (15) minus insurance claim (19) minus deductible (18)
21	Homeowners' unrecovered loss	Total damage (15) minus insurance claim (19) minus SBA loan (20)
22	Homeowner's loan cost	Present value of monthly payments on SBA loan (20) discounted by homeowners' borrowing rate (10%)
23	Government loan cost	Amount of loan (20), minus present value of homeowners' monthly payments discounted at government's borrowing rate (7%)
24	Total homeowner's cost	Sum of attributes 21 and 22

50% of r.v. if r.v. is less than $17,500

40% of r.v. if r.v. is between $17,500 and $35,000

30% of r.v. if r.v. is greater than $35,000

Type of house. Determined from questionnaire based on whether house has a basement (Q. 101), whether it is split level (Q. 106) and number of stories (Q. 107).

Elevation. For those respondents suffering flood damage, ground floor elevation is determined by computing percent damage (i.e. property damage from the most severe flood (Q. 68) divided by residence value). Based on the type of house, and the updated FIA depth-damage curves we determined the water height required to produce this percent damage. We assumed that this damage was caused by a 100 year flood inundating the hypothetical community. This arbitrary procedure for assigning elevations to homes was necessary because ground elevations are not easily accessible and are not provided on FIA flood maps.

Socio-economic variables. The following data are derived directly from the field survey: Age of Household Head (Q. C4 from screening form), Income (Q. 218 and 220) and Education (Q. 207 and 213).

A summary of the attributes of homeowners and their properties with the appropriate data sources appears in Table 1.

b. Distributions of Homeowners' Characteristics

The marginal distributions of the socio-economic and property characteristics of the representative community are detailed in Tables 2 through 8. To illustrate the types of data assembled in each of these tables consider Table 2, based on the age distribution of household heads. For each of the five age classes, descriptive statistics are presented on average annual income and average property value. Thus homeowners in the age class 41-50 have the highest average annual income ($23,200); the 51-60 age class has the highest property value ($47,503). Table 2 also summarizes the pre-and post-disaster positions of homeowners in each of the age classes if Program I is in effect. For example, 30 of the 42 homeowners age 40 or under had flood insurance policies; the average coverage for these 30 homeowners was $23,496. Only 25 of these homeowners had flood insurance claims from damage caused by a 100 year flood.

Tables 3 through 9 present similar summary data for the other variables describing the hypothetical community. The pre- and post-disaster positions of residents are all based on Program I being in effect.

Table 2.

Distributions by Age of Household Head

Age of Household Head			Average Annual Income	Average Property Value	Flood Insurance in Force		Homeowners with Damage from 100 yr. Flood		Flood Insurance Claims		SBA Loans		Average Homeowner's Total Cost
Upper Limit	No.	Average			No. of Policies	Average Coverage	No.	Average Amount	No.	Average Amount	No.	Average Amount	
40	42	34	22667	46832	30	23496	33	7643	25	7164	11	5754	1609
50	50	46	23200	42617	34	18459	36	7643	22	6989	19	6266	2526
60	66	55	19652	47503	46	24170	45	6161	28	6555	22	3783	1499
70	66	66	13607	34863	36	16050	44	4593	25	4910	23	3010	1306
85	14	77	11357	34719	8	12199	6	5775	3	5693	5	3273	2067

Table 3.

Distributions by Annual Income

Annual Income			Average Age	Average Property Value	Flood Insurance in Force		Homeowners with Damage from 100 yr. Flood		Flood Insurance Claims		SBA Loans		Average Homeowner's Total Cost
Upper Limit	No.	Average			No. of Policies	Average Coverage	No.	Average Amount	No.	Average Amount	No.	Average Amount	
7500	36	4670	64	26067	20	15080	26	3936	13	4062	15	2956	1366
10000	40	9600	64	28946	24	22900	28	6235	18	8544	11	2574	938
15000	48	13625	47	45387	24	17372	35	7371	19	7187	21	5394	2447
25000	46	20087	47	43107	28	22892	31	7739	16	10617	18	3503	1617
35000	46	28609	52	49110	42	22404	27	6730	25	5119	7	6295	1645
50000	22	46394	50	50154	16	17050	17	5409	12	2465	8	7271	2587

Table 4.

Distributions by Education Level of Household Level

	Education Level	No.	Av. Age	Average Annual Income	Average Property Value	Flood Insurance in Force: No. of Policies	Flood Insurance in Force: Average Coverage	Homeowners with Damage from 100 yr. Flood: No.	Homeowners with Damage from 100 yr. Flood: Average Amount	Flood Insurance Claims: No.	Flood Insurance Claims: Average Amount	SBA Loans: No.	SBA Loans: Average Amount	Average Homeowner's Total Cost
(2)	1-8 yrs.	32	62	11814	31722	16	13164	25	4579	12	4611	15	3622	1679
(3)	9-11 yrs.	32	57	15252	32825	22	15110	22	5539	14	5410	10	4032	1517
(4)	H.S. grad.	66	53	18167	45562	40	23740	44	6042	25	6141	22	4689	1812
(5)	College	38	50	16921	16374	22	22137	25	8319	15	8195	14	5608	2409
(6)	College grad.	46	52	24739	15373	42	20148	34	8640	30	7765	11	4395	1339
(7)	Post grad.	24	51	25833	14242	12	24332	14	3190	7	2246	9	2949	1469

Table 5.

Distributions by Residence Value

Residence Value: Upper Limit	Residence Value: No.	Residence Value: Average	Av. Age	Average Annual Income	Average Property Value	Flood Insurance in Force: No. of Policies	Flood Insurance in Force: Average Coverage	Homeowners with Damage from 100 yr. Flood: No.	Homeowners with Damage from 100 yr. Flood: Average Amount	Flood Insurance Claims: No.	Flood Insurance Claims: Average Amount	SBA Loans: No.	SBA Loans: Average Amount	Average Homeowner's Total Cost
10000	16	6667	58	13750	9938	8	10276	14	2698	6	2698	8	1774	865
13000	24	12938	60	15083	19428	10	10601	17	3741	6	1192	14	3861	2315
20000	24	17808	63	15833	25708	20	16612	15	6707	13	6124	4	3948	1067
25000	42	22554	50	15976	32482	23	18695	26	5964	12	7350	17	3656	1815
30000	12	27733	56	15917	38758	5	9199	7	6438	1	2424	6	7042	4185
35000	24	32871	54	16335	45763	16	21813	17	7786	11	9578	9	2491	1172
40000	20	37588	51	20100	49881	14	21857	15	6100	11	7131	6	1450	687
45000	30	42532	50	19467	55861	20	24249	22	8622	16	7173	8	8531	2424
50000	20	47165	48	24600	62249	14	20642	16	10448	12	8213	7	9023	3041
99000	26	57715	51	29692	75073	24	29208	15	4380	15	4080	1	234	345

Table 6.

Distributions by Contents Value

Contents Value: Upper Limit	Contents Value: No.	Contents Value: Average	Av. Age	Average Annual Income	Average Property Value	Flood Insurance in Force: No. of Policies	Flood Insurance in Force: Average Coverage	Homeowners with Damage from 100 yr. Flood: No.	Homeowners with Damage from 100 yr. Flood: Average Amount	Flood Insurance Claims: No.	Flood Insurance Claims: Average Amount	SBA Loans: No.	SBA Loans: Average Amount	Average Homeowner's Total Cost
5000	16	3271	58	13750	9938	8	10278	14	2698	6	3531	8	1774	865
7500	28	6563	61	14000	20209	14	13286	21	4421	10	3480	14	3862	1951
10000	62	8687	53	16340	29737	34	19370	37	6067	14	9876	17	4588	1665
12500	46	11551	53	16500	46674	38	18447	31	7235	26	6194	16	3441	1479
15000	54	13492	49	22370	55104	34	21882	45	8860	29	8142	23	6508	2571
25000	32	18766	54	27313	72785	26	28693	16	4402	16	4104	1	240	348

Table 7.

Distributions by Type of House

Type House: Stories	Type House: Basement	Type House: No.	Av. Age	Average Annual Income	Average Property Value	Flood Insurance in Force: No. of Policies	Flood Insurance in Force: Average Coverage	Homeowners with Damage from 100 yr. Flood: No.	Homeowners with Damage from 100 yr. Flood: Average Amount	Flood Insurance Claims: No.	Flood Insurance Claims: Average Amount	SBA Loans: No.	SBA Loans: Average Amount	Average Homeowner's Total Cost
1	no	92	58	19392	35202	72	16735	50	8111	39	7799	21	4039	1492
≥ 2	no	20	46	17800	45930	8	31875	11	9340	3	8193	8	9620	4895
Split	no	8	42	25000	44782	8	20750	6	13063	6	11537	2	3196	1189
1	yes	28	52	17679	40498	14	17714	19	5565	8	5876	13	4247	2170
≥ 2	yes	78	52	19192	47238	46	23997	66	3933	41	4021	28	1585	682
Split	yes	12	51	26500	57190	6	23332	12	11024	6	7724	8	10428	4963

Table 8.

Distributions by Elevation (In Relation to 100 Year Flood)

Elevation				Flood Insurance in Force		Homeowners with Damage from 100 yr. Flood		Flood Insurance Claims		SBA Loans		
Upper Limit	No.	Average Income	Average Property Value	No. of Policies	Average Coverage	No.	Average Amount	No.	Average Amount	No.	Average Amount	Average Homeowner's Total Cost
-15	13	17540	35458	10	22980	13	20020	10	17521	6	13319	4599
-10	14	15070	31177	9	14957	14	16505	9	12703	11	10206	5805
- 5	11	14000	34234	9	17189	11	12623	9	10771	6	6329	2718
- 3	10	18100	41678	7	21042	10	10114	7	9037	4	8763	2680
- 2	14	16500	34120	8	20725	14	5842	8	5987	6	5115	1728
- 1	13	22390	45153	11	22146	13	5690	11	5854	4	1294	611
0	27	18630	38510	18	19500	27	2874	18	2640	11	2079	846
1	42	18550	40694	31	18874	10	2365	5	2999	6	1106	655
2	38	21320	47612	27	18199	20	2008	14	1824	7	1292	589
3	33	20500	49480	12	28792	32	628	12	506	20	581	324
4	23	17457	46688	12	22333	0	0	0	0	0	0	0

Table 9.

Distributions by Insurance Coverage on House

Insurance on House							Homeowners with Damage from 100 yr. Flood		Flood Insurance Claims		SBA Loans		
Upper Limit	No.	Average	Average Total Coverage	Average Income	Average Age	Average Property Value	No.	Average Amount	No.	Average Amount	No.	Average Amount	Average Homeowner's Total Cost
0	84	0	0	15179	56	37051	61	4044	0	0	61	4044	2765
5000	26	4492	7400	17040	59	32953	15	4690	15	3141	6	2869	1187
10000	42	9595	14419	20381	52	41938	29	6943	29	5201	5	7720	1320
17500	50	15804	21424	19120	53	43306	30	9085	30	7200	6	7392	1416
25000	20	21100	28850	25600	51	51188	16	11161	16	11559	2	2180	615
35000	16	35000	40000	26500	46	68793	13	4729	13	4405	0	0	324

Appendix A.3

Outline of Flood Questionnaire

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		4. Connection with Homeowner's Policy	49
		5. Convenience of Purchase	50,51
		6. Cost	52
		7. Coverage	53,54
		8. Required to Purchase	55-57
		9. Likelihood to Cancel	63-65
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Appendix A.4

FLOOD QUESTIONNAIRE

INSTITUTE FOR SURVEY RESEARCH
TEMPLE UNIVERSITY
-Of The Commonwealth System Of Higher Education-
PHILADELPHIA, PENNSYLVANIA 19122

Card 1

SPRING, 1974

STUDY #599-400-27

STUDY OF SELECTED

NATURAL HAZARDS

7-10

LA# [ ][ ][ ][ ]

11 13

HU# [ ][ ][ ]

Time interview began: ________A.M.____P.M.

Time interview ended: ________A.M.____P.M.

14-16

(LEAVE THESE SPACES BLANK) [ ][ ][ ]

RESPONDENT'S NAME: ____________________

ADDRESS: ____________________
(NUMBER) (STREET)

____
(CITY) (STATE) (ZIP)

TELEPHONE NUMBER: (   ) ____________________

Good__________. I am __________________ from the Institute for Survey Research at Temple University. We are talking to people about natural disasters, such as floods and earthquakes.

17-20 21-23

INTERVIEWER'S NAME: ____________________ ID# [ ][ ][ ][ ] DATE________

INSTITUTE FOR SURVEY RESEARCH
SPRING, 1974

STUDY #599-400-27

CALL REPORT FORM

AFFIX LABEL

NAME OF FAMILY: ____________________

PHONE NUMBER: (   ) ____________

IF HU IS NOT OWNED OR IS A PLACE OF BUSINESS, ASK: How long have you lived at this address? ______ MONTHS or ______ YEARS

(RECORD CODE 6, RECORD CODE 7, AND DATE AND TIME IN PERSONAL CALL RESULT RECORD.)

PERSONAL CALL RESULT RECORD

CALL	1	2	3	4	5	6
DATE						
TIME						
RESULT*						

*CODES FOR RESULT OF CALL

1. COMPLETED INTERVIEW
2. RESPONDENT NOT HOME (EXPECTED: DATE ______ TIME ______)
3. NO ONE HOME (ASK NEIGHBORS TIME USUALLY HOME): ______ a.m. ______ p.m.
4. REFUSED HOUSEHOLD LISTING (RECORD WHO REFUSED AND REASON): ____________________
5. SELECTED RESPONDENT REFUSED INTERVIEW (REASON): ____________________
6. HOUSE IS NOT OWNED BY PEOPLE LIVING IN HOUSEHOLD (SPECIFY): ____________________
7. BUILDING PRIMARILY USED AS A PLACE OF BUSINESS (SPECIFY): ____________________
8. NO HOUSING UNIT AT GIVEN ADDRESS
9. SELECTED RESPONDENT ABSENT FOR DURATION OF STUDY (EXPLAIN): ____________________
10. LANGUAGE BARRIER (SPECIFY): ____________________
11. VACANT
12. OTHER (SPECIFY): ____________________

INTERVIEWER: ____________________ ID#: __________ DATE: __________

13-36

INSTITUTE FOR SURVEY RESEARCH | SCREENING FORM--FLOODS | STUDY #599-400-27

Good (morning/afternoon/evening). I am _____________ from the Institute for Survey Research of Temple University. We are talking to people about natural disasters, such as floods and earthquakes. In order to determine whom I am to interview, I need to know about the people living in this household.

A. Is this residence owned by the people who live in this household?

	Yes	1
(RECORD NAME, PHONE NO., AND LENGTH OF RESIDENCY ON CALL REPORT FORM, AND TERMINATE)	No	2

B. Is this building used primarily as a place of business?

(RECORD NAME, PHONE NO., AND LENGTH OF RESIDENCY ON CALL REPORT FORM, AND TERMINATE)	Yes	1
	No	2

C. Is this household's usual place of residence here or somewhere else?

Here	1
Somewhere else	2

1. How many people live in this household? (CIRCLE NUMBER IN COLUMN 1)
2. What is each person's relationship to you? (IN COLUMN 2, LIST ALL PEOPLE LIVING IN HOUSEHOLD, INCLUDING CHILDREN, BY THEIR RELATIONSHIP TO THE REPORTER, WHO MUST BE A HOUSEHOLD MEMBER.)
3. IN COLUMN 3, RECORD THE FIRST AND LAST NAMES OF ALL PERSONS LISTED IN COLUMN 1.
4. IN COLUMN 4, RECORD THE AGE OF EACH PERSON.
5. IN COLUMN 5, RECORD THE SEX OF EACH PERSON BY CIRCLING THE APPROPRIATE CODE.
6. IN COLUMN 6, RECORD AN H TO INDICATE THE HEAD OF THE HOUSEHOLD.
7. Who in this household knows the most and makes decisions about such matters as insurance?
IF ONE PERSON IS DECISION-MAKER, RECORD AN X IN COLUMN 7 AND AN R IN COLUMN 8, AND INTERVIEW THAT PERSON.
IF TWO OR MORE HOUSEHOLD MEMBERS ARE EQUALLY KNOWLEDGEABLE, RECORD Xs NEXT TO THEIR NAMES IN COLUMN 7. SELECT THE RESPONDENT ALPHABETICALLY FROM THOSE IN COLUMN 7 AS FOLLOWS: SELECT AND INTERVIEW THE PERSON FROM COLUMN 7 WHOSE FIRST NAME COMES FIRST IN THE ALPHABET. RECORD AN R IN COLUMN 8.

COL. 1	COLUMN 2	COLUMN 3		COL. 4	COL. 5		COL. 6	COL. 7	COL. 8
#	RELATIONSHIP TO REPORTER	NAME FIRST	LAST	AGE	SEX M	F	HEAD	DECISION-MAKER	RESPONDENT
1	REPORTER				1	2			
2					1	2			
3					1	2			
4					1	2			
5					1	2			
6					1	2			
7					1	2			
8					1	2			

13-37

First, I'd like to talk to you about something which affects people in this part of the country -- flooding. By flooding we mean an overflow from a body of water such as a river, lake or ocean. Such flooding is due to natural causes, like a spring thaw, storms or hurricanes.

1. Do you consider this immediate neighborhood to be an area where floods can occur?

		24
	Yes	1
(SKIP TO	No	2
Q. 3)	Don't know	8

2. How did you find out about the flood problems around here?

25

(HAND R CARD #1)

3. Here is a list of five things which people living in different places consider to be problems.

   a. Which one of the things on this list do you think is the most serious problem for people in this neighborhood?

   b. Which one is the second most serious?

   c. Which one is the third most serious?

   d. Which one do you think is the least serious problem for people in this neighborhood?

	Letter	
a. Most Serious	______	26
b. Second Most Serious	______	27
c. Third Most Serious	______	28
d. Least Serious	______	29
		30

4. How many years have you lived in this immediate neighborhood, the area right around here?

			31–33
____ MONTHS or ____ YEARS or			
	(SKIP TO Q. 6)	All my life	997

5. Did you think that there were flood problems in this immediate neighborhood when you moved to this neighborhood?

	34
Yes	1
No	2
Don't know	8

6. Did you buy this property, are you buying it, or did you get it in some other way?

		35
	Bought, buying	1
(SKIP TO Q. 11)	Inherited it; gift	2
	Other way (SPECIFY): ____________	3

7. When you decided to buy this property, did anyone tell you there was a flooding problem here?

	Yes	xx
(SKIP TO Q. 9)	No	98

8. Who? (PROBE): Who else?

		36-37
(CIRCLE ALL THAT APPLY)	Real estate agent	01
	Former owner	02
	Tax assessor	04
	Friends or relatives	08
	Neighbors	16
	Other (SPECIFY): ______________	32

9. When you decided to buy this property, did anyone tell you there was not a flooding problem here?

	Yes	xx
(SKIP TO Q. 11)	No	98

10. Who? (PROBE): Who else?

		38-39
(CIRCLE ALL THAT APPLY)	Real estate agent	01
	Former owner	02
	Tax assessor	04
	Friends or relatives	08
	Neighbors	16
	Other (SPECIFY): ______________	32

11. These days, many different kinds of insurance are available to protect people against losses. I'd like to know which kinds of insurance you may have heard of. Have you ever heard of:

	Yes	No (40)
a. life insurance?	1	2
b. hospitalization insurance?	1	2
c. homeowner's insurance?	1	2
d. automobile insurance?	1	2
e. flood insurance?	1	2
f. health insurance?	1	2
g. disability insurance?	1	2

(IF "YES" TO FLOOD INSURANCE, SKIP TO Q. 13)

12. Have you ever heard of insurance which protects homeowners against losses due to floods?

		41
	Yes	1
(SKIP TO Q. 66)	No	2

Now, a few questions about flood insurance. Please keep in mind that we are talking here about insurance for floods caused by natural disasters.

13. As far as you know, is flood insurance subsidized by the government?

	42
Yes	1
No	2
Sometimes	3
Don't know	8

14. How did you first hear about flood insurance?

		43
(CIRCLE ONE ONLY)	Friends, relatives, or neighbors	1
	Newspaper, radio, or television	2
	Mortgage holder	3
	SBA (Small Business Administration)	4
	Insurance agent	5
	Civic organization (SPECIFY): ____________	6
	Other (SPECIFY): ____________	7

15. In this neighborhood, do insurance companies write policies covering damage from floods?

		44
	Yes	1
(SKIP TO Q. 22)	No	2
	Don't know	8

16. In what year did flood insurance become available in this neighborhood?

19____
YEAR

	45-46
Don't know	98

17. What limit, if any, is there on the total dollar amount of flood insurance coverage that homeowners can purchase for a house and its contents?

$________
COVERAGE

		47-51
(SKIP TO Q. 19)	No limit	99997
	Don't know	99998

18. (IF AMOUNT GIVEN IN Q. 17, ASK): How much of that is for the house itself and how much is for the contents of the house?

$________ HOUSE

$________ CONTENTS

52–56

57–61

19. How much does flood insurance cost per year for (coverage from Q. 17/ $20,000 if no coverage given in Q. 17) coverage for a house of the same construction as yours?

$________ COST

62–65

A lot, too much, very expensive	9997
Don't know	9998

(IF COST GIVEN, SKIP TO Q. 21)

20. How much do you think flood insurance costs? Just give me your best guess?

$________ COST

66–69

21. What deductible amount, if any, is written into a policy?

$________ AMOUNT OR ________% PERCENT

70–73

74–75

None	999797
Don't know	999898

22. How do you think people who have flood insurance are paid for possessions damaged from floods? Do you think they are paid the actual value of the damaged possessions, even though it may be less than the original cost, or do you think they are paid the current cost of replacing the damaged possessions with new ones?

	76
Actual value	1
Current cost	2
Don't know	8

23. In flood-prone areas, do banks, loan companies, or government agencies ever require people to buy flood insurance when they borrow money to buy, rebuild, or improve a house?

	77
Yes	1
No	2
Don't know	8

24. Would you consider such a requirement to be fair, unfair, or very unfair?

	78
Fair	1
Unfair	2
Very unfair	3

79—80
34

Card 0

25. Have you ever thought about buying flood insurance?

		7
	Yes	1
(SKIP TO Q. 30)	No	2

26. Was flood insurance available when you first thought about buying it?

	8
Yes	1
No	2
Don't know	8

27. Think back to what caused you to start thinking about buying flood insurance. What made you start thinking about buying it? (CIRCLE ALL THAT APPLY IN COLUMN A) (PROBE): What else?

(IF MORE THAN ONE CIRCLED IN COLUMN A):

28. Which one is the most important reason that you thought you should buy flood insurance? (CIRCLE ONE CODE IN COLUMN B)

(IF MORE THAN TWO CIRCLED IN COLUMN A):

29. Which one is the second most important reason that you thought you should buy flood insurance? (CIRCLE ONE CODE IN COLUMN C)

	Q. 27 COL. A	Q. 28 COL. B	Q. 29 COL. C
		MOST IMPORTANT	SECOND MOST IMPORTANT
Knew area is flood prone	001	01	01
There was a flood here	002	02	02
There was a flood somewhere else	004	03	03
Insurance agent suggested	008	04	04
Friends/relatives suggested	016	05	05
Neighbor suggested	032	06	06
Mortgage holder suggested	064	07	07
Publicity about flood insurance	128	08	08
Required by bank, government agency, or loan agency	256	09	09
Other (SPECIFY): ______________	512	98	98
No (2nd/3rd) mention	//////	00	00

	9-
	12-
	14-15

30. How many different insurance agents, if any, have you been in contact with about buying flood insurance?

		16
(SKIP TO Q. 32)	None	1
	One	2
	Two	3
	Three or more	4

31. (Think about the first agent.) Did you first contact the agent, or did the agent first contact you?

	17
Respondent contacted agent	1
Agent contacted respondent	2
Don't know	8

32. Do you currently have flood insurance on this house?

		18
(SKIP TO Q. 47)	Yes	1
	No	2
	Don't know	8

33. How likely are you to buy flood insurance in the near future? Do you think that you:

		19
(SKIP TO Q. 35)	definitely will buy it,	1
(SKIP TO Q. 35)	probably will buy it,	2
	probably will <u>not</u> buy it, or	3
	definitely will not buy it?	4

34. Why aren't you likely to buy flood insurance in the near future?

20-21

(CIRCLE ALL THAT APPLY)		
	Flood insurance not available	01
	Too expensive	02
	Don't need it	04
	Deductible too high	08
	Other (SPECIFY): ______	16

35. Say you decided to buy flood insurance. How much coverage in dollars would you want to have on your house and its contents?

$______ TOTAL COVERAGE OR $______ HOUSE AND $______ CONTENTS

22-26
27-31
32-36

Don't know	99998 99998 99998

36. What would be the highest dollar amount you would be willing to pay each year for that amount of coverage?

$______ COST

37-40

(SKIP TO Q. 38)	Don't know	9998

37. How did you decide on this amount?

41

38. Have you ever had flood insurance that insures your house and/or its contents against damage from flooding?

		42
	Yes	1
(SKIP TO Q. 43)	No	2

39. Was that (last) insurance bought for this house that you are living in now?

		43
(SKIP TO Q. 41)	Yes	1
	No	2

40. In what city and state is the house you bought that (last) insurance for?

______________ CITY ______________ STATE

44

41. In what month and year did that (last) policy lapse?

______ MONTH AND 19____ YEAR

45-48

Don't know	9898

42. Why didn't you keep that insurance? (PROBE):

49-50

(ALL SKIP TO Q. 47)

43. Have you ever tried to buy flood insurance for your house and/or its contents?

51

	Yes	1
(SKIP TO Q. 46)	No	2

44. In what year was the last time?

19____
YEAR

52-53

45. Why didn't you buy flood insurance at that time?

54-55

(CIRCLE ALL THAT APPLY)	Flood insurance not available	01
	Too expensive	02
	Decided didn't need	04
	Deductible too high	08
	Other (SPECIFY): ____________	16

46. If a severe flood occurred in this area, do you think that insurance companies would or would not be able to pay all the claims?

	56
Would	1
Would not	2
Don't know	8

(ALL SKIP TO Q. 66)

(ASK QQ. 47-62 ABOUT R'S <u>CURRENT</u> FLOOD INSURANCE, OR ABOUT R'S LAST PREVIOUS INSURANCE IF R DOES NOT <u>CURRENTLY</u> HAVE INSURANCE)

47. Now, I'd like to talk about the flood insurance which you (have/had). In what month and year did you first buy flood insurance (on this house)?

_______ MONTH 19____ YEAR

	57-60
Don't know	9898

(Q. 48 HAS BEEN DELETED.)

61

Blank

49. Did you first buy flood insurance at the same time you bought or renewed a homeowner's insurance policy?

	62
Yes	1
No	2
Don't know	8

50. Thinking about the amount of time and effort you spent getting flood insurance, would you say that buying flood insurance was:

		63
(SKIP TO Q. 52)	convenient, or	1
	inconvenient?	2
(SKIP TO Q. 52)	Don't know	8

51. Why do you say that?

64

52. How much (does/did) that insurance cost you each year (now/when your policy lapsed)?

$______
COST

65-68

Don't know	9998

53. What (is/was) the total dollar amount of coverage you (have now/had when your policy lapsed)?

$______
COVERAGE

69-73

(SKIP TO Q. 55)	Don't know	99998

74-78
Blank

54. (IF AMOUNT GIVEN IN Q. 53, ASK): How much of that (is/was) for the house itself and how much (is/was) for the contents of the house?

79-80
34

Card 0

$______
HOUSE

7-11

$______
CONTENTS

12-16

Don't know	99998
	99998

55. Were you ever required to buy flood insurance?

		17
	Yes	1
(SKIP TO Q. 58)	No	2

56. By whom?

		18–20
(CIRCLE ALL THAT APPLY)	FHA (Federal Housing Administration)	001
	VA (Veterans' Administration)	002
	Cal-VET	004
	Bank	008
	Loan Company	016
	Federal Government Disaster Loan	032
	Other (SPECIFY): ____________	064

57. What were the circumstances? That is, why were you required to buy flood insurance?

21–22

58. How many claims have you made on your flood insurance policy?

		23
(SKIP TO INSTRUCTIONS BEFORE Q. 63)	None	1
	One	2
	Two	3
	Three	4
	Four or more	5

59. In what month and year did you make your (last) claim?

__________ 19_____

MONTH YEAR

	24-27
Don't know	9898

60. Was the (last) claim on insurance for this house?

	28
Yes	1
No	2

61. How much in dollars was your (last) claim?

$__________

AMOUNT

	29-33
Don't know	99998

62. How much money did you actually receive from your flood insurance policy?

$________
AMOUNT

34-38

Don't know	99998

(IF R DOES NOT CURRENTLY HAVE INSURANCE, "NO" TO Q. 32, SKIP TO Q. 66)

63. (IF R CURRENTLY HAS INSURANCE, ASK): How likely are you to cancel your flood insurance in the near future. Do you think that you:

39

	definitely will cancel it,	1
	probably will cancel it,	2
(SKIP TO Q. 65)	probably will not cancel it, or	3
	definitely will not cancel it?	4

64. Why are you likely to cancel your flood insurance in the near future? 40-41

(CIRCLE ALL THAT APPLY)	Too expensive	01
	Don't need it	02
	May move	04
	Deductible too high	08
	Other (SPECIFY): ________ ________	16

65. Suppose the cost of flood insurance was increased. What would the yearly cost of flood insurance have to be, for your current coverage, to make you cancel your policy?

42-45

46-78 *Blank*

$______ COST

Don't know	9998

79-80 *34*

Now I'd like to talk about floods you have experienced.

66. How many different times have floods caused damage to this house or its contents while you have owned and lived in this house?

Card

______ NO. OF TIMES

7-8

Don't know	98

67. (Including the floods you just mentioned,) How many times have you suffered flood damage to any house or its contents which you owned and lived in at the time?

______ NO. OF TIMES

(IF "NONE" SKIP TO Q. 97)

9-10

Don't know	98

(IF MORE THAN 5 in Q. 67, ASK Q. 68 ABOUT THE 5 MOST RECENT FLOODS)

68. In what month and year did (each of these/the five most recent) floods take place? (RECORD IN COLUMN A, FROM MOST RECENT TO LEAST RECENT)

COLUMN A MONTH	COLUMN A YEAR	COLUMN B CONTENT DAMAGE	COLUMN B LETTER	COLUMN C STRUCTURAL DAMAGE	COLUMN C LETTER
______	______	$______	or ______	$______	or ______
______	______	$______	______	$______	______
______	______	$______	______	$______	______
______	______	$______	______	$______	______
______	______	$______	______	$______	______

11–24
25–38
39–52
53–66
7–20

67–78 *Blank*
79–80 *34*
Card 01

(FOR EACH MENTIONED IN Q. 68, ASK):

69. How much damage, in dollars, did the (month and year) flood cause to just the contents of your house? (RECORD IN COLUMN B ABOVE) (IF R CANNOT GIVE AMOUNT, HAND R CARD #2 AND ASK): What is your best guess? Tell me the letter on this card which you estimate the damage to the contents of your house was.

(FOR EACH MENTIONED IN Q. 68, ASK):

70. How much damage, in dollars, did the (month and year) flood cause to your house itself? (RECORD IN COLUMN C ABOVE) (IF R CANNOT GIVE AMOUNT, HAND R CARD #2 AND ASK): What is your best guess? Tell me the letter on this card which you estimate the damage to your house itself was.

(IF ONLY ONE FLOOD EVER EXPERIENCED, Q. 67, SKIP TO INSTRUCTIONS BEFORE Q. 72).
(IF ONLY ONE FLOOD EXPERIENCED SINCE JANUARY 1960, Q. 68, SKIP TO INSTRUCTIONS BEFORE Q. 72).

(IF NO FLOODS EXPERIENCED SINCE JANUARY 1960, ASK):

71. Of all the floods you have experienced, which flood caused the most serious damage to a house which you owned and were living in at the time? Tell me the month and year.

(IF MORE THAN ONE FLOOD EXPERIENCED SINCE JANUARY 1960, ASK):

Think now about the floods you have experienced since January 1960. Which flood caused the most serious damage to a house which you owned and were living in at the time? Tell me the month and year.

________ MONTH   ______ YEAR

(IF ONLY ONE FLOOD EVER EXPERIENCED, ASK QQ. 72-96 ABOUT THAT FLOOD)

(IF ONLY ONE FLOOD EXPERIENCED SINCE JANUARY 1960, ASK QQ. 72-96 ABOUT THAT FLOOD)

(IF NO FLOODS EXPERIENCED SINCE JANUARY 1960, BUT MORE THAN ONE FLOOD EVER EXPERIENCED, ASK QQ. 72-96 ABOUT MOST SERIOUS FLOOD FROM Q. 71)

(IF MORE THAN ONE FLOOD EXPERIENCED SINCE JANUARY 1960, ASK QQ. 72-96 ABOUT MOST SERIOUS FLOOD EXPERIENCED SINCE JANUARY 1960, FROM Q. 71)

72. Think now about the ________ (MONTH) ______ (YEAR) flood. (RECORD MONTH AND YEAR)

21-24

73. At the time of the flood, were you living in this house or in some other house?

		25
(SKIP TO Q. 75)	This	1
	Other	2

74. What was that address?

NUMBER STREET

CITY STATE ZIP

26

75. What damage was done to your house and its contents as a result of that flood? (PROBE FOR ALL DAMAGE)

27-28

76. After the flood damage occurred, how much did you receive in payment from any insurance which covered losses from floods?

29-33

$_______
AMOUNT

None	99997
Don't know	99998

77. Other than any loans you may have taken out, how much of your personal savings did you spend to restore the house and grounds to their original condition and to replace possessions?

$________
AMOUNT

	34–38
None	99997
Don't know	99998

78. How much in dollars did you receive from a bank loan or savings and loan association loan?

$________
AMOUNT

	39–43
None	99997
Don't know	99998

79. How much in dollars did you receive from a federal government loan?

44–48

$________
AMOUNT

(SKIP TO Q. 84)	None	99997
	Don't know	99998

80. How much of this loan was used to refinance an existing mortgage on your home?

49–53

$________
AMOUNT

None	99997
Don't know	99998

81. How much, if any, of that loan was forgiven? That is, how much did not have to be repaid?

54–58

$________
AMOUNT FORGIVEN

None	99997
Don't know	99998

(IF TOTAL AMOUNT OF LOAN FORGIVEN, SKIP TO Q. 84)

82. What was the total amount of time that you had to repay that loan?

________ OR ________
MONTHS YEARS

59–61

Don't know	998

83. What was the annual percentage interest rate on that loan?

_______ %
INTEREST RATE

62-63

Don't know	98

84. How much in dollars did you receive from the state government?

$_______
AMOUNT

64-68

None	99997
Don't know	99998

85. Not including emergency relief, how much in dollars did you receive from the Red Cross for repairs to your house or replacement of your possessions?

$_______
AMOUNT

69-73

None	99997
Don't know	99998

86. How much in dollars did you claim as a casualty loss on your federal income tax that year?

$_______
AMOUNT

74-78

None	99997
Don't know	99998

79-80
34

Card

87. After the flood, did you make any repairs for flood damage done to the house and grounds?

7

	Yes	1
(SKIP TO Q. 90)	No	2

88. After you made the repairs, would you say the house and grounds were the same as they were before the flood, better than they were before, or worse than they were before?

		8
(SKIP TO Q. 90)	Same	1
	Better	2
	Worse	3

89. In what way were they (better/worse) than before the flood?

9–10

90. During the week before the flood, did you hear any official warnings that a flood might occur in your area?

		11
	Yes	1
(SKIP TO Q. 96)	No	2

91. How many hours before the flood did you hear those warnings?

________ HOURS OR ________ DAYS

12–14

Don't know	998

92. Did you believe that what the warnings predicted would happen?

	15
Yes	1
No	2

93. Did you take any action based on those warnings?

		16
	Yes	1
(SKIP TO Q. 96)	No	2

94. What did you do?

17-18

95. What were your savings in dollars, if any, from taking that action?

$________
SAVINGS

	19-23
None	99997
Don't know	99998

(ALL SKIP TO Q. 97)

96. What would your savings in dollars have been if you had heard warnings and taken action?

$ ____________
SAVINGS

24-28

None	99997
Don't know	99998

29-78 *Blank*
79-80 *34*

97. (Other than the times you mentioned, when flood damage occurred to a house which you owned and were living in at the time,) what other flood experiences have you had? That is, how many times have you ever lived in or been visiting an area when flooding occurred?

Card

____
TIMES

(IF "NONE," SKIP TO Q. 100)

7-8

Don't know	98

98. In what year did (that/the most serious flood) occur?

____
YEAR

9-10

Don't know	98

99. What damage, if any, occurred to the area as a result of (that/the most serious) flood?

11-13

Now, some questions about your house.

100. What is the construction of this house? Is it primarily:

		14
(CIRCLE ONE CODE ONLY)	wood frame or frame and stucco,	1
	brick,	2
	concrete block, or	3
	stone?	4
(DO NOT READ)	Other (SPECIFY): ____________	7
	Don't know	8

101. Does this house have a basement?

	15
Yes	1
No	2
Other (SPECIFY): ____________	7
Don't know	8

102. Think about the lowest level or floor in this house. Is it above ground level, below ground level, or at ground level?

		16
	Above	1
(SKIP TO Q. 104)	At ground	2
	Below	3
	Other (SPECIFY): ______	4

103. How many feet (above/below) ground level is the lowest floor or level in this house?

______ FEET

17-18

Don't know	98

104. What do you have on the lowest floor in your house? Do you have a:

	Yes	No	Q. 104 $ To Replace	
a. Washer	1	2	$	19-23
b. Dryer	1	2	$	24-28
c. Heating unit	1	2	$	29-33
d. Hot water heater	1	2	$	34-38
e. Tools	1	2	$	39-43
f. Recreational equipment	1	2	$	44-48
g. Television	1	2	$	49-53
h. Stereo or phonograph equipment	1	2	$	54-58
i. Furniture	1	2	$	59-63
j. Carpeting	1	2	$	64-68
k. Clothing	1	2	$	69-73
l. Anything else worth more than $100 (SPECIFY): ______	1	2	$	74-78

105. (FOR EACH "YES" in Q. 104, ASK): How much would it cost you to replace the (item in Q. 104)? (RECORD ABOVE) 79-80

106. Is this a split level house?

	7
Yes	1
No	2
Other (SPECIFY): ________________	7
Don't know	8

107. (Including the basement), How many different stories does this house have?

____
NO. OF STORIES

8 [ ]

108. About how many feet above the ground is the highest part of the roof on your house?

____
FEET

	9-10
Don't know	98

109. Not including bathrooms, but including the kitchen, how many rooms does this house have?

____
NO. OF ROOMS

11-12 [ ]

Now, I'd like to talk about minor and severe flooding which could occur in this area.

110. First, suppose there were a minor flood in this area. What damage, if any, would a minor flood cause to your house and its contents?

13—15

Don't know	998

(IF "NO DAMAGE," SKIP TO Q. 117)

111. How many feet above the floor of the lowest level of your house would the water rise in a minor flood?

_______ FEET

16—17

Don't know	98

112. After a minor flood, how much, in dollars, do you think it would cost to repair the damage to just the contents of this house?

$__________
AMOUNT

(IF AMOUNT GIVEN, SKIP TO Q. 114)

18-22

Don't know	99998

(HAND R CARD #2 IF "DON'T KNOW" TO Q. 112)

113. Here is a card with different dollar ranges on it. Tell me the letter of the range that includes your best guess of what it would cost to repair the damage to just the contents of this house.

____
LETTER

23-27

114. How much, in dollars, do you think it would cost to repair the damage to just this house itself?

$__________
AMOUNT

(IF AMOUNT GIVEN, SKIP TO Q. 116)

28-32

Don't know	99998

(HAND R CARD #2 IF "DON'T KNOW" TO Q. 114)

115. Here is a card with different dollar ranges on it. Tell me the letter of the range that includes your best guess of what it would cost to repair the damage to just the house itself.

____
LETTER

33-37

116. How many dollars of the total damage would be caused by the wind?

$__________
AMOUNT

38-42

Don't know	99998

117. Now, suppose there were a <u>severe</u> flood in this area. What damage, if any, would a severe flood cause to your house and its contents?

(IF "NO DAMAGE," SKIP TO INSTRUCTIONS BEFORE Q. 124)

43-45

Don't know	998

118. How many feet above the lowest floor or level of your house would the water rise in a severe flood?

____
FEET

46-47

Don't know	98

119. After a severe flood, how much, in dollars, do you think it would cost to repair the damage to just the contents of this house?

$__________
AMOUNT

(IF AMOUNT GIVEN, SKIP TO Q. 121)

48-52

Don't know	99998

(HAND R CARD #2 IF "DON'T KNOW" TO Q. 119)

120. Here is a card with different dollar ranges on it. Tell me the letter of the range that includes your best guess of what it would cost to repair the damage to just the contents of this house.

______ LETTER

53–57

121. How much, in dollars, do you think it would cost to repair the damage to just this house itself?

$______ AMOUNT

(IF AMOUNT GIVEN, SKIP TO Q. 123)

58–62

Don't know	99998

(HAND R CARD #2 IF "DON'T KNOW" TO Q. 121)

122. Here is a card with different dollar ranges on it. Tell me the letter of the range that includes your best guess of what it would cost to repair the damage to just the house itself.

______ LETTER

63–67

123. How many dollars of the total damage would be caused by the wind?

$______ AMOUNT

68–72

Don't know	99998

(INTERVIEWER: ADD AMOUNTS OF DAMAGE FROM QQ. 119 OR 120 AND QQ. 121 OR 122. IF RANGE IS GIVEN, ADD HIGHEST AMOUNT OF RANGE. IF NO AMOUNTS GIVEN IN EITHER QQ. 119 AND 120 OR QQ. 121 AND 122, USE $10,000) 73–77

RECORD TOTAL AMOUNT OR $10,000 HERE: $____________ 78 *Blank*

124. If there were a flood here and the costs to repair the damage to your house and its contents were $ (total damage or $10,000), from what sources, such as help from your relatives or friends, federal aid, flood insurance, personal savings, or a bank loan, do you think you would get money to restore your house and possessions? 79–80 *34*

Card (

7–9

		Q. 124	Q. 125 AMOUNT	
(CIRCLE ALL THAT APPLY)	Relatives/friends	001	$________	10–14
	Federal government loan	002	$________	15–19
	Flood insurance	004	$________	20–24
	Homeowner's insurance	008	$________	25–29
	Money on hand, bank account, cash	016	$________	30–34
	Bank loan	032	$________	35–39
	Selling stocks/bonds	064	$________	40–44
	Other (SPECIFY): ____________	128	$________	45–49
(SKIP TO Q. 126)	Don't know	998		

(FOR EACH SOURCE MENTIONED, ASK):

125. How much money would you expect to get from (source in Q. 124)? (RECORD ABOVE)

In the next few questions, we would like to know your estimates of the chances of a flood causing damage to your home sometime in the future. The following example may be helpful.

(HAND R CARD #3)

126. Using birth and death statistics, it is possible to estimate the number of males born today who will be alive at a certain age. This card shows the chances of males being alive at different ages. For example, 1 out of every 2 male babies will be alive at age 70, while only 1 out of every 100,000 will be alive at the age of 108.

(ALLOW R TO READ CARD #3)

Now, I'd like you to think about the chances of a flood occurring here in the next year.

(SHOW R CARD #4)

Please tell me, one out of how many is your estimate of the chances of a flood occurring in the next year causing (total damage from Q. 124 or $10,000) or more damage to your home. (PROBE FOR AN ESTIMATE)

1 OUT OF ________
NUMBER

	50-55
Don't know	999998

127. For comparison, please tell me, 1 out of how many is your estimate of the chances of a fire occurring in the next year causing (total damage from Q. 124 or $10,000) or more damage to your home. (PROBE FOR AN ESTIMATE)

1 OUT OF ________
NUMBER

(TAKE BACK CARD #4)

	56-61
Don't know	999998

128. In the next year, would you say that it is more likely that a fire will cause (total damage from Q. 124 or $10,000) or more damage to your home, or that a flood will cause (total damage from Q. 124 or $10,000) or more damage to your home?

		62
	Fire	1
	Flood	2
(SKIP TO	Same likelihood	3
Q. 130)	Don't know	8

129. How many times more likely would you say the (fire/flood) would be? (PROBE FOR AN ESTIMATE)

______ TIMES MORE LIKELY

	63-68
Don't know	999998

130. Of any 1,000 homes similar to yours in value and construction, how many would you estimate will suffer fire damage of (total damage from Q. 124 or $10,000) or more in the next year? (PROBE FOR AN ESTIMATE)

______ NUMBER

	69-71
Don't know	998

131. How many floods causing (total damage from Q. 124 or $10,000) or more damage to your home do you think will occur in the next 100 years? (PROBE FOR AN ESTIMATE)

______ # OF FLOODS

	72-74
Don't know	998

132. Suppose you had thought about buying flood insurance, and decided not to buy it because you felt that the chances were small of flood damage occurring to your home. After that, suppose there were a flood here causing (total damage from Q. 124 or $10,000) or more damage to your home. How would you then feel about your decision not to buy flood insurance? Would you think it was:

	75
a good decision, even though it turned out badly,	1
a bad decision, or	2
neither a good nor a bad decision?	3

(IF R CURRENTLY HAS FLOOD INSURANCE, "YES" TO Q. 32, SKIP TO Q. 136)

133. Suppose there were a flood here causing $ (total damage from Q. 124 or $10,000) or more damage to your home. After the flood, how likely would you be to buy flood insurance for your home? Do you think that you:

	76
definitely would buy it,	1
probably would buy it,	2
probably would not buy it, or	3
definitely would not buy it?	4

134. Suppose there were a severe flood in another area along (coastal or river area). After the flood, how likely would you be to buy flood insurance for your home? Do you think that you:

	77
definitely would buy it,	1
probably would buy it,	2
probably would not buy it, or	3
definitely would not buy it?	4

135. Now, suppose you learned that nearly all of the homeowners in this neighborhood had flood insurance. How likely would you then be to buy flood insurance for your home? Do you think that you:

	78
definitely would buy it,	1
probably would buy it,	2
probably would not buy it, or	3
definitely would not buy it?	4

79 80

(HAND R CARD #5)

136. Here is an interesting problem I'd like you to think about. Suppose you had to move out of this house and live in another house in this area for exactly one year. Also, suppose that no flood insurance was available in the area. Which of two identical houses would you prefer to own for this one year period?

	7
a. One to which a flood will cause $2,000 damage sometime in the next 10 years,	1
or	
one to which a flood will cause $6,000 damage sometime in the next 25 years?	2

(HAND R CARD #6)

	8
b. How about one to which a flood will cause $6,000 damage sometime in the next 25 years,	1
or	
one to which a flood will cause $25,000 damage sometime in the next 100 years?	2

(HAND R CARD #7)

	9
And finally, which home would you prefer to own:	
c. one to which a flood will cause $2,000 damage sometime in the next 10 years,	1
or	
one to which a flood will cause $25,000 damage sometime in the next 100 years?	2

(TAKE BACK CARDS)

(HAND R CARD #8)

Please read this card along with me. Once after a severe flood four men spoke about the possibility of another severe flood occurring in the area. The first said that a severe flood would come again soon because when severe floods occur, more are soon to come. The second man thought that a severe flood would come again but did not know when, because floods could happen in any year. The third man said that he knew when a severe flood would occur for there is a regular time, and that time must pass before a severe flood will occur again. The fourth man thought that a severe flood would not occur for a long time because when severe floods occur, it is less likely that they will occur again soon.

137a. With which man's idea about floods do you most closely agree? (RECORD BELOW)

137b. With which man's idea about floods do you next most closely agree? (RECORD BELOW)

137c. With which man's idea about floods do you least agree? (RECORD BELOW)

10-12

	Q. 137a MOST CLOSELY AGREE	Q. 137b NEXT CLOSELY	Q. 137c LEAST AGREE
First man	1	1	1
Second man	2	2	2
Third man	3	3	3
Fourth man	4	4	4

138. What kinds of help, if any, does the federal government currently provide to homeowners who suffer losses after a flood?

13-14

(CIRCLE ALL THAT APPLY)	Flood Insurance (Program)	01
	Income tax deduction	02
	Loans (SPECIFY:______________)	04
	Aid to communities	08
	Food and shelter	16
	Other (SPECIFY):______________	32
	None	97
	Don't know	98

(IF "LOANS" MENTIONED, CODE 04, SKIP TO Q. 140)

139. Does the federal government currently provide loans to homeowners to help restore flood damages?

		15
	Yes	1
(SKIP TO Q. 143)	No	2
	Don't know	8

140. Is there currently a forgiveness clause in federal loan agreements? That is, is there a clause saying part of the loan does not have to be repaid?

		16
	Yes	1
(SKIP TO Q. 142)	No	2
	Don't know	8

141. How much does not have to be repaid?

$ ________ OR ________ %
AMOUNT PERCENT

	17-22
Don't know	999898

142. What annual percentage interest rate is currently charged on such a loan?

________ %
RATE

	23-24
Don't know	98

143. What (other) kinds of help, if any, should the federal government provide after a flood?

	25-26
Don't know	98

(144.) What has been done or is being done by the federal, state, or local government to reduce flood damages to homeowners in this area?

		27-28
(CIRCLE ALL THAT APPLY)	Building codes	01
	Land-use regulations	02
	Engineering works (dams or levees)	04
	Other (SPECIFY): ________	08
	Nothing	97
	Don't know	98

(145.) A land use regulation specifies where houses can be built. In this area, what land-use regulations, (if any,) are there to reduce flood damages?

	29
None	7
Don't know	8

(146.) What land-use regulations, if any, do you think there should be?

	30
None	7
Don't know	8

(147.) A building code sets minimum standards for how a house can be built. In this area, what building codes, (if any,) are there to reduce flood damages?

	31
None	7
Don't know	8

(148.) What building codes, if any, do you think there should be?

	32
None	7
Don't know	8

(149.) Think now about the cost of flood insurance premiums. Should the government pay for all, most, little, or none of this cost?

	33
All	1
Most	2
Little	3
None	4

(150.) How about the cost of reducing flood damage by making flood-resistant building improvements? Should the government pay for all, most, little, or none of this cost?

	34
All	1
Most	2
Little	3
None	4

(151.) Suppose there were a flood which damaged your home. Should the government pay for all, most, little, or none of your losses?

	35
All	1
Most	2
Little	3
None	4

152. What else, if anything, should federal, state, or local governments do to reduce flood damage?

36-37

153. What, if anything, have you done to this property, your house or possessions to reduce the possibility of damage a flood could cause? (PROBE):

	Q. 154 COLUMN B YEAR	Q. 155 COLUMN C COST	
			38–44
a. ______	______	$______	45–51
b. ______	______	$______	52–58
c. ______	______	$______	59–65
d. ______	______	$______	66–72
e. ______	______	$______	

(SKIP TO Q. 157)	Nothing	97

(ASK QQ. 154-156 FOR EACH MENTION IN Q. 153)

154. In what year did you (MENTION FROM Q. 153)? (RECORD IN COLUMN B)

155. How much money did you spend to (MENTION FROM Q. 153)? (RECORD IN COLUMN C)

156. What caused you to decide to (MENTION FROM Q. 153) at that time? (RECORD BELOW)

a. ______________________________

____

b. ______________________________

____

c. ______________________________

____

d. ______________________________

____

e. ______________________________

____

73–77

78 *Blank*

79-80

Card 11

157. What (else) could you do to this property, house or your possessions to reduce the possibility of flood damage? (PROBE)

1st mention: ____________________

2nd mention: ____________________

3rd mention: ____________________

7-12

(SKIP TO Q. 165)	Nothing	979797
	Don't know	989898

(ASK FOR EACH MENTION IN Q. 157)

158. What are some of the reasons that you haven't (mention from Q. 157)?

13-18

(CIRCLE ALL THAT APPLY)		1st Mention in Q. 157	2nd Mention in Q. 157	3rd Mention in Q. 157
	Too expensive	01	01	01
	Really won't help anyway	02	02	02
	Don't have the time	04	04	04
	Never got around to it	08	08	08
	Other (SPECIFY): ______ ______	16	16	16
	No (2nd/3rd) mention		00	00

(QQ. 159-164 HAVE BEEN DELETED)

19-34
Blank

165. If your house were totally destroyed by a flood, would you rebuild on the same site?

			35
	Yes	1	
	No	2	
(SKIP TO Q. 167)	Don't know	8	

166. Why (not)?

36-37

167. Suppose you were buying another house identical to yours in this neighborhood, and could spend an extra thousand dollars to make the house flood-resistant. Would you spend the money?

			38
	Yes	1	
	No	2	
(SKIP TO Q. 169)	Don't know	8	

168. Why (not)?

39-40

169. Have you ever discussed flood insurance with anyone?

	Yes	xx
(SKIP TO Q. 171)	No	97

170. Who? (PROBE): Who else?

		41-42
(CIRCLE ALL THAT APPLY)	Insurance agent	01
	Spouse	02
	Other relative(s) (SPECIFY): ______	04
	Neighbor(s)	08
	Friend(s)	16
	Other(s) (SPECIFY): ______	32

171. Does anyone you know have an insurance policy covering flooding?

	Yes	xx
(SKIP TO Q. 173)	No	97

172. Who?

43-44

(CIRCLE ALL THAT APPLY)	Relative(s) (SPECIFY): ______	04
	Neighbor(s)	08
	Friend(s)	16
	Other(s) (SPECIFY): ______	32

173. Of every 100 homeowners in this immediate neighborhood, how many do you think currently have flood insurance?

______
NUMBER

45-46

174. Who should be responsible for making sure that everyone knows that flood insurance is available?

47-48

(CIRCLE ALL THAT APPLY)	Federal government/federal officials	01
	Banks, savings and loan associations	02
	Insurance company/agent	04
	The media (newspapers, radio, TV)	08
	Local government/local officials	16
	Other (SPECIFY): ______	32
	Don't know	98

175. Here are some of the different kinds of insurance that people can carry. Do you (or your spouse) have any kind of: (RECORD IN COLUMN A)

	Q. 175 COLUMN A			Q. 176 COLUMN B			Q. 177 COLUMN C	Q. 178 COLUMN D		Q. 179 COLUMN E		
	YES	NO	DK	YES	NO	DK	$ PER YEAR	YES	NO	YES	NO	
a. life insurance?	1	2	8	1	2	3	$______	1	2	1	2	49-56
b. auto insurance?	1	2	8	1	2	3	$______	1	2	1	2	57-64
c. health insurance?	1	2	8	1	2	3	$______	1	2	1	2	65-72
d. disability insurance?	1	2	8	1	2	3	$______	1	2	1	2	73-78 Blank

79-80
34
Card 12

(ASK Q. 176 FOR EACH "YES" IN Q. 175)

176. Do you pay for any of that (kind of insurance from Q. 175)? (RECORD IN COLUMN B)

(ASK QQ. 177-179 FOR EACH "YES" IN Q. 176) 7-14

177. How much does that cost each year? (RECORD IN COLUMN C)

178. Is any of the cost of that insurance taken directly out of a paycheck from an employer? (RECORD IN COLUMN D)

179. Were you required to buy any of that insurance? (RECORD IN COLUMN E)

180. Do you have a homeowner's, comprehensive, or fire and extended coverage insurance policy, the kind that includes several types of coverage on your home and possessions?

		15
	Yes	1
(SKIP TO	No	2
Q. 186)	Don't know	8

181. Were you required to buy that insurance?

	16
Yes	1
No	2

182. What is the total dollar amount of coverage you have with that insurance policy?

$____________
COVERAGE

	17-21
Don't know	99998

183. How much do you pay each year for your homeowner's policy?

$____________
COST

	22-24
Don't know	998

184. Does your homeowner's policy insure you against damage caused by floods from natural disasters?

	25
Yes	1
No	2
Don't know	8

(IF R CURRENTLY HAS FLOOD INSURANCE, "YES" TO Q. 32, SKIP TO Q. 186)

185. Suppose you found out that the cost of flood insurance was one half of the cost you now pay for your homeowner's insurance, with the same coverage. How likely would you then be to buy flood insurance for your home in addition to your homeowner's insurance? Do you think that you:

	26
definitely would buy it,	1
probably would buy it,	2
probably would not buy it, or	3
definitely would not buy it?	4

186. Have you ever bought a service contract for a:

	Yes	No	
a. home heater?	1	2	27
b. refrigerator?	1	2	28
c. television?	1	2	29
d. washer?	1	2	30

(IF NO SERVICE CONTRACTS, SKIP TO Q. 190)

187. Did you cancel (any of those/that) service contract(s)?

		31
	Yes	1
(SKIP TO Q. 190)	No	2

188. On which appliance(s)?

(CIRCLE ALL THAT APPLY)

	32-33
Home heater	01
Refrigerator	02
Television	04
Washer	08

189. (IF MORE THAN ONE CANCELLED, ASK ABOUT FIRST ONE MENTIONED) Why did you cancel that service contract? (SPECIFY APPLIANCE:__________) 34

35-36

190. Now, think about the next five years. Do you think that within the next five years you will:

			37
		definitely move from this house,	1
		probably move from this house,	2
	(SKIP TO Q. 192)	probably not move from this house, or	3
		definitely not move from this house?	4
(DO NOT READ)	(SKIP TO Q. 192)	Don't know	8

191. What is the main reason why you may move?

38-39

(192.) In what year was this house originally built?

YEAR

40-42

Don't know	998

(193.) In what year did you get this house?

YEAR

43-44

(194.) How many (months/years) you have actually lived in this house?

MONTHS OR YEARS

45-47

(195.) What was the dollar value of this house and land when (it was bought/you built the house)?

$ DOLLAR VALUE

48-52

Don't know	99998

(196.) About how much would this property sell for on today's market, including the lot and all buildings on it?

$ AMOUNT

53-57

Don't know	99998

197. About how much would you estimate the land alone is worth, without any buildings?

$______
AMOUNT

58-62

Don't know	99998

198. How many mortgages have you had on this house and property? (CIRCLE NUMBER IN COLUMN A)

63

Q. 198 COL. A	Q. 199 COL. B	Q. 200 COL. C	Q. 201 COL. D	Q. 202 COL. E
# OF MORTGAGES	YEAR	$ ORIGINAL	# OF YEARS	ANNUAL INTEREST RATE
0	(SKIP TO Q. 203)			
1		$		%
2		$		%
3		$		%
4		$		%

64-74
75-78 *Blank*
79-80 *34*

Card 13

(ASK QQ. 199-202 FOR EACH MORTGAGE)

199. In what year did you originally get that mortgage? (RECORD IN COLUMN B) 7-17

200. What was the original amount of that mortgage? (RECORD IN COLUMN C) 18-28

201. For how many years was that mortgage made? (RECORD IN COLUMN D) 29-39

202. What annual percentage interest rate was charged? (RECORD IN COLUMN E)

203. In 1974, how much will you pay for local taxes on this house and property?

$______
1974 PROPERTY TAX

40-43

Don't know	9998

(204.) I am going to read two statements. After I read them, tell me which one best describes how you feel. Please select the statement which you believe to be more true, and not the one that you would like to be true.

(HAND R CARD #9)

Here is the first statement.

A. Many of the unhappy things in people's lives are partly due to bad luck.

Here is the second statement.

B. People's misfortunes result from the mistakes they make.

Which statement best describes how you feel?

	44
Statement A	1
Statement B	2

(HAND R CARD #10)

(205.) Here are two more statements. The first one is:

A. Many times I feel that I have little influence over the things that happen to me.

The second statement is:

B. It is impossible for me to believe that chance or luck plays an important role in my life.

Which statement best describes how you feel?

	45
Statement A	1
Statement B	2

(TAKE BACK CARDS)

Now, some questions about you.

(206.) What is your religious preference, if any? Is it Protestant, Catholic, Jewish, or what?

	46
Protestant	1
Catholic	2
Jewish	3
None	4
Other (SPECIFY): ________	7

207. What is the highest grade in school which you completed?

	47
None	1
1 - 8	2
9 - 11	3
12 (high school graduate)	4
Some college or training past high school	5
College graduate	6
5 or more years college	7

208. Are you currently employed, retired, unemployed, or what?

	48
Employed	1
Retired	2
Unemployed	3
Other (SPECIFY): ______	7

(209.) What is your usual occupation? What kind of work do you usually do?

OCCUPATIONAL TITLE

DUTIES

(210.) In what business or industry is that?

BUSINESS OR INDUSTRY

49-51

(211.) Do you usually work for yourself or for someone else?

Self	1
Someone else	2
Partnership	3

(212.) Are you currently:

52

married,	1
widowed,	2
divorced,	3
separated, or	4
have you never been married?	5

(ASK QQ. 213-217 ABOUT HOUSEHOLD HEAD FROM SCREENING FORM. IF R IS HOUSEHOLD HEAD, SKIP TO Q. 218)

213. Now, some questions about (name of head). What is the highest grade in school which (he/she) completed?

53

None	1
1 - 8	2
9 - 11	3
12 (high school graduate)	4
Some college or training past high school	5
College graduate	6
5 or more years college	7

214. Is (he/she) currently employed, retired, unemployed, or what?

54

Employed	1
Retired	2
Unemployed	3
Other (SPECIFY): ________	7

215. What is (his/her) usual occupation? What kind of work does (he/she) usually do?

____
OCCUPATIONAL TITLE

____
DUTIES

216. In what business or industry is that?

____
BUSINESS OR INDUSTRY

55-57

217. Does (he/she) usually work for (him-/her-) self or for someone else?

Self	1
Someone else	2
Partnership	3

(HAND R CARD #11)

218. Here is a card with different incomes on it. In 1973, what was your total family income, before taxes, from all sources? Just tell me the letter.

______ LETTER

58-59

(HAND R CARD #12)

219. In 1973, how much of that income was saved or invested? Just tell me the letter.

______ LETTER

60

Don't know	8

THANK R AND TERMINATE

(INTERVIEWER: FILL IN)

220. (IF R REFUSED TO GIVE TOTAL FAMILY INCOME): Estimate total family income for 1973.

$______
ESTIMATED YEARLY INCOME

61-62

221. Race (BY OBSERVATION):

63

White	1
Black	2
Other (SPECIFY): ______	3

222. What records, if any, did R look up or consult during the interview?

		64
(CIRCLE ALL THAT APPLY)	Insurance policy(ies)	1
	Mortgage papers	2
	Other (SPECIFY): ______	4
	None	0

223. Respondent's cooperation was:

	65
Very good	1
Good	2
Fair	3
Poor	4

224. Other persons present at interview were:

		66
	No one	0
(CIRCLE ALL THAT APPLY)	Children	1
	R's spouse	2
	Other adults (SPECIFY): ______	4

225. Is this interview of questionable quality?

		67
	Yes	1
(SKIP TO Q. 227)	No	2

226. (IF "QUESTIONABLE QUALITY") Reason for this:

(CIRCLE ALL THAT APPLY)

	68–70
Spoke English poorly	001
Evasive, suspicious	002
Drunk, mentally disturbed	004
Had poor hearing or vision	008
Low intelligence	016
Confused by frequent interruptions	032
Bored or uninterested	064
Other (SPECIFY): ____________	128

227. What questions, if any, did R have difficulty in understanding or answering?

____
QUESTION NUMBERS

71–76

228. NOTE ANYTHING ELSE ESSENTIAL TO THE INTERPRETATION AND UNDERSTANDING OF THIS INTERVIEW.

77

78
Blank

79–80
34

CARD #1 #599-400-27

A. Crime - crime and the safeness of the neighborhood

B. Education - the quality of education for children in this neighborhood

C. Flooding - the neighborhood is a flood-prone area

D. Housing - the condition of housing in the neighborhood

E. Public Transportation - the adequacy of public transportation in the neighborhood

CARD #2 #599-400-27

A.	$0 - $200
B.	$201 - $500
C.	$501 - $1,000
D.	$1,001 - $2,000
E.	$2,001 - $3,000
F.	$3,001 - $4,000
G.	$4,001 - $5,000
H.	$5,001 - $7,500
I.	$7,501 - $10,000
J.	$10,001 - $12,500
K.	$12,501 - $15,000
L.	$15,001 - $20,000
M.	$20,001 - $25,000
N.	$25,001 - $30,000
O.	$30,001 - $35,000
P.	$35,001 - $40,000
Q.	$40,001 - $50,000
R.	$50,001 - $75,000
S.	$75,001 - $100,000
T.	$100,001 - $125,000
U.	More than $125,000

CARD #3 #599-400-27

CHANCES	
1 out of 1	JUST BORN
1 out of 2	ALIVE AT AGE 70
1 out of 5	ALIVE AT AGE 82
1 out of 10	ALIVE AT AGE 85
1 out of 50	ALIVE AT AGE 93
1 out of 100	ALIVE AT AGE 95
1 out of 300	ALIVE AT AGE 98
1 out of 800	ALIVE AT AGE 100
1 out of 2,000	ALIVE AT AGE 102
1 out of 7,000	ALIVE AT AGE 104
1 out of 20,000	ALIVE AT AGE 106
1 out of 100,000	ALIVE AT AGE 108

CARD #4 #599-400-27

CHANCES

1 OUT OF 1 (certain to happen)

1 OUT OF 100,000 (almost impossible to happen)

CARD #5 #599-400-27

You must own one of two identical houses for a period of one year.

You cannot buy flood insurance.

$2,000 damage sometime in the next 10 years

or

$6,000 damage sometime in the next 25 years

CARD #6 #599-400-27

You must own one of two identical houses for a period of one year.

You cannot buy flood insurance.

$6,000 damage sometime in the next 25 years

or

$25,000 damage sometime in the next 100 years

CARD #7 #599-400-27

You must own one of two identical houses for a period of one year.

You cannot buy flood insurance.

$2,000 damage sometime in the next 10 years

or

$25,000 damage sometime in the next 100 years

CARD #9 #599-400-27

A. Many of the unhappy things in people's lives are partly due to bad luck.

OR

B. People's misfortunes result from the mistakes they make.

CARD #8 #599-400-27

Once after a severe flood four men spoke about the possibility of another severe flood occurring in the area.

The first said that a severe flood would come again soon because when severe floods occur, more are soon to come.

The second man thought that a severe flood would come again but did not know when, because floods could happen in any year.

The third man said that he knew when a severe flood would occur, for there is a regular time, and that time must pass before a severe flood will occur again.

The fourth man thought that a severe flood would not occur for a long time because when severe floods occur, it is less likely that they will occur again soon.

CARD #10 #599-400-27

A. Many times I feel that I have little influence over the things that happen to me.

OR

B. It is impossible for me to believe that chance or luck plays an important role in my life.

13-103

CARD #11 #599-400-27

	Weekly	Monthly	Yearly
A.	$29 or less	$125 or less	$1,500 or less
B.	$30 - $58	$126 - $250	$1,501 - $3,000
C.	$59 - $87	$251 - $375	$3,001 - $4,500
D.	$88 - $115	$376 - $500	$4,501 - $6,000
E.	$116 - $154	$501 - $667	$6,001 - $8,000
F.	$155 - $192	$668 - $833	$8,001 - $10,000
G.	$193 - $231	$834 - $1,000	$10,001 - $12,000
H.	$232 - $288	$1,001 - $1,250	$12,001 - $15,000
I.	$289 - $346	$1,251 - $1,500	$15,001 - $18,000
J.	$347 - $423	$1,501 - $1,833	$18,001 - $22,000
K.	$424 - $500	$1,834 - $2,167	$22,001 - $26,000
L.	$501 - $577	$2,168 - $2,500	$26,--1 - $30,000
M.	$578 - $673	$2,501 - $2,917	$30,001 - $35,000
N.	$674 - $769	$2,918 - $3,333	$35,001 - $40,000
O.	$770 - $962	$3,334 - $4,167	$40,001 - $50,000
P.	$963 or more	$4,169 or more	$50,001 or more

CARD # 12 #599-400-27

A. $249 or less

B. $250 - $499

C. $500 - $749

D. $750 - $999

E. $1,000 - $1,999

F. $2,000 - $4,999

G. $5,000 or more

Appendix A.5

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