Disaster Insurance Protection

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Disaster Insurance Protection
Public Policy Lessons

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with

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To

DONALD CARROLL

and

GILBERT WHITE

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Foreword

The following study is path breaking in opening up a new field of inquiry, the large-scale field study of risk-taking behavior. For the first time the analysis has used not only market behavior, or how much insurance is bought, but also the direct questioning of motives such as a sociologist might do. The analysis is further fortified with parallel laboratory experiments, the whole constituting a multipronged empirical study that permits a careful and powerful discrimination among alternative hypotheses of risk-taking behavior.

The empirical results are certainly disconcerting from the point of view of generally accepted theory and equally so for believers in the omnicompetence of the market system. Even someone like myself, with a very qualified view of the market system and a sharp belief in its limits, has to be surprised at the failure of the flood-insurance market. Our usual theories anticipate risk aversion on the part of the average individual. He or she is, we believe, willing to pay something more than an actuarially fair premium to gain protection against loss. Indeed, the premium the rational individual of our theories is willing to pay increases as the probability of loss decreases and as the amount of loss—if it does take place—increases.

Yet this study demonstrates that this is not so with regard to flood and earthquake insurance—relatively rare events with high losses if they occur. Their laboratory findings cohere with the experience in the field. Further, their findings are consistent with some of the observed phenomena in medical insurance. Let me cite a personal reaction. When major medical insurance, covering office care as well as hospitalization, first became available commercially, I bought some as a good expected-utility maximizer. I was astounded to find that there was a relatively low ceiling ($15,000) on a year's benefits. This seemed entirely wrong from the risk-aversion viewpoint, which was also my personal view. I pointed out to the agent and the company that I was much more interested in protecting myself against the highly improbable event of really massive health expenditures. The actuarial premium for what is now known as catastrophe coverage was clearly going to be extremely low and I would cheerfully pay several times that premium to prevent a financial disaster that could affect my entire life or, alternatively, the need to do without such extended and necessary care.

Part of the obstacle was indeed the conservatism of insurance companies, which did not want to issue policies with no basis for experience rating, even though common sense would indicate upper bounds on the risks. Clearly, a good part of the obstacle was the lack of interest on the part of purchasers. Indeed, in the case of medical insurance the most interesting point is the lack of interest of the labor unions, for, of course, most policies are part of collective bargaining agreements. In this respect we may assume that the unions are reflecting the concerns of their members. It appears that avoidance of or protection against large risks with low probabilities is given little value.

In the same vein is the preference for medical insurance policies with little or no deductibles; in fact, many individuals having deductibles buy supplementary policies to cover the initial range of costs. This is the opposite side of the coin; people seek coverage of high-probability risks even though they are small in magnitude.

What is behind these anomalies? To judge from the evidence that follows the problem is one in cognition. The average individual is simply not aware of these events unless he or she or a friend has unusual perceptions. Obviously in some sense it is right that he or she be less aware of low-probability events than of high-probability events, other things being equal; but it does appear from the data that the sensitivity goes down too rapidly as probability decreases. Psychologists have already argued that the expected-utility and similar rationalizations of behavior do not conform to the empirical facts in the laboratory. They may be able to explain the neglect of small probabilities in terms of the difficulties of awareness. Perhaps also these explanations can be given an economic interpretation in terms of the costs of keeping open little-used channels of communication and observation.

Statistical theory may also be relevant here. Low probabilities are also relatively poorly estimated probabilities. Perhaps the uncertainty about the probability somehow causes it to be disregarded, although a clear-cut interpretation in expected utility terms is not obvious.

I have dwelt on the implications for theoretical research stimulated by these extraordinarily interesting empirical findings. One could also dwell on the policy implications, some possibly contrary to current popular wisdom: if individuals in their own lives undervalue low probability events, should such probabilities also be given low weight in public decisions? The implications for the nuclear safety debates are obvious, but these remarks simply emphasize the power and novelty of the study, to which the reader will gain most by turning.

KENNETH J. ARROW
James Bryant Conant
University Professor
Harvard University

Cambridge, Massachusetts
October 1977

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Introduction

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 book *Disaster Insurance Protection: Public Policy Lessons* 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 book 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 book demonstrates empirically that, even if they have 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 had commenced in 1969.

Publication of the book 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 that account not only for irresponsible development of floodplains 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 book 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 we should not ignore the finding of this book that individuals will not purchase hazard insurance without some extrinsic compulsion.

The book 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
1969–1974

Washington, D.C.
October 1977

Preface

The principal purpose of this book is to bring about a deeper understanding of the decision processes utilized by individuals in dealing with low probability events that have the potential of causing severe losses to themselves and to society. Only by learning more about the behavioral processes of people under conditions of risk and uncertainty can we develop meaningful public policies for coping with these problems.

Society is faced with an increasingly large number of environmental and man-made hazards that at a specific time and location appear to have a small chance of happening, but spread over a long enough interval or geographic region are almost certain to occur. Yet little action has been taken by individuals or society to reduce potential damage from these events until after a disaster has wreaked havoc. Hence it is important to understand what factors influence the adoption of protective measures so that policy makers can utilize this knowledge in designing programs for the future.

The book sheds light on the following questions which have been posed in popular and in scientific journals, but until now have not been satisfactorily answered:

1. Why are individuals reluctant to wear seat belts despite the overwhelming statistical evidence supporting the benefits of their use and the extremely low costs of buckling up?

2. Why has there only been widespread interest in breast cancer examination after the extensive mass publicity surrounding Betty Ford's and Happy Rockefeller's mastectomies despite the detailed evidence provided before their operations that early detection of a tumor markedly improves the chances of complete recovery?

3. Why is there a large demand for flight insurance by travelers even though it is more expensive than regular life insurance?

4. Why has there been a negligible sale of crime insurance to renters, homeowners, and commercial property owners despite the fact that it is highly subsidized by the federal government?

5. Why have so few individuals purchased flood or earthquake insurance even though it is readily available in areas subject to these hazards?

This book provides a detailed analysis of the last question. In fact, the three year study was initiated in July 1973 through generous financial support from the National Science Foundation—Research Applied to National Needs Program because of growing evidence that individuals were unwilling to protect themselves against the consequences of floods and earthquakes by purchasing insurance or adopting other hazard mitigation measures. In the case of the flood hazard, this behavior by individuals was particularly disturbing because premiums on existing homes were highly subsidized by the federal government. This problem was considered to have social import because if people would not protect themselves voluntarily against the consequences of a low probability event then society would continue to bear a large portion of the costs following a disaster. Thus our study was also motivated by the increasingly liberal federal relief provided to victims of natural disasters which has resulted in a significant cost burden to all taxpayers.

To enable us to better understand the decision processes of individuals with respect to their protective activities, we interviewed 2055 homeowners residing in 43 areas in 13 states subject to coastal or riverine flooding and 1006 homeowners in 18 earthquake-prone areas of California. Half of those interviewed had purchased flood or earthquake insurance. In addition to the field survey, we undertook controlled laboratory experiments related to insurance purchase decisions.

The face-to-face interviews with homeowners were undertaken during the spring and summer of 1974. The timing of the field survey was fortunate. Two years after Tropical Storm Agnes, the worst natural disaster in American history, and three years after the San Fernando earthquake, most uninsured homeowners were aware of the existence of flood or earthquake insurance. Furthermore a relatively small percentage of the insured group had been required to purchase coverage as a condition for receipt of mortgage or disaster loan. Hence we were in the ideal position of being able to investigate the factors that translated an awareness of a protective activity into a decision to adopt it. The results of the study should thus shed light on the factors influencing such voluntary actions as wearing seat belts, obtaining a breast cancer examination, buying subsidized crime insurance, and purchasing relatively high priced flight insurance.

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 was necessitated by a lack of interest among homeowners in voluntarily buying coverage. A much larger percentage of the insured population is now required to purchase coverage and, if the field survey were undertaken today in flood-prone areas, it would be difficult to delineate those factors influencing the purchase of coverage without using a much larger sample.

The material in this book has been organized to make the reader aware of the importance of this research to public policy. The introductory chapter raises a set of public policy issues which the study has addressed. Chapter 2 provides a historical perspective on the development of flood and earthquake insurance. These two chapters provide the institutional setting for understanding the theoretical and empirical analyses that follow.

Chapter 3 offers a theoretical perspective on the decision processes of individuals regarding low probability events by discussing two competing models of choice under uncertainty. These two approaches, the expected utility model and a sequential model of choice, are shown to have radically different implications for public policy. Chapter 4 is devoted to a discussion of the design of the sample plan for the field survey. Chapters 5 and 6 analyze data from the questionnaire as well as taped interviews with groups of insured and uninsured homeowners to shed light on factors influencing a person's decision on whether to purchase flood or earthquake insurance. These findings are complemented by the controlled laboratory experiments that determine causal relationships between specific variables and the decision to purchase insurance. Chapter 7 discusses the results of the experiments and synthesizes these findings with the analysis of field survey data.

The questionnaire data indicate how aware homeowners are of other hazard mitigation measures (such as land-use regulations) as well as disaster relief programs. A discussion of these findings appears in Chapter 8. We also collected sufficient demographic data from homeowners to provide a profile of the socioeconomic characteristics of residents in flood- and earthquake-prone areas as well as a physical profile of the communities. These figures are presented in Chapter 9, where comparisons are made between riverine, coastal, and earthquake-prone areas. The concluding chapter summarizes our findings and discusses their implications for public policy.

It is hard to describe in words the involvement of the entire project staff since its inception. We hope the material in this book conveys the intellectual excitement 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 these findings for public policy. Considerably more work must be undertaken in the future. We hope you agree after reading this book.

HOWARD KUNREUTHER

Philadelphia, Pennsylvania
October 1977

Acknowledgments

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 Balanced Repeated Replication for specifying significant variables. Paul Slovic, Sarah Lichtenstein, and Baruch Fischhoff 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 which appear in this book.

Roy Popkin fashioned an 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 Administration
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 and Daniel Kahneman offered valuable 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, Peter Diamond and Steven Margulis provided useful suggestions on ways to revise and extend an earlier draft of the book. Eugene Klotz devoted countless hours to reviewing the manuscript and offered numerous helpful suggestions 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.

Throughout the course of the three-year investigation there were lively interchanges and 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.

It is hard to describe in words the involvement 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 book.

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Introduction

1.1 OBJECTIVES OF THE STUDY

How do people determine whether to protect themselves against low probability events having severe consequences? 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? These are the main questions 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.

The viewpoints of the individual and society toward low probability events often conflict. For example, a homeowner residing near a river may picture a damaging flood as having a small probability of occurrence or 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.

The development of protective activities for mitigating flood and earthquake losses to residents in hazard-prone areas is representative of the following important general question which this book addresses:

What appropriate institutional arrangements should be developed in our society so that individuals can share the risks of uncertain events with others? Insurance is a prime example of how losses from calamities can be shifted from an individual or business to a risk-bearing institution. Recent pathbreaking studies by economists (see Arrow, 1963, and Akerlof, 1970) have shown that insurance markets for some perils may not exist because the insurance industry has less information on the risks and consequences of the peril than do the potential insured. Hence companies cannot profitably offer coverage against such events. In the case of flood and earthquake hazards social institutions have emerged in recent years to cope with such problems faced by the insurance industry. Flood and earthquake insurance policies are readily available to homeowners residing in hazard-prone areas, but few residents have shown an interest in purchasing coverage.

This study enables one to gain a better understanding of why the consumer may be the source of market failure when he feels the chances of suffering a loss are relatively small. Furthermore it provides a theoretical and empirical foundation for evaluating the consequences of alternative public policies dealing with low probability events. By analyzing data on individual behavior collected through a field survey and through controlled laboratory experiments, we have been able to determine those factors that influence the purchase of flood or earthquake insurance. These findings should be useful in evaluating whether it is feasible to induce individuals to buy coverage voluntarily. Policymakers may then want to consider whether alternative institutional arrangements, such as having banks require insurance as a condition for a new mortgage, are necessary as a means of protecting individuals against the consequences of these hazards.

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 of a disaster. For example, few residents of California purchased earthquake insurance prior to the San Fernando quake of February 1971, hence many of the victims turned to the federal government for relief. Congress then responded with low interest loans and forgiveness grants.

Before an appropriate course of action can be determined for future disaster policy, interested parties must decide how the responsibility for mitigation and recovery should be shared between residents of hazard-prone areas and federal, state, and local governments. We hope the results of this study will facilitate these decisions so that specific programs for reducing losses from future disasters can be developed.

1.2 PUBLIC POLICY ISSUES

The public policy issues associated with this problem revolve around private and social risks. *Private risks* refer to actions taken by an individual which affect himself but not society. An example is a decision by a person to construct a house near a fault line even though he knows full well that he would have to bear the entire financial burden should the structure suffer damage from an earthquake. *Social risks* arise when the general public bears the costs of negative outcomes associated with a particular action. The above location decision would be classified as a social risk if the federal government were to pay for all earthquake losses to private property.

Most actions involve both type of risks.[1] The relative magnitude of the private and social costs will depend on the nature of the public policies in force and the time horizon under consideration. For example, should a flood or earthquake occur tomorrow, the physical destruction would be identical whether homeowners expect to be compensated by insurance (Policy 1) or by federal relief (Policy 2). Their decision to locate in these hazard-prone areas has an element of social risk to the extent that other taxpayers bear some of the recovery costs through either federally subsidized insurance or generous federal relief. Any difference in the social risks between Policy 1 and Policy 2 is also reflected in the resulting income distributions of victims and nonvictims following a disaster.

Let us now consider the impact of these two policies on disaster losses over a longer time horizon. Policies 1 and 2 will cause different potential losses should homeowners' location decisions be affected by whether they have the option of purchasing insurance or have to rely on federal relief. If, on the other hand, individuals do not consider the hazard potential of a region in their choice of houses, then future losses will be independent of whether Policy 1 or 2 is in effect. In this case, should there be an interest in mitigating the long-run effects of natural hazards, the government may have to rely on direct controls such as land-use restrictions and building codes. Of course, such regulations will have negative side effects whenever there are economic and social benefits to be derived from developing these hazard-prone regions in comparison to existing alternatives.

From this discussion it should be clear that one cannot talk about private and social aspects of risk without also considering how individuals react to the hazards that they face. The research described in this book is designed to further our understanding of this decision process.

1.3 THE DECISION TO PROTECT AGAINST FLOOD OR EARTHQUAKE LOSSES

Nature of the Problem

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 1950s, federal financial assistance during this period has grown even more rapidly.

Evidence on increased federal disaster relief through the 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 12 fiscal years of operation (1954–1965) with the next 11 (1966–1976). This growth is particularly significant in the case of home loans, where both the total number and total dollar values in the 1966–1976 period were more than 25 times what they were in the first 12 years of the program.

Part of this increase may have been the result of a rise 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 1965. 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.

Tropical Storm Agnes was the most costly disaster in the history of this country. Its financial repercussions led to the formation of an Office of Emergency Preparedness/Office of Management and Budget Presidential Task Force, whose principal charge was to compare the cost and benefits of federal disaster relief with those of an insurance program. A detailed analysis of the data collected for this task force for three severe disasters (the San Fernando earthquake of 1971, the Rapid City flood of 1972, and Tropical Storm Agnes) and a discussion of the changing role of the federal government in disaster relief can be found in Kunreuther (1973).

Since the Task Force Report, Congress has conducted an extensive set of hearings and appraisals of experience with federal disaster assistance. In April 1973 legislation was passed (PL 93–24) rescinding the $5,000 forgiveness grants authorized after Tropical Storm Agnes and increasing the annual interest rate from 1 to 5 percent. The interest rate was raised even further to $6\frac{5}{8}$ percent in August 1975 (PL 94–68).

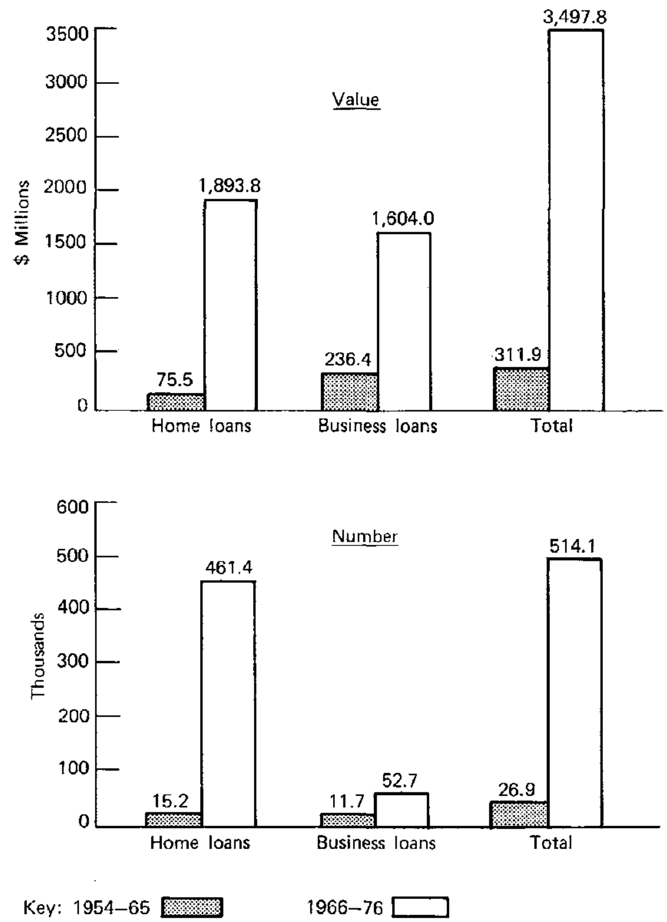

Figure 1.1 Comparison of value and number of SBA Disaster Loans, by category, for fiscal years 1954–1965 and 1966–1976. *Source:* Small Business Administration, Office of Reports.

The severe drought in the West and spring flooding in Appalachia during 1977 has led Congress to liberalize the disaster relief provisions once again. Legislation passed in August 1977 (PL 95–89) permits individuals to obtain 1 percent interest loans on their first $10,000 of uninsured damage, 3 percent loans on the next $30,000, and 6⅝ percent loans for that portion of a loan covering uninsured losses exceeding $40,000. Any victim who has received an SBA loan related to a disaster that occurred since July 1, 1976, can take advantage of these provisions retroactively.

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 locations after the areas are recognized to be subject to special flood risks, for this would, in fact, encourage further development 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 adopted 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 were specified by the federal government, private firms marketed policies and deposited premiums into a common pool operated by the National Flood Insurers Association. A system of government reinsurance protected 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 floodplains.

There is substantial evidence that most individuals in flood-prone areas do not voluntarily purchase insurance. Even though coverage was highly subsidized 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 was that no federal financial assistance for the construction or acquisition of buildings in *special flood hazard areas*[2] will be available to any flood-prone community that does not join the National Flood Insurance Program. All homeowners on the floodplain 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 July 31, 1977, 15,611 communities had joined the program and 1,027,771 residential policies were in force. Thus, by invoking sanctions on communities and residents in flood-prone areas, the program has grown markedly since 1973.

The financial incentive to join the flood insurance program has been threatened by amendments to PL 93–234, which were incorporated as part of the Housing and Community Development Act of 1977 (PL 95–128) in October, 1977. Residents in special flood hazard areas in communities that are not part of the NFIP are now allowed to obtain conventional loans from banks for new construction. Some communities currently in the flood program may now consider leaving it if they are anxious to develop areas that are now subject to land-use regulations. If the community undertakes such a move, residents who currently have flood coverage will lose their insured status and will become ineligible for disaster relief should they suffer future losses.

Earthquake Insurance. Earthquake coverage has been privately marketed by American insurance companies since 1916. In California premiums for wood-frame homes, 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 of the lack of interest in 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 an historical perspective on the development of flood and earthquake insurance, and 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.

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 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 flood insurance is an attractive option by considering the insurance premium, the estimated damage to his property from future floods of different magnitudes, and the probability that each of these disasters will occur. In other words the individual is assumed to behave as if he engaged 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 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 are extremely significant variables. These factors do not lie 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 activities. 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 must 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 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, 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 when the rates are subsidized.

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 identify causal relationships between variables by specifically controlling their levels.

Field Survey. The sampling plan for the field survey involved face-to-face interviews with 2055 homeowners residing in 13 states, in 43 areas subject to coastal and riverine flooding, and 1006 homeowners living in 18 earthquake-prone areas of California. Half the respondents had purchased flood or earthquake insurance, 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 appears in Chapter 4.

The field survey was designed to provide insights into the decision processes of these individuals. 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 amount, 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 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 concurrent variables on the insurance purchase decision. These techniques also enable us to estimate the relative influence 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 us to determine whether insured individuals are better informed than uninsured persons about the event against which they are protecting themselves. It also allows us to specify what effect, if any, alternative disaster programs have had on the insurance purchase decision and on the recovery process of those suffering damage. For example, in the past the federal government has provided low interest loans and forgiveness grants to victims of severe natural disasters. We want to know how much individuals know about these disaster relief programs, to what extent victims have utilized these sources of funds, and whether they regard 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 socioeconomic profile of homeowners living in flood- and earthquake-prone communities, as well as a comparison between coastal, riverine, and earthquake areas. Chapter 9 presents these characteristics of residents in each community surveyed. In addition, data from SBA loan files on three selected disasters enable us to examine the socioeconomic characteristics of those who utilize this program for recovery.

Controlled Laboratory Experiments. The field survey provides information on the magnitude of the relations between variables (e.g, previous flood experience and purchase of flood insurance), but does not enable us 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 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 and the analysis of field survey data.

Policy Analysis

The study has been designed to inextricably interweave the data collection and policy analysis phases. The field survey and controlled laboratory experiments enable us to differentiate alternative models of choice in the predisaster period and to describe property and socioeconomic characteristics of homeowners residing in flood- and earthquake-prone areas. Responses to the field survey questionnaire provide data on homeowner knowledge and attitudes toward hazard mitigation and disaster relief programs. In Chapter 10 we analyze the relative merits of alternative disaster programs based on these models and discuss their implications for public policy.

1.4 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.

The Decision to Wear Seat Belts

There is a substantial body of evidence compiled by such groups as the National Safety Council and the Insurance 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 made 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.

Robertson (1976) has concluded that safety ads have had no effect in increasing seat belt usage. He reports on a set of carefully designed, controlled experiments in which television and radio messages were broadcast to some households but not to others. Comparison of belt use by drivers revealed no statistical differences between those exposed to the ads and those who had not seen them. Another proposal for increasing seat belt usage in the U.S. has been to enact laws requiring that they be worn. The only U.S. jurisdiction that has passed such a law, Puerto Rico, had only a small temporary increase in use. Robertson cites a report by the Insurance Institute of Highway Safety (1975), indicating that usage reached a maximum of 24 percent but that the adverse public reaction to the law resulted in a reduction in the penalty for conviction. Belt usage then fell to 10 percent.

What factors do induce individuals to wear seat belts? A survey National Analysts conducted for the Department of Transportation (1971) revealed that there is a tendency to buckle up on longer trips but not on 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 of the importance of personal influence in the decision-making process.

Respondents for the Department of Transportation survey noted that a principal reason for not wearing shoulder harnesses or lap belts was "I never formed the habit." Similar rationale was found in a survey of drivers in Regina, Saskatchewan (Knapper, Cropley, and Moore, 1976). 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 sheds light on the factors that appear to be important in the adoption of such protective activities.

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 checkups 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*, November 4, 1974, p. 107). Four hospitals in Nashville reported 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 over the same period the year before. The comparative analysis also indicated that a large proportion of the cases were in the early stages, hence presumably more likely to be cured. *(New York 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 people could protect themselves 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 that are useful in inducing change.

The Decision to Stop Smoking

When an individual decides to stop smoking he is undertaking a protective activity regarding his health. Tamerin and Resnik (1972) summarize a substantial body of statistical data that indicates the major risks of cigarette smoking to the individual. They note that each year—as a result of smoking—77 million working days are lost, 88 million days are spent ill in bed, and 306 million days are spent in restricted activity. The life expectancy of a man 25 years of age who smokes two or more packs a day 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 3000 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 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 are 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 caused by 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 often behave as if a small probability meant a zero probability. The smoker's gamble may well be an instance of this behavior. Others may have tried to stop but have been unable to, or have decided that it was too much of a sacrifice.

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 are 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 indicate that knowing someone with the disease greatly increases the desire to get a medical checkup. It thus suggests the importance of salient observations on the consequences of an event before a person is willing to undertake protective measures.

A Gallup survey completed in December 1976 also revealed that over 70 percent of heavy cigarette smokers (at least a pack a day) would attempt to stop if urged to do so by their doctors. This finding suggests the importance of information provided through personal contact with experts whom people trust. We return to this point in Chapter 10, when discussing the role of insurance agents in promoting flood or earthquake coverage.

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 noncancelable 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; they 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 $5000 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 insurance 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 (*New York 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 those 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. Relatively few central city businesses may have thus 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?

The Decision to Purchase Flight Insurance

In contrast to the lack of interest in federally subsidized crime insurance, a substantial demand exists 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 of the chance of a plane crash because the extensive publicity such accidents receive makes people believe plane crashes are relatively frequent. A related explanation is that the location of insurance facilities stimulates concern with the consequences of a plane crash and enables the individual to relieve his anxiety on the spot. The low premium then makes such insurance very attractive. We explore the relative importance of these factors in our analysis of individual behavior toward natural hazards.

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 that may produce severe bodily harm. Given these findings we 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. Indeed, 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 suggest 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 a high cost of habit formation 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 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 compared with life insurance. What steps, if any, should society take to protect people against themselves? This question of individual versus societal responsibility should be debated in the public arena before policy recommendations are made.

1.5 SUMMARY

This introductory chapter states the principal motivation behind this book: 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 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 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 of 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.

NOTES

1. For an interesting discussion of private and social aspects of risk in the context of safety, see Lave (1972).
2. A special flood-hazard area is that part of the floodplain subject to inundation by a flood that has a 1 percent chance of occurrence in any given year.

2

The Context: The Nature of the Hazards and Insurance Coverage

2.1 NATURE OF FLOODS AND EARTHQUAKES

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 arises from 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 reduces 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 as a result of 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 onshore winds must also be recognized as having the potential to create serious flooding to coastal areas.

The threat of floods exists 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. (p. 255).

The Federal Insurance Administration estimates that 1 out of 10 Americans resides in locations where flooding is likely to occur. Figure 2.1 depicts the approximate percentage of the population of each state residing in a flood-prone area.

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 2000 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.

Other natural hazards triggered by earthquakes are often more destructive than the quake itself. Fire caused by the breaking of gas lines and made uncontrollable by the disruption of waterlines caused over 80 percent of the damage in the 1906 San Francisco earthquake. The failure of dams through 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

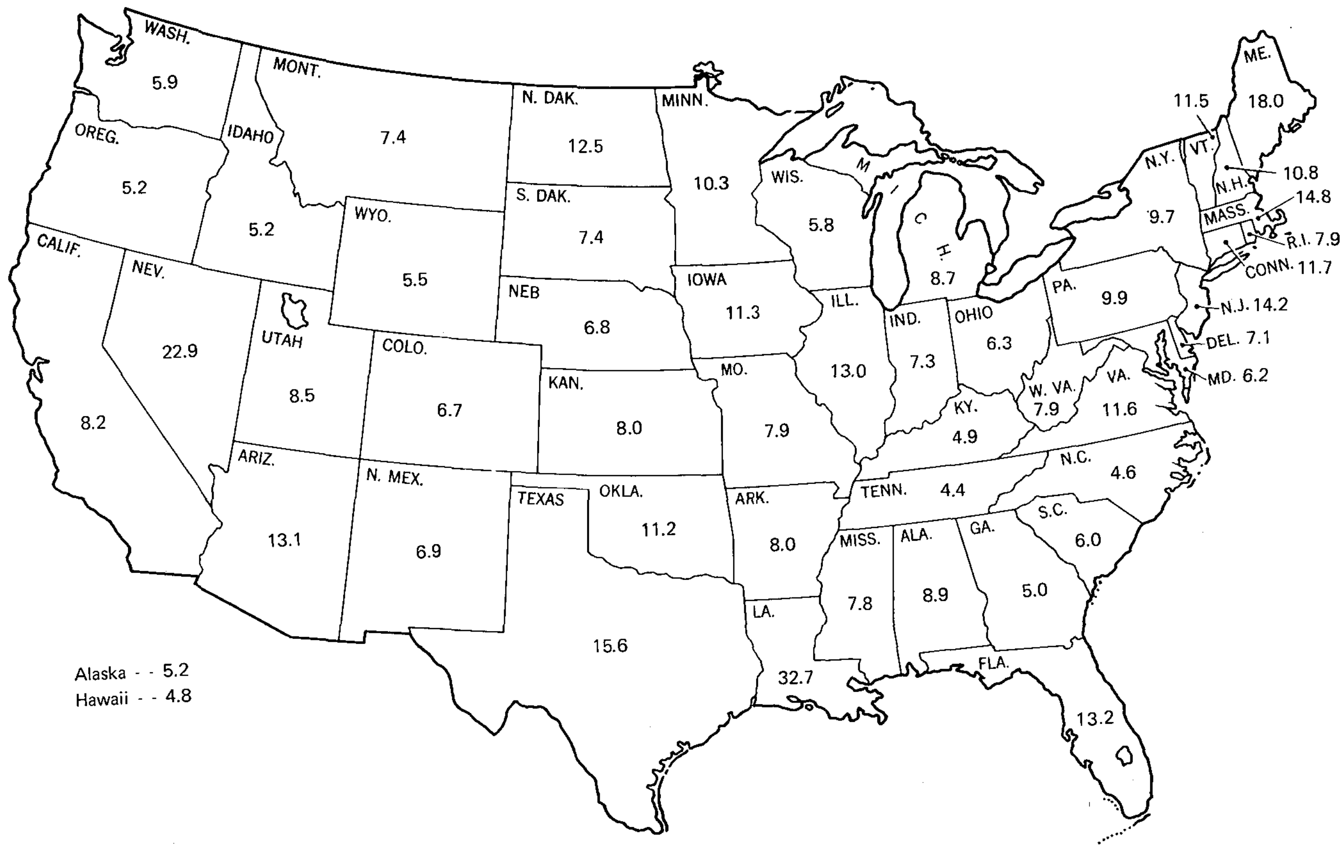

Figure 2.1 Percentage of population, by state, residing in flood-prone areas (June 30, 1976). Source: Federal Insurance Administration.

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.

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.

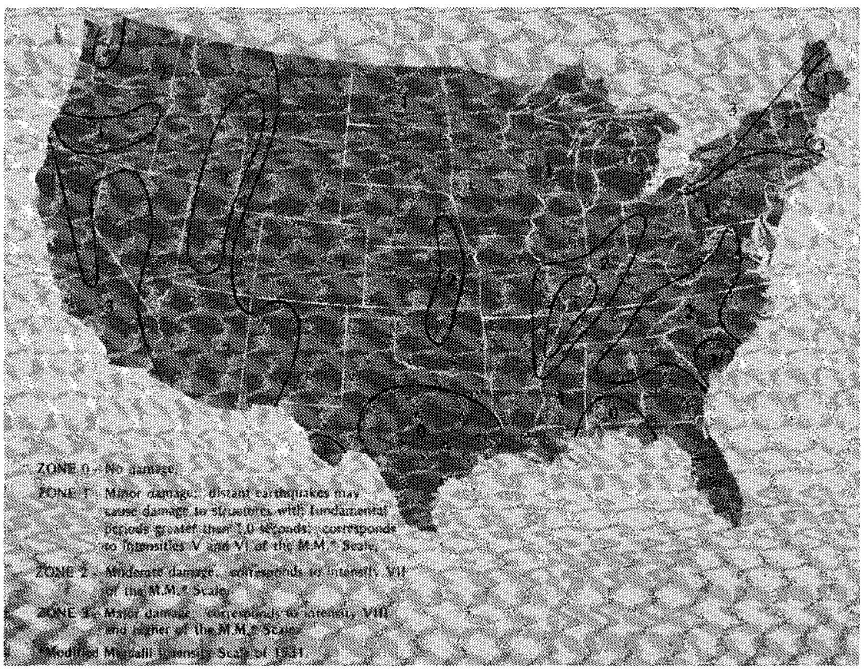

Figure 2.2 Seismic risk zones in the United States. This map is based on the known distribution of damaging earthquakes and the M.M. (Modified Mercalli Intensity Scale of 1931) intensities associated with these earthquakes, evidence of strain release, and consideration of major geologic structures and 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: U.S. Office of Emergency Preparedness (1972), Vol. 3.

Other areas of the country also face the threat of earthquakes, as shown by the seismic risk map in Figure 2.2.[1] It is worth noting that such Eastern cities as Boston, Massachusetts, Charleston, South Carolina, and Memphis, Tennessee, are classified in Zone 3, the same zone encompassing the Western coast of California. These maps reflect the recorded frequency of occurrence of earthquakes over a very short time period, in most cases not more than 200 years. Where there are longer records, as in the case of the more than 2000 years' history in the People's Republic of China, there is an indication that seismic action over a period of 100 to 200 years may not be a good predictor of the likelihood of major earthquake activity in subsequent periods.

Though considerable work is currently underway on earthquake prediction, it is not yet possible to warn residents of such an impending disaster. Thus 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

Introduction

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

Flood and earthquake insurance are not part of the fire and extended coverage policy that 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.[2] The problem of severe losses is caused by 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 in risk-prone areas.[3] As a safeguard against possible catastrophic losses, insurance firms can either build large reserves or enter into reinsurance agreements to transfer part of the risk to other firms. Both actions are costly to them.

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. This 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 came in the mid-1920s. At this time insurance magazines praised 30 fire insurance companies for placing 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, and 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 1920s 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 series of severe floods and hurricanes in the 1950s and 1960s. Following the disasterous 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 flooded many areas in the 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 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 Insurers Association, 1976, p. 3).

The primary reasons for Congressional refusal to fund the 1956 program were the serious questions raised both within government and by outside observers as to the potentially harmful effects on floodplain development of instituting a system of uniform premiums by river basins. The report of the Task Force on Federal Flood Control Policy, published as House Document No. 465 (U.S. Congress, 1966), recognized these deficiencies of the 1956 act and established a new federal program for dealing with flood losses. This landmark report made explicit reference to the need for a different type of flood insurance program and indicated how such coverage could be related to other types of adjustments such as land-use regulation.

Hurricane Betsy in September 1965 finally provided the impetus for the successful legislation that led 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 that was to be undertaken by the Department of Housing and Urban Development. The results of this study, coupled with House Document No. 465, were instrumental in initiating Congressional action which eventually culminated in the National Flood Insurance Act of 1968.[4]

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, 10 years after the San Francisco earthquake, such coverage attracted scant attention. Little was purchased despite a rate for dwellings of 4 cents per 100 dollars (with a 5 percent deductible provision). The low demand was largely caused by 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 businessmen, like this repondent, felt they had no reason to even consider earthquake insurance because 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, earthquakes were predicted for 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 1976. Following the San Fernando earthquake in February 1971, coverage rose markedly, though most of this increase has resulted from new coverage by business establishments rather than by homeowners. In fact, in 1976 fewer than 5 percent of all homeowners in California were covered by earthquake insurance.

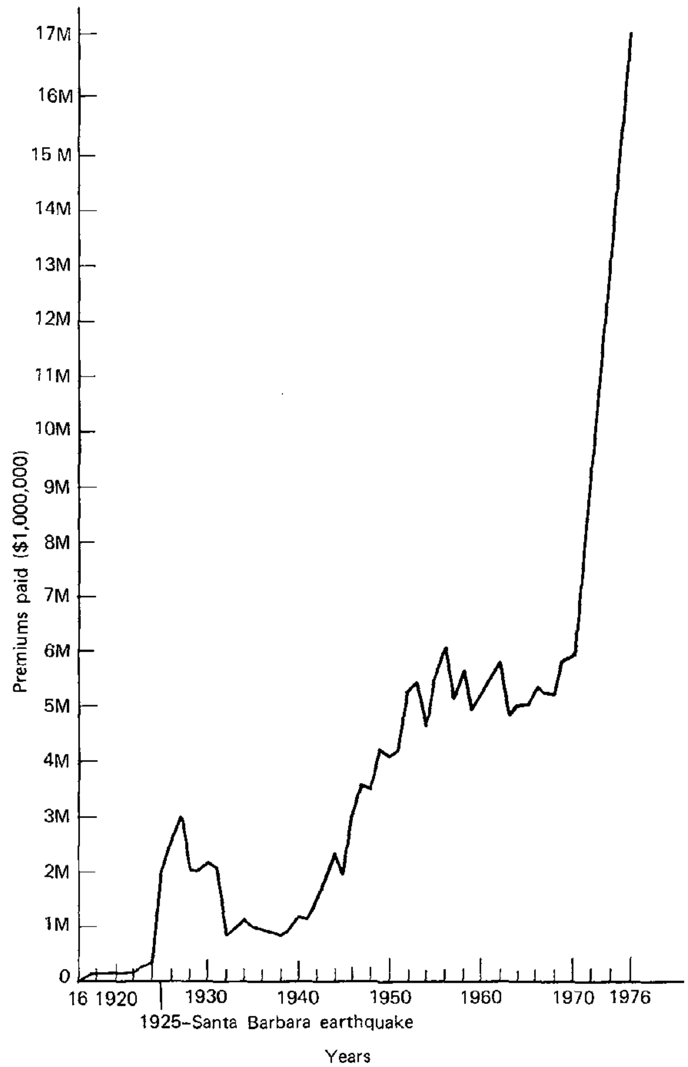

Figure 2.3 California earthquake insurance premiums (1916–1976). *Source:* compiled by Karl Steinbrugge.

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 (now part of the Insurance Services Office). This department issued a standard set of regulations regarding coverage that is still in effect today.

2.3 PRESENT STRUCTURE OF FLOOD AND EARTHQUAKE INSURANCE

The National Flood Insurance Program[5]

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, through 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 hazard mitigation requirements for participating communities. Up until the end of 1977 the writing of flood insurance was overseen by the National Flood Insurers Association (NFIA), an organization that represented a pool of 130 of America's major property and casualty insurance companies. The private insurance industry, under the auspices of the NFIA, commited a percentage of the risk capital, bore a portion of the expenses and insured losses, and, through licensed insurance agents and brokers, sold and processed flood insurance policies. Through an agreement between the 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 that 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 by Congress of the Flood Disaster Protection Act of 1973 (PL 93–234). This legislation increased 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 all but emergency forms of disaster assistance in the 100 year flood plain.

Once a community becomes eligible, homes and businesses located in the special flood-hazard areas (i.e., areas subject to inundation from a flood having a 1 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 Corporation) for new acquisition or construction purposes. Homeowners with existing mortgages at the time the community enters the program have a choice of whether 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

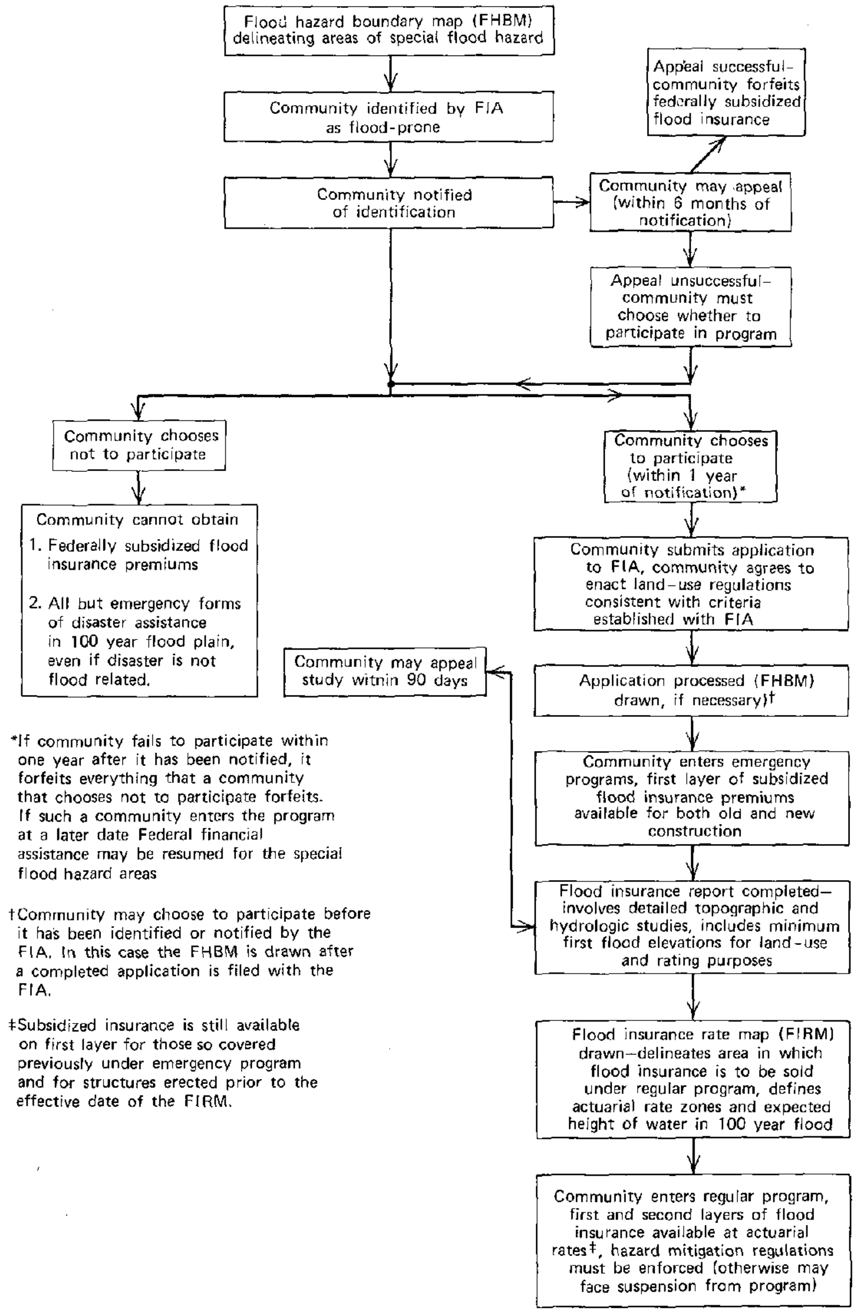

Figure 2.4 Diagram of community participation in the National Flood Insurance Program.

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 the FIA for reduction of flood damage.

The minimum floodplain management measures for these hazard-prone areas are incremental, depending on 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. To maintain eligibility in the NFIP under the emergency program the community's floodplain 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.
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 deemed eligible under the emergency program and a Flood Hazard Boundary Map has been issued, the FIA undertakes detailed flood studies 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 1 percent chance of occurring each year (100 year flood). The data gathered in these studies is used to prepare a flood insurance report 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[6] must have their lowest floor, including basement, elevated to or above the level of the 100 year flood. New or substantially improved nonresidential structures must be similarly elevated, or must be floodproofed 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).[7]

In coastal high hazard areas, in addition to applying elevation and floodproofing 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.
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 $200 or 2 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 on 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 limits are substantially higher than those under the emergency program. The second layer of coverage at actuarial (nonsubsidized) rates is available, together with the subsidized first layer of

Table 2.1 Flood Insurance Rates for the Continental United States

	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¢	150,000	Varies	$180,000
Other Residential	100,000	25¢	150,000	Varies	250,000
Non-Residential	100,000	40¢	150,000	Varies	250,000
Contents, Residential (per unit)	10,000	35¢	50,000	Varies	60,000
Contents, Non-Residential (per unit)	100,000	75¢	200,000	Varies	300,000

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.

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 80 percent of the structure's value (or the maximum amount of coverage available to him, if that amount is less), a claim is paid at full replacement cost. Otherwise the insurance payment is based on the actual cash value of the losses.

Structure of the Program. This section describes the structure of the flood program which was in effect until the beginning of 1978. Normally an insurance agent deals directly with the firm(s) he represents. As shown in Figure 2.5 the agent who wrote flood insurance had to

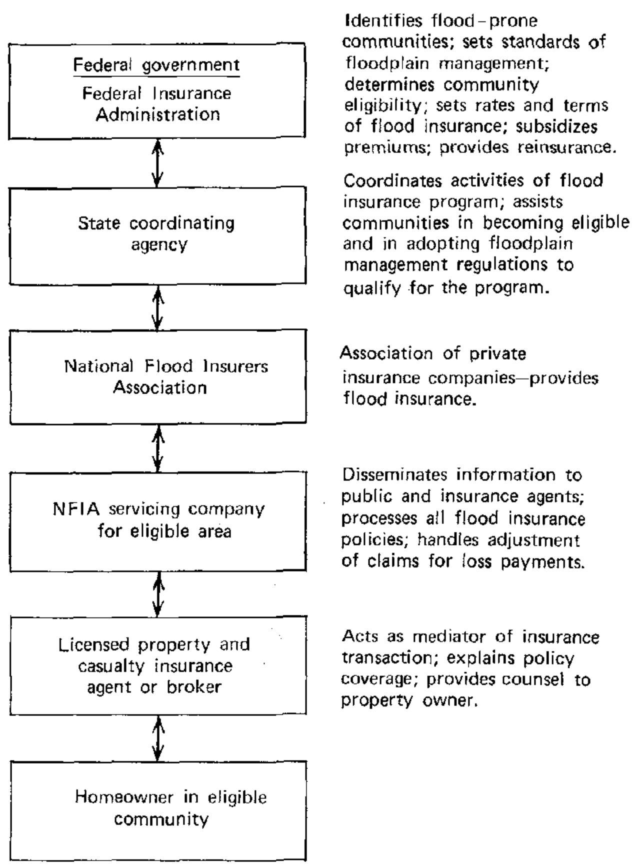

Figure 2.5 Structure of National Flood Insurance Program.

deal with a single NFIA servicing company in his area. Servicing companies were 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 the state or region. Servicing companies were reimbursed on a sliding scale determined by the volume of flood insurance they handle.

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 was 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 appointed 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 15 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 economic incentive to actively market this coverage. This problem is exacerbated by a lack of interest in flood coverage by many residents, even those facing serious potential problems.[8] 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

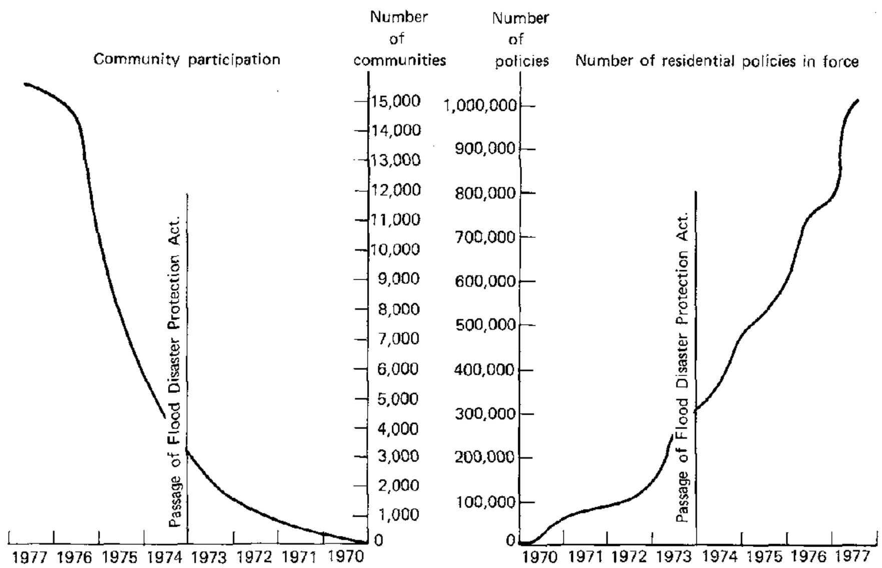

Figure 2.6 Historical growth of the National Flood Insurance Program.

areas affected by both Tropical Storm Agnes in 1972 and Hurricane Eloise in 1975. Although Eloise caused approximately 60 percent less damage to homes and contents than Agnes, the amount of insurance claims resulting from the 1975 hurricane was more than 10 times greater than that 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).[9]

Of the 21,000 flood-prone communities in the United States, 14,356 were part of the emergency program and another 1,255 were in the regular program as of July 31, 1977 and over 1 million residential policies were in force. The distribution by states of communities participating in the program and the residential policies in force is shown in Figure 2.7. The Northeastern states have the most communities enrolled in the program while the Gulf Coast states have the most residential policies in force of all regions of the country.

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 in force covers commercial and industrial properties. Residential coverage is

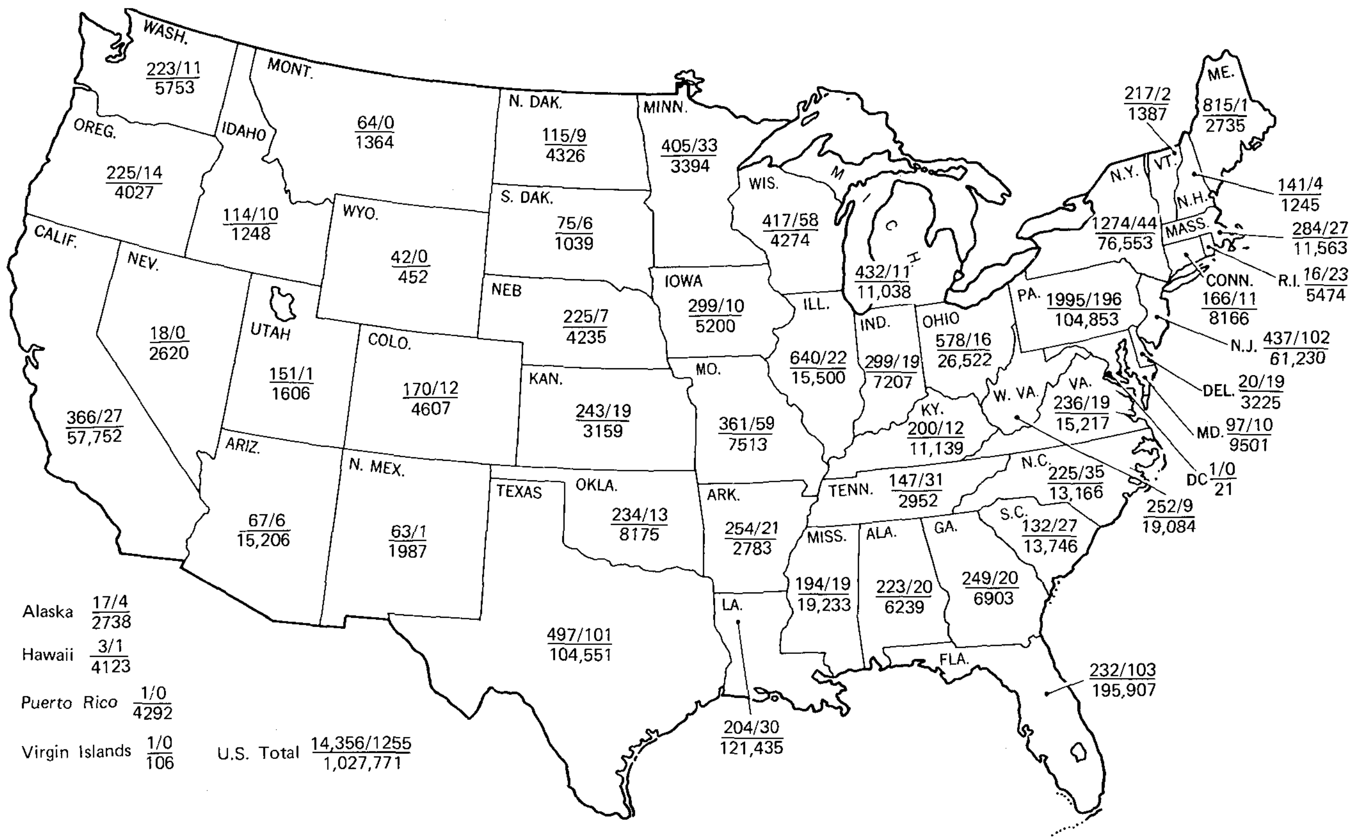

Figure 2.7 Status of National Flood Insurance Program by state.

Key to figures: $\dfrac{\text{Number of communities: emergency/regular}}{\text{Number of residential policies in force}}$ (as of July 31, 1977).

Source: Federal Insurance Administration.

readily available; however, few homeowners have had an interest in such protection. In 1976 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 5, 10, or 15 percent, depending on the type of construction.

The structure of the California earthquake insurance industry is similar to that of most other types of property insurance. As Figure 2.8

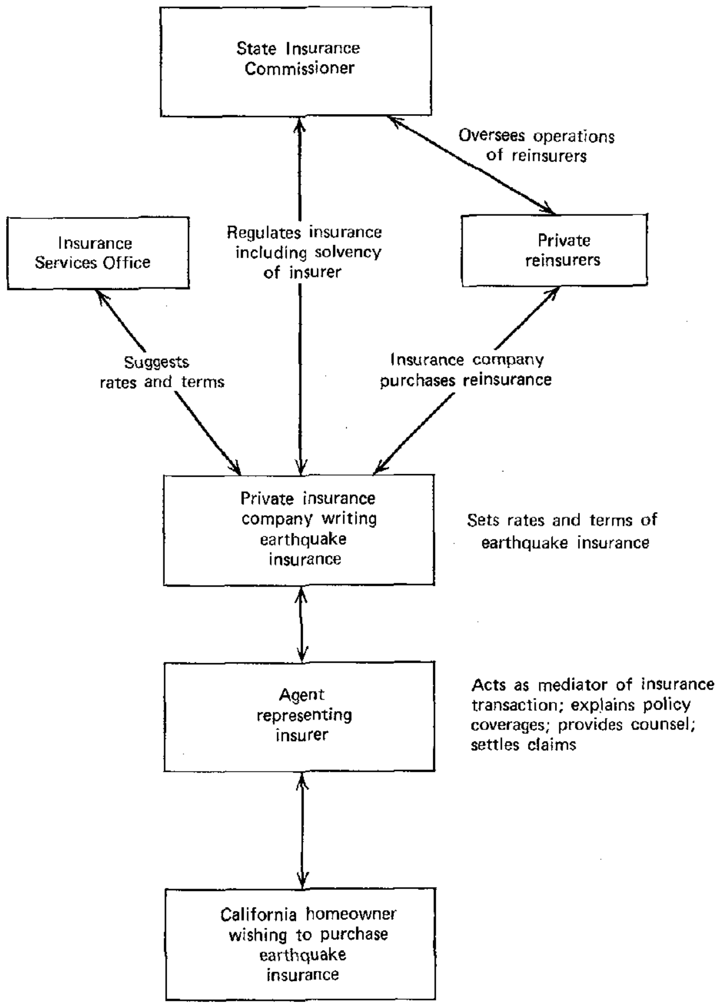

Figure 2.8 Structure of California earthquake insurance industry.

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.

indicates, 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. When ISO rates are not used, the deviation averages 10 to 15 percent in either direction.

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 5 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 70 percent of the value of the structure is insured against earthquake damage. When the amount of insurance is less than 70 percent of the value of the structural damage, 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 other 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.

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.

Earthquake insurance, which is similar to most other lines of property insurance, is marketed by licensed property and casualty agents and is normally written as an endorsement to homeowners policy. The coverage has been readily available in California since 1916 at nonsubsidized rates set by private insurance firms according to state regulations.

2.5 SUMMARY

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

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.

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 5 percent deductible on the actual cash value of the policy. Reinsurance coverage is available from private firms.

	Flood	Earthquake (California)
Provided by:	Private insurance agents with the cooperation of the federal government	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.

Table 2.3 Comparison of Flood and Earthquake Coverage for Single Family Residential Property

NOTES

1. A more detailed seismic risk map of the United States, based on probabilistic ground acceleration, has been developed by Algermissen and Perkins (1976).
2. When some insurance companies actually promoted earthquake insurance in California after the San Fernando quake, there was little interest in coverage by homeowners (see Chapter 1, p. 7).
3. 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 floodplain 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 will deteriorate as the premium rises. As a result it is possible that no insurance sales will take place at any price.
4. 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).
5. The institutional arrangements with respect to the flood insurance program described in this section are based on Part A of the National Flood Insurance Act which was in effect until Dec. 31, 1977. As of January 1, 1978 the Federal Insurance Administration instituted Part B of the Act thus ending its partnership with the National Flood Insurers Association. Private insurance agents still market flood policies but the underwriting of risks for the insurance is completely assumed by the federal government.
6. A substantial improvement is defined to be an improvement or repair of a structure, the cost of which equals or exceeds 50 percent of the market value of the structure before the improvement is started or the damage has occurred.
7. In a study undertaken for the FIA, Brown and Lind (1976) suggest that the 100 year flood standard is an arbitrary one. They advocate a procedure whereby structures are floodproofed or elevated to the point at which the net benefits of protection are maximized. They define net benefits to be the benefits from flood probability reduction less the cost of raising or floodproofing the structure. The authors demonstrate that in some cases this level will be above the 100 year flood standard while in others it will be below.
8. 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).
9. A detailed evaluation of the National Flood Insurance Program as it relates to flood plain management appears in Anderson (1974) and Platt (1976).

3

Theoretical Perspectives

Our primary interest in this book lies 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 models of choice which assume that individuals are able to collect and process information for making detailed comparisons of the benefits and costs associated with specific actions. 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 assigned probabilities to different states of nature (e.g., chance of a severe flood), assigned numerical utilities to the possible results of each course of action (e.g. a severe flood with no insurance protection), and then chose the action that would give him the highest expected utility.

In this chapter we provide a brief overview of expected utility theory and show how it may be used to evaluate whether insurance is an attractive option. The main purpose in introducing this theory is to indicate how it can be subjected to empirical testing, using data from the field survey and controlled laboratory experiments. We then propose a sequential model of choice as an alternative view of consumer decision making with respect to insurance purchases. A set of hypotheses implied by this model is also examined in later chapters with the use of data from the field survey and controlled laboratory experiments.

3.1 A MODEL OF INSURANCE BASED ON EXPECTED UTILITY MAXIMIZATION

Basic Principles*

The objective of expected utility theory is to provide a rational means for making decisions under conditions of uncertainty by 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; the columns correspond to possible states of nature. Expected utility theory is designed to determine the optimal course of action.

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

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

Table 3.1. Example of a Payoff Matrix

		States of Nature	
Alternatives		Severe Flood	No Flood
A_1	Do not purchase insurance	No insurance, severe flood (−2000)	No insurance, no flood (0)
A_2	Purchase insurance covering market value of house	Insurance, severe flood (−100)	Insurance, no flood (−100)

For simplicity, assume two states of nature: a severe flood or no flood. The values given in the cells of Table 3.1 represent the homeowner's utilities for the various consequences. If the probabilities 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:

$$E[U(A_1)] = 0.1(-2000) + 0.9(0) = -200$$
$$E[U(A_2)] = 0.1(-100) + 0.9(-100) = -100$$

In this situation the individual will purchase insurance because it has greater expected utility than does 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 satisified 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, not always objective.[1]

Application to Insurance Decisions*

The preceding framework can be extended to the more general case in which an 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 having 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 that 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 that 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 disaster causing damage to his property occurs.[2]

We now consider the case where there are only two states of nature: disaster or no disaster, and the person has the same utility curve regardless of whether he suffers a loss.[3] To determine an optimal

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

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

The individual has predisaster 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

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

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, $z(1-p-t-f)$. We 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 "nondisaster state" if I dollars of insurance is 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 purchase more insurance than his maximum loss L if he were allowed to do so. Since he is not, 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 postdisaster wealth to predisaster 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, 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.

An Illustrative Example

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), and 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 arising from 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 her household Ms. Smith is the most knowledgeable person about matters related to insurance. She feels that minor flooding of the Green Brook would cause no damage to their house and contents but that severe flooding of the brook would result in a loss to them of $L = \$20{,}000$. The chances of such a severe flood occuring next year are estimated by her to be 1 out of 100, hence $z = .01$.

The annual family income is approximately $18,000, so that with appropriate deductions the Smiths have a marginal federal income tax rate (t) of 0.25. Ms. Smith just became aware that flood insurance is available in Plainfield but does not know the premium. However, she estimates the cost per $1000 coverage to be $3, so that $p = .003$. If flood insurance actually cost her this amount, then protection against a $20,000 loss would be $60. If a severe flood caused damage to their house and they were uninsured, Ms. 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 their entire loss. With a current market interest rate of 9 percent such a loan represents a potential write-off of $f = 0.04$.

Based on the family's current wealth (W), Ms. Smith has been able to specify her utility function to analyze her optimal decision with respect to purchasing insurance. In determining this utility function she 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, Ms. Smith assigns a utility of 0 to their current wealth level W, which is equivalent to the outcome "no insurance and no flood." For the case "no insurance and a severe flood" the Smiths' wealth level drops to W - 20,000 and she assigns a utility of -2000 to this outcome. These preassigned values represent the two extreme cases for this problem, and form the end points of Ms. Smith's utility curve. Using these two values Ms. Smith can determine the utility associated with any outcome to her that results in wealth between W and W - 20,000. These utilities comprise the curve shown in Figure 3.1.

From the data provided by Ms. 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 Ms. Smith

Alternatives		States of Nature: Severe flood ($z = .01$)	States of Nature: No flood ($1 - z = .99$)
A_1	Do not purchase insurance	−2000	0
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 Ms. Smith follows action A_2 and purchases full insurance for $60, then the utility to her of this course of action is −5 whether or not a flood occurs. If on the other hand she 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, Ms. Smith would prefer to purchase full coverage rather than no insurance, since A_2 has a higher utility. If she can purchase any amount of insurance, the optimal amount (I^*) is determined by relating the insurance premium to the chances and consequences of a severe flood. This premium/loss ratio

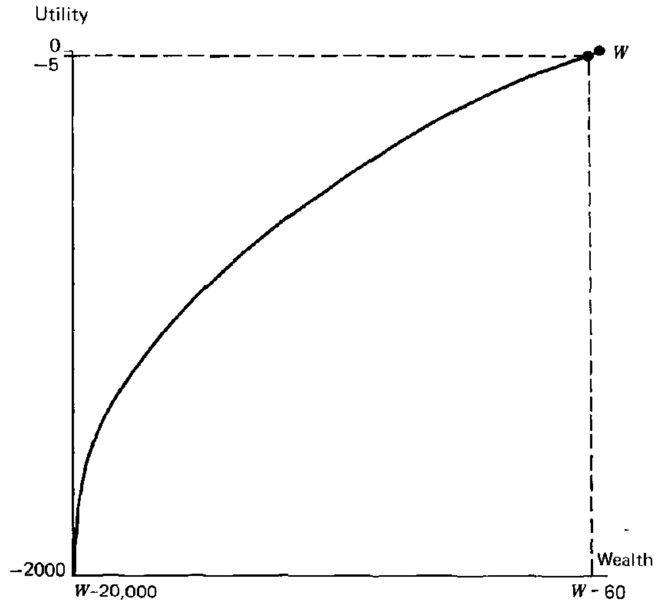

Figure 3.1 Ms. Smith's utility curve.

has been termed a "contingency price ratio" and is given by the left-hand side of equation (3.1). If Ms. Smith's estimates are used, the value of this ratio, R, is 0.42. As discussed above, whenever R is less than 1 it is optimal to purchase full insurance coverage. Hence Ms. Smith should buy a $20,000 policy.[7]

Empirical Tests of Utility Theory

Despite the widespread acceptance of utility theory as a model for predicting insurance purchase decisions, relatively few empirical studies have been undertaken to test its descriptive accuracy. Markowitz (1952) presented individuals with choices between a certain loss x and a probabilistic one (i.e. a one in ten chance of losing 10 times x). He found that when x was sufficiently high individuals preferred to gamble rather than incur a certain loss. This risk seeking behavior in the loss domain runs counter to the conventional assumptions made by economists in analyzing optimal insurance decisions. Yaari (1965) presented data suggesting that the propensity of an individual to buy insurance and gamble can be explained by the subjective exaggeration of the probabilities of rare losses or gains. In the few controlled experimental studies of insurance buying, behavior contrary to utility theory has been observed. For example, Murray (1971, 1972) and Neter and Williams (1971) found that utility functions scaled individually for each of their subjects failed to predict insurance preferences. Schoemaker (1976), studying clients of an insurance agency, found preferences for low-deductible policies, context effects, and scale effects, all of which run counter to the theory.

An experiment by Williams (1966) showed that people's preferences among gambles offering no chance of gain were unrelated to their preferences among speculative gambles, which have a chance of loss or gain. Neither of these preferences predicted insurance behavior outside of the laboratory (for similar results, see Greene, 1963, 1964). A recent review of laboratory studies not involving insurance decisions, by Slovic, Fischhoff, and Lichtenstein (1977), indicates that the expected utility theory accounts poorly for preferences among speculative gambles except in very simple situations. Finally Kahneman and Tversky (1978) presented subjects with a series of choice problems among risky prospects. They found that individuals exhibited several pervasive effects that are inconsistent with the basic tenets of utility theory. One of their principal findings is that people underweight outcomes that are probable when compared with outcomes that are obtained with certainty. This tendency frequently produces risk aversion in choices involving sure gains and risk seeking behavior in choices involving sure losses.

Incorporating Search Costs into the Model

The preceding analysis and empirical tests in the literature assume that there are no costs of collecting data on either the probabilities of flooding, the resulting losses, or the insurance premiums. In reality some time and effort are involved in gathering information, and this may cause individuals not to purchase insurance even though the 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 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 toward 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 homeowner 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 who compared prices only 45 percent purchased 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 8 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.

This modification of the expected utility model enables us 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 we can isolate important variables that describe this process, policy recommendations for changing behavior may not produce the intended effect.

3.2 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 satisfied the axioms on which the theory is based. For example, his choice among alternative policies (e.g., purchase no insurance, purchase full insurance coverage) is determined as if he multiplied 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 that 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 on 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 *conclusions*, the assumptions on which the model are based are easily forgotten. But it is precisely the empirical validity of these *assumptions* 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 modeling 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, 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 to purchase coverage by selec-

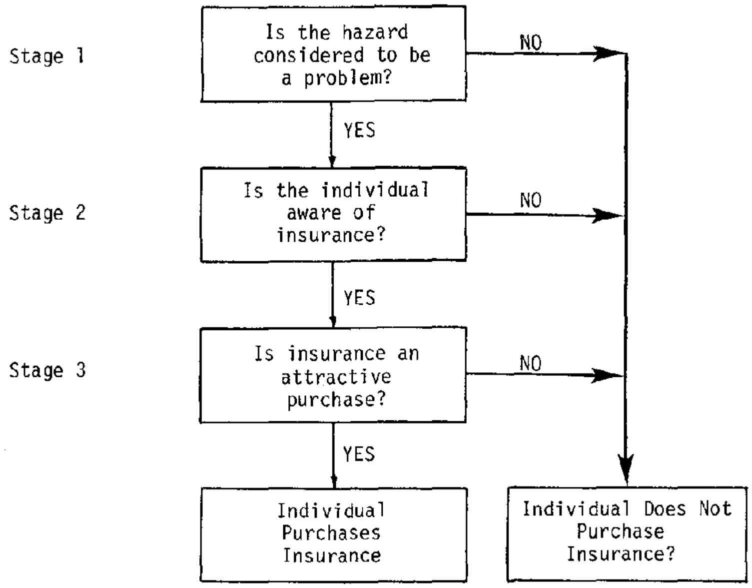

Figure 3.2 Stages of individual's insurance purchase decision.

tively 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 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 can impart. However, to one group of people 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 do residents in their area who were not aware of its existence at the time they located there.

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 that 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 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 needed to obtain 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.

3.3 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 that should influence his decisions: probabilities, losses, premiums, deductibles, and so forth. Considerable empirical evidence exists that is consistent with this information–processing perspective.

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 living in floodplains 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 of 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 they judge the probability of an event by the ease with which such instances are readily retrieved from memory. The notion of availability may explain why individuals have been reluctant to protect themselves against hazards until they personally experience a loss. Prior to a disaster individuals are likely to assign a low probability to such events if they utilize the availability heuristic. Once people treat the chances of the hazard as being small, they are likely to consider it to be a problem worthy of attention.

The limited ability of individuals to deal with information on natural hazards and their reliance on past experience have been reinforced through a series of cross-cultural field surveys summarized by White (1974) and Burton, Kates, and White (1978). In the latter book the three geographers characterize individual behavior related to 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, 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 in which a firm having 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 its 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, individuals frequently show little reaction to a new stimulus. Inertia and established habit lead the consumer to classify the new stimulus as familiar. Sufficient personal experience is required for the consumer to become aware of a particular problem.

Diffusion of Information

Once the individual is aware of the problem, he is receptive to ways in which he can alleviate its consequences. He may not have adequate information on protective measures open to him; however, in the case of flood insurance, subsidized policies have only been marketed in the United States since 1969, so this form of protection is viewed as a new product by individuals on the floodplain. Even though earthquake insurance has been readily available in California since 1916, some homeowners do not know of its existence or assume that 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 conducted 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 questions of how data is collected and 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 to purchase a policy by comparing the premium with the potential benefits of coverage. Because the model is static in nature, it ignores the facts that information is a scarce resource and that 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, 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 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 undoubtedly provided visible information, and the farmers 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 on 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 first be 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 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, between 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 are thus required to determine the effect that these differences between insurance and other products have on the adoption process.

Processing of Information

The literature on adoption of innovations suggests ways in which individuals obtain data, but does not address the questions of what information they collect and how they process it. Should the individual be presented with figures on 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 products they purchase. 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 that the hazard in question presents a serious problem. Because the diffusion of information on the availability of coverage takes time, the adoption process is likely to be slow even if people are interested in coverage. In deciding whether to buy, a person is likely to use limited data and follow simple decision rules rather than behave as if he maximized expected utility.

In their new and important book on decision making, Janis and Mann (1977) develop a conflict theory of choice, grounded in research related to the psychology of stress. Their principal interest is in how external cues affect emotions and behavior. They then relate the impact of individuals' coping patterns to information processing strategies and the determination of a course of action. The sequential model of choice proposed here is concerned with the relative importance of external factors, such as past experience and interpersonal communication, on the final outcome rather than with coping strategies.

3.4 SUMMARY

The first part of this chapter develops a model of insurance buying behavior based on expected utility theory. 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 people are reluctant to collect information on insurance unless they perceive the hazard to be a problem. The studies on adoption of innovations further suggest that information on insurance may not be diffused rapidly enough for all people who are interested in coverage to 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), then be aware of the existence of insurance (Stage 2) before he determines whether to buy coverage (Stage 3). Past experience plays a key role in making him aware of the problem, and interpersonal communication is a primary means of gathering information on the terms of a policy. If he reaches Stage 3, his final decision is 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 are used to specify the relative importance of different factors as they affect the insurance purchase decision, but the analysis does 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 subjects' demand for insurance. However, these data are collected in an artificial setting and thus must be synthesized with the field survey results before implications can be drawn for public policy.

NOTES

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 (1971).
2. For illustrations of the application of a state preference model to investment and insurance decisions, see Marshall (1969), Hirshleifer (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 that 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* were 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, enabling derivation of an explicit expression for the marginal utility curve.
8. The seminal work in this area was done 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) 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 in 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 inoculations 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).

4

Considerations in Designing The Field Survey

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 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 the ISR during all phases of the survey, from the design of the sampling plan to the coding of the interview responses.

4.1 THE SAMPLING PLAN[1]

The field survey consisted of a stratified cluster sample selected from a significant proportion of insured and uninsured homeowners residing in flood- and earthquake-prone areas. It 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 was to determine the factors that influence the insurance decision for the different hazards: hurricanes, riverine flooding, and earthquakes. On the basis of statistical considerations we decided to interview equal numbers of policyholders and nonpolicyholders 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). Because budgetary considerations necessitated geographical clustering of interviews, the only counties eligible for sampling were those having at least 25 policyholders. Our flood sample was limited to areas in which 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] Under these 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 1 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 the decision processes utilized by insured and uninsured homeowners required comparability between the groups with respect to socioeconomic and property characteristics as well as geographic location. If we had based our sample plan on the first criterion, 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 might 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 would provide 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 would have the attractive feature of minimizing the differences between policyholders and nonpolicyholders on variables such as objective risk, value of property, and income. Such a plan would therefore maximize 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 would be that it would not reflect the actual distribution of nonpolicyholders, since they are arbitrarily preselected to live next door to insured homeowners.

The sampling plan actually employed for choosing uninsured homeowners incorporated features of each of the foregoing plans while maintaining standards of statistical rigor. Specifically, we utilized a nonproportionate sampling plan by oversampling uninsured homeowners in high hazard zones. In this way we could determine the effect

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	

of such variables as past disaster experience and interpersonal communication on the decision to purchase insurance, yet could still generalize statistically to the homeowner population under study. To illustrate, consider the design of the flood sample. Hydrographic surveys had been carried out for the FIA in each of the communities in the regular program. Based on these studies, flood insurance rate maps were drawn that delineated geographic zones corresponding to objective probabilities of flood damage. A simple random sampling plan would have resulted in most 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 are henceforth referred to as A and B, respectively.) A similar procedure was utilized for the earthquake portion of the survey.

The desired total number of interviews was 3000: half with insured homeowners, half with uninsured homeowners. Approximately 2000 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 nonproportionate split, policyholders were 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.

4.2 SELECTION OF STUDY SITES

Flood Survey

Eligible for selection in the flood sample were all counties in the regular program in which at least 25 insurance policies had been sold. 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, 109,453 policies had been 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 its chances of being selected for inclusion in the sample.

An average of 25 interviews with policyholders constituted a "hit." For counties having 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 two hits and anticipated interviewing 100 persons. Nonpolicyholders were selected in the same counties that constituted "hits." On average the number of uninsured homeowners interviewed was expected to equal the number of insured in each county. Two communities were then selected within each county for inclusion in the sample. The sampling plan was not designed to have equal proportions of policyholders and nonpolicyholders at the community level, which accounts for differences in the number of interviews for these two groups in some of the 43 communities comprising the field survey.

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, a result of the large number of flood insurance policies that have been sold in this part of the country. Table 4.2 provides data on 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 July 31, 1977, 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 nonpolicyholders.

It should be kept in mind that the current insurance status of the homeowner may differ from what was expected when the property was

Figure 4.1 Communities in the flood portion of the survey (numbers refer to location of communities in Table 4.2).

Table 4.2 Communities in the Flood Portion of the Survey

Community*	Date Community Entered Emergency Program	Date Community Entered Regular Program	Flood Insurance Policies Sold 8/31/73	Flood Insurance Policies Sold 7/31/77	Number of Interviews Insured A	Insured B	Uninsured A	Uninsured B	Total
Coastal									
1. Ft. Lauderdale, Fla.	11/20/70	11/ 3/72	2,410	6,222	13	21	5	38	77
2. Hollywood, Fla.	6/ 4/71	11/ 3/72	653	2,581	17	9	4	17	47
3. Dade County, Fla. (Miami Beach, Miami, Homestead)	8/14/70	9/29/72	5,733	20,032	12	3	4	0	19
4. Monroe County, Fla. (Islamorada)	6/12/70	6/15/73	2,704	9,311	15	0	9	0	24
5. Indian Rocks Beach, Fla.	7/17/70	5/ 7/71**	44	577	78	0	14	0	92
Belleair, Fla.	6/30/70	5/14/71	604	819					
6. Redington Beach, Fla.	5/15/70	5/ 7/71	450	639	34	0	3	0	37
Maderia Beach, Fla.	6/ 5/70	5/ 7/71	709	1,172					
7. St. Petersburg, Fla.	6/19/70	5/28/71	2,310	8,535	32	6	20	19	77
8. Treasure Island, Fla.	6/30/70	5/ 7/71	1,061	1,553	38	0	15	0	53
St. Petersburg Beach, Fla.	5/22/70	5/14/71	1,103	2,054					
9. Ocean Ridge, Fla.	9/18/70	4/ 9/71	105	302	14	1	7	0	22
Gulf Stream, Fla.	7/16/71	1/24/73	78	140					
10. Sarasota County, Fla. (Englewood, Nokomis)	7/10/70	7/30/71	1,152	5,792	9	0	11	0	20
11. Venice Fla.	8/28/70	7/30/71	197	768	14	11	6	2	33
12. Jefferson Parish, La. (Avondale, Gretna, Harvey, Kenner, Metairie)	a	6/25/69	9,808	41,600	57	33	62	49	201
13. New Orleans, La.	7/10/70	10/20/72	11,295	34,632	45	19	48	32	144
14. St. Bernard Parish, La.	a	3/13/70	3,087	8,987	35	21	11	5	72
15. Marion, Mass.	10/ 8/71	4/ 6/73	83	167	15	0	1	0	16
16. Wareham, Mass.	7/10/70	5/28/71	610	1,224	11	0	19	6	36

Table 4.2 *(Continued)*

Community*	Date Community Entered Emergency Program	Date Community Entered Regular Program	Flood Insurance Policies Sold 8/31/73	Flood Insurance Policies Sold 7/31/77	Number of Interviews Insured A	Insured B	Uninsured A	Uninsured B	Total
Coastal--Continued									
17. Hancock County, Miss. (Pearlington Bay St. Louis)	6/30/70	7/11/70	1,294	1,762	7	0	68	0	75
18. Waveland, Miss.	6/30/70	9/11/70	441	790	19	0	0	4	23
19. Harrison County, Miss. (N. Biloxi)	7/17/70	9/18/70	2,344	4,426	6	1	28	0	35
20. Long Beach, Miss.	6/19/70	9/11/70	266	616	5	0	1	0	6
21. Atlantic City, N.J.	6/30/70	6/18/71	451	1,799	5	0	6	0	11
22. Islip, N.Y.	10/16/70	11/17/72	641	1,841	3	11	17	39	70
23. Charleston S.C.	10/30/70	4/ 9/71	383	2,130	8	0	8	1	17
Folly Beach, S.C.	9/11/70	4/ 2/71	220	379					
24. Isle of Palms, S.C.	9/ 4/70	4/ 2/71	187	519	10	0	1	0	11
25. Galveston County, Tex. (Galveston City, Kemah, League City, Hitchcock, San Leon)	6/19/70	4/ 9/71	5,368	10,610	65	7	30	18	120
26. Matagorda County, Tex. (Bay City)	6/19/70	4/30/71***	896	1,487	6	0	3	0	9
27. Aransas Pass, Tex.	6/19/70	6/25/71	145	254	7	12	0	2	21
28. Sinton, Tex.	6/19/70	3/26/71	594	573	18	21	5	1	45
Riverine									
29. Los Angeles County, Cal. (Los Angeles County, Union, Altadena, Malibu)	7/10/70	8/27/73	398	560	1	8	16	2	27
30. La Puente, Cal.	9/11/70	6/25/71	197	279	0	11	0	15	26
31. Prince's George's County, Md. (Prince Georges, Queens Chapel Manor, College Park, Hyattsville)	8/ 7/70	8/ 4/72	518	793	0	3	12	6	21
32. Pompton Lakes, N.J.	6/ 5/70	9/ 4/70	131	324	21	0	20	0	41
33. Wayne Twp., N.J.	7/10/70	2/16/73	216	502	15	3	25	1	44

Table 4.2 *(Continued)*

Community*	Date Community Entered Emergency Program	Date Community Entered Regular Program	Flood Insurance Policies Sold 8/31/73	Flood Insurance Policies Sold 7/31/77	Number of Interviews Insured A	Insured B	Uninsured A	Uninsured B	Total
Riverine--Continued									
34. Clark Twp., N.J.	7/10/70	12/23/71	42	161	14	9	0	7	30
35. Cranford Twp., N.J.	6/19/70	6/25/71	277	822	44	11	11	10	76
36. Elizabeth, N.J.	5/22/70	5/ 7/71	344	581	23	1	19	29	72
37. Plainfield, N.J.	6/19/70	6/25/71	53	498	10	20	13	27	70
38. Minot, N.D.	a	3/17/70	1,053	2,089	44	10	28	0	82
39. Clackamas County, Ore. (Milwaukie, Oregon City, Portland, Eagle Creek)	4/ 2/71	8/25/72	229	580	0	12	0	4	16
40. Josephine County, Ore. (Grants Pass)	12/31/70	9/10/71	129	247	19	1	1	0	21
41. New Braunfels, Tex.	12/ 4/70	12/ 1/72	241	239	9	5	0	6	20
42. Abilene, Tex.	6/19/70	7/23/71	196	618	13	8	10	0	31
43. Alexandria, Va.	a	8/22/69	384	455	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.

[a]Emergency Program did not exist when the community joined the National Flood Insurance Program.

Table 4.3 California Communities in the Earthquake Portion of the Survey

	Community	Number of Interviews Insured	Uninsured	Total
1.	Walnut Creek	7	73	80
2.	San Raphael	2	12	14
3.	Daly City	13	15	28
4.	San Bruno	8	23	31
5.	San Mateo	13	20	33
6.	Palo Alto	11	18	29
7.	San Jose	63	49	112
8.	Sunnyvale	13	24	37
9.	Fremont	4	23	27
10.	San Leandro	6	24	30
11.	Oakland	16	33	49
12.	San Francisco	19	23	42
13.	Los Angeles	54	120	174
14.	Long Beach	8	24	32
15.	Huntington	3	13	16
16.	San Bernadino	8	26	34
17.	Misc. Los Angeles County	126	13	139
18.	Misc. San Francisco Bay Area	87	12	99
	Total	461	545	1,006

selected for inclusion in the sample. One reason is that the family may have bought insurance or canceled the 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 differ from that of the previous family.

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 6000 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

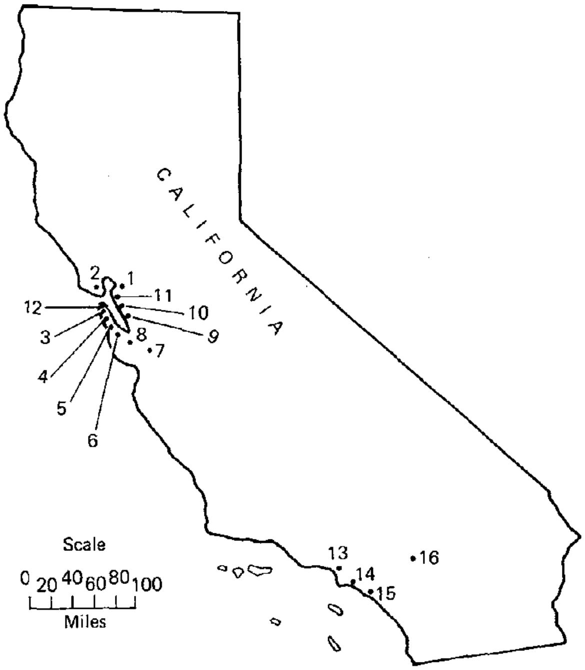

Figure 4.2 California communities in the earthquake field survey (numbers refer to location of communities in Table 4.3).

the rate of policy buying in each one. All uninsured homeowners living in communities where there were at least 5 policyholders from the sample of 6000 names were included in the universe. The remaining areas were omitted just as Zone D was eliminated in the flood-prone communities. The insurance purchase rate 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 floodplain.

We estimate that the communities in our universe include 96 percent of all policyholders in the 11 county area, where at least 1 out of every 15 homeowners had purchased earthquake insurance. The counties and communities were chosen in a manner analogous to the selection of the flood sample. Hence the number of insured and uninsured homeowners in any specific community may have differed, even though they were designed to be approximately the same on the county level. Data on the number of interviews in each of the communities are presented in Table 4.3, and their locations are depicted in Figure 4.2.

4.3 CONDUCTING THE SURVEY

Presurvey Analysis

In preparation for the development of the flood and earthquake questionnaires, six focus group depth interviews were conducted by the ISR. 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, 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 insurance decision process 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 predisaster behavior. For example, most participants suggested that a person must personally experience flood losses before becoming interested in purchasing flood insurance. 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's (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 lies in the clues provided by respondents 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 dialogue is ordinarily not obtained in structured interview settings. In subsequent chapters such comments are 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 relating 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 tested in Atlantic City, New Jersey (a coastal flood-prone area), and San Francisco, California (an earthquake-prone area). The final version was pretested in nearby Norristown, Pennsylvania (a riverine area), so that members of the project staff could conduct the interviews.

Structure of the Questionnaire

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

1. 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 compensate for damage from the disaster. To our knowledge this is the first questionnaire to attempt 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. These data are analyzed in Chapters 5 and 6.

2. 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 by 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.

3. Questions on age, income, religion, occupation, and education provide a profile of the socioeconomic 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, are discussed in Chapter 9.

Appendix A. 2 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.3.

Field Activities for the Surveys

The first major problem encountered in interviewing was that a smaller percentage of households was found to be eligible than was originally expected. In other words, many housing units were found to be nonowner occupied, despite an 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 nonpolicy portions of the sample, an additional list of approximately 1000 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, 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 have been 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, hence were unwilling to admit an interviewer who might "case" the house. Telephone calls made by the ISR personnel confirmed this fear.

In an effort to reduce the magnitude of the nonresponse 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 that the 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. All occupants of the 1000 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 this 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 the ISR actually received numerous phone calls from prior refusals asking to be interviewed.

The extra time and effort spent in the data collection phase yielded direct benefits. The high completion rates among eligible respondents increased the extent to which the findings may be generalized. Tables 4.4 and 4.5 summarize the relevant statistics on interview cooperation and completion rates among eligible respondents for the six different

Table 4.4 Interview Cooperation

	Coastal Flood		Riverine Flood		Earthquake		
	(Policy)	(Non Policy)	(Policy)	(Non Policy)	(Policy)	(Non Policy)	Total
Completed Interviews	579	834	305	337	460	546	3,061
Interviews Refused	129	169	78	102	136	170	784
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

*Ratio of (Completed Interviews/Interviews Attempted) × 100.

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[a]	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

[a]Non-owner occupied housing units.

*Ratio of (Eligibles/Completed Interviews) × 100.

groups classified in the sample plan. As shown in Table 4.4, the completion rates vary from 76 percent (earthquake nonpolicyholders) to 83 percent (coastal flood nonpolicyholders), with an overall average of 79.6 percent. The magnitude of the effort undertaken by the 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 percentage of completion among eligibles varied from 64.1 percent (riverine nonpolicyholders) to 70.8 percent (coastal nonpolicyholders), with an overall average of 68.9 percent. We should point out that the data in Tables 4.4 and 4.5 reflect the insurance status of the property when it was selected for inclusion in the sample, in contrast to those in Table 4.1 which represent the actual status. These figures differ for two principal reasons. One is that some families may have bought insurance or canceled their policies between August 1973 and the interview date. Another reason is that some houses may have changed hands in the interim period. In such cases the insurance status of the new homeowners may differ from that of the previous family.

4.4 DETERMINING THE QUALITY OF DATA

During all phases of the field survey great care was taken to ensure 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 discuss the quality of data under the headings of reliability, and bias. These possible sources of error should be considered in interpreting the data analyses presented in the following chapters.

Reliability

Reliability refers to the amount of nonerror variation in the answers to a particular question. Low reliability of a particular question implies that respondents are not very consistent in their response and 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 may 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, this variable should not be given as much importance in a model of the insurance purchase decision as it would 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 enough 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 caused by, for example, changed conditions between interviews (e.g., the occurrence of a severe flood).[6]

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 a useful magnitude.

Bias

Bias refers to the difference between the expected value of estimates derived from samples such as the one drawn and the true value of the population under study.[7] It is comprised of at least the following four elements: (1) systematic interviewer bias, (2) systematic coding and keypunching errors, (3) lack of response from homeowners who could not be located or refused to be interviewed, and (4) a pattern of misstatements by respondents.

The ISR has instituted strict procedures to minimize the first three elements of bias. Interviewer bias was minimized through extensive two day training sessions throughout the country. Systematic coding and keypunching errors were eliminated by coding all the interviews and questionnaires twice and comparing the two codings for discrepancies. Errors found were corrected. The nonresponse rate was reduced by utilizing extensive call-back procedures. However, it is difficult to determine whether 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 that appeared to be misunderstood by some respondents was "In this neighborhood, do insurance companies write policies covering damage from floods (earthquakes)?" Approximately 10 percent of the flood insured homeowners answered "No" to this question. On the other hand, less than 1 percent of the insured homeowners in earthquake-prone areas misunderstood the question. 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.

4.5 SUMMARY

This chapter describes the design of the sampling plan and the questionnaire for the field survey portion of this study. The field survey consists of a stratified sample selected from a significant portion of insured and uninsured homeowners residing in flood- and earthquake-prone areas. We evaluate three competing sampling plans, and show

how the final sampling plan incorporates features from each one. The statistical procedures for selected sampling study sites in the flood and earthquake survey are then outlined, and we specify the location, population, and insured status of each site in which interviewing took place. The chapter then discusses the presurvey analyses, the structure of the questionnaire, and the field activities for the survey. The high response rate, a result of extensive effort by the ISR, has increased the extent to which the findings may be generalized. The final portion of the chapter discusses the steps taken to ensure high quality data from the field survey. We also note that two possible sources of error—reliability and bias,—should be considered in interpreting the data, the subject to which we now turn.

NOTES

1. This section is based on the sampling report by Eugene Ericksen, which appears as Appendix A.1.
2. Less than 2 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 of between .01 and .002. Zone C has a probability of less than .002. Zone D has no perceptible probability of damage. This area included about 6 percent of all policyholders and was excluded from the universe of nonpolicyholders.
5. Kates (1962), Czamanski (1967), Jackson (1974), and Burton, Kates, and White (1978) all developed questionnaires that provided valuable perspectives on the subject.
6. An alternative to reinterviewing is to ask the same question at different points in the interview. We opted not to employ this approach, because for the questions where we wanted to check accuracy this ploy would have been too obvious to the respondent.
7. For an excellent discussion of bias and its effect on statistical significance of survey results, see Kish (1965).

5

Analysis of Predisaster Behavior Using Field Survey Data

One of the more 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 that, according to 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. The figures presented in this chapter are based on unweighted data from the field survey.

5.1 FACTORS RELEVANT TO THE EXPECTED UTILITY MODEL

Awareness of Insurance Availability

The field survey was intentionally designed to cover only those communities in which flood or earthquake insurance could be purchased.

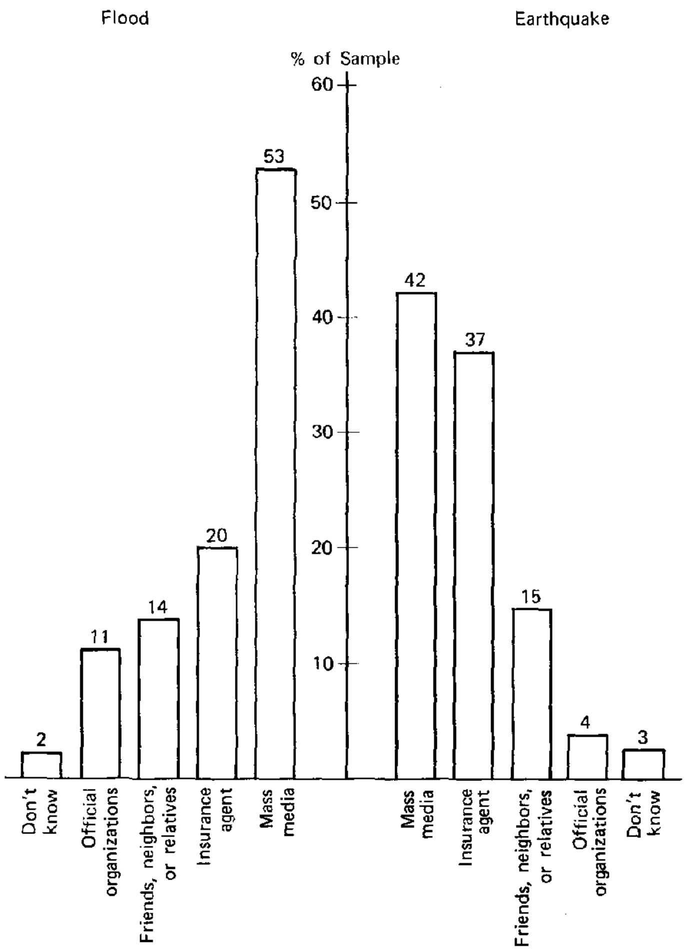

Figure 5.1 Initial source of contact regarding insurance for those aware of coverage.

Data from the field survey indicated that 10 percent of the uninsured homeowners in flood-prone areas and one-quarter of the uninsured homeowners in earthquake-prone regions of California were unaware that insurance existed.

Figure 5.1 depicts the means by which those who knew of such insurance 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 15 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 homeowners 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 homeowners 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, 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 homeowners 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 the 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 who 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.

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; 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.[7]

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

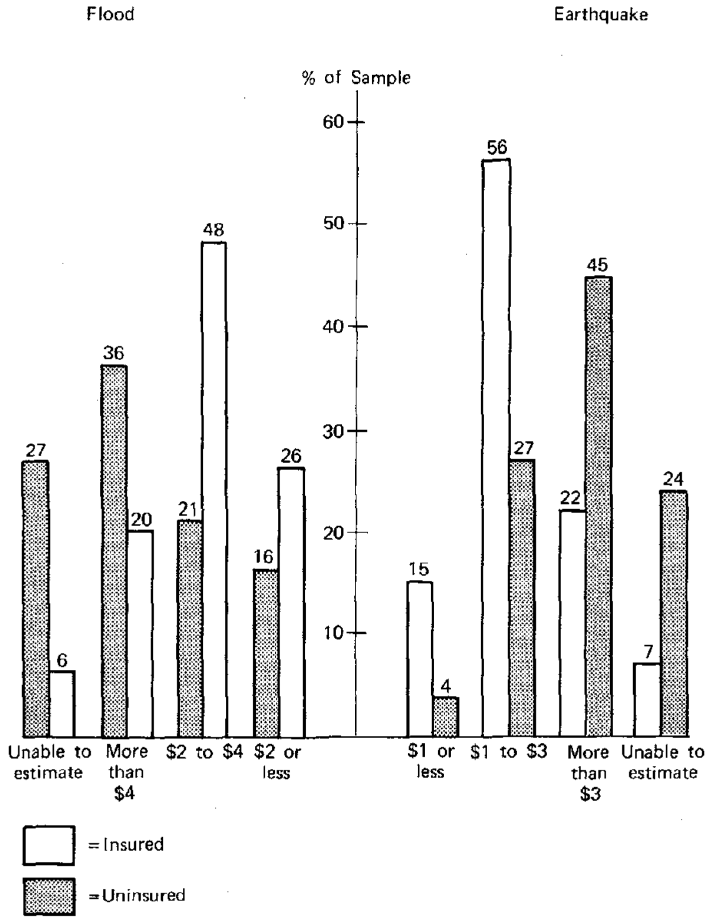

Figure 5.2 Subjective estimates by policyholders and nonpolicyholders of cost of flood or earthquake insurance per $1000 coverage.

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, inaccurate estimates of the actual premiums can also be expected. Figure 5.2 summarizes these findings by showing the rate estimates of those homeowners. It should come as no great surprise that approximately one-quarter of the nonpolicyholders who were aware that coverage was available in their neighborhood were unable to provide any estimate of the cost of insurance even when prodded by the interviewer to offer their best guess. Less than 7 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 homeowners 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 can 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 $1 of the actual rates; approximately 36 percent of those in the flood sample and 45 percent in the earthquake sample overestimate the premium by more than $1. 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 are consistent with this hypothesis. Consider the group of uninsured homeowners who could provide such a dollar estimate.[3] In Figure 5.3 the premium per $1000 coverage ($Z$) is varied from $0 to $10 and the percentage of nonpolicyholders willing to pay Z or more for this desired coverage is plotted. 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

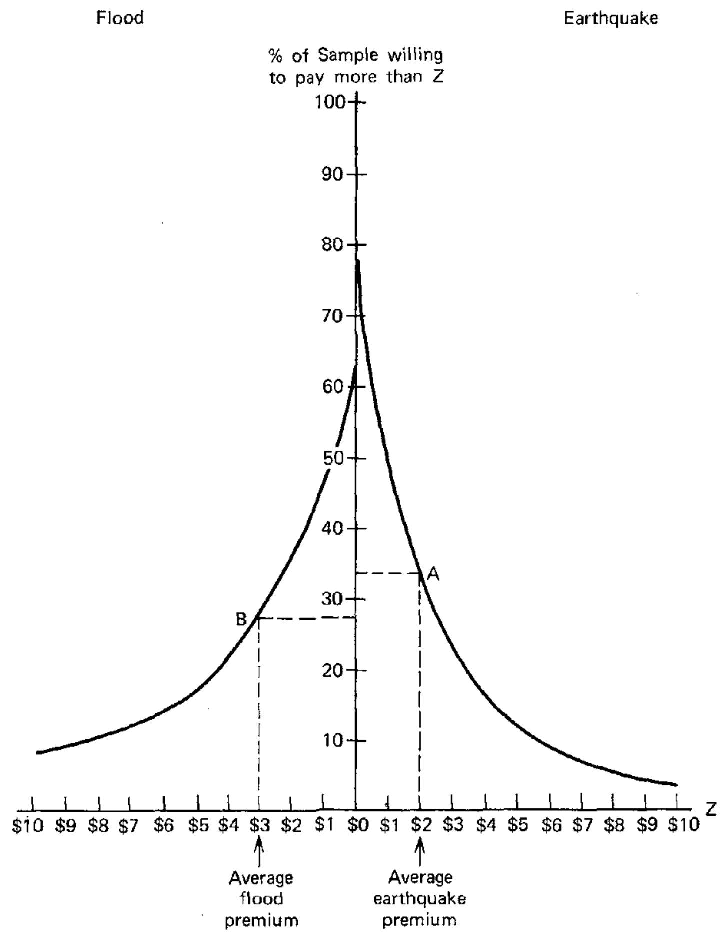

Figure 5.3 Maximum premium uninsured individuals are willing to pay for insurance per $1000 coverage.

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 5.4 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 labeled "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

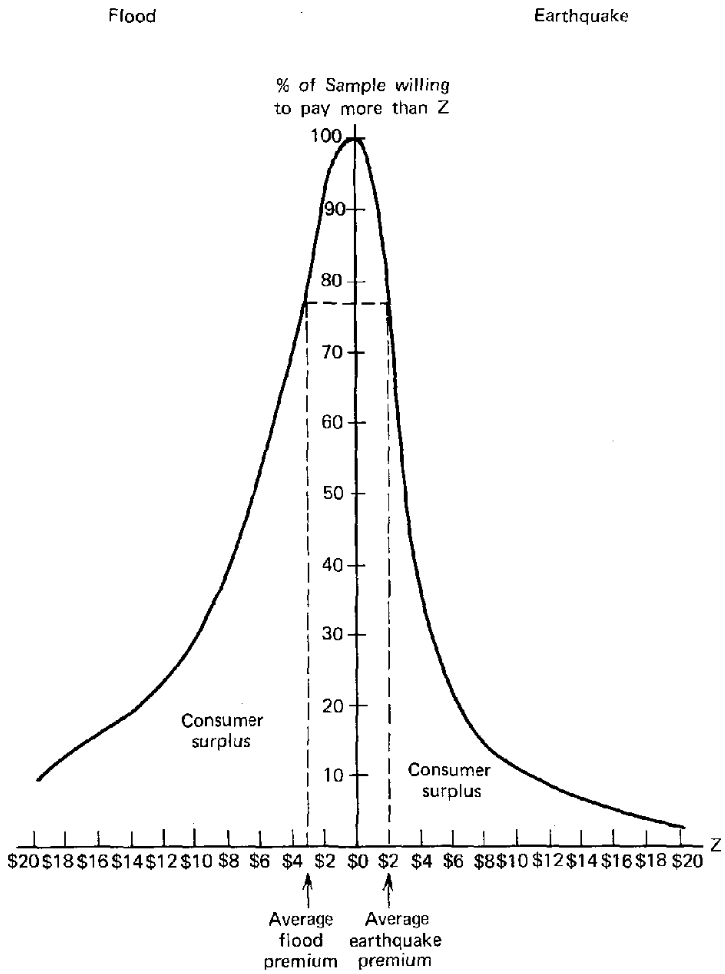

Figure 5.4 Maximum premium insured individuals are willing to pay for insurance per $1000 coverage.

$1,000 for coverage, whereas the current rate is approximately $3. The earthquake insured group is less enthusiastic about an increase in premiums above the current rate. This is understandable, since rates are not subsidized, 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.

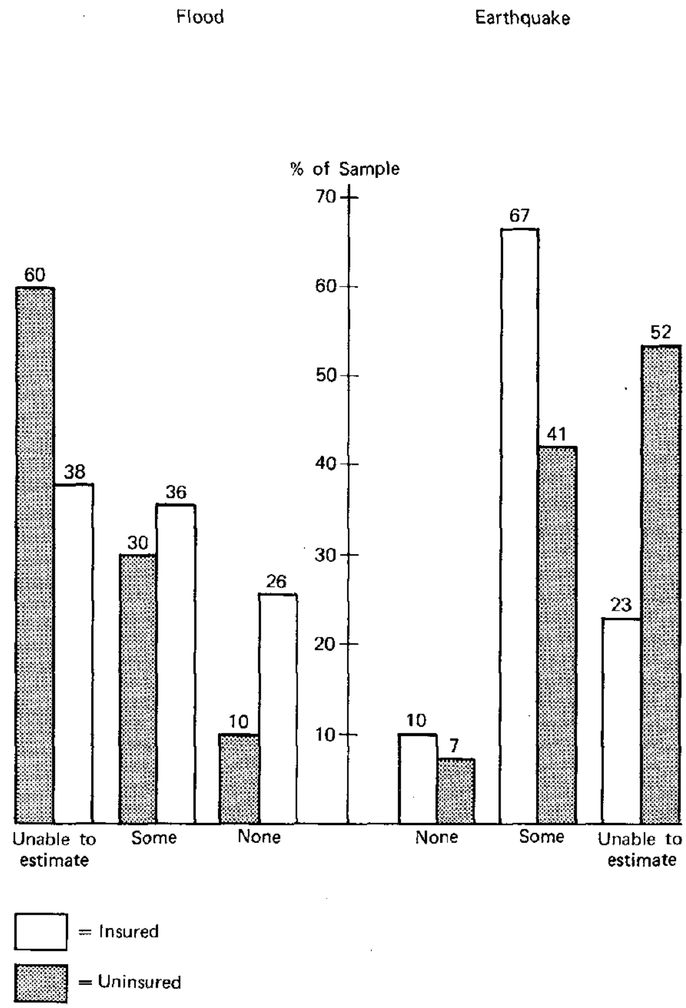

Figure 5.5 Subjective estimates by homeowners of deductible on a policy.

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.

People also know little about the deductible clause in a flood or earthquake insurance policy, as shown in Figure 5.5. It is understandable that the majority of the uninsured individuals do 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]; 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 chances of my 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. If he has a small loss, 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.

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 5.6 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.

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

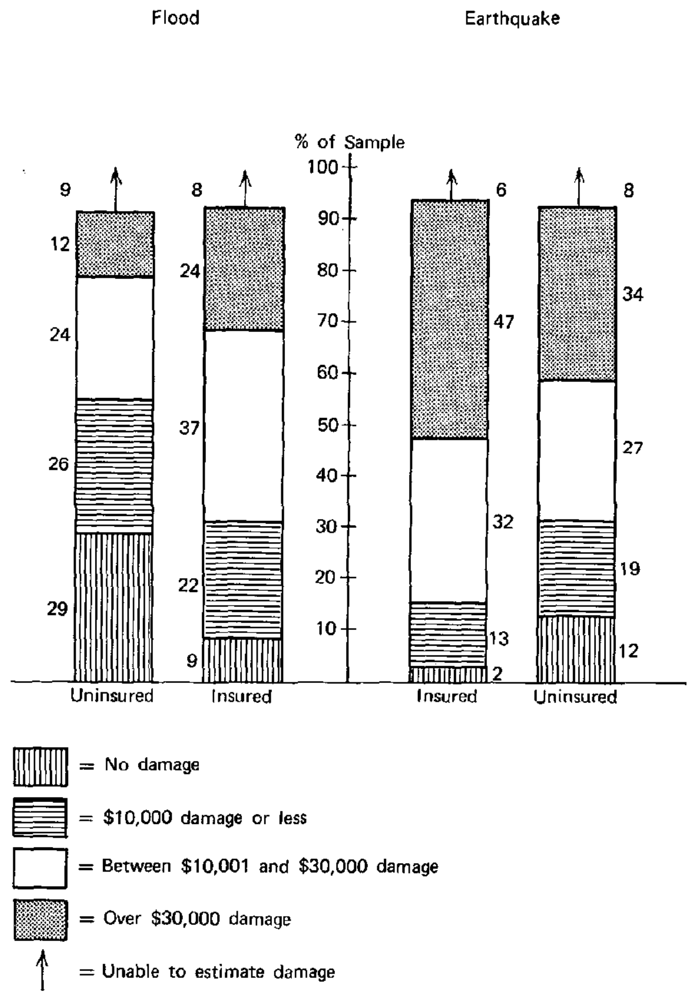

Figure 5.6 Estimates of damage from a severe flood or earthquake.

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 a large percentage of uninsured individuals 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.

Awareness of Probability

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 that 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 5.7 presents the distribution of subjective probabilities associated with the occurrence of a severe flood or earthquake in each respondent's area. These probabilities were determined by asking each individual to estimate the chances of a flood or earthquake occurring in the next year[6] causing a specific dollar amount of damage or more to his home. The dollar figure used by the interviewer was the combined property and contents losses which the person had previously estimated he would suffer if a severe flood or earthquake occurred in his

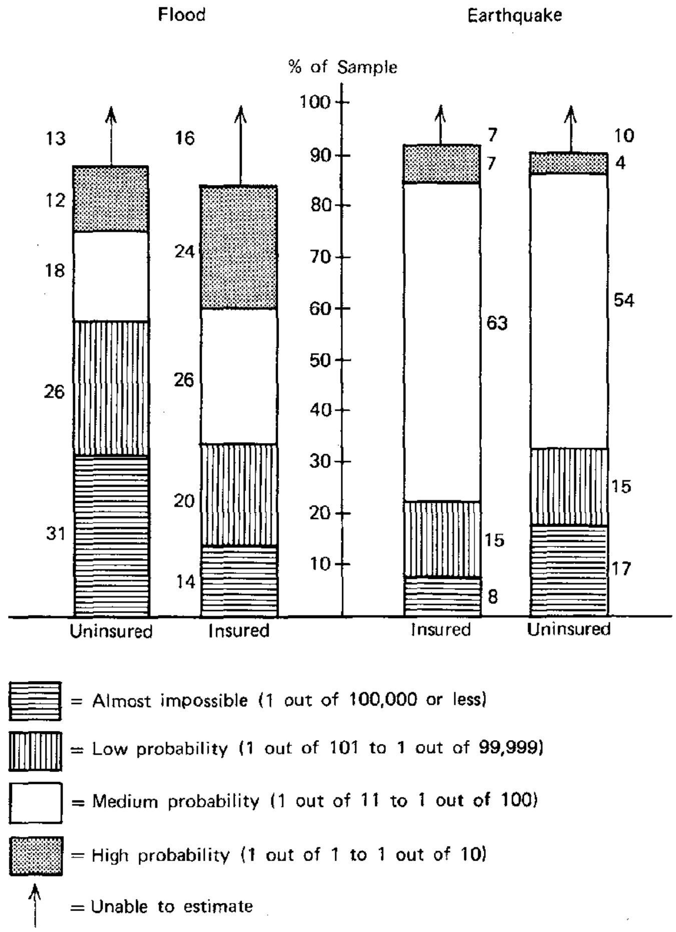

Figure 5.7 Subjective annual probability of severe flood or earthquake causing damage to home in next year.

area. Those unable to estimate either their property or contents losses were asked to base their probability estimates on "$10,000 or more damage" to their home. Not unexpectedly uninsured individuals in flood-prone areas estimate a much lower 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 5.7 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 ex post facto 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 persons' 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 future disaster. This story appears as Question 137 of the questionnaire. (See Appendix A.3).

Over two-thirds of our sample in flood-prone areas considered the hazard to be 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, "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 considering 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, this 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.

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 predisaster 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.

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 $5000 of each loan and provide 1 percent interest rates on the remaining portion. If property damage to a home or business were greater than 30 percent of its predisaster 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 predisaster payment.

After the cost of disaster loans to the federal government skyrocketed in 1972, Congress decided to rescind the forgiveness grants and increased the annual interest rates on SBA loans from 1 to 5 percent (PL 93-24). Our field survey was conducted in areas where few of the respondents had suffered any flood or earthquake losses since the time that this legislation was enacted.[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 test this hypothesis 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. He was assisted in answering the question, by being given a possible list of sources including federal aid. Even though the government was explicitly mentioned as a potential source of relief, the 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. The survey 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-

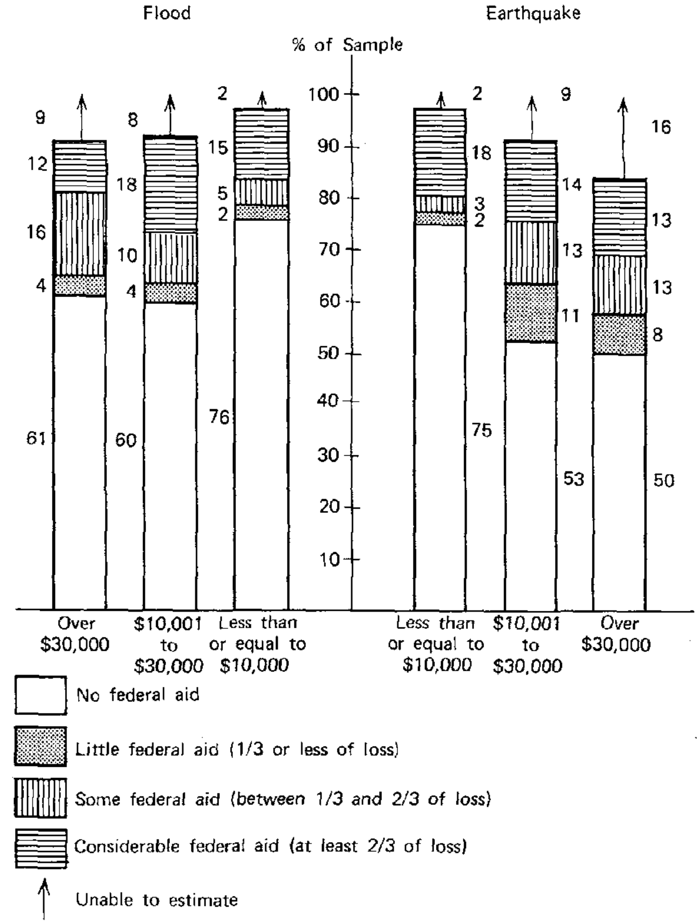

Figure 5.8 Proportion of federal aid expected as a function of future damage for uninsured homeowners.

and earthquake-prone areas also said they expect *no* federal aid regardless of their estimated loss from a future disaster. Figure 5.8 graphically depicts these results for the three damage classes delineated earlier. When the losses are $10,000 or less, approximately three-quarters of both the flood and earthquake uninsured respondents expect no aid. Of 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. The proportion of homeowners who do not know how much they will receive from the federal government increases as the amount of 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. After a disaster many of these victims will undoubtedly be anxious to obtain federal relief to aid their recovery.

Even for individuals who 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 *not* been a motivating factor in the decision to buy or not buy insurance.[9]

5.2 EVALUATING THE EXPECTED UTILITY MODEL

The figures presented in the preceding 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 a small group of individuals in our sample were required to purchase flood or earthquake insurance, 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

SBA 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 the 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 $3000 contents and $4000 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 required to do so is an open question.

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 or earthquake, 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 ratio 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 can 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 5.9 plots the percentage of insured homeowners with subjective estimates of R below any given value in the range from 0 to 1000. 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, the cost of insurance in relation to its

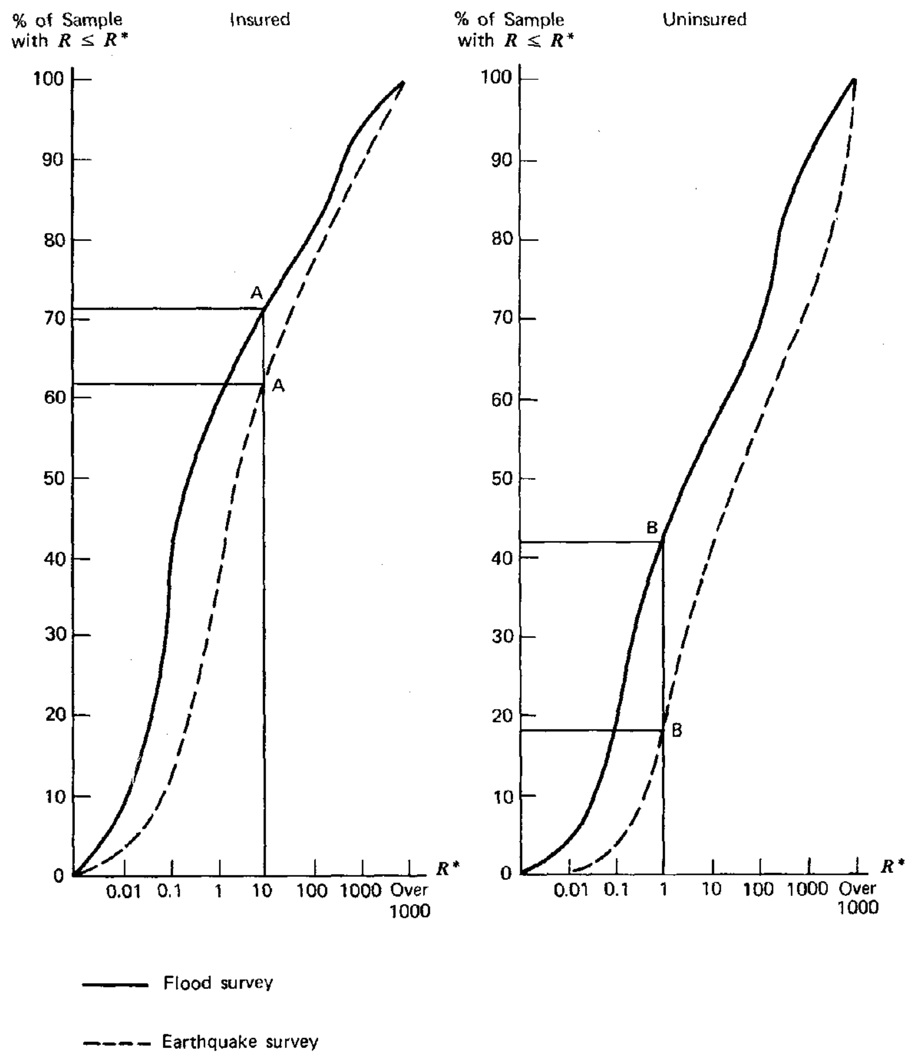

Figure 5.9 Contingency price ratio (R) for insured and uninsured homeowners.

potential benefits is so high that it is unlikely that a person would voluntarily protect 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, a number of insured individuals estimate such a low probability of a future severe disaster that their value of R exceeds 100. It is conceivable that these insured individuals have actually purchased coverage to protect themselves against damage from moderate or minor disasters. Although there are no quantitative data from the field survey 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 is 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 1, hence *should* have purchased insurance if they were trying to maximize expected utility. These individuals viewed insurance as being subsidized for them. Note the large number of uninsured homeowners in the flood sample whose subjective estimates implied values of R less than .1; coverage should 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.

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 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 75 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:

> 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 $1000 of coverage in this valley costs $2 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 $1000 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 is and how simple it is to purchase coverage.

In the case of earthquake insurance it is typical for a person to purchase a policy as an endorsement to his homeowners 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 homeowners 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 homeowners policy is renewed, which won't happen for almost another year. I'm hoping that a flood won't occur during that time.

It would have been interesting to reinterview this person to determine whether he actually bought a policy at the intended time.

Table 5.1 Categorization of Insured and Uninsured Individuals in Flood and Earthquake Surveys (percentage 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.

Summary of Findings on Utility Theory

Table 5.1 summarizes the findings regarding the adequacy of the expected utility model in explaining behavior. Only 42 percent of the flood-insured individuals and 33 percent of the earthquake insured individuals had estimates of R that were clearly consistent with the expected utility model. Another 9 percent of the flood insured group and 20 percent of the earthquake insured might have been sufficiently risk averse (i.e., $1 < R \leq 10$) to have been expected utility maximizers. Other insured persons 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 10 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 29 percent of the uninsured respondents in flood-prone areas and 12 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. Evidence from the field survey data support this conjecture. Most uninsured persons had not even thought about buying insurance. When asked why they did not intend to buy coverage, most claimed that they did not need it.

5.3 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. They also enable us to delineate the important variables for determining whether 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 are discussed in the next chapter. In this section we summarize the variables that, after analyzing our data in great detail, we have found to be important in explaining behavior at each stage of the decision process.

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 know that there were flood problems in their immediate neighborhood when they moved there. Even though California is considered a seismologically active state, over 40 percent of the residents we interviewed did not believe 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 shootingmatch.

A primary reason that 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 such potential problems. Thus in the earthquake portion of the survey 30 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 *New York 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? (*New York Times*, April 15, 1976, p. 20).

Once located in a particular neighborhood, families may obtain sufficient information on the hazard to view it as a problem. Homeowners were asked whether they felt their neighborhood was a place where floods or earthquakes could occur and how they would rank the hazard in relation to other problems typically facing residents in a community (i.e., crime, education, housing, public transportation). By combining the responses to these questions we classified homeowners' current perception of the problem as being either serious, minor, or nonexistent.

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 a problem today.

Awareness of Insurance *(Stage 2)*

How did individuals in hazard-prone areas become interested in buying flood or earthquake insurance? Figure 5.10 indicates that the awareness of a problem 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 is 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 controlled laboratory experiments (discussed in Chapter 7) is particularly relevant here. People often behave as if a low probability were a zero probability. Hence there is a critical threshold that must be crossed before an individual treats a perceived hazard as a problem. Only if he reaches that stage is insurance worth considering.

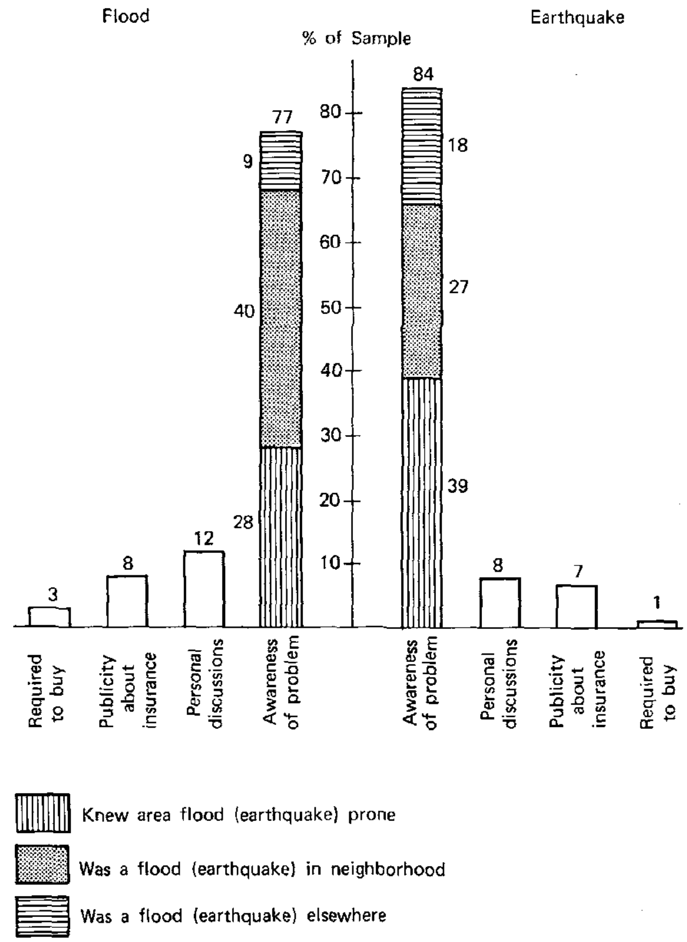

Figure 5.10 Principal factor triggering interest in insurance.

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 a long interval exists between the awareness of the new item and the actual adoption decision. If individuals do have a difficult time collecting and processing information and making decisions, it is understandable why good intentions may not actually be carried out immediately.

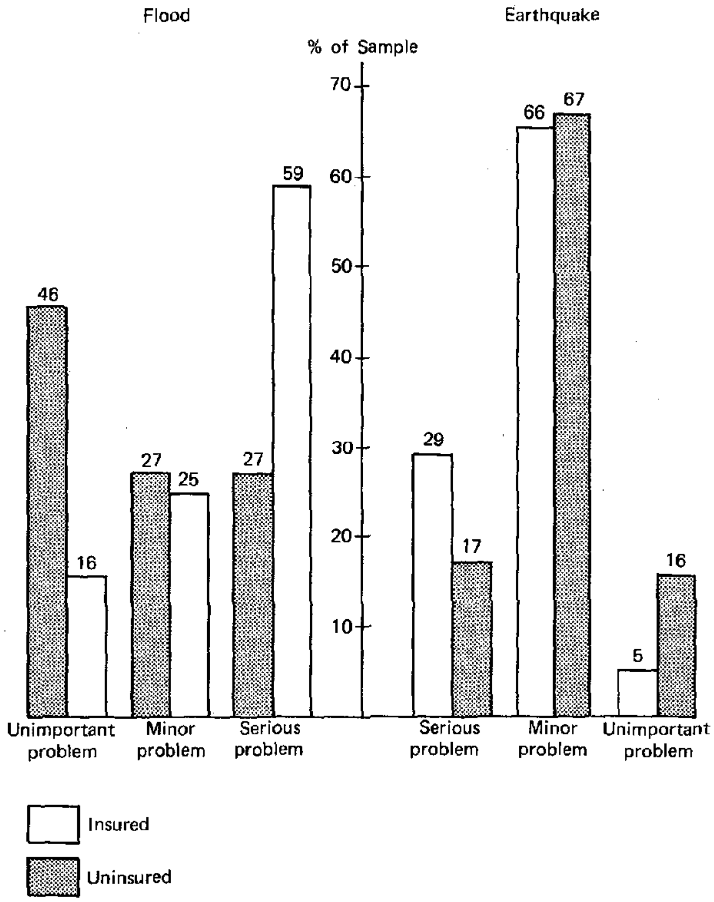

Figure 5.11 Perception of the problem.

Our field survey was *not* designed to investigate the diffusion process 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 dividing the sample equally between insured and uninsured homeowners was to strengthen the possibility of isolating those variables that discriminate between these two groups. This section summarizes the key factors found to be important in differentiating insured from uninsured homeowners. The statistical importance of each of these factors and interaction effects between variables are presented in Chapter 6, utilizing recently developed tools for analyzing qualitative and quantitative variables.

Table 5.2 Effect of Cumulative Flood or Earthquake Damage to Present Home on Insurance Status

	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.

Perception of the Problem. From the discussions in the preceding 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 5.11 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 a significant number of insured 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, 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 of an uninsured homeowner. As might be expected, small flood or earthquake losses had a negligible or even negative effect on the purchase of insurance. Given the 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 $2500, the majority suffering 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 has 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 *needed* insurance.

Another example of the influence of past experience on 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 from 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 do not purchase insurance is that 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 90 percent of us live from payday to payday . . . 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 even if they feel it is likely that they will suffer severe losses from a future disaster. Figure 5.12 shows that insured individuals have a higher income level than do the uninsured 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 that they have more at stake should they be hit by 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 we would expect interest in insurance to increase as a person became 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, health, disability, and homeowners) we decided to classify respondents into three different groups. Those who voluntarily had bought either none or one policy were considered to have slight risk aversion; those who voluntarily purchased two or three policies were

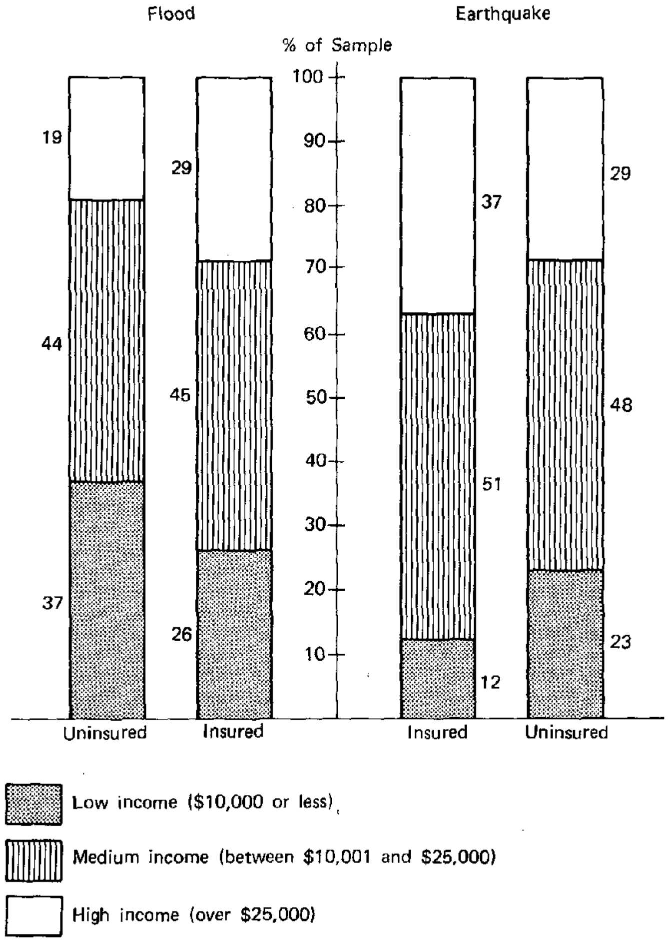

Figure 5.12 Annual income of insured and uninsured.

classified as being somewhat risk averse, while those who voluntarily had purchased four or five policies were regarded as highly risk averse.

Figure 5.13 plots the proportion of insured and uninsured in each category. Most homeowners had purchased at least two policies voluntarily, so relatively few were classified as having only slight risk aversion. The data show that the insured individuals tend to be more risk averse than the uninsured group. Thus we find that 46 percent of the insured individuals in flood-prone areas were considered highly risk averse, compared to 36 percent of the uninsured group. Only 5 percent

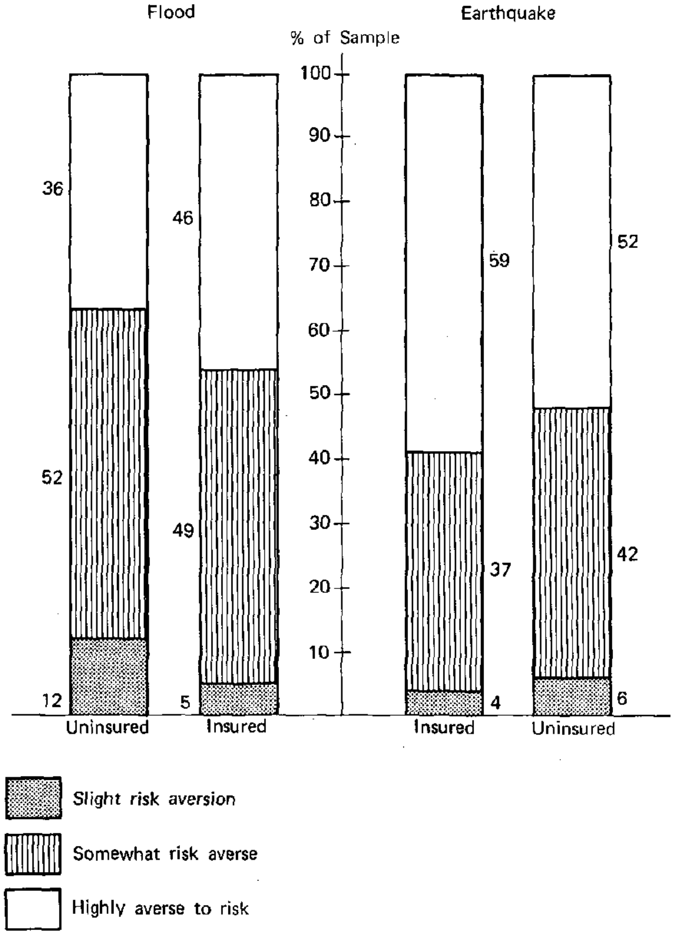

Figure 5.13 Aversion to risk of insured and uninsured.

of the insured flood group were slightly risk averse, while 12 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 5.7 presented earlier shows 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 and 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 such an 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 not to take out insurance:

> 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 20 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 (*New York 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, and did not have any understanding of the 5 percent deductible on their insurance policy.

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

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 on 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 5.14 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 who 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, we would argue that it is likely that such interchanges took place before the homeowner purchased insurance and that it was through these discussions that the nonpolicyholder learned that some of his peers had already bought coverage.

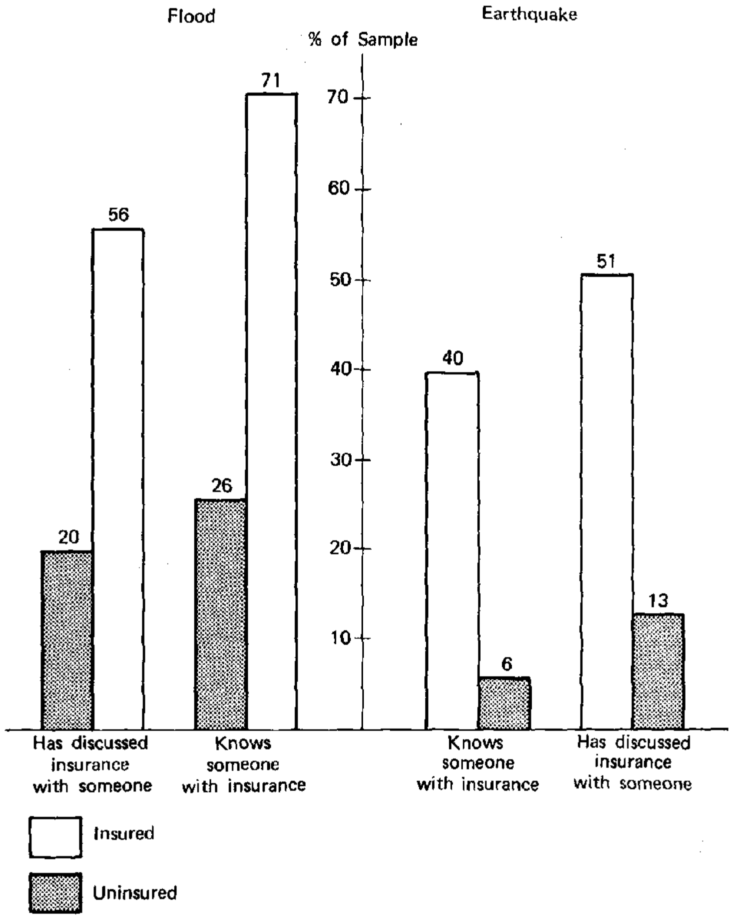

Figure 5.14 Amount of interpersonal communication on insurance.

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. Upon hearing that coverage was "quite reasonable" he added, "I am going to have to look into earthquake insurance myself."

Suppose that interpersonal communication only occurred after a homeowner purchased insurance. Such a process can be modeled more formally in the following way. Assume that 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.

Data on the proportion of insured and uninsured homeowners in our sample universe make it possible to determine values of n and N that rationalize the differentials between insured and uninsured homeowners depicted in Figure 5.14. If n or N is unusually large, it is safe to conclude from this analysis that some uninsured individuals initiated contact with insured people and a proportion of them decided to purchase a policy only 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 that 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 that pointed to the importance of the primary group, and the key role of interpersonal communication in the decision process.

Our study of insurance behavior 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.

5.4 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 influencing the decision process are the individual's perception of the problem and interpersonal communication. Table 5.3 presents the statistical significance of the variable pairs associated with the specific figures and tables in the chapter. The definitions of the variables used in the analysis of the field survey data can be found in Appendix A.4. Chi-square values and tests of significance from two-way tables related to the sequential model of choice are summarized in Appendix A.5.

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 is undertaken to examine the joint effects of several qualitative independent variables and to determine the quantitative importance of different factors on the insurance buying decision.

NOTES

1. More specifically, 9 percent of the insured and 13 percent of the uninsured incorrectly assumed that earthquake premiums were subsidized.
2. Of the homes in our survey, 98 percent 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 2 percent of the loss, whichever is larger.
5. Five other questions on probability were included in the questionnaire, but this 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 10 years. We approximated the annual probability by dividing this estimate by 10.

7. Similar findings on the perception of the flood hazard are reported by Burton, Kates, and White (1978), 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 7 percent of the flood homeowners and less than 1 percent of the earthquake respondents had suffered damage to their homes.
9. We investigated income level and education of uninsured individuals to see whether either of these variables affected anticipation of federal relief. However, neither factor was statistically significant.
10. Since few of these individuals had any knowledge of the deductible clause in the insurance policy, 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 5.3 Description of Association of Variables in Figures and Tables

		Flood			Quake			
Figure or Table	Variables	χ^2	Degrees of Freedom	Significance Level **	χ^2	Degrees of Freedom	Significance Level **	Section in Text for Interpretation
Figure 5.1	CONTACT. INSUR	*			*			5.1
Figure 5.2	HAVE. INSUR COST. INSUR	211.84	3	0.0	89.66	3	0.0	5.1
Figure 5.3 5.4	MAX. PREMIUM	*			*			5.1
Figure 5.5	HAVE. INSUR DEDUCTIBLE	63.29	2	0.0	51.75	2	0.0	5.1
Figure 5.6	HAVE. INSUR FUT. DAMAG	194.04	4	0.0	53.29	4	0.0	5.1
Figure 5.7	HAVE. INSUR PROBABILITY	140.53	4	0.0	26.88	4	0.0	5.1
Figure 5.8	FUT. DAMAG GOVERN. AID	32.53	8	0.0001	35.91	8	0.0	5.1
Figure 5.9	CONTINGENCY. PRICE (R)	*			*			5.2

Table 5.1	HAVE. INSUR FUT. DAMAG KNOW. PREMIUM PROBABILITY CONTINGENCY.PRICE (R)	*			*			5.2
Figure 5.10	INTEREST. INSUR	*			*			5.3
Figure 5.11	HAVE. INSUR PROBLEM	282.08	2	0.0	41.44	2	0.0	5.3
Table 5.2	HAVE. INSUR PAST. DAMAG	102.16	4	0.0	4.70	3	0.200	5.3.
Figure 5.12	HAVE. INSUR INCOME	42.10	2	0.0	21.13	2	0.0	5.3
Figure 5.13	HAVE. INSUR RISK. AV	44.03	2	0.0	6.50	2	0.039	5.3
Figure 5.14	HAVE. INSUR KNOWONE	417.28	1	0.0	172.85	1	0.0	5.3.
Figure 5.14	HAVE. INSUR DISCUSS	278.89	1	0.0	172.06	1	0.0	5.3

*Not applicable.

**Significance level of 0.0 indicates less than 0.00005.

6

Analysis of Survey Results Using Multivariate Methods

The preceding chapter discussed the effects of several factors on the purchase of insurance by a homeowner. 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 taking into account the impact of several variables simultaneously and the use of 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 enable us 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 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 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, we must severely qualify any statement concerning the impact of each variable separately. On a more positive note, interactions enable us 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 such 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 contains material that is more technical in nature, which forms the basis of our main statistical findings. It will be of interest to those who wish a more detailed treatment of how contingency table methods and logit regressions have been used to analyze the field survey data.[1] There is also a section describing the implications of the sampling plan on statistical analysis.

In this chapter then multivariate methods are utilized on unweighted data from the survey to test for possible interactions and to measure more precisely than in Chapter 5 the effects of different factors in the sequential model of choice. The statistical analyses are based on 75 percent of the flood and earthquake samples randomly picked from the responses. In addition, the two samples have been combined to test for similarities between the two types of hazards. The equation that best discriminates between policyholders and nonpolicyholders is then used to predict the insurance status of the remaining 25 percent sample, thus permitting us to determine how well the final model generalizes to new data. Appendix A.6 contains tables for the flood and earthquake portions of the survey as well as additional regressions for the combined sample.

6.1 TESTING THE SEQUENTIAL MODEL OF CHOICE

Through the use of multivariate methods we are able to isolate factors that provide explanations for homeowners' behavior at each stage of the sequential model of choice discussed in Chapter 5. The findings presented in this section are based on ordinary least squares regression analyses and illustrate the main results of this chapter.[2] The techniques described examine variables simultaneously (including interactions) rather than in a stepwise manner. Hence we do not have to concern ourselves with the sequence in which variables are introduced into the analysis.

Awareness of the Problem *(Stage 1)*

Data from the field survey enabled us to isolate those variables that 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. In 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 is hazard-prone, who has never experienced a disaster, and anticipates some damage, has a 24.0 percent chance of considering the hazard to be a serious problem.

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 20.8 percent greater chance of considering floods or earthquakes to be a serious problem than do 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 an 18.4 percent greater chance of viewing the hazard as serious than do those who have not been victims. Those with more than one experience have this probability increased by another 18.3 percent. Thus there is a .367 probability difference between those who have suffered more than one disaster and those who have suffered none.

The equation also indicates that, although the effects of probability and expected future damage *per se* are statistically significant, their substantive impact as determinants of seriousness is relatively small

Table 6.1 Determinants of Awareness of Problem (Regression for 75% Combined Sample)

Probability of homeowner thinking hazard is a serious problem = .240 +

.0	if didn't know area hazard prone when moved in or lived whole life in neighborhood	
.208	if knew area was hazard prone when moved in	+
.0	if never experienced disaster	
.184	if experienced one disaster	
.367	if experienced more than one disaster	+
.037 ×	log (subjective probability of disaster)	+
-.027	if can't estimate future damage	
-.072	if thinks will suffer no future damage	
.0011 ×	estimate of future damage (in $1,000) if thinks will suffer some	+
.263 - .0034 ×	years lived in house if in coastal zone A	
.038 + .0012 ×	years lived in house if in coastal zone B	
.292 + .0017 ×	years lived in house if in riverine zone A	
.093 + .0017 ×	years lived in house if in riverine zone B	
.0 - .0041 ×	years lived in house if in earthquake area	

but in the expected direction: those homeowners who estimated the probability or loss from a future disaster to be relatively high were more likely to treat the hazard as a serious problem than those with low estimates of these two variables.

Table 6.1 also illustrates an interaction effect between the type of hazard-prone area and the length of time a homeowner has lived in his current house. In coastal Zone A and earthquake-prone areas the longer a resident lives in a house the less chance that he will view the hazard as a serious problem. In all other areas this probability increases slightly with length of residence in the area. The small coefficient in each region associated with a change in occupancy length, though statistically significant, suggests that this variable is not very important in predicting whether the person will view the hazard as serious.

These figures also illustrate intuitively appealing differences among hazard-prone areas. Homeowners are most likely to view the hazard as

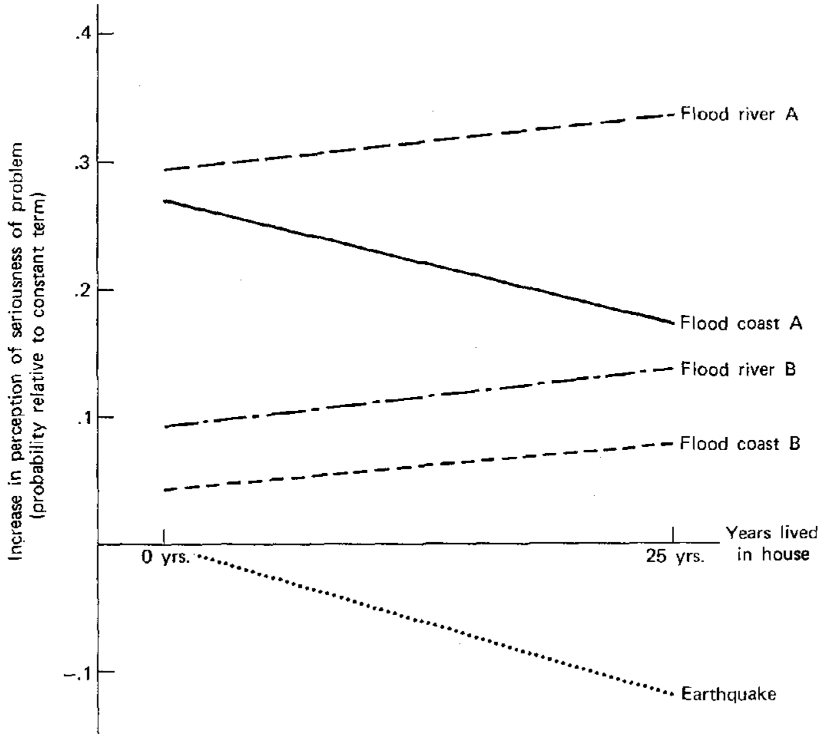

Figure 6.1 Interaction between years lived in house hazard area (75% combined sample). Note: Only differences are meaningful.

serious if they live in the high hazard coastal and riverine areas (Zone A), hence the coefficients of .263 and .292 associated with these areas compared to .038 and .093 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 Zone A 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 other areas. The height of the lines at the point "0 years in neighborhood" reflects the chances of viewing the hazard as serious for different areas. The lines clearly demonstrate that homeowners in Zone A are more likely than those in Zone B to view the hazard as a serious threat when they move into the area.

Tables 6.14 and 6.15, which follow the chapter, specify 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.

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 in Tables 6.16 through 6.18, which follow this chapter. We briefly summarize the principal findings here.

The most significant variables differentiating those aware from those unaware of the availability of insurance in their neighborhood 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 were those who felt the problem was minor or unimportant. But the "Problem" variable interacted with educational level. Of those who considered the hazard to be a minor or serious problem, homeowners who had graduated from high school were much more likely to know insurance was available to them than were those who had not. Of 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 both educational level and whether he considered the hazard to be a problem. Higher income and single people were more likely to be aware of insurance than their respective counterparts. Those having a higher perceived probability of a flood or earthquake were more likely to 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 about 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 caused in part by an artifact of our final sample. In flood-prone areas approximately 54 percent of the respondents currently had insurance, 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 would a respondent in the earthquake sample.

Adoption of Insurance *(Stage 3)*

Most of the statistical analyses were undertaken to determine those variables that 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 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 whether he knows someone who has purchased the insurance. These two factors interact with each other. Someone who thinks the hazard is a problem and who also knows a policyholder 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, residing in the same hazard zone, who do not know someone and think there is no problem.

Another significant variable is whether the person expects any future damage from a flood or earthquake. The data in Table 6.2 show that a person who expects *no* 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 1 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 socioeconomic 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. A person more averse to risk is more likely to have purchased coverage.

Table 6.2 Determinants of Insurance Purchase (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	

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 are those who are relatively new to the area. The coefficient associated with this variable is so small (-.00036), however, that it does not change the overall probability of having insurance by very much (less than a 1 percent decrease in probability between one who just moved to his house and a homeowner residing there for 25 years).

It is interesting to note that the model that fits the data best is generally consistent with the earlier two-way analyses depicted in Chapter 5. The multivariate statistical techniques, however, provide us with considerably deeper insight into the process of choice and enable us to determine significant interaction effects (such as between "PROBLEM" and "KNOWONE"). Furthermore, and perhaps most importantly, these techniques permit 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.

6.2 DETECTING AND MEASURING EFFECTS*

Screening for Spurious Correlation and Interactions

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 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 are presented in Table 6.3.

The logic of tests of effect generalizes the familiar chi-square (χ^2) test of two-way tables and is easy to grasp intuitively. Suppose that we want 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 *independent* 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

*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 } continuous 4 = $400,000 damage } 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
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 3 = $200,000 damage } variable between limits
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

account knowing someone and again calculate the fit. If the fit is substantially improved, then knowing someone has an effect; otherwise it does not.

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 *not* 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 χ^2 values between the two models (*a*) and (*b*) tests the significance of the interaction effect in improving the explanatory power of the model.

Finally, it should be noted that the χ^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 per se.[3]

Table 6.4 presents the results of several such tests. The analyzed contingency table 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 insured from uninsured homeowners. This can be seen through a comparison of models without each of these variables with ones in which they are present. These results are shown on the right-hand panel of Table 6.4. The resulting high χ^2's 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 ($\chi^2 = 21.19$; 2 degrees of freedom [d.f.], and 11.97; 4 d.f., respectively) though not nearly as significant as the first 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 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: $\chi^2 = 8.64$; 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 is 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 $\chi^2 = 100.77$, 84 d.f., significance level $p = .103$). Model 9, with a

Table 6.4 Tests of Effects in Contingency Table Models of Insurance Purchase (75% Combined Sample)

Model Number	Terms Added to (+) or Deleted from (-) Baseline Model	Goodness of Fit Model: χ^2 (P = Goodness of Fit)	Goodness of Fit Model: Degrees of Freedom	Comparison of Model with Baseline: (P = Significance)	Comparison of Model with Baseline: 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

PROBLEM *KNOWONE interaction term fits very well indeed (χ^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 (χ^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 (χ^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 preceding 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 that we will want to analyze further. There also appear to be differences between hazard types which cannot be due to variations in the socioeconomic characteristics of people 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.

Effects of the Independent Variables: Contingency Table Methods

The preceding section illustrates how to determine which variables and combinations of variables have significant effects, but does not analyze the nature of these effects. We now undertake this analysis. We want to measure 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 already explained, to eliminate spuriousness we re-

Table 6.5 Tests of Effects in Contingency Table Models of Insurance Purchase (75% Flood Sample)

Model Number	Terms Added to (+) or Deleted from (-) Baseline Model	Goodness of Fit Model: X^2 (P = Goodness of Fit)	Goodness of Fit Model: Degrees of Freedom	Comparison of Model with Baseline: X^2 (P = Significance)	Comparison of Model with Baseline: 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 of Insurance Purchase (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

quire that our measures be as free as possible of the effects of the other variables.

The same contingency table methods utilized in the preceding section to test for statistically significant effects are appropriate for this phase of analysis. The procedure is easy to grasp intuitively with 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 one-fourth of the difference between logits. When logit differences exceed 2, the probability differences will be less than one-fourth 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 we adjust for, and the measure is derived from relationships in the predicted table.

Table 6.7 (a) displays the effects on the predicted logits implied by Model 1 of Table 6.4. Table 6.7 (b) displays approximate probability differences using the rule of thumb given here. 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 χ^2 from Table 6.4, namely, that seriousness and knowing someone have very large effects compared with those of 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.

Table 6.7 also indicates—and this is not apparent in the χ^2 from Table 6.4—that differences among zones are largely due to a contrast

Table 6.7 Measures of Effects in Contingency Table Model of Insurance Purchase (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.

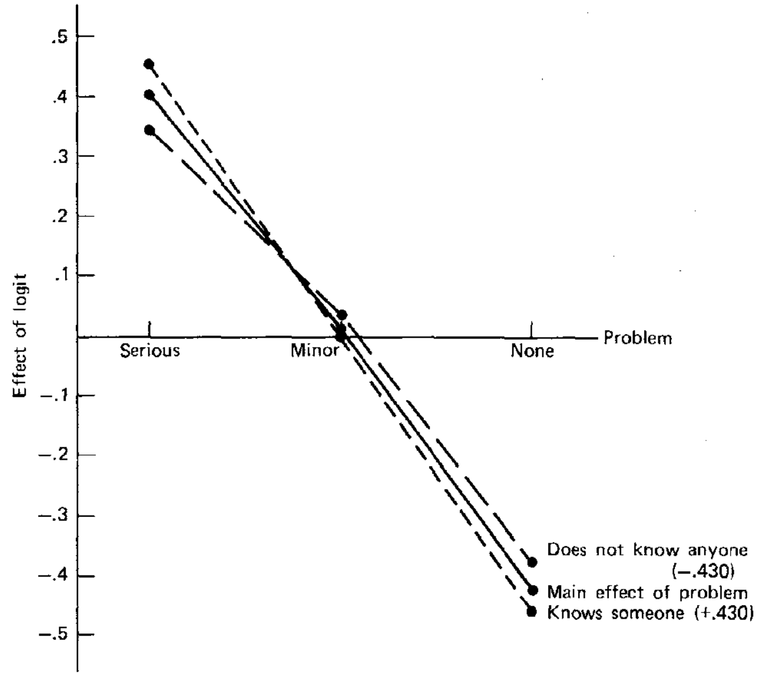

Figure 6.2 Interaction between PROBLEM and KNOWONE in contingency table model of insurance purchase (75% combined sample). Note: The dashed lines represent the effect of PROBLEM in each KNOWONE group.

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 preceding 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 *not* parallel. PROBLEM has a stronger effect (steeper line) for those who know someone than for those who do not (flatter line).

Thus, someone who thinks the hazard is a serious problem and also knows a policyholder is more likely to purchase insurance than these variables would imply separately. In Figure 6.2 a horizontal line implies that 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. 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 parentheses next to the line. This amount is the average effect of knowing someone or not knowing someone.

6.3 MODELS OF INSURANCE PURCHASE: REGRESSION ANALYSIS*

The measures of effect derived from the contingency table analyses of the preceding 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 to form the table can create artifactual results.

In this section we use logistic and simple linear regression models to develop a detailed model of the probability of purchasing insurance. This permits one to include qualitative and quantitative variables and to handle a large number of independent factors simultaneously. We concentrate on the variables and interactions that emerged as being important in the two-way analyses of Chapter 5 and the contingency table analyses.

The logistic regressions are generalizations of the contingency table models and their coefficients have the same interpretation. The "linear

*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.

probability" models treat the probability of purchase itself (rather than the logodds) as a linear function of independent variables and estimate 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 some instances while the logistic regressions are always meaningful. Table 6.8 specifies these models. As in the preceding sections technical details are kept to a minimum and results are emphasized.

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 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 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, such as hazard and income, the category included in the constant term has a coefficient of 0.0 by definition, 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 does the group without a high school degree. For fully quantitative variables, such as age, the coefficient represents the change in probability (or logodds in the logit regression) per unit change in the variable. Thus the chance of being a policyholder in the OLS Model 1 is 3.4 percent higher per 10 year 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), which act like qualitative variables, contrast 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 $t = 0.25$). Persons in the "zero damage" group have an 18.1 percent lower probability of purchasing insurance than do 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 $1000 estimated damage among those people who think there will be some (nonzero) 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,

Table 6.9 Determinants of Insurance Purchase (Regression for 75% Combined 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]	- .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.

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 is 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 compared with those 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 education 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 the possibility of 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 declines 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 problem–know someone" group and the "no

Table 6.10 Determinants of Insurance Purchase (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–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

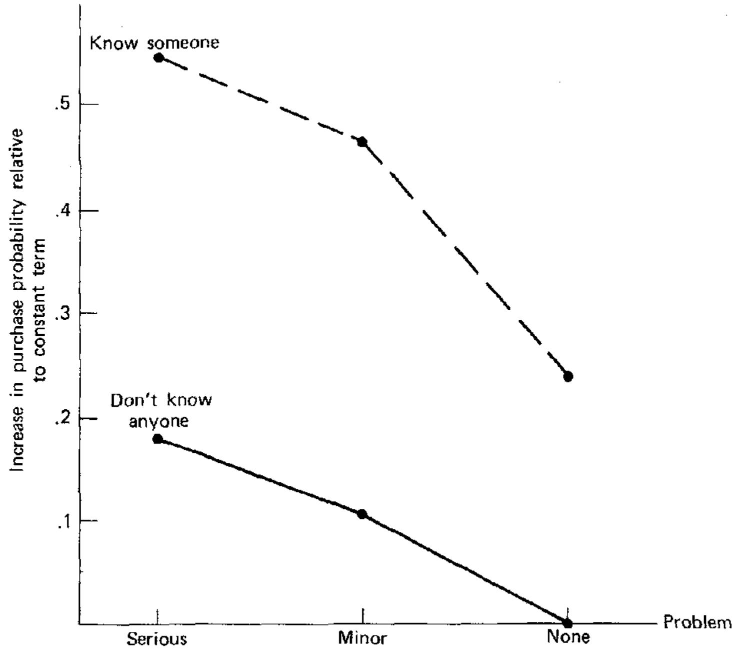

Figure 6.3 Interaction between PROBLEM and KNOWONE (75% combined sample). Note: Only differences are meaningful.

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 a result of a stronger contrast between "none" and "minor" problem among people who know someone with insurance than in the don't know someone group, which is what we found previously.

6.4 IMPLICATIONS OF SAMPLING PLAN ON STATISTICAL ANALYSIS*

This section is more technical than the preceding one, but 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

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

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 χ^2's, and different coefficients.

As explained in Chapter 4, our sampling plan was complex, being 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 nonproportionate sampling of homeowners (i.e., the overrepresentation in our sample of insured individuals), and the use of a 25 percent subsample. As discussed in Chapter 4, clustering and nonproportionate 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 overrepresentation 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 was to be replicated. We discuss each of these procedures in turn.

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. This practice, though understandable, at times yields misleading results. For example, with a cluster sample in which 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 that would have occurred if the survey had been 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 balanced 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 both the number of half samples to be used and how to choose them.

Weighted and Unweighted Samples

As 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 minirepresentation of the population of all homeowners and is not 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.

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 1 and reflects the effects of cluster sampling.

The standard errors in column (2) 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 1 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 nonzero effects, the weighting reduces the absolute value of the estimated effects. The standard errors of these effects for the weighted sample, estimated again using BRR, are presented in column (7). Tables 6.19 and 6.20, which follow the chapter, present BRR results for the riverine flood sample and the earthquake sample.[6]

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 caused by 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]

Table 6.11 Balanced Repeated Replication using Ordinary Least Squares for 75% Coastal Flood Sample

	Unweighted Data					Weighted Data	
Variable Name	(1) Coefficient	(2) Standard Error	(3) T-ratio	(4) Design Effect	(5) Corrected T-ratio	(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	.003	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.

Table 6.12 Validation of Insurance Purchase Model for 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

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 under "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 model we have constructed appears to have considerable validity in differentiating policyholders from nonpolicyholders.

6.5 SUMMARY OF STATISTICAL PROCEDURES

The methodology for analyzing the unweighted survey data is summarized in Figure 6.4. Step 1 utilizes the entire sample data for developing cross-tabulations and contingency tables. These pro-

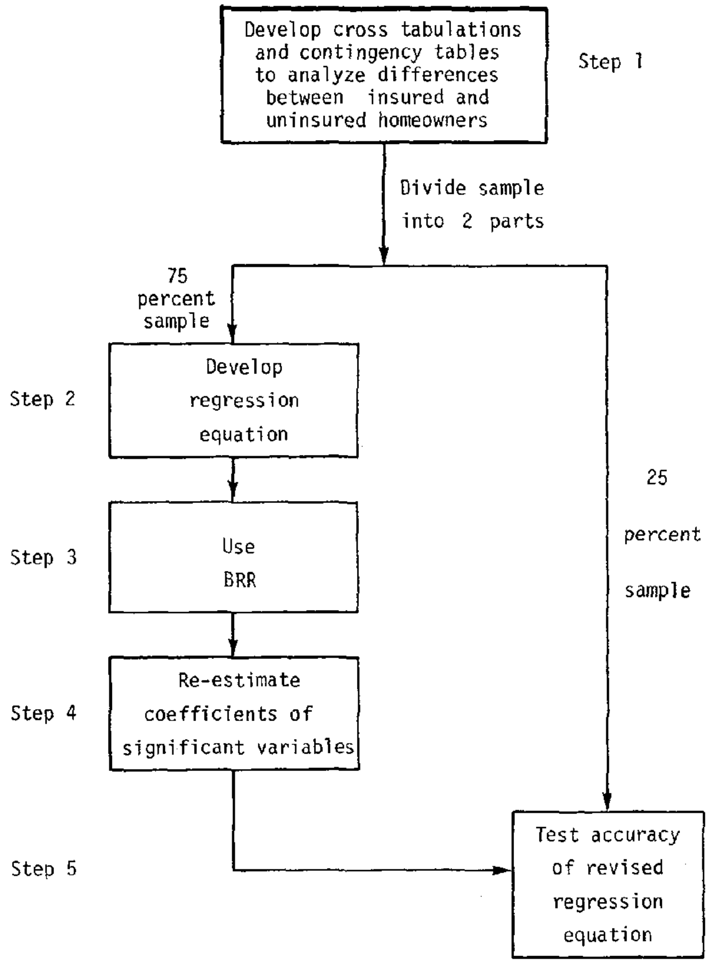

Figure 6.4 Procedure for Systematically Analyzing Survey Data.

cedures enable us to isolate those variables that 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 reestimated 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 6.13 Determinants of Awareness of Problem (Regression for 75% Combined Sample)

REGRESSION FOR 75% COMBINED SAMPLE

	Ordinary Least Squares	
Name of Variable	Coefficient	T-ratio
Hazard is a serious problem	Dependent Variable	
Constant term[1]	.240	
Knew area hazard prone when moved in		
Yes	.208	10.4
Disaster experience		
One disaster	.184	6.4
More than one disaster	.367	10.0
Log (probability)	.037/unit	7.0
Future damage		
Can't estimate	-.027	.24
No damage	-.072	- 2.5
Some damage	.0011/$1,000	2.8
Years lived in house and Type of hazard		
Coastal zone A	.263 - .0034/yr.	7.9
Coastal zone B	.038 + .0012/yr.	.89
Riverine zone A	.292 + .0017/yr.	6.4
Riverine zone B	.093 + .0017/yr.	1.8
Earthquake	.000 - .0041/yr.	2.5
R^2 = .231		

[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,
(b) has never experienced a disaster, and
(c) expects $1 future damage.

Table 6.14 Determinants of Awareness of Problem (Regression for 75% Flood Sample)

REGRESSION FOR 75% FLOOD SAMPLE

	Ordinary Least Squares	
Name of Variable	Coefficient	T-ratio
Hazard is a serious problem	Dependent Variable	
Constant term[1]	.316	
Knew area hazard prone when moved in		
Yes	.284	11.0
Disaster experience		
One disaster	.243	7.0
More than one disaster	.398	9.8
Log (probability)	.040/unit	6.0
Future damage		
Can't estimate	-.066	- .50
No damage	-.090	- 2.7
Some damage	.0012/$1,000	2.2
Years lived in house and Type of hazard		
Coastal zone A	.163 - .0033/yr.	3.2
Coastal zone B	-.041 + .0014/yr.	- .71
Riverine zone A	.187 + .0020/yr.	3.2
Riverine zone B	.000 + .0022/yr.	.78
R^2 = .273		

[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,
(b) has never experienced a disaster, and
(c) expects $1 future damage.

Table 6.15 Determinants of Awareness of Problem (Regression for 75% Earthquake Sample)

REGRESSION FOR 75% EARTHQUAKE SAMPLE

	Ordinary Least Squares	
Name of Variable	Coefficient	T-ratio
Hazard is a serious problem	Dependent Variable	
Constant term[1]	.294	
Knew area hazard prone when moved in		
Yes	.091	2.9
Disaster experience		
One disaster	.049	.99
More than one disaster	.219	2.5
Log (probability)	.033/unit	3.7
Future damage		
Can't estimate	.063	.67
No damage	.038	.60
Some damage	.0012/$1,000	2.0
Years lived in house	-.0042/yr.	- 2.5
R^2 = .058		

[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,
(b) has never experienced a disaster, and
(c) expects $1 future damage.

Table 6.16 Determinants of Awareness of Insurance (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 Determinants of Awareness of Insurance (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 Determinants of Awareness of Insurance (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 Effects in Contingency Table Models of Insurance Purchase (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 Effects in Contingency Table Models of Insurance Purchase

(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.

NOTES

1. These multivariate methods are discussed in Bock (1975), Cox (1970), Ginsberg (1972), Goodman (1972a, b), 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 6.3).
3. If fit is measured by the (likelihood ratio) χ^2, the difference between χ^2 in (1) and (2) and (a) and (b) is χ^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.

7

Controlled Laboratory Experiments[1]

The field survey described in the preceding chapters provides 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 generalizability of the research.

7.1 METHODOLOGICAL CONSIDERATIONS

The Experimenter's Problem

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). In principle, one could provide subjects with a substantial asset that could then be put at risk. However, even if the economics of scientific research enabled making those staked assets substantial, losing someone else's money might not be the same as losing one's own funds.

The Urn Solution

To minimize these problems we decided to pose insurance questions in the abstract. The "hazard" that our subjects faced was the drawing of a blue ball from an urn containing a predominance of red balls. Their potential losses and the insurance premiums for policies that 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 here reflect the way people believe they would insure themselves in a given hypothetical situation.

As an isolated research tool such urn studies would clearly be inadequate. However, in conjunction with the field survey and a more realistic paradigm called the farm game simulation (described in Section 7.3), they comprise part of a multimethod research program. 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 laboratory the trade-off is reversed. The package of studies should indicate the results that would be obtained in that realistic *and* controlled study that is beyond one's power to conduct.

7.2 EXPERIMENTS WITH THE URN GAME

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

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		

loss from drawing one ball from the urn [$P(L)$ multiplied by L] was also one point. For example, an urn might contain 1 blue ball in 1000 balls, and drawing it incurred a loss of 1000 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 of some of these attributes are investigated below; the effects of other changes await further research.

About 700 individuals took part in these experiments, most of them 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 this was a study in which members of the Eugene, Oregon, chapter of the 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.

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 regarding which of these six urns will be insured. If subjects are averse to risk, then there is a concave relationship between (negative) 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 less than or equal to the expected loss.

However, it is reasonable to suppose that some subjects will occasionally not purchase insurance because of the time and effort required to process information, because of error in the subjective assessments of utility, or because they may believe that the experimenter implicitly wants them to choose some but not all policies. In such a situation utility theory predicts that subjects would be most likely to insure against low probability, high loss urns, since those provide 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 to ignore urns for which the probability of loss is too low to constitute a real threat. That is, there may be a probability threshold that needs to be

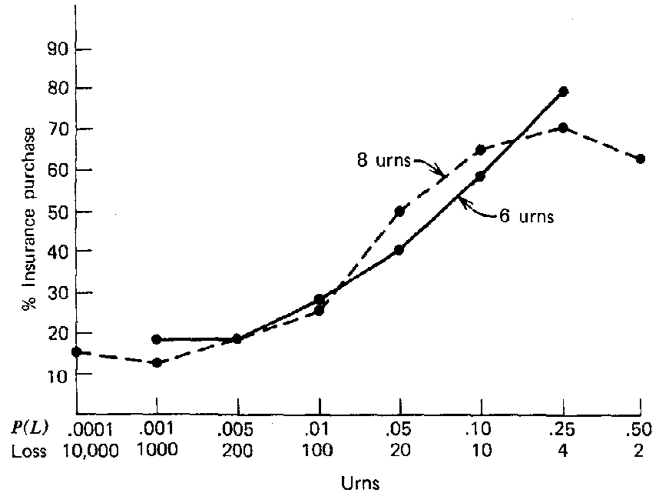

Figure 7.1 Percentage of subjects purchasing insurance for urns varying in probability and amount of loss, six- and eight-urn games.

exceeded before protective action appears desirable. Presumably, such a threshold would vary from individual to individual. 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, and so forth. 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.

Results of the Urn Game

The solid curve in Figure 7.1 presents the pooled responses of 109 subjects who were presented the game in Table 7.1. Contrary to the predictions derived from utility theory, we found a strong preference for insuring against events that are relatively likely to happen but incur only 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 $P(L) = .25$. Thus the number of subjects willing to insure against a likely loss of 4 points was four times higher than the number who would insure against an unlikely loss of 1000 points.

Preference patterns of individual subjects were also examined. Each subject's responses were classified into one of six categories: (1) buy all six policies; (2) buy no policies; (3) insure against 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) insure against some subset of most likely losses (e.g., urns 6;

Table 7.2 **Patterns of Insurance Purchase**

	Buy All	Buy None	Buy Some Subset of: Least Likely Losses	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.

5 and 6; 4, 5, and 6; etc.); (5) buy insurance for some subset of contiguous middle likelihood losses (e.g., urns 2 and 3); and (6) other patterns (e.g., urns 3 and 5; 1 and 4). 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 losses. Almost half of all subjects insured against some subset of the most likely losses, compared with only about 7% insuring against some subset of the least likely losses. Roughly one subject in five bought no insurance at all, while one in eight bought all available policies.

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 this eight-urn game appear as the broken line in Figure 7.1. The pattern found with six urns 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. At the high end there was a slight decline in demand with the increase of $P(L)$ from .25 to .50. For this last urn the premium was half as large as the possible loss. 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 purchase for the smallest loss with the largest probability (Figure 7.1).

Robustness of the Probability Effect

However dramatic the results depicted in Figure 7.1, 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. We would like evidence showing that these results 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 eight-urn study with 46 members and spouses from the Eugene, Oregon, chapter of the League of Women Voters (33 women, 13 men). Only individuals who participated in making insurance decisions for their household were studied. 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 (and possible loss decreased). Whereas only 33% said they would purchase insurance at $P(L) = .0001$, 63% would purchase insurance at $P(L) = .50$.

Order of Presentation. One aspect of the experimental format that may have introduced some bias is the order in which the various urns were presented in the questionnaire. In the results reported here, 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 some perspective acquired 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 or "pure" insurance (whose premium equaled the expected value of the gamble), which is seldom encountered in real life. Figure 7.2 compares the results of offering 178 subjects several different urn games for which the expected loss of the gamble was greater than, less than, or equal to the premium. These represent subsidized, commercially offered, and pure insurance, respectively. Subsidized insurance was created in four different ways: by decreasing the premium by 20% or 50% (and holding loss constant), or by decreasing the loss by 20% or 50% (and holding the premium constant). Commercially offered insurance situations were created by 20% or 50% increases in either premium or loss. The same eight probabilities of loss were used

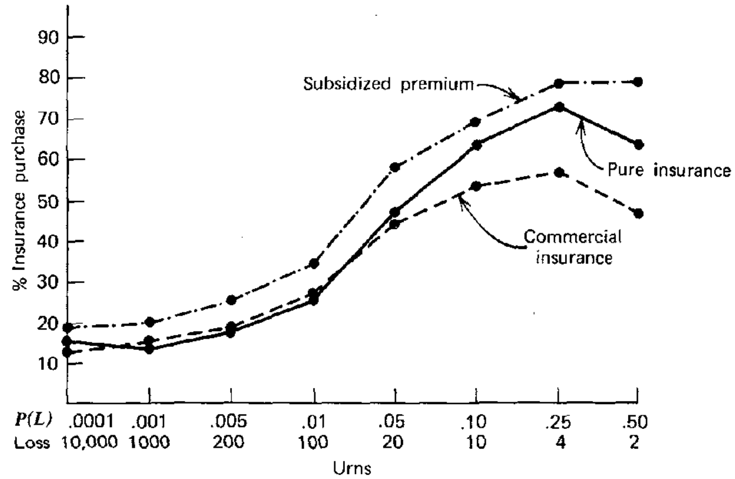

Figure 7.2 Effect of varying the relationship between premium and expected loss of the gamble.

as before. The results of these variations, averaged across the four types of subsidized and commercial insurance, are shown in Figure 7.2. Subjects were somewhat sensitive to these expected-value manipulations. However, the preference for insuring against high probability, low loss risks remained strong in all conditions.

Simultaneous vs. Separate Urns. Another aspect of the experimental design that we considered was the appearance of all six or eight urns in a single game. One might argue that presenting subjects with such a portfolio of risks might induce some peculiar strategies not found when risks are considered one by one. Table 7.3 shows the results of presenting urns separately (to 36 subjects) as opposed to presenting them simultaneously in one game (to 134 subjects). The particular urns used here in this experiment were different from those used in the previous experiments; they were adopted from work done by Amos Tversky and Daniel Kahneman at the Hebrew University in Jerusalem. With separate presentation the differential 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 somewhat less likely to insure against the urn with the highest loss and highest premium. Schoemaker (1977) has reported a similar finding. This result, too, is inconsistent with predictions derived from utility theory if individuals are risk averse with respect to losses.

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	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

Promoting Insurance Against Unlikely Calamities

Compounding with Other Risks. How can one get people to insure against low probability, high consequence events? Perhaps disaster insurance should be treated as an unmarketable commodity and ways sought to package it more effectively. One such possibility is that if people really prefer to insure against high probability, low loss events, perhaps they will also insure against unlikely diasters if such insurance is sold in combination with insurance against likely losses, at a reasonable extra cost. We first attempted to do this by offering subjects a comprehensive policy, in which the only insurance available protected against all eight urns (those in Figure 7.1) for a premium of 8 points. Of 35 subjects only 11 bought this policy. Whereas the previous studies offering insurance against eight urns individually "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 eight-urn comprehensive insurance policy subjects were asked to buy more than twice as much insurance as they ordinarily would have purchased (8 vs. 3.3 points). Perhaps greater success would be achieved with a relatively less expensive insurance package. 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 and an insurance premium of 2 points. The second game also

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

had one urn, carrying a .001 chance of losing 1000 points with a 1-point premium. The third game included both of these urns and a combined (3-point) premium; here subjects had to draw once from each urn and could insure only against both. The three games were presented to subjects in varying orders, none of which affected the results. Pooled 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, resulting in over twice as many people being insured against the low probability loss. Our subjects were willing to spend 30% more for compound insurance than the sum of their expenditures for the two single-urn policies. If it is in society's best interest for people to insure themselves against unlikely calamities, then adding protection against a small but likely loss might accomplish this.

Compounding over Time. Another variation that might change one's attitude towards insuring against an unlikely loss is to extend the time span during which that risk is faced. This can be done in an experiment by increasing the number of times the urn must be sampled, and in life by selling multiyear policies. Perhaps when one faces repeated chances for possible disaster, the increase in subjective probability of loss may outweigh the increase in premium, making insurance more attractive.

We tested this hypothesis with 72 subjects, assigned to four groups of approximately equal size. Group 1 was exposed to a gamble offering 1 chance in 100 of losing $100. Group 2 faced 1 chance in 20 of losing $20. Subjects in both groups could take their chances or purchase insurance at an acturially fair premium ($1). Groups 3 and 4 saw these same gambles, but were told that they had to play the gamble five times. Group 3 was told that over all five plays, each having only 1 chance in 100 of losing $100, they faced a .05 probability of losing $100 at least one time. Group 4 was told that five plays each having a 1/20 chance to lose $20, provide a .23 probability of losing $20 at least once. Subjects were allowed to either go uninsured on all five plays or purchase insurance for all five plays for a $5 premium.

Multiple exposure to the .01 gamble did not affect the proportion of subjects who bought insurance (63% for the single-play, 65% for the five-play condition). However, whereas 58% of the subjects purchased insurance against a single chance of 1 in 20 to lose $20, 94% paid the $5 premium to insure against five plays of this gamble. (This difference in proportions was statistically significant at $p < .01$.) Thus it does appear possible that multiple exposures can induce people to purchase insurance by boosting the overall probability of loss.

Insurance as an Investment. 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 caused, at least in part, by this preference: insuring against high probability, low loss urns gives people a good chance of getting a monetary return (reimbursement of a loss).

One way to improve the possibility of getting something back with low probability losses is to offer to reimburse subjects who make no claims. Of the many possible refund arrangements, we adopted a comprehensive insurance plan (one premium for eight urns) that refunded all of a subject's premium if no claims were made, that is, if no blue balls were drawn. Actuarially fair insurance offering this option must, of course, carry a higher premium than insurance that reimburses only when losses occur. For the eight-urn situation, the fair premium is 11.7 points.

Each of the 35 subjects offered the comprehensive, no-refund insurance described 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 as purchased the no-refund comprehensive. This amounted to 7.54 insurance points per subject, or 62.8% of all insurance possible, compared with 31.4% of all comprehensive insurance possible and 41.3% of all noncomprehensive insurance purchased in earlier eight-urn games. 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. They appeared to neglect the likely possibility that they would be reimbursed for losses smaller than the premium.

7.3 EXPERIMENTS WITH THE FARM GAME

In the experiments with urns, subjects considered well-defined insurance problems in isolation and without real stakes at risk. To increase our confidence in these results we designed a farm game presenting a much more realistic task, in which insurance was not the sole object of attention.

Details of the Game

Instructions and Format. Subjects were told

> Farming is a business that requires decisions. In this game, the number of decisions has been reduced considerably 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 15 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 each subject was 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 1 to 1.5 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 faced.

For each 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 Hazards. 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 af-

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

forded 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 purchases in our urn studies. Losses and premiums were established so that *(a)* the largest loss equaled or exceeded the value of the farm, thus ending the game should it be incurred; and *(b)* the cost of the premium was nonnegligible. The average subject's net profit was approximately $6000 per year. Thus the purchase of insurance at $500 per hazard was a significant expense.

Subjects. 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 19 men and 11 women, with a mean age of 25.

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 7.3 shows that the first round responses of the farm game subjects were similar to the responses of urn game subjects who avoided insurance against low probability, high loss hazards and preferred 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 spend the same amount to insure against the loss of their whole farm.

Figure 7.3 also shows subjects' responses on the last (fifteenth) round of this game. Here we find a marked increase in subjects' willingness to

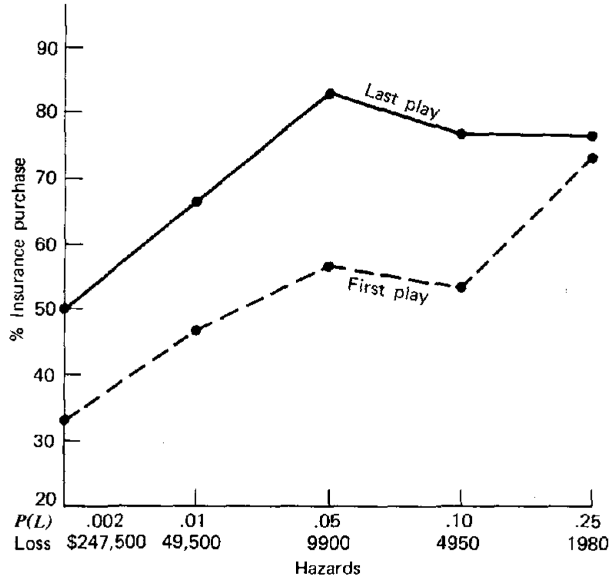

Figure 7.3 Effect of probability of loss on insurance purchasing in the first farm game.

insure against all but the most likely losses. This increase is largely the result of an increase in the number of subjects who bought all policies (from 5 subjects on the first round to 15 on the last round). All but one of the subjects who insured against the least likely loss on the last round also insured against all other losses, suggesting that the attractiveness of insuring against the rarest event increased only as a result of the increase in "buy all" strategies. There are several possible reasons for the increased purchase of insurance over time: (1) As subjects became more familiar with the game, they may have devoted relatively more attention to insurance decisions (as opposed to crop and fertilizer decisions) and thereby discovered the wisdom of insurance. (2) Since the farms were gaining in value over time, the subjects may have become more conservative, wishing to protect their increased assets. (3) Subjects may have believed that the lower probability disasters, which 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 is examined more closely later in this chapter.

Combining all rounds, farm game subjects bought much more insurance than urn subjects; 30% of the time they insured against all five

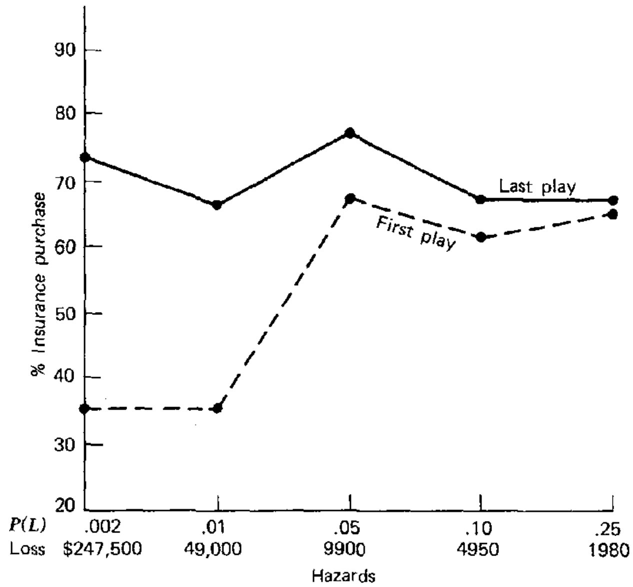

Figure 7.4 Effect of probability of loss on insurance purchasing in the second farm game.

disasters, compared to 12.6% of subjects buying full coverage for the six-urn games and 6.7% for the eight-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).

Farm Game II

Rationale. One possibly important difference between the farm game and real-life decisions is that subjects were not rewarded for managing their farms properly. 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 31 new subjects whose earnings for participating in the experiment depended on their farm earnings. They were paid from $2.50 to $20, depending on their net worth at the end of Round 15.

Results. Figure 7.4 shows first play and last play decisions. A comparison of this figure with the previous one reveals that hourly pay

Table 7.6 Effect of Hazard Experience on Round N on Decisions for Round $N + 1$

			Decision on Round N + 1			
Outcome on Round N		No. of Decisions	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.

(Game I) and pay-by-farm earnings (Game II) produced similar patterns. The only marked difference was increased purchase of insurance against the greatest possible loss on the last play in Game II. This appears to have been caused by specific end-game behavior, with some subjects taking care not to lose the farm on the last round before "cashing out." Even when earnings were dependent on final net worth, subjects purchased more insurance against the most likely losses than against the least likely ones when all rounds of the game were combined. (see Table 7.2 row 4, columns 3 and 4).

In as realistic a context as may be possible in a laboratory experiment, where insurance was not the subjects' sole consideration, we have found unwillingness to insure against low probability, high loss events. Although this aversion was weaker than with the urn games, these results still clearly violate the predictions of utility theory.

Effect of Past Experience. What effect did the occurrence or nonoccurrence of a disaster have on subsequent insurance behavior? Table 7.6 shows insurance purchases as a function of whether a hazard was incurred on the previous round. Looking at the last two columns of line 1, we see that when no hazard occurred on the previous round, only 9%

of the decisions on the next round were changes from the previous decision. These changes were about equally divided between buying a policy against a previously uninsured hazard (4.9%) and canceling an existing policy (4.1%).

In examining decisions after the occurrence of a hazard (line 2), it is instructive to divide the data into two categories—decisions made relevant to the hazard that had just occurred (line 2a) and decisions for the other hazards, which had not just occurred (line 2b). Here we see that there was a much greater rate of cancellation of existing policies for hazards that had just occurred (9%) than cancellation of other policies (2.5%). This suggests a belief that, because the hazard has just happened, it is unlikely to repeat soon. This belief, known as the "gambler's fallacy," has been found often in laboratory studies as well as among residents of hazard areas (Slovic, Kunreuther, and White, 1974).

A slightly different way of looking at the effect of hazard experience is to examine people's behavior toward hazards on which they have just incurred an uninsured loss. On the round following such losses 15.4% purchased insurance for that hazard. This is only slightly higher than the rate of new insurance purchases on hazards other than the one that just occurred (14.5%) or the rate of new insurance on rounds that were not preceded by hazards (13.0%). Thus people did not markedly increase their insurance holdings after an uninsured hazard, a result that conflicts with observations of actual insurance behavior in the aftermath of a disaster (see, for example, Chapter 5 p. 112). The reason for this difference is unclear. One 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 its recurrence.

7.4 EXPLAINING THE PROBABILITY EFFECT

A Utility Explanation

The most striking result shown by the experiments just described is that people buy more insurance against moderate or high probability, low loss events than against low probability, high loss events. How might this behavior be explained? Two possible explanations come to mind, both of which are contrary to traditional utility theory. The first postulates a utility function that is convex over losses, as shown in

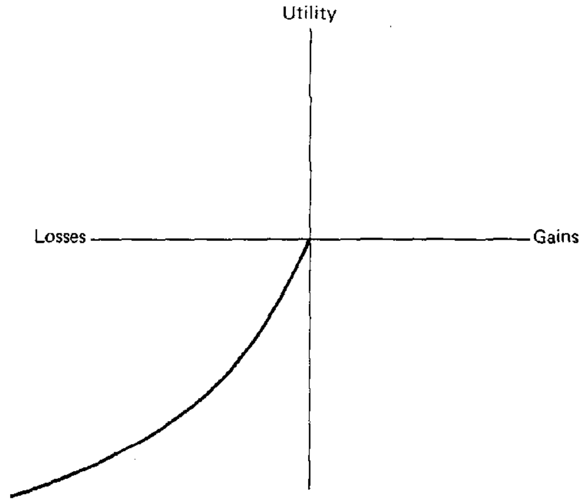

Figure 7.5 A utility function that is convex in the domain of losses.

Figure 7.5, instead of the traditional concave (risk averse) curve shown in Figure 3.1. A convex curve, implying diminishing marginal utility over losses, has solid empirical support beyond the present study. Galanter has repeatedly obtained convex functions in carefully done psychophysical experiments aimed at scaling the subjective value of various monetary and nonmonetary losses (Galanter and Pliner, 1974; Galanter, 1975). Swalm (1966) observed convex functions over monetary losses with corporate executives, a result apparently neglected by other theorists and practitioners. Most recently Kahneman and Tversky (1978) observed preferences among gambles that could be explained only by a convex utility function for losses. Kahneman and Tversky noted that diminishing marginal utility is compatible with well-substantiated principles of perception and judgment, according to which sensitivity to changes decreases as one moves away from a neutral point (here, no change in asset position).

A Threshold Explanation

A second hypothesis invokes the notion of a probability threshold to explain the tendency to buy less insurance as probability of loss decreases. As already suggested, people may refuse to worry about losses whose probability is below some threshold. Probabilities below the threshold are treated as though they were zero.

When asked why they made the insurance decisions they did, most of our subjects referred to some sort of threshold notion. For example:

"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."

Judging by these comments and our results, the threshold apparently varies across individuals. Whether it also varies within individuals across situations is a topic for future research. The threshold may be affected by factors other than just probability, such as the salience of the loss. If so, then it may best be viewed as defined on a variable called "worry" or "concern." 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 obsessively protecting ourselves against a Pandora's urn of rare horrors.

Ideas similar to the threshold notion have appeared in previous discussions of people's failure to protect themselves against natural hazards. Haas (1971) classed people's inattention to earthquake risks with their failure to check the air pressure in their spare tire before a long auto trip or to examine their house roof yearly for leaks. He commented:

> What do people attend to most of the time? They pay attention to that which is most pressing, that which must be attended to, that which has deadlines, that which is generally considered most critical, that which one would be severely criticized for if he or she didn't attend to (p. 78).

Senator Robert Taft, Jr. (1972) observed:

> 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 individual homeowners and businessmen in the floodplain areas. People just do not buy the 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 (p. 18).

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 probabilites 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").

The threshold notion is also 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 probabilites of these hazards. If the event isn't expected to happen, it doesn't matter how inexpensive the insurance is.

The role of perceived probability may also explain the inconsistency of individuals' insurance behavior across situations having 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 popularity of low deductible insurance plans (Pashigian, Schkade, and Menefee, 1966; Schoemaker, 1977) and appliance service contracts is further evidence of the preference for insuring against high probability events. It should be noted that the idea that people view insurance as an investment (and like to be able to make claims, thereby getting something for their money) is also consistent with most of these results.

7.5 SUMMARY

To date, relatively few experiments have studied the expected utility theory of insurance or, for that matter, any type of insurance decision. The laboratory experiments described here 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 game and the farm game. The urn game 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 low probability, high loss events. 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 multirisk insurance policy against loss from all or combinations of the urns, and offering a premium refund if the subject did not collect on his multirisk policy.

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 experiment was not an hourly wage, but was dependent on their performance. Successful farmers received higher pay for participation. Despite this difference, the two games produced similar results.

Two possible hypotheses were proposed to explain why people buy more insurance against moderate or high probability, low loss events than against low probability, high loss events. One postulates a utility function that is convex over losses. The second implies 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 latter hypothesis helps explain why many survey respondents showed little concern about floods or earthquakes and why insured persons had greater perceived probabilities of loss than did the uninsured individuals.

NOTE

1. This chapter was written by Paul Slovic, Baruch Fischhoff, Sarah Lichtenstein, Bernard Corrigan and Barbara Combs.

8

Behavior and Attitudes Toward Mitigation and Relief Programs

Preceding chapters have analyzed homeowners' 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 toward 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. For descriptive purposes 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 deals with effects of this variable on knowledge, attitudes, and behavior by classifying homeowners into two groups: those who have suffered damage from past disasters (the "experienced" class) and those who 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, hence the need for insurance protection. The general conclusion emerging 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 are discussed in Chapter 10.

8.1 PAST EXPERIENCE WITH DISASTERS

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 on losses suffered from floods and earthquakes. A significant proportion of the respondents suffered damage at some time to a house they 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 struck twice" for many of these homeowners: over 200 of the flood victims had two or more disasters to their present home. Only 32 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 difference in the size of losses from these two types of disasters provides an interesting contrast. The bottom half of Table 8.1 details the per capita damage figures for those homeowners who were able to provide loss estimates. Floods were much more costly to homeowners than earthquakes, whether we aggregate over all disasters or consider 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 $9539 compared to only $1412 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 wreaked more havoc to residential victims than earthquakes. One hundred, sixty-seven homeowners suffered losses from floods totaling more than $5000 while only eight earthquake vic-

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

tims had damage exceeding this figure. Only two homeowners in earthquake country suffered damage over $10,000, while ninety flood victims had losses above this amount.

Looking at Worst Experiences—What Happened?

The cold figures cited here are a bit sterile and do not indicate the nature of the damage. Many individuals responding to open-ended questions 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.

Table 8.2 Distribution of Amounts of Damage in Most Serious Disaster

Flood Survey: Damage range (in $)	Number of Respondents	Percent	Earthquake Survey: 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

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 11½ 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 to or loss of irreplaceable 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

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

people described specific damage to contents. These included everything expected 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 with 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 following one 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."

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 with those in floods.

Many of those who suffered earthquake damage, like the Huntington Beach homeowner quoted, did not make repairs. Of the group making repairs their reasons for believing that their property was 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

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)

> 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 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.

Table 8.5 Reasons for Believing Property Was Better or Worse than Predisaster 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

8.2 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 65 homeowners claimed they had purchased flood coverage prior to the disaster. For the earthquake survey only 4 homeowners had earthquake insurance at the time they suffered losses and only 3 reported collecting on their policy, so it is meaningless for us to separate quake victims into insured and uninsured categories.

To provide a meaningful analysis of these data we selected only those respondents who could estimate the amount they received from *each* recovery source utilized. For the flood sample only insured individuals who knew when they had purchased a policy were eligible for inclusion, since our interest was in making comparisons on the basis of whether individuals were insured or uninsured at the time of their most serious disaster. We eliminated any flood victims whose losses were below $500 because 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. The relatively small number of cases in some of the damage classes suggests that these results be viewed as illustrative and informative but not statistically precise.

Table 8.6 provides an overview of the recovery process for three different damage ranges and four sources of funds (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 with 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. For those who did not have flood coverage, 91 percent of the total damage was repaired using savings and another 35 percent with government loans. On the average, insurance covered 6 percent of their damage, presumably that caused by wind losses (which are included in a homeowners policy) or vehicle damage (which is included in an automobile or marine policy). The money utilized by uninsured homeowners from different sources amounted to 140 percent of their damage. Hence their houses should have been worth more after the flood than before. Insured victims in the lowest damage class fared even better than their uninsured counterparts. Their primary source of funds was also savings (88 percent of damage), with insurance running a close second (78 percent). This group estimated that their recovery funds totaled 169 percent of their average damage.

Looking across the damage ranges of flood victims, we note that uninsured homeowners did not fully recoup their losses in the highest two ranges of damage: insured homeowners fared very well in the middle range but those who suffered the highest amount of damage only

Table 8.6 Recovery from Past Most Serious Disaster (funds as a percentage 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

utilized funds to cover approximately half of their losses. The low percentage 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 in 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 were much less prone to make repairs than those who suffered flood losses.

Table 8.7 Recovery from Past Most Serious Disaster (percentage 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

The picture of the recovery process would not be complete without showing 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 government loans, 12 percent of those having between $501 and $2500 damage relied on loans, and 41 percent of the victims suffering more than $2500 damage received disaster loans.

Table 8.8 provides a perspective on the relative importance of particular sources for those homeowners who used them. Thus we see

Table 8.8 Recovery from Past Most Serious Disaster (funds as a percentage of damage; averaged over victims using source)

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

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 we conclude about the recovery process of disaster victims on the basis of these three tables? With the appropriate cautionary note

Table 8.9 Distribution of Expected Damage to Property from a Future "Severe" Disaster (percentage 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

that our sample in each class is relatively small, the following suggestive differences can be gleaned from the data:

1. Victims with flood insurance, except those whose damage was in the highest category, were able to cover most of their losses through claims payments.

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 for the 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 would be anticipated.

3. Personal savings were used by most flood and earthquake victims (Table 8.6) but, as seen from Table 8.8, the proportion of losses 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 that was a substantial fraction of their losses, particularly in the low damage classes (Table 8.8).

8.3 EXPECTATIONS OF FUTURE DISASTERS

What type of damage do people expect 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 cost of repairing the damage to the house and its 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 7 percent of the experienced respondents expect no damage from a future severe flood, while almost one quarter of the inexperienced homeowners anticipate no loss from severe flooding in their area. Almost all homeowners in the earthquake sample anticipate some damage. The really striking aspect of the distributions, as pointed out in Chapter 5, is the generally large amounts of damage predicted should either disaster occur. For the earthquake hazard this result was surprising in view of the rather modest losses that respondents had 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 that 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 anticipate recovering 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 is now included. The insured/uninsured groupings reflect the respondents' current status.

The three most important sources of funds expected by uninsured homeowners in both flood and earthquake areas are bank loans, government loans, and personal savings in that order. Naturally policyholders anticipate using primarily 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 70 to 80 percent of their costs from a policy, irrespective of damage. Those homeowners in the lowest damage category undoubtedly have no knowledge of the 5 percent deductible clause in their earthquake insurance policy.

For the insured groups—in both the flood and earthquake samples—the ratio of estimated total recovery funds to expected damage is close to 100 percent whether damage is expected to be high or low.

Table 8.10 Recovery from Future Serious Disaster (funds as a percentage of damage)

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

Uninsured homeowners would be forced to rely primarily on outside sources of funding. 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 with past recovery experience it appears that most homeowners are overly optimistic about the amount of money they would utilize from all sources (except

Table 8.11 Attitudes Toward Rebuilding on the Same Site If House Were Destroyed (percentage 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

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 with inexperienced homeowners and summarizes their responses to this question. In the flood survey 70 percent of those who suffered damage in the past claimed that they would not rebuild on the same site if their house were destroyed; 45 percent of homeowners without previous flood experience would not rebuild. In the earthquake sample, on the other hand, the difference between the two groups was 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

Table 8.12 Awareness of Government Disaster Loans (percentage 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

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 floodplain 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.
>
> I have already built back after one flood, and if it happens again, I'll move somewhere else. The mental strain is too much.

8.4 AWARENESS OF GOVERNMENT LOAN PROGRAMS

Although some respondents mentioned government loans as a possible source of relief from damage from a severe flood or earthquake, this does 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 who 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 whether the federal government provides such relief. Table 8.12 compares the percentage of respondents who volunteered loans with and without prompting.

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.

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 80 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, as shown by Table 8.13, which displays the percentage of respondents who knew whether 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 there was a forgiveness clause.

The interest rate at the time of the survey was 5 percent, but until April 1973 it had been below this figure. In evaluating the question on

Table 8.14 Attitude Toward Government Responsibility for Personal Losses (percentage 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

interest rate, we considered correct any estimate less than or equal to 5 percent. 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 government-provided 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 group were generally more inclined to favor substantial government assistance than were the inexperienced respondents. In the earthquake survey, for example, 42 percent of the experienced group felt the government should be primarily responsible for covering losses, while only 19 percent of those who had not suffered losses fell into this category. Although the insured and uninsured homeowners in flood-prone areas have similar attitudes, the corresponding groups exhibit substantial differences within the earthquake sample. Only 12 percent of the earthquake policyholders feel that the government should bear the brunt of the responsibility for covering losses, compared to 31 percent of 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.

8.5 PERSONAL PROTECTIVE MEASURES

Though the main thrust of our research was directed at understanding the factors that influence the insurance purchase decision, it is of interest to examine the behavior of homeowners with respect to other protective measures adopted in the predisaster period. To what degree do people protect themselves? What are their motivations? What are their 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.

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 that 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 for several different dichotomous classifications of the respondents. Twenty-seven percent of the flood respondents and twelve percent of the earthquake respondents described measures 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 (1974), in his survey of 302 residents of earthquake areas on the West Coast of North America, found 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.

We might expect the proportion of people adopting protective measures to be higher among those who had experienced a previous flood or earthquake than among those who had 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

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.

than among the uninsured homeowners. There are at least two relations between insurance and other protective measures which would affect the adoption of preventive measures. If insured individuals are more sensitive to the dangers of the hazard, these individuals may be 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 these two conflicting incentives.

The data on adoption costs shown in Table 8.16 are 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

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.

how much it cost them to undertake specific protective measures. For the earthquake sample nearly half of the respondents were unable to provide these figures. 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 the subgroups in Table 8.16 those who could give figures on the amount expended on personal protective activities, gave per capita costs ranging 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, totaling 78 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,"

Table 8.18 Reasons for Not Undertaking Protective Activities by Those Mentioning Possible Action (percentage 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

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.

Measures Not Adopted

We also were curious about why people did not adopt 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 into why they had not chosen to undertake such activities. The number of people mentioning possible measures was disappointingly small. This suggests that most homeowners in hazard-prone areas are *not* concerned with ways to reduce future disaster losses.

The percentage of people responding is given at the bottom of Table 8.18. Their reasons are tabulated for both the experienced and inexperienced groups. Among those who 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 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." One of the responses in the "other" category was "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.

Attitude Toward Disaster Proofing

Table 8.16 shows that homeowners who took personal protective measures spent, on the average, $1370. In the preceding 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 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 that 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

Table 8.19 Willingness to Spend $1000 for a Disaster Resistant House (percentage 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

Table 8.20 Attitudes Toward Governmental Financial Responsibility in Making Building Improvements for Disaster Resistance (percentage 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	-	-

to the one on the government responsibility for disaster relief (see Section 8.4), was asked of all respondents. The results summarized in Table 8.20, are similar to those given to the question dealing with government responsibility for bearing losses (Table 8.14). Homeowners having some flood or earthquake experience are more likely than those having 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, 30 percent of uninsured homeowners in the earthquake sample felt that the government should assume all or most of the financial responsibility for making structures more quake resistant, compared to only 13 percent of the insured group who felt this way.

8.6 AWARENESS OF LAND-USE REGULATIONS AND BUILDING CODES

Land-use regulations and building codes are important means for 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 sometimes exceed 100 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. These localities 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

Table 8.21 Awareness of Government Mitigation Measures (percentage 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

Table 8.22 Attitudes Toward Land-Use Regulations and Building Codes (percentage 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

areas. It is worth noting that engineering works were cited more frequently by homeowners in riverine areas than by those in coastal regions.

Land-use regulations and building codes were then briefly defined. All respondents were asked whether they knew of any such measures that had been adopted in their area. Another set of questions dealt with what land-use regulations or building codes should exist. These results are summarized in Table 8.22, in which 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 support the hypothesis that people are *not* aware of land-use regulations or building codes. Even with prompting the number of positive responses is relatively low. There

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, waterproofing)	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

were many more positive responses to the "what should exist" questions than to the "what now exist" ones. Persons responsible for formulating and implementing public policy might find these proposals for land-use regulations and building codes to be of interest. They are tabulated in Tables 8.23 and 8.24 without editorial comment.

8.7 WARNINGS

Although the subject of disaster warning systems is not in the mainstream of issues addressed in this project, it is 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

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

situations, and on perceptions concerning the potential savings from an earthquake prediction.

Flood Warnings

How effective have warnings been in reducing flood damages? The respondents in the flood survey who 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 had 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 summarizes the actions taken by those who heeded the warnings.

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

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

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 on the circumstances of the floods or on whether a warning was actually issued.

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 prediction: location, severity, and likelihood. As Table 8.28 shows, the overall rankings appear in that order. These results might be rationalized in the following way. A

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

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

Table 8.29 Actions Based on an Earthquake Prediction

person first wants to know whether he will be affected by an earthquake. Then he wants to know whether 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 that they would do nothing because, "There is no action I could take." Whether they would feel this way if an earthquake prediction were actually announced for their community is another question.

8.8 SUMMARY

This chapter examines homeowners' past experiences with floods and earthquakes, as well as their knowledge and attitudes toward 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 toward government relief programs. We also focus on the personal protective measures that 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 is on past experience because such knowledge 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. The findings suggest that further research could be undertaken with these data using the sophisticated statistical tools described in Chapter 6. Such analyses are only marginally related to the objectives of this particular study and therefore were not undertaken.

9

Characteristics of Hazard-Prone Regions

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 by using data from the field survey and a sample of loan recipients from SBA disaster loan files.

All figures describing the characteristics of communities were developed through the use of weighting factors corresponding to the objective probability of selection from the sample universe.[1] Hence the data presented in the chapter represent population characteristics rather than simple averages of the field survey responses. The high cost of determining confidence intervals for these data did not appear to us to justify undertaking these computations.

9.1 AVERAGE CHARACTERISTICS OF HAZARD-PRONE AREAS

Differences in House Construction

According to the Federal Insurance Administration depth-damage curves, differences in house construction affect the structure's

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

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:

1. Houses with basements are more susceptible to damage than houses without basements if they are similarly situated on the floodplain.
2. 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, hence are susceptible to considerable damage during a severe flood. On the other hand few have basements, which means they 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

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

communities are located 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.

Development of Hazard-Prone Areas

Data from the field survey, presented in Table 9.2, support the hypothesis that development in 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 those areas that 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 in 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 in Zone B.[2] The original purchase price in coastal Zone A was higher than in coastal Zone B, and the ratio of yearly appreciation rate to purchase price in coastal Zone A has been 0.20 versus 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:

> 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).

The figures from the field survey are reflected in national trends. For example, White and Haas (1975), in comparing the percentage change in population between 1960 and 1970 for different regions of the country, report that "along the South Atlantic coast the growth rate in counties with shorelines subject to hurricane storm surge is on the average three times as high as in adjoining inland counties (p. 106)." A recent article by Funk (1977) in the *New York Times Magazine* provides insight into the decision processes of residents who choose to move to coastal areas:

> A key element of the problem is the massive population shift that has been taking place in this country in recent years. Americans are moving to the shore. From their new condominiums apartment houses, homes and villas, they appear to be looking for satisfactions of the soul in the seascapes beyond their picture windows. But they are also gazing, in many cases, into the face of potential death. . . . many of them do not really understand this because they have never known a major hurricane. From Brownsville, Tex., to Eastport, Me., along coasts where all tropical storms reach their eventual landfalls in the United States, 78 percent of the 37 million residents have never seen a big hurricane, or even had a brush with the core of a minor one, according to one recent survey (p. 40).

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 the overall high cost of living there.

Mobility of Homeowners

Table 9.3 presents three factors relating to the mobility of the respondents: average length of time in the neighborhood, the likeli-

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.

hood 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. 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. (p. 384)

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 actually suffering losses. A similar interpretation holds for contents damage. Thus in flood-prone areas, average property damage was $5900, based on the 12 percent who experienced losses, while average contents damage was $5200 for the 14.1 percent who experienced such losses. The "per capita total damage given damage" row of the table shows that coastal high and low hazard areas incur

Table 9.4 Magnitude of Damage by Area

	Flood	Coastal Zone A	Coastal Zone B	Riverine Zone A	Riverine Zone B	Earthquake
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

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, because of a prevalence of multistory houses, the average amount of damage to contents is considerably less than the damage to the structure. 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 15 percent suffered some structural losses; however, the average was only $1200. Average contents damage was approximately $500 for the 13 percent in this category. These low figures are largely a result of the ability of wood-frame structures to absorb earth tremors.

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

9.2 DIFFERENCES IN DAMAGE BY SOCIOECONOMIC GROUPS

From a social welfare viewpoint it is important to examine the socioeconomic characteristics of families who have incurred losses from natural hazards. In this section we 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 indicate both the percentage in each group who have suffered damage and the per capita losses for the disaster victims.

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 45 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 25 percent of the homeowners over age 65 residing in coastal Zone A incurred losses.

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

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 compared with the other two age groups. The most noticeable single statistic is the per capita figure of $22,900 for the 45 and under population residing in Zone A of the coastal regions. This unusually high loss is caused by the 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.

Damage by Income Groupings

The damage pattern with respect to income, displayed in Table 9.6, is not as clear-cut 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 suffered $1700 in losses compared to an $8100 average for high income victims. The actual losses experienced by the low income group, however, are likely to be high in relation to their earnings.

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

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 home 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 11 percent of the highest valued residences (over $50,000) incurred losses. The reverse is true for the riverine Zone A areas: only 17 percent of the lower valued houses had losses and over 40 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 did those in the other two groups.

With the exception of coastal Zone B the largest per capita damage for homes occurred in the highest value category. Thus in coastal Zone A the per capita damage for homes over $50,000 was $13,500, compared to $6000 for the lowest valued homes. In coastal Zone B the highest valued homes had only $1500 per capita damage, compared to between $4600 and $5000 for the lower valued groups. Earthquake damage was relatively low for all house value groupings.

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.

9.3 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 predisaster 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 analyses of SBA home loan files have been completed,[3] here we focus on one example from each of the three types of disasters relevant to our field survey: riverine flooding, hurricane flooding, and earthquakes, and on only two of the loan recipients socioeconomic 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 9.9 groups the data according to income level, Table 9.10 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 preceding 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.

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.

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.

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 over the age of 64 in the sample, and in the California flood fewer than 4 percent of the sample fell in this category even though the Census figures reveal that 11.6 percent of the population in the state was over 65. Data from Hurricane Camille show a similar pattern. The data do not reveal whether elderly requested aid and were denied it because of low income or whether they preferred not to incur more debt at their age.

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 which included victims from many disasters, suggests that the latter factor is more important because 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:

> 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. (p. 81–2)

Cochrane also cites a study of Mileti (1975) in which Rapid City disaster victims were questioned about their recovery process:

> 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. (p. 82–3)

Furthermore, Kunreuther (1973) reported:

> 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. (p. 32).

9.4 SUMMARY

This chapter uses field survey data to draw contrasts among the five types of hazard areas surveyed with respect to physical aspects of property, development of hazard prone areas, and mobility of homeowners. An analysis of damage by age, income, and house value is also undertaken for the specific hazard-prone areas comprising the field survey. A sample from the SBA loan files, for three different disasters, is examined to provide insight into the age and income characteristics of recipients. Taken together these findings provide a profile of the socioeconomic and physical characteristics of flood-prone communities in the regular portion of the National Flood Insurance Program and earthquake-prone areas in California.

NOTES

1. Appendix A.1 contains a discussion of the weighting procedure and the use of such data in making references about the entire homeowner population in the flood and earthquake communities.
2. The same is true for 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).

10

Significant Findings and Implications for Public Policy

The field survey and laboratory experiments provide considerable insight into the decision processes utilized by homeowners in coping with hazards that have a relatively low probability of occurrence but which may cause severe losses to their property. This chapter summarizes the principal findings of the study, indicates their implications for public policy and suggests ways of overcoming the problem associated with the failure of individuals to protect themselves against flood and earthquake damage. The concluding section proposes directions for future research.

10.1 SIGNIFICANT FINDINGS

The analysis of field survey data has revealed the limited knowledge possessed by most homeowners residing in hazard-prone areas 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 provide 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.

Knowledge of Insurance

Most respondents in the field survey were aware that flood and earthquake insurance existed, but over 60 percent of the uninsured homeowners residing in hazard-prone areas said they 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 25 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 we might expect, most uninsured individuals did not know whether 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. These earthquake policyholders in particular will be disappointed to find that there is a 5 percent deductible on the actual cash value of their policies; they will collect nothing if their losses are relatively small.

Knowledge of the Hazard

Turning now to the hazards themselves, the field survey reveals that over 90 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 35 percent of the nonpolicyholders in the flood sample and over 60 percent of the uninsured in the earthquake group estimate more than $10,000 damage to their property should a severe disaster occur. 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 causing damage to their property during the next year. This probability was based on the respondents' earlier estimates of damage. Approximately 15 percent of the flood respondents and 8 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 do 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 they have thought about the chances of occurrence of relatively low probability events.

Expectation 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 SBA provides aid to victims, the respondents generally have little knowledge of the loan terms or whether they can receive forgiveness grants from the SBA.

Even more important, most homeowners said they *do not* anticipate turning to the federal government for aid should they suffer losses 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 after a disaster many victims do not utilize 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 having losses over $10,000 collected insurance claims totaling only 30 percent of their damage. Only one quarter of these individuals obtained an SBA loan. Funds from this source averaged less than 10 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 15 percent of those who suffered flood damage and 40 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 predisaster condition.

Homeowners' attitudes toward government responsibility for personal losses are consistent with this lack of interest in relief. Almost 70 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.

Knowledge of Mitigation Measures

The field survey data also reveals a lack of awareness by respondents about measures that could mitigate losses from future disasters. Relatively few homeowners have adopted protective activities to reduce physical damage 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 30 percent of the policyholders and 20 percent of the nonpolicyholders had taken such action. In the earthquake sample less than 20 percent of the insured and 7 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 that they *could* adopt in the future.

There was also a general lack of knowledge of governmental regulations 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 had been required to enact such measures 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.

Development of Hazard-Prone Areas

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 where 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 reveal that housing values appreciated faster in the high hazard coastal and riverine areas (Zone A) than in the less hazardous regions (Zone B). Riverine communities tend to have the lower valued houses close to the water, 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 reveal 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 suffer another severe disaster in their lifetime.

Accuracy of Expected Utility Model

Taken together these 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, 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 of 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 that 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, people do not even reflect on its consequences. In this case they feel no need to consider protective mechanisms such as insurance.

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 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 that are most important in differentiating insured from uninsured homeowners are consistent with such a sequential model of choice. By constructing multidimensional 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 finding 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 results indicate a 55 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 indicates that past experience was the most important factor in alerting homeowners to the seriousness of the hazard. This variable was particularly 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.

Role of Socioeconomic Variables

Socioeconomic 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 both were statistically significant in discriminating 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 seriousness of the hazard problem.

Older people were more likely to buy insurance than their younger counterparts, but the longer a person lived in the neighborhood, the smaller the chance that he actually would have coverage. There was also a significant interaction effect between the length of time lived in different hazard-prone areas and perception of the problem. Thus homeowners in the most hazardous parts of the coastal areas 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 as a serious problem. The field survey data do not enable us to determine why these regional differences exist.

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 availability of insurance and terms of a policy.

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 survey finding 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 purchase observed in the survey data is most likely caused by 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.

10.2 IMPLICATIONS FOR PUBLIC POLICY

The policymaker's view toward the hazards and insurance is quite different from that of the individual homeowner. The policymaker 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 occurring in California within the next 25 years). From this perspective the probability of disaster becomes high enough to cause him to view these events as a problem.

In deciding on appropriate disaster-related policies he must consider the impact that direct controls such as land-use regulations and building codes will have on reducing future losses. He must also weigh the impact that measures such as insurance or government relief are likely to have on distributing the costs of the disasters among victims and nonvictims. What is the appropriate role of insurance in such a mix of adjustments? This study suggests that the policymaker cannot answer such a question without considering the decision processes of individuals facing potentially severe consequences from these hazards.

Our results strongly suggest that the consumer is the source of market failure. It thus may be necessary to substitute other institutional mechanisms for the free market if individuals are to be protected against the consequences of low probability high loss events. In the following section we discuss some available options open to the policymaker for alleviating market failure.

Reasons for Limited Markets for Insurance

Society has been concerned for many years with developing mechanisms, such as insurance, that enable individuals or businesses to protect themselves against their risks. In this section we indicate the problems that insurance companies have faced in offering widespread coverage against losses from certain hazards such as floods and earthquakes. We then show how social institutions have emerged in recent years to cope with these problems.

From a company's viewpoint the price charged for protection must 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, including 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. In an ideal world with perfect information and no transaction costs, companies would offer policies at rates reflecting the above considerations.

Insurance companies have faced practical problems which have forced them to deviate from this ideal set of conditions. As noted in Chapter 2, the principal difficulty facing the industry when it initially tried to market flood insurance was *adverse selection*. Since the demand for coverage was concentrated in relatively few areas, the companies marketing this insurance in the 1890s and 1920s went bankrupt due to severe flooding in areas where a number of policies were sold. 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 that has limited the supply of insurance is *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 that was caused by deliberate or negligent actions on the part of the insured homeowner and one that resulted from 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 could replace damaged equipment with new items. In the event of an earthquake an insured victim might claim that plaster cracking was caused by the shaking of the house even though it had been caused by the normal settling process. To minimize such moral hazard problems there is a 5 percent deductible on the actual cash value of an earthquake policy.

Infrequent events such as floods and earthquakes yield limited statistical data for determining the probabilities and losses associated with the hazard. Even if there were detailed figures from past experience upon which to base rates, a substantial *transaction cost* is incurred in developing customized premiums. For example, the elevation of each house on the floodplain 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 insurance rates is the problem of *externalities*, the effect that the location of structures in one part of the floodplain has on damage to other parts. An example of this problem is the construction of new facilities on an upstream portion of a river, which might increase water runoff 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. Although it is virtually impossible to specify such damage for individual structures, it is possible to determine the effect of a given volume of new construction upstream on the increase in flooding potential downstream. Even if one could specify the impact of such developments on insurance rates, the implementation of such a system would be an administrative nightmare.

Social Institutions for Coping with Market Failure

These 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 financial recovery from natural hazards, we noted in the introduction that until recently the government had assumed this institutional role by providing low interest loans and forgiveness grants to uninsured victims of natural disasters. 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 here. By having the federal government subsidize rates, people are able to buy coverage at attractive prices. The subsidized rates eliminate the high transaction costs that would otherwise be required in setting customized rates for all existing structures on the floodplain. 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 protected any participating insurance 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 federally subsidized flood insurance and all but emergency forms of assistance in the areas subject to severe flooding. When 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 is now designed to be a required one.

It should be pointed out, however, that these sanctions apply only to communities in the regular program, that is, those localities for which a rate map has been drawn delineating the special flood-hazard areas. Communities in the emergency program are thus not subject to the above restrictions. In these communities the only homeowners required to purchase flood insurance are those who obtained new FHA and VA mortgage loans. As of July 31, 1977, only 1255 of the communities participated in the regular program; the remaining 14,356 were in the emergency program. The proportion of structures for which flood insurance will be required depends on the turnover of homes in floodprone areas and the speed with which rate maps can be drawn.

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 5 percent deductible clause, together with the relatively minor damage to wood-frame structures caused by severe quakes, makes such coverage relatively 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 *not* based their decision on such objective information. Most nonpolicyholders are unaware of the deductible amount and do not 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, we would expect the majority of California residents to carry earthquake insurance. Yet less than 5 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).

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 caused by 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 that 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 that 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 when imperfections affect the supply side (the insurance companies), but we are only beginning to learn about the imperfections of individuals in processing information and making decisions.

Impact on Private and Social Risks

The limitations of individuals in collecting and processing information regarding low-probability events has important implications with respect to the private and social risks associated with different public policies.

The results of the field survey and laboratory experiments suggest that homeowners are unlikely to pay attention to protective mechanisms such as insurance or the potential financial consequences of a disaster if they view the hazard as having a low probability of occurrence. In making their location decisions these individuals will be unconcerned as to whether insurance is available or whether the government is currently providing liberal disaster relief. If the government continues to provide liberal relief to uninsured disaster victims, then such actions create social risks, since general taxpayer funds will be used to bail out these individuals.

There may also be potentially severe private risks associated with locating in hazard-prone areas and not purchasing coverage. Vinso (1977) has shown that many uninsured victims in Wilkes-Barre were saddled with severe debts following Tropical Storm Agnes. They have thus been financially crippled despite the generous SBA loan policy provided them after the disaster.

As to the private and social risks in the longer run, our study suggests that under current programs most individuals will locate in hazard-prone areas without being aware of the potential problems or the available mitigation measures open to them. Those required to purchase flood insurance under the Flood Disaster Protection Act of 1973 will forcibly be made aware of the potential threat facing them. It would be interesting to determine whether they decide to adopt other hazard mitigation measures (e.g., floodproofing) as a result of having this new information.

This study also suggests an interesting policy implication (not implied by the expected utility model) regarding the positive value of promoting subsidized flood insurance. A utility theorist would argue that subsidized flood coverage should create severe social risks since individuals should be happy to locate in hazard-prone areas, knowing that if they suffer a disaster they are essentially benefiting at the taxpayers' expense. The findings of the field survey suggest the opposite conclusion: individuals are likely to voluntarily purchase insurance when they feel the hazard is a problem. Suppose one was able to convince homeowners of the value of this coverage through effective promotional means. Their concern with the consequences of the hazard is also likely to make them more cautious and responsible. Hence promotion of subsidized insurance may induce secondary effects, such as adoption of hazard mitigation measures, which have a positive social payoff.[1]

10.3 MECHANISMS FOR ALLEVIATING MARKET FAILURE

In this section we will suggest different ways of overcoming the problems associated with the failure of a market for flood or earthquake coverage. These options are suggested because we have concluded that insurance is likely to have both private and social benefits even if it is subsidized. The fact that we are focusing on the value of the insurance option does not imply that this measure is necessarily superior to other adjustments. In fact, we will suggest at the end of this section that insurance can serve as a mechanism for coordinating other mitigation and relief measures rather than being utilized as a substitute for them.

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 occurrence 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 one way to increase the concern with a future disaster may be 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 enough to raise the subjective probability of the event above the person's critical threshold.[2]

Existing evidence regarding the extent to which media publicity, films, or graphic displays have generated concern with future disasters is not very reassuring. A study by Roder (1961) revealed that floodplain maps circulated to Topeka residents, bankers, realtors, and officials had a negligible impact on their perception of the flood problem. Thousands of pamphlets have been circulated in Boulder showing that a 100 year flood would rise on the door of the Municipal Building, but this personalized picture has not prevented the City Council from authorizing still further encroachments into the same floodplain (White, 1977).

Another way to increase concern with the hazard may be 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 100 year flood, one could note that for someone living in a house for 25 years the chance of suffering damage at 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 and/or adoption of other mitigation measures such as floodproofing his structure.

Role of the Insurance Agent

The insurance agent may serve a very important and useful function in triggering interest in coverage. To the extent that he has the trust of his clients, he can stimulate their awareness of the hazard by indicating the likelihood of a disaster occurring in the future and noting the potential losses that 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, making unnecessary a search for the best price.

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 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, 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 10 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 might then be willing to invest more time and effort in trying to convince potential clients of the attractiveness of such insurance.

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 probably would not be very large. For one thing, there would 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 contraints, 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 for them to remain unconcerned 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. Some laws have attempted to make hazard disclosure mandatory. For example, the Interstate Land Sales Full Disclosure Act (PL 90-448) requires developers selling land on an interstate basis to file a statement listing the hazards facing potential occupants. California requires that natural hazards be covered in real estate buyer reports and Environmental Impact Reports. Other states, such as Texas, have made unsuccessful tries at passing disclosure laws. Preston, Moore, and Cornick noted that local officials in the Susquehanna Basin had a limited understanding of the National Flood Insurance Program, 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.

Role of Financial Institutions

If voluntary methods of promoting insurance are viewed as too costly and time-consuming, *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.[3]

In fact, the Flood Disaster Protection Act of 1973 makes flood insurance a requirement on new mortgages for property in identified flood hazard areas. In the case of earthquake insurance, coverage today is normally written as an endorsement on a homeowners policy for those who voluntarily desire coverage. The National Association of Insurance Commissioners in 1972 recommended that Federal agencies regulating commercial and savings banks require earthquake coverage on all new mortgages in high risk earthquake zones. Similarly a report to the California Legislature by its Joint Committee on Seismic Safety (1974) recommended that "all new borrowers who are purchasing one-to-four family residential buildings should be required by lending institutions to have earthquake insurance, just as in the case for fire insurance (p. 29)." Should banks require coverage on all new mortgages in California, it might 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 that 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. When asked 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 60 percent of the respondents replied in favor of such a regulation and only 30 percent were opposed to it. The rest did not have an opinion.

Role of Disaster Relief

Even if flood and earthquake insurance were required tomorrow as a condition for a new mortgage, there would still be people who would be hurt financially from future disasters. Some would be long-term residents who were not required to have insurance and had not voluntarily purchased coverage. Some families who are renting property would not have insurance against contents damage from floods or earthquakes. It is likely that a large proportion of this uninsured group would be in the low income bracket, either because they could not afford coverage or because they would not possess sufficient information on the availability and terms of a policy. The field survey data also suggest that many of the insured victims would 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, because many of the victims have not taken full advantage of existing loan programs and other sources of aid, their property was in worse shape after repairs had been made than it was before the disaster. If governmental aid is deemed desirable, 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 aware of such programs and most in need of relief. At present, federal agencies do make a concerted effort to disseminate information to the affected population, but they are severely handicapped by the overlapping and somewhat inconsistent character of legislative authorities under which individual federal agencies providing relief operate.

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, giving them information on such possible measures and offering a 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 floodplain management is the fragmented and uncoordinated responsibility for different programs. There is a need to coordinate land-use regulations, floodproofing, flood warning systems, and insurance as part of a unified national program of floodplain management. The report thus supports the need for coordinating insurance with other adjustments.

An Executive Order issued by President Carter on Floodplain Management (11988) on May 23, 1977, represents an attempt to implement some of the recommendations of the U.S. Water Resources Council report. The order directs all federal agencies to protect the floodplains and to reduce the risks of flood losses by prohibiting new construction projects in these areas unless no practical alternative exists.

10.4 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 highlighted by the survey and about which we need to learn more is the influence of communication with friends and neighbors on insurance decisions. Some individuals may follow societal norms by conforming to others without giving the matter much thought. Others may 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 fieldwork 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, hence they 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 socioeconomic 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) analyzed individuals' awareness of selected economic data (e.g., the current minimum wage). He concluded that considerable variation exists between population groups in their degree of knowledge. By understanding which groups are uninformed or misinformed on available hazard-mitigation and recovery options, we 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 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 that have experienced a disaster since they were interviewed. These data would enable us to determine what effect a recent disaster has had on changes in subjective damage and probability estimates and on 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, it is likely that their original lack of interest in coverage was caused by their limited knowledge of flood insurance. On the other hand, if they let their policies lapse, 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 to 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 that affect property losses and those that affect life or health. The fact that flight insurance is relatively popular and earthquake insurance is not, despite the 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 our 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 on 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 that 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:

> 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).

More research is also needed to determine differences between the way consumers and firms process information, and the types of social institutions that 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 condition 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 as a condition for obtaining a mortgage?

All these questions are worthy of investigation, as they promise to increase our understanding of how individuals and institutions operate in an uncertain world where there are high costs associated with collecting and processing information.

NOTES

1. We are indebted to Sidney Winter for pointing out this policy implication to us.
2. An example of such an audiovisual program was developed by Patton, Breed, and Kindy (1976) after the severe Tulsa floods of 1976.
3. Critical analyses of the feasibility of alternative forms of hazard insurance appear in Cornelius (1974); Hall (1973); and Levin, Griffin, and Tierney (1973).

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Appendixes

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A.1

Sampling Report for Field Survey

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1. Rationale for Sample Design

This is an investigation of what determines whether people buy insurance against selected natural hazards. The universe consisted of homeowners living in areas thought to be particularly prone to these hazards: 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 an insurance policy had been bought. Because of variations in the relevant natural factors, there was particular interest in whether buying behavior differed among areas prone to hurricane floods, riverine floods, and earthquakes. Because the critical comparisons were to be made between policyholders and nonpolicyholders, it was decided to interview equal numbers of each group in each of the three types of areas.

In all groups policyholders were selected with equal probability. Flood insurance policyholders were selected from the files of the National Flood Insurers 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. Two important, but conflicting, criteria underlay 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 was that the nonpolicyholders should be comparable to the policyholders. A sample designed to satisfy only the first criterion 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 only the second criterion would have included those nonpolicyholders most similar to 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 on. These plans were:

1. To study six subjectively selected communities, two each in earthquake-prone, hurricane flood-prone, and riverine flood-prone areas, of which one had suffered a recent disaster and the other had not.
2. 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.
3. To select an equal probability sample of policyholders, and then to select a matched sample of nonpolicyholders, such as next-door neighbors.

These plans are discussed in turn.

The main advantage of the first plan is that it would have been possible to isolate two important variables, the type of natural hazard and the recency of a disaster. There are two major drawbacks, however. One is 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 policymaking. 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 has 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 would have 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 that 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 these other variables.

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 3000, 1500 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 area policyholders. Those included in the regular portion of the National Flood Insurance Program 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 area policyholders. Those 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 areas of California. The definition of the area boundaries are given later in this section. The eight companies are

1. Allstate Insurance Company
2. Fireman's Fund American Insurance Company
3. Hartford Insurance Company
4. Insurance Company of North America
5. Kemper Insurance Company
6. State Farm Insurance Company
7. Transamerica Insurance Company
8. Travelers Insurance Companies

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 on 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 = 4374, and the expected number of times a given county was selected was equal to the ratio (number of policyholders in county/4374) 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/2187) 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 10 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 that could not be found on a map and for which directions could not be given to an interviewer. Both ineligible selections and addresses that could not be found were eliminated from the sample. An example of an address that could not be found was, "Box 290, Biloxi, Mississippi". After elimination of the ineligibles and those who could not be found, the final number of selected hurricane flood-prone policyholders was 1205 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 6000 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 the following counties, where the rates of buying were sufficiently high, were included in the study:

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	0.79

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 6000 names were grouped into pages that 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 the 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 turned out to have policyholders in them, even though they did not appear on our list of policyholders, either because the policy had only recently been bought 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 of the characteristics of earthquake policyholders doing business with other companies or outside our 11 county area, or 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 located in a flood-prone area recognized by the Federal Insurance Administration. The specific rules for inclusion were as follows:

1. The person owning the home lived in it.
2. The home was on the list of counties obtained from the NFIA list including at least 25 policyholders.
3. The homeowner was not included in the NFIA list.
4. The area in which the homeowner was living had been rated by a hydrographic survey as having a recognizable nonzero 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 for 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 communities 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 NFIP, 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 Federal Insurance 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 percent of all policyholders and were excluded from the universe of nonpolicyholders. The areas of moderate probability, labeled Zone B or C, included the remaining 30 percent of policyholders. The six cells into which nonpolicyholders were stratified for the two samples of nonpolicyholders as well as the sampling intervals, are as follow:

	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	2536	11,664
2	6 to 15 percent	1903	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:

$$\text{Pr (listing area } i \text{ selected)} = P_i = A_i \times B_i \times C_i \times D_i$$

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 preceding table,

C_i = (number of owner-occupied housing units in tract or ED)/(number of owner-occupied housing units in the community),

$D_i = 2 \times$ (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; that is, within each of the 12 cells the probability of selection was $P_i/f_i = K_c$.

For some listing areas 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. To reduce the increase in variance caused by 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.

For 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. Included in the universe were all nonpolicyholding homeowners living in communities having at least five policyholders from the sample of 6000 names supplied by the insurance companies. The remaining areas were omitted, 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; for 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, we found the overall probability of selection of a housing unit to be 1/164 in Group A and 1/278 in Group B.

Within a selected household, in both the flood and earthquake samples, all persons who considered themselves 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 is therefore not included in the weighting scheme.

4. Expanding the Sample

After interviewing had begun, it became necessary to increase the size of the sample beyond what had originally been selected, 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 the listing area sampling interval f_i, which in turn depended on the probability of selection of the listing area P_i. The final probabilities of selection of households in the samples of nonpolicyholders were as follows:

Stratum	Proportion of Listing Areas Reselected	Overall Sampling Rates	
		$f_i \geq 2.5$	$f_i < 2.5$
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 this suppose that f_i for a listing are in the hurricane flood prone stratum was 4.0. Then the overall probability of selection of a given house in that listing area is 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

$$P_h = P_i/1.8 + (.8)(.8/1.8)(1 \times P_i) = 1.64P_i/1.8$$

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 nonzero 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 now discussed.

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 number of 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. A second category of statistics should 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 includes those that either do not depend on significance testing or have assumptions 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 need to use weighted data is necessitated by the use of differential sampling fractions in selecting representative samples of our six groups. 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.

These weights enable users to make inferences regarding 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 if weighted data are used. 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 that 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. When considering this question, however, we should realize that there are also problems with using the weighted date. Among these are the following:

1. There may be a sizable bias as a result of nonresponse.
2. The set of communities in the regular portion of the flood program may be very different from the set of communities where the national policy would be applied.
3. Some communities or sections of communities within the flood-prone population 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
4. Earthquake insurance policyholders doing business with companies not cooperating with the study were also excluded
5. 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 that 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.

A.2

Outline of Flood Questionnaire

I. *Insurance Decision*	Questions
A. *Currently Insured*	32
1. Year Purchased	47
2. Connection with Homeowners Policy	49
3. Convenience of Purchase	50,51
4. Cost	52
5. Coverage	53,54
6. Required to Purchase	55–57
7. Likelihood to Cancel	63–65
B. *Previously Insured*	38
1. House Insured (Current or Other)	39,40
2. Cancellation of Policy	41,42
3. Year Purchased	47
4. Connection with Homeowners 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
C. *Never Insured*	
1. Tried to Buy Insurance	43,44
2. Reason for Not Purchasing	45

D. *Future Purchase Intentions*	
1. Likelihood to Buy	33,34
2. Desired Coverage	35
3. Amount Willing to Pay	36,37
4. Effect of Regret	132
5. Effect of Future Floods on Decision	133,134
6. Effect of Neighbors on Decision	135
7. Effect of Cost on Decision	185
II. *Factors Influencing Insurance Decision*	
A. *Awareness of Flood Problem*	
1. Knowledge of Neighborhood	1-5
2. Discussion with Others	7–10
3. Previous Experience with Floods	
a. Number of Experiences	66,67,97
b. Recency of Experiences	68,71,98
c. Magnitude of Damage	69,70,99
d. Most Recent Severe Flood	72–75
B. *Awareness of Flood Insurance*	
1. Role of Friends and Neighbors	169–173
2. Role of Insurance Agent	30–31
3. Attention Mechanisms	14,25–29
C. *Information on Flood Damage and Probability*	
1. Potential Damage from Minor Flood	110–116
2. Potential Damage from Severe Flood	117–123
3. Probability of Severe Flood	126–131,137
4. Processing Information on Damage/Probability of Flood	136
D. *Information on Flood Insurance*	
1. Availability	11,12,15,16
2. Cost	13,19,20
3. Coverage	17,18
4. Deductible	21
5. Expected Payment on Claims	22,46
6. Required to Buy	23,24
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1. Life Insurance	175a–179a
2. Automobile Insurance	175b–179b
3. Health Insurance	175c–179c
4. Disability Insurance	175d–179d

IV. *Characteristics of Homeowners and Property*	
A. *Relationship of Homeowner to Property*	
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2. Likelihood of Moving in Next Five Years	190–191
3. Length of Time Residing in House	193–194
4. Homeowners Insurance Data	180–184
5. Mortgage Data	198–202
6. Local Taxes	203
B. *Description of Property*	
1. Construction of Home	100,101
2. Lowest Floor in Relationship to Ground Level	102,103
3. Value of Contents on Lowest Floor	104,105
4. Number of Stories	106,107
5. Top of Roof in Relationship to Ground Level	108
6. Number of Rooms	109
7. Age	192
8. Change in Value Property Over Time	195–197
C. *Socioeconomic Data of Homeowner*	
1. Age and Family Size	C1,C4 (screening form)
2. Religion (Respondent)	206
3. Education (Respondent)	207
4. Education (Head of Household)	213
5. Occupation (Respondent)	208–211
6. Occupation (Head of Household)	214–217
7. Marital Status	212
8. Race	221
9. Annual Income	218,220
10. Annual Savings	219
V. *Characteristics of Interview*	
Use of Records	222
Cooperation	223
Other Persons Present	224
Quality of Interview	225,226
Questions Respondent Had Difficulty Answering	227
Other Comments on Interview	228

A.3

Flood Questionnaire

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: ____________

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
No	2

(RECORD NAME, PHONE NO., AND LENGTH OF RESIDENCY ON CALL REPORT FORM, AND TERMINATE) [No]

B. Is this building used <u>primarily</u> as a place of business?

(RECORD NAME, PHONE NO., AND LENGTH OF RESIDENCY ON CALL REPORT FORM, AND TERMINATE) [Yes]

Yes	1
No	2

C. Is this household's <u>usual</u> 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 <u>most</u> 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			

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 is the least serious problem for people in this neighborhood?

	Letter	
		26
a. Most Serious	____	27
b. Second Most Serious	____	28
c. Third Most Serious	____	29
d. Least Serious	____	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
(SKIP TO Q. 11)	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:

40

	Yes	No
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?

70-73

74-75

$______ AMOUNT OR ______% PERCENT

None	999797
Don't know	999898

-6-

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 02

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

9-11
12-13
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
	probably will buy it,	2
	probably will not 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

	Flood insurance not available	01
(CIRCLE	Too expensive	02
ALL	Decided didn't need	04
THAT	Deductible too high	08
APPLY)	Other (SPECIFY): ________	16

-12-

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
(ALL SKIP TO Q. 66)	Don't know	8

(ASK QQ. 47-62 ABOUT R'S CURRENT FLOOD INSURANCE, OR ABOUT R'S LAST PREVIOUS INSURANCE IF R DOES NOT CURRENTLY 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*

79-80 *34*

Card 03

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?

$_______ 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?

______ MONTH   19___ 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

$______ COST | Don't know | 9998

46-78 *Blank*

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 04*

______ 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

9-10

(IF "NONE" SKIP TO Q. 97)

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 05

(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?

$______ AMOUNT

29-33

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?

______ MONTHS OR ______ 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 06

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 07

______
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	wood frame or frame and stucco,	1
ONE	brick,	2
CODE	concrete block, or	3
ONLY)	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 34

(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 meny 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 $ (<u>total damage or $10,000</u>), 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 09

7-9

		Q. 124	Q. 125 AMOUNT	
(CIRCLE	Relatives/friends	001	$_______	10-14
	Federal government loan	002	$_______	15-19
ALL	Flood insurance	004	$_______	20-24
	Homeowner's insurance	008	$_______	25-29
	Money on hand, bank account, cash	016	$_______	30-34
THAT	Bank loan	032	$_______	35-39
	Selling stocks/bonds	064	$_______	40-44
APPLY)	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 (<u>source in Q. 124</u>)? (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

-37-

(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

34

Card 10

(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	
a. ______	______	$______	38-44
b. ______	______	$______	45-51
c. ______	______	$______	52-58
d. ______	______	$______	59-65
e. ______	______	$______	66-72

(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 *34*

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

		1st Mention in Q. 157	2nd Mention in Q. 157	3rd Mention in Q. 157
(CIRCLE ALL THAT APPLY)	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 Q. 186)	No	2
	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		$		%	64-74
2		$		%	75-78 *Blank*
3		$		%	
4		$		%	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

-55-

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

A.4
Definition of Variables in Analyzing Field Survey Data

Appendix A.4

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

Appendix A.4 *(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

Appendix A.4 *(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

Appendix A.4 *(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	<u>For Flood</u> 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 <u>For Earthquake</u> 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

Appendix A.4 *(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

A.5

Relationships Among Variables in Field Survey: Chi Squares and Tests of Significance from Two-Way Tables

Appendix A.5

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.

Second Variable	χ^2	Degrees of Freedom	Significance Level *	Trend Description (based on .05 significance level)
		Flood Survey		
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.

Second Variable	χ^2	Degrees of Freedom	Significance Level *	Trend Description (based on .05 significance level)
		Flood Survey		
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.

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.

Appendix A.5 *(Continued)*

Flood Survey

Second Variable	χ^2	Degree of Freedom	Significance Level *	Trend Description (based on .05 significance level)
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.

Appendix A.5 *(Continued)*

Second Variable	χ^2	Degrees of Freedom	Significance Level *	Trend Description (based on .05 significance level)
		Earthquake Survey		
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.

Earthquake Survey				
Second Variable	χ^2	Degrees of Freedom	Significance Level *	Trend Description (based on .05 significance level)
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.

Appendix A.5 *(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.

Appendix A.5 *(Continued)*

Second Variable	χ^2	Degrees of Freedom	Significance Level *	Trend Description (based on .05 significance level)
		Earthquake Survey		
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.

Appendix A.5 *(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.

A.6

Multivariate Analyses of Flood, Earthquake, and Combined Samples

Appendix A.6.1 Determinants of Insurance Purchase (Regression for 25% Combined 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]	.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.

Appendix A.6.2 Determinants of Insurance Purchase (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.

Appendix A.6.3 Determinants of Insurance Purchase (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.

Appendix A.6.4 Determinants of Insurance Purchase (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.

Appendix A.6.5 Determinants of Insurance Purchase (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.

Appendix A.6.6 Determinants of Insurance Purchase (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]	- .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.

Appendix A.6.7 Determinants of Insurance Purchase (Regression for 25% 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]	- .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.

Appendix A.6.8 Determinants of Insurance Purchase (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.

Appendix A.6.9 Determinants of Insurance Purchase (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.

Appendix A.6.10 Determinants of Insurance Purchase (Regression for 75% Flood 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]	.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.

Appendix A.6.11 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.

Appendix A.6.12 Balanced Repeated Replication Using Ordinary Least Squares for 75% Earthquake Sample

Variable Name	Unweighted Data					Weighted Data	
	(1) Coefficient	(2) Standard Error	(3) T-ratio	(4) Design Effect	(5) Corrected T-ratio	(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.

Appendix A.6.13 Validation of Insurance Purchase Model for 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

A.7

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