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Effects of the Accident at Three Mile Island on Residential Property Values and Sales

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ABSTRACT

This study examined the effects of the accident at Three Mile Island on residential property values and number of sales within a 25-mile radius of the plant. Regression analyses, using data on 583 actual market sales of single family homes from 1977 through 1979, examined the effects before and after the accident on the basis of distance and direction from the plant and on three different property value classes. All valid single family property sales between 1975 and 1979 within the 25-mile area were examined in a time series analysis. Interviews were conducted with realtors, financial institution officials and building contractors in the area.

The accident had no measurable effects, positive or negative, on the value of single family residential properties within a 25-mile radius of the plant, or in any direction from the plant, or on low, medium, or high value properties. The plant had no measurable effects on residential property values for the 2 years prior to the accident. Immediately following the accident there was a sharp decline in the number of residential sales within 10 miles of the plant, but the real estate market returned to near normal conditions within 4-8 weeks. The interviews basically confirmed the above findings.

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PREFACE

The authors wish to acknowledge the assistance provided by tax assessors and other county officials who cooperated with us in providing much of the data. Special thanks are due to personnel of the State Tax Equalization Board. We also wish to thank the many realtors, bank and savings and loan officials, and contractors who so willingly answered our questions.

Within the Institute for Research on Land and Water Resources, Dan Huegel was of great assistance in collecting and processing the data. Robert Brewer and Chris Forney also provided valuable assistance in much of the data processing and coding. Esther Jordan skillfully handled all the typing chores.

Finally, we wish to acknowledge and thank the Nuclear Regulatory Commission, and in particular Clark Prichard and Michael Kaltman, for supporting this study and for providing background information on the study site and the accident of March 27, 1979. Views expressed and the conclusions reached are those of the authors and not necessarily those of the sponsor, the U.S. Government, The Pennsylvania State University, or of any of the above named individuals.

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EFFECTS OF THE ACCIDENT AT THREE MILE ISLAND ON RESIDENTIAL PROPERTY VALUES AND SALES

I. INTRODUCTION

1.1 Purpose and Relevancy of the Study

The March 28, 1979, accident at the Three Mile Island (TMI) nuclear power plant near Harrisburg, Pennsylvania, has generated much concern over the health, safety, and welfare of citizens living in the area. Several studies have already been made which examine some of these effects.[1/] One effect that is often mentioned is a decrease in real property values in the vicinity of the plant. The authors are aware of one class action suit that has been filed in the courts addressing the recovery of damages because of reduced residential property values following the accident.

None of the studies cited above that have examined the issue of real property damages have uncovered evidence that the accident did have a strong adverse effect on property values, or that there has been panic selling on the market by people anxious to move away from the area. However, none of the market value studies were conducted in comprehensive and exhaustive manner based on rigorous scientific methodology.

The purpose of this study is to correct this shortcoming by examining in depth, using large sampling numbers, control areas, and acceptable research procedures, the likely effects, if any, of the accident on residential property values by distance and direction from the plant during the remainder of 1979.

Residents in the vicinity of the plant, after experiencing the uncertainty and trauma that existed for a time after the severity of the accident became publicly known, understandably may question why newcomers to the area would want to purchase a house and live near the plant. Thus their beliefs that there were adverse effects on the real estate market; that they would be unable to sell their property for the value they could have received had there been no accident. Such feelings have been mentioned as not uncommon in some of the telephone interviews reported in the studies cited above. To state this condition in more precise economic terms, if the demand for housing decreases, resulting in a leftward shift of the demand curve, while at the same time the supply of housing offered on the market remains constant or possibly increases, resulting in a rightward shift of the supply curve, then, ceteris paribus, the price of housing must drop.

However, ceteris paribus conditions do not hold in the real world. There are many variables or factors operating simultaneously in the

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1/ See, for example, Flynn, Flynn and Chalmers, President's Commission on the Accident at Three Mile Island, Governor's Office of Policy and Planning, and Shearer. This list is not exhaustive.

market that affect housing prices, and all of these must be taken into account when trying to determine the effect of one variable, such as the TMI accident, on price. Unfortunately, in the months that followed the accident, two interrelated conditions occurred that had strong influences on the real estate market: a rapid and phenomenal rise in interest rates and a severe shortage of mortgage funds. Inflation was a continuing problem over this time. These influences, which choked off housing demand, were felt nationwide, although regionally the severity of the effects varied.

To arrive at an answer to what effects the TMI accident had on residential property values, one must compare conditions in the actual real estate market in the vicinity of TMI over the 9 months following the accident to what the conditions likely would have been in the absence of the accident. This suggests (1) that if time series data are used, a carefully selected control area or areas are necessary; and (2) if cross sectional data are used, all important variables affecting housing prices must be included along with a control area or areas. This study incorporates both procedures.

1.2 Objectives of the Study

The primary objective of this study is to determine if the accident on March 27, 1979, at the Three Mile Island nuclear power plant near Harrisburg, Pennsylvania, had any effect on the value of single family residential properties. In addition, we sought more specific information to determine if there might have been property value effects related to distance and direction from the plant, as well as to different value classes of residential property. Three main approaches were used: (1) statistical analysis of cross sectional data on actual property sales; (2) analysis of time series data on number of sales and mean sales values; and (3) personal interviews with individuals in the Harrisburg area who, because of the nature of their work, would be familiar with the local real estate and housing market. The results of this study are reported as separate tasks.

Tasks A through C used multiple regression analysis of cross sectional data on actual single family property sales. A sampling of property sales from 1975 to 1978 within 25 miles of TMI and in a control area formed the data base for Tasks A and B. The purpose of Task A was to see if the plant might have had any adverse effects on property values before the accident, in which case such effects would have to be accounted for in the determination of the net effects after the accident. Task B analyzed the property sales data for post-accident effects with specific attention directed toward determining the presence of effects in terms of both distance and direction from the plant and on three property value classes. All single family property sales formed the data base for Task C, which developed a predictive regression model to compare before and after sales values. This approach was useful in determining possible effects in the restrictive geographical cells defining simultaneously distance and direction from TMI.

Time series analyses of yearly, quarterly, and monthly means and numbers of sales for single family properties from 1975 through 1979 for the TMI area and two control areas were done in Tasks D and E. Mean sales prices and number of sales, based on historical trends, were predicted for distance zones around TMI after the accident and then statistically compared to the actual values and numbers. Value class effects were also examined. We had originally intended to ascertain if there were any possible effects on sales values and number of sales of undeveloped land and lots. However, data from the State Tax Equalization Board (STEB) made no distinction between improved and unimproved lots, or provided any information on lot size. Because of these data shortcomings we were unable to complete this analysis.

Further insights into the possible effects of the accident on the real estate market from the observations and experiences of persons knowledgeable about the market was the purpose of Task F. Personal interviews were conducted with realtors, appraisers, officials of mortgage lending institutions, and general contractors. The final section of this report summarizes the research results and findings and presents the conclusions.

1.3 Literature Cited:

Flynn, C. B. Three Mile Island Telephone Survey: Preliminary Report on Procedures and Findings. NUREG/CR-1093. Mountain West Research, Inc., Tempe, AZ, 1979.

_____ and J. A. Chalmers. The Social and Economic Effects of the Accident at Three Mile Island. NUREG/CR-1215. Mountain West Research, Inc. with Social Impact Research, Inc., Tempe, AZ, 1980.

Governor's Office of Policy and Planning. Three Mile Island Socio-Economic Impact Study. Commonwealth of Pennsylvania, Harrisburg, PA, 1979.

President's Commission on the Accident at Three Mile Island. The Accident at Three Mile Island. Washington, D. C., 1979.

Shearer, D. P. Three Mile Island Nuclear Accident Community Impact Study on Real Estate. Greater Harrisburg Board of Realtors, Harrisburg, PA, 1980.

II. TASK A

2.1 Introduction

The area within a 25-mile radius of the TMI plant was arbitrarily delineated as the study area. It was felt that any possible effects of the accident on property values would be apparent here, with the severity of the effects decreasing with increasing distance from the plant. In order to determine what the net effects from the accident might have been during the remainder of 1979, it was necessary to first ascertain if the presence of the plant might have had any adverse or beneficial effects on single family residential property values before the accident. If any such effects existed, these would have to be taken into account to accurately determine the net effects from the accident.

A study completed shortly before the accident found no evidence that nuclear power plants exerted any adverse influence on residential property values.[1/] This study examined 4 plants in the Northeastern United States, but the results are not necessarily applicable to TMI. The purpose of this task, in a very real sense, is to replicate this earlier study for the TMI plant. Multiple regression analysis using data on single family homes that sold in 1977, 1978, and the first quarter of 1979 was the approach used.

2.2 The Basic Model

A hedonic pricing approach to housing forms the conceptual framework for this analysis. Specifically, the various attributes or characteristics of a house serve as surrogates for the flow of services provided by that house (and its location) when attempts are made to relate housing price to service flows. This follows from the belief that people, in choosing their homes and residential location, reveal their preferences by their willingness to pay for certain housing and locational characteristics. If people value quiet, nearness to employment, or relief from a potential hazard, the real estate market should reveal these preferences.

An economic relationship must therefore exist between market price and the quality and quantity of housing service that any given dwelling provides the occupant. Location is one attribute that can provide a number of such services: nearness (accessibility) to employment, schools, and shopping, as well as distance or remoteness from undesirable environmental variables such as noise, congestion, odors, or perceived hazards from a nuclear power plant. This relationship implies that for consumer equilibrium in the housing market, price differential must arise among various locations which compensate consumers for the differences in housing services associated with specific locations. Otherwise, consumers would not remain at particular locations and locational choice

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1/ See Gamble, et al.

for new entrants would be restricted. Because of mobility and the ability to buy and sell in the housing market, consumer equilibrium requires that for identical housing in all respects at two different locations, except that location 1 is near a nuclear plant and location 2 is well removed, the price of housing at location 1 must be less than that at location 2 by an amount which will just compensate buyers for the additional hazards they perceive at location 1. Otherwise, the consumer would be better off at location 2. We feel that in the TMI study area there are little or no constraints in mobility and that there has been sufficient time following the accident for consumers of housing to make their preferences felt in the market, as evidenced by the number of sales.

Accepting the rationale above, the relationships between housing prices and housing services and characteristics can be expressed mathematically:

$$(1) \quad V_i = b_0 + b_1 X_{1i} + b_2 X_{2i} + \ldots b_n X_{ni} + u_i =, \ldots, N$$

where V is the selling price of the i th house in dollars; $X_1, \ldots, X_n$ are the variable amounts of the housing characteristics, including distance from the nuclear plant; $b_1, \ldots b_n$ are the implicit prices to be estimated; b_0 is a constant term; and u is a stochastic error term reflecting possible omitted variables and measurement errors.

In order to show the effect, if any, that proximity to TMI or the March accident had on the value of housing it is important to include in the analysis as many variables as possible among those that a priori are known to explain variations in housing prices. Potentially, a large number of variables contribute to housing price differences within a given area. These variables may be logically grouped into several broad classes:

1. House characteristics - the number of square feet of living space by floors, the number of bathrooms, the presence of a finished basement, the type and quality of construction, existence of central air conditioning, materials used in construction, the size of the garage, etc.

2. Lot characteristics - the size and dimension of the lot, the presence of large trees, the landscaping, the view from the lot, the topography or slope, etc.

3. Accessibility characteristics - distance of the lot to the nearest schools, shopping centers, limited access highway, employment centers, recreational facilities, etc.

4. Locational characteristics - characters of the neighborhood, land use mix, waterfront location, distance from nuclear plant, etc.

5. Public sector characteristics - availability of water, gas, sewer; the type of road the lot fronts upon; the real property tax rate; the existence and kind of land use controls, etc.

6. Transaction characteristics - such factors as month of sale, mortgage terms, etc.

Originally, about 75 variables were identified before the data were collected as likely to influence housing prices. Trial regressions were run, and from these,38 variables proved significant in explaining housing price variations in the TMI and control areas. A description of these significant variables, together with their data source, means, and ranges are given in Appendix A. For a more complete discussion of the regression methodology used in this and the next task, the reader should refer to the earlier study by Gamble et al. If the reader wishes more information on the development of the theory underlying property values, he should refer to Rosen and the work by Freeman. The conceptual economic framework and the development of the basic theoretical model of housing markets is well described by Nelson.

2.3 Selection of Control Area

The high interest rates and shortage of mortgage funds throughout 1979 had the effect of choking off the demand for housing. Unfortunately these effects coincided with the TMI accident, and it is imperative that these market effects and the accident effects, if any, be accounted for. The market effects were felt throughout Pennsylvania as well as the Harrisburg area. Therefore, selecting a control area and using it as a basis for comparing housing prices over time should identify the market effects from high interest rates and mortgage money availability.

The choice of a control area is very important. It should duplicate, in as many respects as possible except for the presence of a nuclear power plant, the TMI study area, so as to minimize the influence of different variables on the housing market. No two areas are exactly alike, of course, so the approach is to select an area in which the descriptors are as nearly alike as possible.

It was felt that the control area or areas should be in Central or Southeastern Pennsylvania, so as to hold constant any influences state government policies (such as taxes) might have, as well as climate and topography. Also, the growth characteristics in Northern and Western Pennsylvania are different from those in the Southeast, and this could be important in terms of the real estate market. One of the most important stipulations was that a control area had to be more than 25 miles from the nearest nuclear power plant, and the more distant the better.

The TMI study area (within 25 miles of the plant) is quite diverse. The City of Harrisburg, the state Capital, is almost 10 miles north of TMI, and reflects the characteristics of many of the older cities in Northeastern United States. Growth over the past several decades has concentrated in the surrounding rural areas, particularly across the Susquehanna River to the west and eastward into Lebanon County. Bordering the Susquehanna River between Harrisburg and the TMI plant are three old urban concentrations, Steelton, Highspire, and Middletown,

that have relied mainly on heavy manufacturing for many years. Lower value older housing as compared to the greater Harrisburg area has characterized this area. However, in the rural areas to the south and west to TMI, particularly in Lancaster, York, and Cumberland Counties there has been considerable new housing development, some of quite high value. Because of the above diversities and the very dominant influence it was felt that Harrisburg would exert, the selection of a control area was made on a comparison of data and characteristics based on the area within 10 miles of the TMI plant.

Six areas were tentatively identified as possible control areas. One of these, Northern Berks County, was eliminated because of its remoteness from any large city and concern over the availability of a good assessment data in the county. Data on population in 1960, 1970, and 1977; population density in 1970; and 1975 per capita income were obtained from the U.S. census and U.S. Department of Treasury general revenue sharing element listings for entitlement period 11. These data for the remaining five areas identified as possible control areas and the 0-10 mile TMI area are shown in Table 2.1. Data on individual municipalities within each area were summed to obtain area totals.

The Southern Lycoming County area, exclusive of the City of Williamsport (which declined in population between 1970 and 1977), was selected as the control area. The growth rates in Lehigh-Northampton and the Bucks County area were felt to be too high. Moreover, population density and per capita income were too low and high, respectively, in the central-northern Bucks area and population density too high in the southern Bucks area. Population growth rate, density, and per capita income were too low in the Lewisburg-Sunbury area which might have meant a lethargic real estate market.

The Williamsport area has other advantages as a control area, despite its growth rate, density, and per capita income being somewhat lower than the study area. It is in central Pennsylvania. The mix of land uses is very similar to the TMI area: new housing developments scattered throughout a rural area dominated by agriculture, but intersperesd with small growing communities. Moreover, the area abuts the Susquehanna River, thus holding constant whatever influence this major feature might exert on the real estate market, possibly from the standpoint of potential flood hazards. Lycoming County over the past few years has developed a high quality system of property tax assessment records.

Because of some property sales data problems in the State Tax Equalization Board (STEB) records for Lycoming County discovered later, Lehigh County was also used as an alternate control area for part of the time series analysis of sales means reported in Task D.

2.4 Data Collection

All real property transactions in Pennsylvania are reported periodically from each county to the State Tax Equalization Board (STEB) in Harrisburg. Since these are reported by use class, such as single family residential,

Table 2.1 Data for selection of control areas.

Area	Population			Population Growth '60-'77	Population Density 1970	Per Capita income 1975
	1960	1970	1977	%	per mile^2	$
TMI 0-10 miles	120,818	130,937	146,226	21.0	430	4,977
Portions of Lehigh, Northampton Counties	80,067	101,452	113,676	42.0	467	5,106
Portions of Southern Bucks County	208,140	267,667	293,983	41.2	1728	5,188
Portion of Central-Northern Bucks County	23,004	29,356	35,932	56.2	146	6,008
Lewisburg-Sunbury area	63,619	68,746	71,935	13.1	215	3,843
Southern Lycoming County less Williamsport City	44,651	50,232	52,230	17.0	243	4,442

commercial, etc. a ready source of information was available. Besides the sale price being listed, information is also available which enables one to trace the property to the tax assessor's file in the respective court houses. From these records information is available on many structural characteristics of the house such as number of floors, bathrooms, bedrooms; square feet; exterior wall material; as well as some information on the lot. The location of the house is accurately given on a tax map.

The STEB data were the prime source of property sales information in this study, and were used for Tasks A-E, inclusive. In Task A, all valid sales (STEB screens the data and eliminates invalid sales) in 1977, 1978, and for the first 3 months of 1979 for the area within about 3 miles of TMI were used. In the area from 3-5 miles from the plant a random sample representing about 20 percent of all valid sales was selected and for the area beyond 5 miles (out to 25 miles) a sampling rate of about 1 percent was used. In the Lycoming Control area a sampling rate of 5 percent was used.

Properties were selected from the STEB sales data using a computer random number generator program. The sampling for both Tasks A and B was done simultaneously, the date the sale was recorded determining its use in Task A or B. In Task A, 505 sales comprised the final data base. Following the accident, 191 sales were used, increasing the data base in Task B to 695 sales. Of these, 112 were in the control area. See Table 2.2 for a tabulation of number of sales by time period and location.

Once a sale was selected from the STEB files, the property record card was located in the appropriate court house Tax Assessor's Office and the details on the structure and lot recorded. Its location on the tax map was pinpointed, and then an on-site inspection of the property was made, at which time many other descriptors were recorded, such as kind of neighborhood and street, presence of trees, condition of the house, and so forth. Owners were not contacted nor were the premises entered. Some properties that had been selected were eliminated at this point for several reasons: incorrect descriptive data at the time of sale, a sale that should have been previously invalidated because the price obviously did not reflect actual market value (other unknown conditions must have been a consideration in the price), and so forth.

The location of all sale properties selected for inclusion in the study, as noted on the tax maps, made it possible to approximate the locations on large scale highway and or topographic maps. From these it was possible to ascertain the accessibility characteristics of the property in terms of miles to large employer, limited access highway, TMI and the like.

Actual sales based on recorded data were the dependent variable in the regression analysis. Sales were recorded by months, and the actual values were corrected for inflation (converted to real values) by a

Table 2.2. Number of valid sales (dependent variable) used in regression analyses.

Area	Time Period	No. of Sales by Group
Control	Before	65
Control	After	47
Control	Total	112
0-5	Before	202
0-5	After	70
0-5	Total	272
6-25	Before	238
6-25	After	73
6-25	Total	311
0-25	Before	440
0-25	After	143
0-25	Total	583
Before	Total	505
After	Total	190
All	Total	695

deflation factor of .7 percent per month.[2/] After all the data were verified for accuracy, they were coded and stored in computer files for the subsequent regression analyses.

[2/] This deflation factor was derived by trial regressions where the month of sale as an independent variable was "forced in" and runs made until it was no longer significant.

2.5 Functional Forms of the Model

Several functional forms of the multiple regression model, equation (1), can be used to explain variation in the selling price of residential housing. In this study both the linear and log-log forms were used, the former being used the most. The functional forms are expressed as follows:

$$(2)\quad V_i = b_o + \sum_{j=1}^{n} b_m X_{ij} + \mu \qquad \text{(Linear)}$$

$$(3)\quad \ln V_i = \ln b_o + \sum_{j=1}^{n} b_j \ln X_{ij} + \mu \qquad \text{(Log-Log)}$$

where V_i = the deflated selling price of the i^{th} residential property,

b_o = constant term,

X_{ij} = independent variables from 1 to n associated with i^{th} property, th

μ = an error term, assumed to be randomly distributed, reflecting all other unexplained variations.

In the linear multiple regression model the regression coefficient (b_j) represents the marginal effect that the j^{th} variable has on selling price. When the variables are not independent, an inter-relationship (multicolinearity) exists between 2 or more independent variables and the interpretation of the meaning of the coefficients becomes more difficult.

The linear model anticipates that all the functions within the model are linear, whereas the log-log model anticipates a curvilinear relationship. Consequently, there is more flexibility in the log-log form in that the coefficients represent rates and not fixed amounts associated with unit changes in each variable. However, certain difficulties arise in interpretation of the log-log coefficients in that the regression curve is through the geometric mean of each variable rather than the arithmetic mean, the latter being the case of the linear form of the model. Therefore, a certain bias arises in the log-log forms.

The functional forms of the models are quite rigid and the direction of change associated with each variable is fixed within the range of the functions. Some of the residential property characteristics (independent variables) fit better into logarithmic forms than into linear forms, and with some the converse is true. Thus neither form of the model can be expected to explain perfectly all of the variation in residential property prices.

2.6 Statistical Package

The California Board of Equalization stepwise multiple linear regression package was used for an initial screening of the variables.[3/] This performs a stepwise regression on a large number of independent variables, some of which may be significant and others may not. From the original list of about 75 independent variables, this procedure identified 38 that were significant in explaining variations in housing prices. These variables were then used in the SAS (Statistical Analysis System) regression package (GLM) for the majority of the runs.

2.7 Regression Results

Our first interest was to determine if there was any significant difference between the control area in Lycoming County and the TMI study area based on a regression analysis. Three time periods were examined: 1) before the accident (1977, 1978, and the first 3 months of 1979); 2) after the accident (the last 9 months of 1979; and 3) the entire time period (1977-1979). The area close to the TMI plant (0-5 miles) was examined first, and the broader study area (10-25 miles) was examined separately. Three binary (dummy) variables were important in these analyses: variable 78, Lycoming (the control area); variable 79, after nuclear accident; and variable 80, close to TMI (0-5 miles). Variables 79 and 80 were interacted as variable 81, (after nuclear accident) X (close to TMI). The regression results comparing the control area and the 0-5 miles area around the plant are shown in Table 2.3. The dependent variable in all of the equations is the real selling price of houses. Runs 1 and 2 include house sales before the accident; runs 3 and 4 include only post accident sales; runs 5 and 6 cover the full time period of the study, with run 5 showing the linear form and run 6 the log-log form of the model.

All the equations are significant and explain a little more than 80 percent of the variation in selling prices among the homes in the two areas. The coefficients appear reasonable in magnitude (for example, in run 5 a fireplace is worth about $3,463 and an attached garage is worth considerably more than a detached garage), and the signs of the coefficients all were in the predicted direction.[4/]

Runs 1 and 2, using pre-accident data, indicate that there was a significant difference between the Lycoming control area and the 0-5 mile zone around TMI, as shown by the two dummy variables 78 and 80, respectively. Single family homes close to TMI sold for about $1,860 less on the average

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[3/] For a more detailed discussion of the use of this statistical package see California State Board of Equalization and also Gamble et al.

[4/] Variable 50, "built on slab," was positive which may seem contrary to that expected. Particularly in the 0-5 TMI area there is a considerable number of lower valued older homes that have only a foundation but no improved basement; thus a newer home on a slab is more desirable.

Table 2.3 Regression results comparing control area to 0-5 mile area around TMI.

	Regression Coefficients (t values)					
	Before Accident		After Accident		Before and After Accident	
Variables	1	2	3	4	5(linear)	6(log-log)
Constant	13,423	15,129	33,025	33,300	19,421	3,8421
5 Built after '68	2,892 (2.88)	2,890 (2.89)	4,020** (2.07)	4,020** (2.07)	3,268 (3.71)	0.0504 (3.26)
7 Lot frontage					31.1** (2.53)	.1060** (2.32)
9 Lot on paved road	5,399 (3.13)	5,487 (3.19)	5.907** (2.08)	5,907** (2.08)	5,555 (3.98)	0.0752 (3.14)
12 House grade - poor	-6,016 (-4.49)	-6,107 (-4.55)	-5,843** (-2.41)	-5,843** (-2.41)	-6,562 (-5.71)	-0.2095 (-10.42)
14 House grade - good	9,641 (4.84)	9,595 (4.83)			8,836 (4.99)	0.0729** (2.38)
25 Flood Plain			-7,979** (2.30)	-7,979** (2.30)		-0.0511* (-1.95)
29 House cond. - poor	-4,901 (-4.22)	-4,859 (-4.20)	-4,555** (-2.52)	-4,555** (-2.52)	-5,181 (-5.38)	-0.1319 (-7.86)
37 Distance to big employer	-447 (-3.34)	-440 (-3.30)	-669 (-3.94)	-669 (-3.94)	-492 (-4.85)	-0.1231 (-3.46)
46 No. bathrooms	2,962 (4.23)	2,980 (4.27)	5,033 (3.65)	5,033 (3.65)	3,092 (5.11)	0.3324 (5.62)
47 Area 1st floor - ft^2	8.09 (5.33)	7.98 (5.26)	6.99** (2.60)	6.99** (2.60)	7.56 (5.80)	0.2321 (5.06)
49 Area finished basement - ft^2	9.58 (4.50)	9.54 (4.49)			7.96 (4.40)	
50 House on slab	2,918** (2.37)	2,933** (2.39)				
51 Full basement floor finished	2,680 (2.80)	2,699 (2.82)			2,606 (3.34)	
53 Garage - attached	2,757 (3.72)	2,771 (3.75)	4,506 (3.25)	4,506 (3.25)	3,273 (5.13)	0.1284 (2.95)
54 Garage - detached			3,249 (2.85)	3,249 (2.85)	1,194** (2.19)	0.0874** (2.26)
55 Fireplace	3,327 (3.71)	3,324 (3.72)	2,939* (1.82)	2,939* (1.82)	3,463 (4.66)	0.0353 (2.68)
58 Modern kitchen	4,181 (4.25)	4,167 (4.25)			2,625 (3.26)	0.0591 (4.26)
63 Tax rate	-332* (-1.84)	-325* (-1.81)	-992 (-3.98)	-992 (-3.98)	-471 (-3.37)	-0.3546 (-3.45)
77 Garage - internal			4,555 (2.65)	4,555 (2.65)	2,205** (2.55)	
78 Lycoming - Control area	1,592* (1.77)		276† (0.20)			
79 After accident					-368† -0.33)	-0.0049† (-0.25)
80 0-5 miles TMI		-1,861** (2.07)		-276†	-1,804** (-2.03)	-0.0269* (-1.67)
81 After accident x 0-5 miles					1,177† (0.86)	0.0138† (0.58)
R^2	.818	.819	.816	.816	.801	.808
F	45.26	45.52	16.97	16.97	55.10	57.67
Standard Deviation	5,511	5,498	5,649	5,694	5,608	0.0976
Residual degreees freedom	242					

† Not significant.
* Significant at the 5-10 percent level of significance.
** Significant at the 1-5 percent level of significance.
All other variables are significant at the 1 percent or better level of significance.

over the 27 months preceding the accident. Over the 9-month period following the accident, neither of the two areas showed significant differences in explaining variations in the selling prices of houses (runs 3 and 4). Over the full time period the price of housing was significantly lower in the linear form of the model (run 5) for the 0-5 mile zone, but in the log-log form this difference was less significant.

The important question is: What accounts for the lower sales prices of houses in the 0-5 mile zone around TMI as compared to the control area? Could this possibly be due to the presence of the plant itself, the answer to which is the purpose of this task?

We feel the existence of TMI is not the cause of lower property values in the 0-5 mile zone. Our reasons are twofold. First, the independent variables in a regression equation do not necessary explain cause and effect relationships even when they are significant. All we can say is that housing values are lower in the 0-5 mile zone. (We can just as readily say that they are lower in the Middletown-Goldsboro-Royalton area). Housing in this area traditionally has been of lower value, because of its age and poorer maintenance, than housing in the greater Harrisburg area. We suspect the lower quality housing in general in this area predates by many years the existence of TMI.

Our second reason is more powerful. Looking at equations 2 and 4, we see that the binary variable 80, 0-5 miles TMI, was significant before but not after the accident. If the proximity of TMI explained lower housing values within 5 miles of the plant before the accident,[5/] then after the accident one would surely expect variable 80 to have even stronger significance and/or a higher coefficient value. But the opposite occurs; the variable was not significant in the "after" equation (number 4). Therefore, reasons other than proximity of the plant must explain the lower housing values before the accident.

Equation 6 has exactly the same data base as equation 5 but uses the log-log functional form of the regression rather than the linear form. This was done to see if the log-log form "fits" the data better; if so, it would explain more of the variation in selling price and provide somewhat more robust answers to the questions with which we are concerned.

The R^2 of .808 for the log-log form of the model is only a slight improvement over the R^2 of .801 for the linear form. Although a few of the independent variables are not significant in both equations, the ones that do appear in both generally have about the same relative magnitude. The results of the two functional forms are so similar that there does not appear to be any particular advantage in using one over the other. In subsequent regression analyses we continue to check the log-log against the linear form.

[5/] The plant became operational in September, 1974.

Our conclusions insofar as this part of Task A is concerned is that before the accident there is a difference in housing values between the Lycoming control area and the 0-5 mile zone around TMI; that the lower values in the 0-5 mile zone are due to long term economic development trends characteristic of the area rather than due to the presence of the TMI plant.[6/]

Let us now turn to a comparison of Lycoming control area to the broader Harrisburg Market area, the 10-25 mile zone around TMI. This step, although reported here, was actually done in the latter stages of the study to support the work in Task D, where it was felt the 10-25 mile zone might be an ideal control area for predicting sales means by quarters and months for the 0-5 and 5-10 mile zones (the impact zones) around the plant.

Table 2.4 shows the regression results. As before, the independent variable is the real selling price of houses. The data set includes 36 months before and after the accident in the Lycoming control area and the 10-25 mile zone around the plant. Variable 78, Lycoming Control area, is entered as a binary (dummy) variable, as is also variable 79 (after accident). Variable 87 (Lycoming Control) x (after accident) is entered as an interaction variable.[7/] All the coefficients have the expected signs and their magnitudes appear reasonable. The equation explains 77 percent of the variation in housing prices. Variable 24, "two-family house," refers to a house in which are rooms for a second family, or to duplexes which sell as a single unit. Variable 78, the Lycoming Control area, when entered as a dummy variable was not significant at the 10 percent level, although it was close.[8/] Likewise variable 79, the time period after the accident, was not significant. When these two variables were interacted there was still no significance. We conclude from the regression results in Table 2.4 that housing prices in the Lycoming Control area do not differ significantly from those in the 10-25 mile zone around TMI, either before or after the accident. These findings lend support to the use of the Lycoming area as a control area in this study.[9/]

[6/] Variables 79 and 81, the coefficients of which are shown in equations 5 and 6, will be discussed in detail in Task B.

[7/] For an excellent discussion of the use and interpretation of interacting two or more variables, see the text by McClave and Benson.

[8/] A t value of 1.64 would be needed for significance at the 10 percent level of significance.

[9/] Some researchers have queationed the combining of two or more distinct housing market areas into a common data set to analyze hedonic price relationships. A recent study by Butler states that "the hedonic relationships of different metropolitan areas are considerably more alike than has generally been thought" (pp. 451).

Table 2.4 Regression results comparing control area to 10-25 mile area arount TMI, linear form of data before and after accident.

	Variable	Regression Coefficient (t values)		Variable	Regression Coefficient (t values)
	Constant	11,813			
1	House built before 1915	-7,968 (-4.48)	47	Area 1st floor ft^2	11.79 (5.51)
2	House built 1915-1933	-5,099 (-3.09)	48	Area 2nd floor ft^2	4.84** (1.98)
3	House built 1934-1946	-6,421 (-3.02)	50	Built on slab	-1,871† (-1.33)
7	Lot frontage	21.00† (1.04)	53	Garage-attached	3,154 (3.82)
10	Low traffic volume road	-1,460† (-1.42)	54	Garage-detached	895† (1.14)
12	House grade - poor	-9,513 (-5.04)	55	Fireplace	3,314 (3.13)
13	Public sewer	1,706† (1.34)	57	Central air conditioning	5,867 (2.91)
14	House grade - good	8,971 (4.08)	58	Modern kitchen	2,638 (2.75)
24	Two-family house	5,260* (1.73)	63	Tax rate	-240 (-3.56)
25	Flood Plain	-6,999** (-2.30)	65	No. bedrooms	1,012† (1.43)
30	House condition - good	3,232** (2.20)	66	Area lot ft^2	0.065† (1.17)
37	Distance big employer	-201 (-2.66)	77	Garage-internal	3,406 (3.18)
45	Number floors	2,816† (1.40)	78	Lycoming-control area	-1,649† (1.26)
46	Number bathrooms	2,693 (2.87)	79	After accident	-374† (-0.32)
			87	(Lycoming) (after accident)	492† (0.25)

R^2
F
Standard Deviation.
Residual degrees freedom.

† not significant.
* Significant at the 5-10 percent level of significance.
** Significant at the 1-5 percent level of signficance.
all other variables are significant at the 1 percent or better level of significance.

2.8 TMI Effects Before Accident

We now turn our attention to the main purpose of Task A, that of determining if the presence of the plant had any positive or negative effects on the value of single family residential property in its vicinity. Our data set includes 440 valid single family residential property sales in the 0-25 mile zone around the plant over the 27 months preceding the accident. Two regressions were performed on the data. In the first one, variable 31 "distance to TMI" was allowed to remain in the stepwise regression equation. In the second regression equation, variable 80, "close to TMI" (0-5 miles) was entered as a binary variable. The results of the regression equations are shown in Table 2.5.

The variables in all three equations show the expected signs and the magnitudes of the coefficients appear reasonable. Between 76 and 78 percent of the variation in selling prices is accounted for by the independent variables. The degree of consistency of significance of the variables between the three equations is reasonable. The log-log equation (#3) appears to account for variation in prices somewhat better than the linear equations, but the greater difficulty in interpreting the coefficients more than counter balances this slight advantage.

Although neither of the constants in the two linear equations are significant, a troublesome point occurs with the constant in equation 1, which is a negative $435, as compared to a positive $2,140 constant for equation 2. Since the magnitudes of the coefficients in equation 1 match closely with the corresponding coefficients in equation 2, except for the last variable in each, one must therefore look to these last two for an explanation. These last variables are "distance to TMI" for equation 1 and "close to TMI" for equation 2. The signs of both are what one should expect. The coefficient for "distance to TMI" is $163, which means that property values are expected to increase by that amount for each mile the property is located from the plant. The distance zone for the "close to TMI" variable is 0-5 miles. Multiplying, $163 x 5 = $815, and adding to this the constant (-435) yields $380. Adding the coefficient for "close to TMI" in equation 2 (-1732) to the constant (2140) yields $408, a value quite close to the $380 for equation 1. We performed this exercise to point out that not much meaning should be placed on the sign or value of the constant term.

2.9 Conclusions

Before the accident, did the presence of TMI have an adverse effect on nearby residential property values? The high significiance of the "distance to TMI" variable in equation 1 would indicate that it might have. Substituting the "close to TMI" variable for the "distance" variable, as was done in equation 2, yields a coefficient that is significant at only the 5-10 percent level of significance. The log-log form of equations 1 and 2 yield (a) a "distance to TMI" coefficient significant at the 5 percent level, which is not shown in Table 2.5 and (b) a "close to TMI" coefficient which is not significant at the

Table 2.5 Regression results for TMI study area (0-25 miles) before the accident.

Variable	Regression Coefficient (t values) 1 (linear)	2 (linear)	3 (log-log)	Variable	Regression Coefficient (t values) 1 (linear)	2 (linear)	3 (log-log)
Constant	-435	2140. †	3.1996				
1 House built before 1915	-6,135 (-4.43)	-5,900 (-4.20)	-0.0730 (-3.51)	45 Number floors	4,169** (2.31)	4,125** (2.27)	0.0154† (0.39)
2 House built 1915-1933	-4,603 (-3.36)	-4,482 (-3.25)	-0.0475** (-2.33)	46 Number bathrooms	2,330 (3.00)	2,294 (2.93)	0.2028 (3.11)
3 House built 1934-1946	-3.426* (-1.86)	-3,055* (-1.65)	-0.0681** (-2.50)	47 Area 1st floor - ft^2	11.26 (5.92)	11.35 (5.93)	0.3202 (5.78)
5 House built after 1968	2,564** (2.14)	2,633** (2.19)	0.0264† (1.48)	48 Area 2nd floor - ft^2	0.512† (0.24)	0.635† (0.30)	0.0156† (1.12)
7 Log frontage	48.54 (5.78)	46.63 (5.53)	0.1579 (5.66)	53 Garage-attached	2,298 (3.20)	2,302 (3.19)	0.028* (1.71)
9 Road-paved	3,470† (1.55)	3,354† (1.49)	0.0579* (1.75)	55 Fireplace	3,571 (3.87)	3,559 (3.81)	0.0318** (2.30)
12 House grade-poor	-6,833 (-3.60)	-6,896 (-3.61)	-0.2264 (-8.04)	57 Central Air Cond.	5,684 (3.02)	5,956 (3.16)	0.0430† (1.56)
13 Public sewer	3,493 (3.42)	3,513 (3.31)	0.0484 (3.12)	58 Modern Kitchen	2,739 (2.69)	2,471** (2.43)	0.0517 (3.47)
14 House grade-good	9,380 (4.19)	9,230 (4.10)	0.0594* (1.81)	63 Tax rate	-168 (-2.83)	-165 (-2.71)	-0.1556 (-2.69)
16 Airport noise	-2,571* (-1.80)	-2,653* (-179)	-0.0372* (-1.70)	65 No. bedrooms	771† (1.40)	768† (1.38)	0.0076† (0.93)
24 Two-family house	6,330** (2.51)	6,517** (2.57)	0.0917** (2.48)	67 Garage-internal	1,355† (1.33)	1,661† (1.63)	0.0762† (1.36)
29 House Condition - poor	-3,646 (-3.01)	-3,853 (-3.17)	-0.1241 (-6.93)	31 Distance to TMI	163 (2.84)	-	-
30 House Condition - good	3,815 (2.73)	3,651 (2.60)	0.0230† (1.12)	80 Close to plant (0-5 miles)	-	-1,732* (-1.82)	-0.0175 (-1.25)
R^2	.767	.764	.782				
F	46.42	45.74	50.61				
Standard Deviation	7,360	7,402	.1090				
Residual degrees freedom	410	410	410				

† Not significant.
* Significant at the 5-10 percent level of significance.
** Significant at the 1-5 percent level of significance.
All other variables are significant at the 1 percent or better level of significance.

10 percent level. Based on these regression results, we have evidence that property values near the plant, at least within 5 miles, are somewhat lower than values for more distant properties. But are these lower values the result of the TMI plant itself, or are they the result of economic trends and the characteristics of residential development over many decades in that area? Regression analysis does not necessarily explain cause and effect; it only shows the existence of certain relationships. Much more detailed knowledge of a situation is needed for a researcher to make judgements on the reasons for certain relationships. Based on our knowledge of the area, we feel that the lower values near the plant reflect primarily the historic trends in development that have occurred there. This view seems to be supported by the data in Table 2.6 which shows the mean sales and ages of houses included in the data base for the 0-5 and 6-25 mile zones around TMI and for the time periods before and after the accident.

Table 2.6 Mean real selling prices and ages of houses in sample, by distance zones and time periods.

		Before Accident	After Accident
Mean real price	0-5	$27,916 n = 202	$27,955 n = 70
	6-25	$34,053 n = 238	$34,157 n = 73
Mean age (years)	0-5	47	46
	6-25	40	37

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III. TASK B

3.1 Introduction

The purpose of this task is to determine what effects, if any, the accident had on residential property values in the greater Harrisburg area during the remainder of 1979. The same multiple regression methodology is used here as was used in Task A. The data base most applicable in this task is all sales in the 0-25 mile zone around the plant after the accident, i.e., the last 9 months of 1979. In some of the regressions the earlier data base, i.e. sales in the 27 months preceding the accident, is combined with the after accident data. When this is done, the binary independent variable "after accident" is inserted and also is interacted with another binary variable "close to TMI."

The first part of this task is to determine if there were any overall effects in the region, with particular attention given to the area close to the plant (0-5 miles) and to any relationship between magnitude of effects and distance from TMI, the latter being a key independent variable. The second part of this task examines the data to see if there might have been any "directional" effects on property values. Perhaps properties downwind from the plant, generally those to the east, might be more discriminated against by prospective buyers than properties to the west. And finally, this task examines the data for any likely effects that were not evenly distributed among the different value classes of properties. Perhaps most of the adverse effects, if any, were sustained by high valued properties, whereas low or medium valued properties were not affected.

3.2 Regression Results: Overall Effects

The results of five multiple regression equations are given in Table 3.1. In the first two equations the data base includes properties sampled after the accident; in the last three equations properties sampled before and after the accident are included. Equation 5 is the log-log form of the model; the other equations show the linear form.

In all of the equations the coefficients display the expected signs. The amount of variation in selling price explained by the regressions (R^2) is high. Because of the much broader data base in equations 3-5, there are more significant variables in these three equations than in the first two. Among the three "before and after" equations, the log-log form has somewhat better explanatory power than the linear form.

Most of the variables that are not associated with either the TMI plant of the accident (the last five variables listed have these associations) are quite self explanatory. One can easily identify those that are the most important. However, there are several that have been bothersome in this analyses and that require further discussion.

Variable 21, "trees on lot," was significant (at the 1-5 percent level) only in the "after" accident equation; it was not significant in the

Table 3.1 Regression results: Effects of accident on residential property values, greater Harrisburg area.

Variables	Regression Coefficients (t values)				
	After Accident		Before and After Accident		
	1(linear)	2(linear)	3(linear)	4(linear)	5(log-log)
Constant	8,964†	13,411*	2,053	5,250†	3.3937
	(1.37)	(1.98)	(0.60)	(1.47)	(20.68)
1 House built before 1915	-5,012*	-4,944*	-6,295	-6,022	-0.0720
	(-1.89)	(-1.89)	-5.18)	(-4.91)	(-3.84)
2 House built 1915-1933	-4.502†	-4,394†	-4,610	-4,474	-0.0402**
	(-1.61)	(-1.59)	(-3.77)	(-3.65)	(-2.15)
3 House built 1934-1946	-6,573**	-6,550**	-4,191	-3,979**	-0.0705
	(-2.00)	(-2.02)	(-2.65)	(-2.51)	(-2.93)
5 House built after 1968	---	---	1,761*	1,792*	0.0235†
			(1.69)	(1.71)	(1.48)
7 Lot frontage	---	---	36.99	35.29	0.1394
			(5.28)	(5.02)	(5.82)
9 Lot on paved road	---	---	3,865**	3,749**	0.0493*
			(2.16)	(2.09)	(1.82)
12 House grade - poor	-10,007	-10,075	-7,475	-7,487	-0.2683
	(-3.77)	(-3.75)	(-4.32)	(-4.81)	(-11.35)
13 Public sewer available	---	---	2,863	2,698	0.0407
			(3.35)	(3.06)	(3.08)
14 House grade - good	6,812*	6,891*	8,563	8,325	0.0684**
	(1.89)	(1.89)	(4.62)	(4.48)	(2.46)
16 Airport noise	---	---	-2,035†	-1,820†	-0.0291†
			(-1.62)	(-1.40)	(-1.53)

21 Trees on lot	3,598** (2.31)	3,206** (2.05)	---	---	---
24 Two-family house	-5,726* (-1.71)	-5,510* (-1.67)	275† (1.63)	3,422* (1.69)	0.0585* (1.92)
25 Flood plain	-8,257 (-2.68)	-8,632 (-2.83)	-3.202* (-1.84)	-3,414* (-1.95)	-0.0447* (1.68)
29 House condition - poor	-4,033* (-1.89)	-4,152* (-1.96)	-3.691 (-3.52)	-3,901 (-3.72)	-0.1249 (-7.84)
30 House condition - good	4,782** (2.09)	3,968* (1.71)	3,349 (2.88)	3,185 (2.72)	0.0185† (1.04)
45 Number floors	---	---	3,254** (2.25)	3,150** (2.16)	---
46 Number bathrooms	2,239† (1.60)	2,216† (1.60)	2.210 (3.28)	2,190 (3.24)	0.1854 (3.19)
47 First floor - ft^2	10.02 (3.45)	10.11 (3.52)	10.34 (6.66)	10.34 (6.64)	0.2914 (6.86)
48 Second floor - ft^2	---	---	---	1.73† (1.02)	0.0211* (1.99)
53 Garage - attached	3,361** (2.35)	3.141** (2.21)	2,845 (4.52)	2,817 (4.46)	0.0894** (2.34)
54 Garage - detached	3,290** (2.52)	2,965** (2.27)	1,289** (2.10)	1,168* (1.88)	0.0631* (1.66)
55 Fireplace	4,447 (2.84)	4,454 (2.89)	4,044 (5.14)	4,007 (5.05)	0.0366 (3.04)
57 Central air conditioning	4,779† (1.41)	4,770† (1.43)	5,346 (3.28)	5,520 (3.38)	0.0405* (1.65)
58 Modern kitchen	---	---	2,142** (2.45)	1,952** (2.24)	0.0423 (3.21)
59 Stone exterior front	2,864** (2.15)	2,730** (2.07)	778† (1.11)	926† (1.33)	0.0218** (2.04)
63 Taxes	-205* (-1.93)	-247** (-2.30)	-196 (-3.83)	-203 (-3.86)	-0.2317 (-4.56)
65 Number bedrooms	1,192† (1.30)	1.212† (1.34)	1,007** (2.19)	1,018** (2.20)	0.0137** (1.97)
77 Garage - internal	5,433 (2.91)	5,112 (2.75)	2,341 (2.66)	2,551 (2.90)	0.799† (1.61)
31 Distance to TMI	105† (1.07)		163 (3.02)		0.0385** (2.27)
79 After accident			924† (0.78)	12.60† (0.01)	-0.0081† (-0.24)
80 Close to TMI (0-5 miles)		-2.950* (-1.91)		-2,136** (-2.42)	
81 (After accident) x (Close to TMI)				334† (0.23)	
82 (After accident) x (Distance to TMI)			-74† (-0.76)		0.0102† (0.30)
R^2	.833	.837	.766	.765	.787
F	19.50	20.02	58.14	57.77	65.83
Standard Deviation	6,590	6,519	7,276	7,294	.1107
Residual degrees freedom	113	113	551	551	551

--- Variables entered but had "t" values less than 1.00.
† Not significant with "t" values greater than 1.00, except last 5 variables.
* Significant at the 5-10 percent level of significance.
** Significant at the 1-5 percent level of significance.
All other variables are significant at the 1 percent or better level of significance.

NOTE: No entry appears for variables not entered in the equation.

"before" accident or "before and after" accident equations. We have no good explanation for this and feel that it is probably a perturbation in the data, although it might be signalling a shift in consumer tastes or preferences towards lots with trees. Whatever the cause, it is not related to the TMI accident and the issue at hand.

Variables 16 and 25, "airport noise" and "flood plain," respectively, have presented problems. There are two airports in the Harrisburg study area, the principal one, Harrisburg International, being located quite close to TMI. We obtained maps showing noise contour intervals for the flight paths of these two airports, and identified all property sales that fell within the NEF 30 noise contour lines.[1/] There were 10 such sales after the accident and 41 before.

Properties that were located on the flood plain were also identified from flood plain maps. There were 7 such property sales after the accident and 15 before. The troublesome fact is that in much of the area the flood plain is coincidental with the area experiencing local aircraft noise, and a fair portion of these areas are also located quite close to TMI. It was for this latter reason that, although there is some difficulty in explaining the significance of these variables as will become apparent shortly, it was felt important to include them in the regressions. To have eliminated them would have made it more difficult to accurately interpret the effects of the accident.

The airport noise coefficient is not significant after the accident but is significant at the 5-10 percent level before the accident (equation 3, Table 3.1 and equations 1-3 in Table 2.5). Discussions with FAA personnel prompt us to offer two possible explanations for the noise coefficient becoming non-significant after the accident: (1) there are fewer flights now than formerly because of higher fuel prices, and (2) noisier aircraft have been replaced with quieter aircraft to conform with federal noise regulations. Both of these reasons are only coincidentally time related to the accident; neither of them came about because of the accident.

The flood plain coefficient is highly significant after the accident, is not significant in the "before accident" regressions (Table 2.5), and is barely significant (5-10 percent level) in the "before and after" equation in Table 3.1. It is difficult to explain why this variable is significant after the accident and not before, particularly since there was not a recent severe flooding episode on the Susquehanna River that would make people cautious about buying homes near the river. We talked to a realtor and several people in state agencies in Harrisburg and two explanations can be offered: (1) Over the past year or so there has been a concerted effort on the part of state and federal agencies to encourage communities and homeowners to take advantage of federal flood insurance; and (2) in response to recent consumer protection legislation, realtors must now fully advsie prospective purchasers about any faults

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[1/] Noise contour lines were obtained from a study by Pennsylvania Department of Transportation.

or potential hazards associated with specific properties. Either or both of these reasons might have increased consumer awareness of the potential hazards from flooding, and be reflected in the market price for such housing.

Let us now turn our attention to a discussion of the last 5 variables in Table 3.1, those that deal directly with TMI and the accident. Variable 31, "distance to TMI," is not significant after the accident (equation 1), but in the "before and after" equations it is highly significant in the linear equation (No. 3) and significant at almost the 1 percent level in the log-log equation (No. 5). However, in all of the "before and after" equations, the binary variable "after accident," (No. 79) is not at all significant. This means that there were no significant differences in the real prices of houses in the two time periods. Moreover, when variable 31 is interacted with variable 79 (distance to TMI x after accident) in equations 3 and 5, to produce variable No. 82, the coefficients have no significance. This indicates that even though distance to TMI may be a significant variable in explaining variations in the price of housing, these differences are not related to the accident. The significance of the "distance to TMI" variable relates to before the accident, but if the accident itself did not affect residential prices, how possibly could the TMI plant before the accident have had an adverse effect on prices? We felt it did not, and that this variable is actually reflecting the housing market in the Middletown-Steelton-Highspire area south of Harrisburg in which older and lower value houses predominate.

Variable 80, "close to TMI" (0-5 miles), is significant at the 1-5 percent level in equation 4, but when interacted with variable 79 (after accident) in the form of variable 81, the coefficient loses all significance. In this case, "close to TMI" is picking up some of the same variation reflected in "distance to TMI" and the same logic in interpretation applies.

Based on the regression results as shown in Table 3.1, we must conclude that the TMI accident had no adverse effect on the price of single family homes within 25 miles of the plant over the remainder of 1979.

3.3 Regression Results: Directional Effects

In this section we are concerned with the distributional nature of any possible effects in terms of the direction from TMI. For example, it is conceivable that properties to the east of the plant (to the lee of the plant from prevailing winds) experienced some adverse effects, while properties to the west may have realized gains, the two offsetting each other yielding net effects of zero for the area analyzed as a whole.

Four quadrants, north, east, south, and west, were identified, the boundaries of which followed river, stream, and municipal boundaries in a general northeast, southeast, southwest, and northwest direction from the TMI plant. The data base was the same as that used in the previous portions of this task, i.e., a sampling of property sales in the

0-25 mile zone around the plant from 1977-79, inclusive. The quadrants were entered in the regression equations as binary (dummy) variables. All regressions were performed using the linear form of the model. For each quadrant, three regression analyses were made based on three subsets of the data: before the accident, after the accident, and before and after the accident. For each quadrant, the "before" equation was the same as equation 2 in Table 2.5, the "after" equation was the same as equation 2 in Table 3.1, and "before and after" equation was the same as equation 4 in Table 3.1 except for the entry of the quadrant dummy variable. In each case, the signs and magnitudes of the coefficients and the level of significance for each variable were very similar. For this reason, we will report only those variables that contribute to an understanding of the effects within quardants, omitting the other variables that are so similar and which would be needless repetition. The results are shown in Table 3.2.

Taking the variables in order and discussing the meaning of the coefficients, we see that "after the accident" (variable 79) was not significant in any of the four "before and after" equations (3,6,9, and 12). It should be pointed out that this variable, as well as variables 80 and 81, refer to the data set for the entire study area and therefore cannot be interpreted in terms of a specific quadrant. Variable 80, "close to TMI," is at times significant and always negative, which of course conforms to the regression results reported in previous sections. Interacting these two variables produces no significant results (variable 81), which also agrees with earlier findings.

The quadrant variable (83-a binary variable) is the one most relevant to our concerns in this section. In the East and West quadrants, the coefficients are mostly positive, the only exception being in the west quadrant after the accident, but in all cases the coefficients are not significant. This means that residential properties in those quadrants, both before and after the accident, did not sell for prices that were significantly higher or lower than prices for properties in the area as a whole.

In the North quadrant, however, properties did bring lower prices before the accident (equation 1) but not after the accident (equation 2). On the average, the lower prices amounted to about $3,400. The North quadrant includes Middletown, Steelton, Highspire, and much of the City of Harrisburg; thus lower prices in this quadrant are not surprising. The fact that after the accident the coefficient for the North quadrant was not significant (though still negative) precludes the likelihood that the accident had any negative effects on house prices. If anything, one might surmise that the accident might have had a positive effect in that it reduced the amount by which prices in the North were lower than the rest of the region, but of course a number of other reasons might just as readily explain this change in the coefficient. Because the coefficient is not significant, little weight should be attached to its importance.

In the South quadrant, the coefficients for variable 83 are positive but only the "before and after" coefficient (equation 9) is significant (at the 5-10 percent level).

Table 3.2 Regression results: Determining effects within quadrants.[1/]

Variables	Regression Coefficients (t values)											
	North			East			South			West		
	B[2/]	A[2/]	B + A[2/]	B	A	B + A	B	A	B + A	B	A	B + A
	1	2	3	4	5	6	7	8	9	10	11	12
79 After accident			206† (0.21)			37.6† (0.04)			-141† (-0.14)			6.76† (0.07)
80 Close to TMI	-879† (-0.64)	-4,651** (-2.27)	-1,850† (-1.49)	-2,078** (-2.03)	-2,778** (-1.64)	-2,459 (-2.58)	-1,333† (-1.34)	-2,334† (-1.45)	-1.640* (-1.80)	-1,276† (-1.20)	-3,133* (-1.80)	-1,767* (-1.80)
83 Quadrant	-33.92 (-3.04)	-1,794† (-0.88)	-3,026 (-3.15)	1,013† (0.90)	572† (0.29)	520† (0.53)	1,869† (1.43)	1.758† (0.84)	2,321** (2.11)	1,107† (0.87)	-257† (-0.10)	742† (0.66)
81 After x close			162† (0.09)			365† (0.24)			585† (0.40)			154† (0.10)
84 Close x quad.	600† (0.32)	3,888† (1.40)	1,267† (0.77)	2,085† (1.12)	-663† (0.21)	1,1918† (1.12)	-3,230† (-0.85)	-6,6682 (-1.88)	-4,231† (-1.17)	1,832† (-0.91)	766† (0.22)	-1,592† (-0.87)
85 After x close x quad			-34.4† (-0.02)			751† (0.29)			174† (-0.04)			505† (0.20)
R^2	.77	.84	.77	.77	.84	.77	.77	.84	.77	.76	.84	.77
F	44.21	18.79	53.77	43.32	18.41	53.01	42.88	19.10	53.04	42.71	18.40	52.48
Standard Deviation	7,314	6,519	7,241	7,371	6,575	7,281	7,400	6,474	7,279	7,411	6,576	7,309
Degrees freedom	408	111	548	408	111	548	408	111	548	408	111	548

† Not significant.
* Significant at the 5-10 percent level of significance.
** Significant at the 1-5 percent level of significance.
All other variables significant at the 1 percent or better level of significance.

1/ Only a portion of the variables are shown in this table. See text for explanation.

2/ B = before accident; A = after accident; B + A = before and after accident.

Examining variable 84, in which close to TMI is interacted with a quadrant, we find that in all four quadrants the coefficients are not significant for the "before accident" equations as well as the "before and after accident" equations. In the "after accident" equations, only in the South quadrant do we find a significant variable, a negative $6,682 significant at the 5-10 percent level. The coefficients for variable 85, which interacts "close to TMI" "after the accident," and the "quadrant" over the whole data set, are not at all significant in any of the four quadrants.

It is difficult to explain the -$6,682 coefficient in the south quadrant close to the plant after the accident, particularly when it is refuted by the coefficient for variable 85 in the "before and after" accident data set which had a t value of only 0.04. We should point out that there are only 8 observations in this geographical area. We cannot affirm that this negative effect is accident related or not. There may be some other factors operating in this market area that have not been accounted for in the equations. From field observations and County Planning Commissions reports we know of one community near York Haven that is not sewered and contains mostly low value properties that for the most part are converted small vacation homes. This might explain the larger negative value of the coefficient.

Our conclusions in this section are that there is no strong evidence to show that the accident had any effects, positive or negative, on property values when examined in terms of their direction from the plant. However, after the accident within 5 miles of the plant in the South quadrant property values were about $6,700 lower than for the area as a whole. We are unable to state, however, that this is positively due to the accident at TMI.

3.4 Regression Results: Value Class Effects

In this part of the study we analyzed the data to see if we could uncover any differential effects among three value classes of residential properties: low, medium, and high. Not finding any strong evidence of any significant effects, positive or negative, when the data were analyzed for the area as a whole would indicate that this task was unnecessary, because for a decrease to occur in one value class it would have to be approximately offset by an increase in another class for net effects to be near zero. But performing this exercise should make our findings more robust.

The parameters of the value classes were selected by use of a histogram for the 1977 sales where the number of sales, listed from the lowest to the highest value, were divided into three groups of equal numbers. Deflators were then applied to the values delineating the group parameters so as to keep the sales values in constant dollars from 1977 through 1979.[2/]

[2/] For a more detailed discussion of the selection of value classes and application of deflators see Task E, Chapter VI.

For the beginning of 1977 the value parameters for the three classes were:

low - 0 - $22,000

medium - $22,100 - $35,000

high - over $35,000

Three regression runs were made using the California Statistical package to ascertain the significant variables for each of the three value classes. The data included the full sample of property values in the 0-25 mile zone around TMI for the 1977-1979 period. The significant independent variables for each value class were then used in the Statistical Analysis System regression package. Three equations were specified for each value class: before accident, after accident, and before and after accident. Three binary independent variables relating to TMI and the accident were entered into the regressions. The results are given in Table 3.3.

Several observations should be noted about the results. The variables important in explaining variations in prices differ widely between the value classes. Sewer availability; number of floors, bedrooms, and bathrooms; central air conditioning; and lot size are important to the high value homes but not for the lower or medium priced homes, which is logical. There are only four important variables which explain variation in low priced homes: house grade and condition, floor area, and modern kitchen. The reason that there are fewer significant variables, in general, in the "after accident," equations is that there are considerably fewer properties included in the sample.

The coefficients of most of the statistically significant variables have the expected signs and their magnitudes appear reasonable. The percent of variation in selling price explained by the independent variables is reasonably good except for the medium valued homes where it is lower. This is not surprising in view of the restricted value range of this class where little variation is expected.

It is readily apparent that the accident had no effect on the low and medium priced homes: all the regression coefficients for variables 79, 80, and 81 are statistically insignificant. Interpretation of these coefficients for the high value class homes is not as clear. Before the accident the price of a high value home within 5 miles of TMI was not statistically different from the price of such a home located farther away. But after the accident, high value homes close to TMI sold for about $4,600 less than other high value homes, a figure significant at the 1-5 percent level of significance. However, in the regression for the entire time period the variables "close to TMI," "after the accident," and the interaction "close to TMI x after accident" all have statistically insignificant coefficients. Thus the results of these two equations seem to be giving inconsistent answers. Further

Table 3.3 Regression results: Determining effects within property value classes.

		Regression Coefficients (t values)								
		Low value			Medium value			High value		
	Variable	B[1]	A[1]	B + A[1]	B	A	B + A	B	A	B + A
	Constant	12,414 (13.37)	10,756 (4.05)	12,230 (13.48)	25,142 (8.75	21,073 (6.64)	22,422 (11.59)	9,676** (2.24)	8,559† (1.13)	11,397 (3.13)
1	House built before 1915				-3,688 (-4.96)	-1,758† (-1.27)	-3,235 (-5.16)	-4,880** (-2.16)	-6,646* (-1.63)	-5,456 (-2.76)
2	House built 1915-1933				-3,492 (-5.06)	-5,866 (-4.07)	-3,657 (-6.19)	-7,141** (-2.32)	-3.116† (-0.61)	-8,145 (-3.21)
9	Lot on paved road				2,883† (1.25)	5,827 (3,28)	5,297 (4.07)			
12	House grade - poor	-5,177 (-6.72)	-7,075 (-4.47)	-5,733 (-8.36)						
13	Public sewer							4,895 (3.65)	-1,171† (-0.59)	3,023 (2.71)
14	House grade - good							10,062 (4.91)	-1,396† (-0.30)	7,599 (4.22)
29	House condition - poor	-2,320 (-3.90)	03,573** (-2.16)	-2,501 (-4.41)						
45	Number floors							7,358 (5.14)	6,579 (2.68)	7,066 (5.78)
46	Number bathrooms							2,440** (2.46)	2,761* (1.60)	3,125 (3.71)
47	First floor - ft^2	5.46 (4.44)	8.82 (2.50)	6.00 (5.08)	3.83 (3.33)	2.23† (0.95)	3.82 (3.83)	4.13* (1.72)	11.22 (3.01)	4.85** (2.49)
48	Second floor - ft^2				2.24 (2.73)	2.26† (1.25)	2.18 (2.99)			
49	Basement - ft^2				7.10** (2.52)	14.70** (2.21)	8.56 (3.38			
51	Full basement floor finished				1,530 (2.68)	2,105** (1.89)	1,449 (2.99)			
57	Central air conditioning							4,647 (2.75)	7,972** (1.82)	4,510 (2.88)
58	Modern kitchen	3,473 (5.60)	775† (0.41)	3,213 (5.38)						
63	Taxes				-128 (-3.37)	3.71† (0.04)	-113 (-3.32)			
65	No. bedrooms							4,187 (4.06)	3,518* (1.64)	3,682 (3.97)
66	Lot area - ft^2							0.094 (3.24)	0.099** (2.03)	0.093 (3.81)
77	Garage - internal				1,781** (2.20)	1,010† (0.67)	1,743 (2.59)			
80	Close to TMI	38.86† (0.07)	2.01† (0.15)	-3.72† (-0.01)	-416† (-0.73)	-437† (-0.45)	-404† (-0.74)	-1,048† (-0.79)	-4,589** (-2.27)	-2,046† (-1.60
79	After accident			-786† (-0.94)			827† (1.18)			-418† (-0.31)
81	Close x after			414 (0.37)			-267 (-0.28)			-914 (-0.41)
	R^2	.61	.73	.64	.44	.48	.42	.65	.69	.63
	F	26.60	11.28	30.64	9.84	3.22	10.67	24.08	8.03	25.15
	Standard Deviation	2,823	3,407	2,957	3,003	2,940	2,987	6.437	6,236	6,504
	Residual degree freedom	117	29	152	150	42	203	140	39	189

† Not significant.
* Significant at the 5-10 percent level of significance.
** Significant at the 1-5 percent level of significance.
All other variables are significant at the 1 percent or better level of significance.

[1] B = before accident; A = after accident; B + A = Before and after accident.

evidence to show the inconclusiveness of the interpretation for the -$4,600 coefficient is found in the coefficients in that equation for "house built 1915-1933," "public sewer," and "house grade good." The "house built 1915-1933" variable (No. 2), has a coefficient considerably lower in magnitude than the same coefficients in the other two high value class equations. The signs of the other two variables (sewer and good condition) are negative, clearly opposite to what we would expect and to the results for those coefficients in all other regression runs. Moreover, all three of the coefficients in this equation are not significant, another surprising result. Therefore, there must be a high degree of multicollinearity in these variables in this equation, which makes an accurate interpretation of the results almost impossible. For these reasons we feel much more reliability should be placed on the results as shown in the high value class equation based on before and after data.

Our conclusion for this part of Task B is that there is no strong evidence to indicate that the accident had any effects on the selling price of low, medium, or high value class properties.

3.5 Literature Cited:

PA Dept. of Transportation. Aircraft Noise Impacts for Harrisburg International and Capital City Airports. Bureau of Advance Planning, Statewide Studies Division, Harrisburg, PA, 1972.

IV. TASK C

4.1 Introduction

The purpose of this task is to predict sales values of properties after the accident and compare these values to the actual market values by means of a simulation technique that uses a regression equation based on actual market sales and assessed property values. The predictive regression equation was developed from actual sales data from January, 1977, to the time of the accident. Based on this equation, a market price was then predicted for each sale that actually occurred after the accident as recorded up to the end of 1979. Comparing the predicted with the actual market price and summing by distance zones and directional quadrant from TMI provides an additional check on the likely effects and adds to the robustness of the findings. To the best of our knowledge this technique has not been used before to predict property values.

The data base includes all valid sales of single family residential properties within 25 miles of TMI and the Lycoming control area as reported by the STEB for the years 1977-79 (see Table 4.1). Sampling rates are also given in this table. Individual STEB sales values of less than $5,000 or more than $100,000 were eliminated because it was felt these were too unrepresentative of the population as a whole.

Table 4.1 Number of sales used and sampling rate by time period and distance zone, Task C.

Time Period	Distance from TMI 0-5	Distance from TMI 5-25	Lycoming Control area
Before accident			
Number sales	1,248	7,631	1,587
Sampling rate (%)	100	25	100
After accident			
Number sales	275	7,689	537
Sampling rate (%)	100	100	100

The dependent variable was the actual sales price deflated to the January, 1977, base. A deflator of 1.007 per month was used; i.e., each sale subsequent to January 1977, was divided by 1.007^t, where t is the number of months from January, 1977, to the month of sale.

Two independent variables were used: (1) the equalized assessed value of the property sold, and (2) the effective tax rate. The actual assessed value of each property was divided by the published assessment ratio, expressed as a percent, for the county in which the property was located. For example, a property assessed at $10,000 with a county published ratio

of 20, has an equalized assessed value of $50,000 (10,000 ÷ .2). Equalizing the assessed values corrects for assessment differences between counties but of course does not correct for assessment errors or differences within a county. The equalized assessed values used as an independent variable in a way capture or reflect the "bundle" of independent variables used in the regression equations in Tasks A and B to describe the characteristics of properties.

The effective tax rate variable is the property tax paid per $1,000 of market value. The mills of county, municipal, and school property taxes for each property were summed and the total tax obligation determined, which was then divided by the market value of the property and multiplied by 1000. Following our earlier example, assume the total millage is 90. The assessed value of 10,000 times .09 yields a tax of $900, divided by the market value of $50,000 gives a dollar rate of .018, or an effective tax rate of $18 per thousand of market value.

Property assessments for taxing purposes are supposed to accurately reflect the true market values of properties. If all assessments were accurate estimates, then we could place a great deal of reliance on this variable to capture or reflect the many descriptors that were used (as independent variables) in the two previous tasks. But we know that the quality or accuracy of assessments with regard to individual properties can vary considerably. For this reason we feel that much less weight or importance should be attached to the findings here than in Tasks A or B.

An indicator of the quality of assessments commonly used throughout the country is the coefficient of dispersion, which really is a measure of individual assessment ratios around the mediam, as given by the following formula:

$$\text{Coefficient of dispersion} = \frac{\text{mean deviation}}{\text{median ratio}}$$

where

$$\text{the mean deviation} = \frac{\text{sum of deviations}}{\text{number of sales}}$$

For each property sold in a county, the assessed value is divided by the market sales price to get the assessment ratio. These are then arrayed in order, the median ratio selected, and then the deviations of each from the median determined and summed. For example, assume out of 5 sales the median ratio was .40 and the sum of the individual deviations around this median was .35. The mean deviation is then .35 ÷ 5 = .07. The coefficient of dispersion would be .07 ÷ .40 = 17.5 percent.

We calculated a coefficient of dispersion for each of the counties in which we have sales data and these are given in Table 4.2. A dispersion coefficient of 20 or less is generally considered to indicate good quality assessments. As can be seen from the table, only one of our counties meets this standard, Cumberland.

Table 4.2 Accuracy of assessment as measured by dispersion coefficients for counties in study area for 1979

County	1979 Dispersion Coefficient
Adams	28.2
Cumberland	20.9
Dauphin	32.3
Lancaster	29.5
Lebanon	23.6
Lycoming	25.5
Perry	37.8
York	33.6

Using the before accident data, we developed regression equations for four distances zones around TMI[1/], for directional quadrants radiating out from TMI, and a combination of these two sets. Applying the regression coefficients to the equalized assessed values and effective tax rates for each property that sold after the accident we then predicted what its sale price should have been. Our regression equations accounted for from 50 to 80 percent of the variation in sales prices.

4.2 Results

Subtracting the mean values predicted by the regressions from the actual mean market values for each of the distance zones and quadrants around TMI gives the differences as shown in Table 4.3. In the two nearest distance zones around TMI (within 10 miles) the differences between the actual and predicted prices after the accident were not significant. Properties in the 11 to 20 mile zone around TMI sold somewhat higher than we predicted, both of these differences being highly significant at the 1 percent or better level of significance. We also performed this exercise on the control area, and found that the actual prices there were weakly significantly higher than what we predicted. The fact that the sign and magnitude of the mean differences in the 0-5 mile zone and in the control area are quite similar lends some support to the selection of the area around Williamsport as the

1/ Distances for this task were calculated somewhat differently than for Tasks A and B. In those two tasks the actual distance in miles to TMI from each sale property was determined. In this task, distances were determined on the basis of the population centroid for each municipality and how far it was from TMI.

Table 4.3 Mean actual market values after accident minus mean predicted values by distance zone and directional quadrants

	Distance from TMI	Directional Quadrant
	0-5 miles	North
Mean difference ($)	+597†	-1,214
Standard error of mean	(487)	(178)
t values	(1.23)	(-6.82)
Number sales	269	1,947
	6-10 miles	East
Mean difference ($)	-445†	+1,686
Standard error of mean	(307)	(307)
t value	(-1.45)	(5.49)
number sales	814	849
	11-20 miles	South
Mean difference ($)	+728	+2,198
Standard error of mean	(114)	(187)
t values	(6.39)	(11,75)
Number sales	4,972	1,728
	>20 miles	West
Mean difference ($)	+2,422	+936
Standard error of mean	(264)	(202)
t values	(9.17)	(4.63)
Number sales	1,625	1,531
	Control area	
Mean difference ($)	+515*	
Standard error of mean	(253)	
t values	(1.76)	
Number sales	530	

† not significant

* significant at the 5-10 percent level on two tailed t test. All other values significant at the 1 percent or better level of significance. The t test for paired variables was used to determine significance.

control area. Based on the mean differences for the various distance zones, there is no substantive evidence to indicate that the accident had any negative impacts on property values.

In terms of the mean differences based on direction from TMI, all four differences (north, east, south, and west) were significant. Properties north of the plant, from 0 to 25 miles, sold on the average for about $1200 less after the accident than what we predicted. Properties to the east, south, and west sold at prices higher than we predicted. In Task B, our analysis of the after accident data showed that direction from TMI had not significant effects on sales prices (Table 3.2, variable 83). Because of the relatively poor quality of assessment data used in this task (Task C), we feel more reliance should be placed on the Task B results.

Combining the data for distance and direction from TMI into discrete cells, we got the results shown in Table 4.4. After the accident and within 5 miles of TMI, only those properties north of TMI showed a mean difference that was significant, a negative $1,776. This does not agree with the regression results in Task B as shown in Table 3.2, equation 2, variable 84, where there was no significance to the coefficient for north quadrant x close to TMI. The quality of assessments in Dauphin County were not good (dispersion coefficient of 32.2), and this amount of error could explain the differences in the findings in these two tasks. For this reason we are inclined to place more weight on the Task B results. The differences in all three distance zones to the north of the plant are significant and negative. We expect the negative signs because of the nature of development north of the plant.

Whether the differences between actual sales values and predicted values are the result of the accident or are due to some other factor or factors we cannot say.

In the east and west quadrants only the differences in the outermost cells (11-20 miles) are significant, and both are positive. In the south quadrant, actual sales values after the accident in the 6-10 and 11-20 mile zones were both significantly higher than those predicted, by as much as $3,744 in the 6-10 miles cell. There is no logical reason to suppose that these increases were due to the accident. Other factors must have been working in the market; for example we know that there has been considerable growth in the Lancaster and York County areas. This growth in the outer zone may explain in part the relatively lower values for the 0-5 mile zone that are showing up in some of the regression coefficients in Tasks A and B.

4.3 Conclusions

One of the questions at the beginning of this study was: If effects from the accident are present, might they be more pronounced downwind from TMI? Since the prevailing winds are westerly in this area, the east quadrant should reveal such effects. The results of the regressions in Task B where we examined the quadrant influences showed the coefficients for the variables related to the east quadrant and after the accident to be insignificant,

Table 4.4 Mean actual market values after accident minus mean predicted values for distance plus direction cells from TMI

Distance Zones	Directional Quadrant from TMI			
	North	East	South	West
0-5 miles				
mean difference ($)	-1,776	-415†	+4,231†	+596†
standard error of mean	(575)	(1424)	(4059)	(891)
t values	(-3.09)	(-0.29)	(1.04)	(0.67)
number sales	129	51	3	86
6-10 miles				
mean difference ($)	-2,627	-170†	+3,744	+427†
standard error of mean	(405)	(1027)	(794)	(597)
t values	(-6.49)	(-0.17)	(4.72)	(0.72)
number sales	412	114	119	169
11-20 miles				
mean difference ($)	-1.284	+2,157	+2,024	+653
standard error of mean	(211)	(330)	(193)	(221)
t values	(-6.09)	(6.54)	(10.49)	(2.95)
number sales	1,406	684	1,606	1,276

† Not significant.
All other values are significant at the 1 percent or better level of significance, based on two tailed t test.

that is the accident appeared to have no effect on housing price in this area. Task C, the east quadrant showed actual market values to be higher than the predicted values after the accident, with the 11-20 mile zone the only one showing significant differences. From those two sets of data we must conclude that there is no evidence that the accident had any significant effects on housing prices downwind from the plant.

Actual housing prices after the accident north of the plant were significantly lower than the predicted values in all three distance zones from 0-20 miles from the plant, a finding that is consistent with those in the earlier regression analyses. As before, we cannot say with certainty that those negative effects stem from the accident. We know that compared to the study area as a whole, housing values north of the plant have been and are traditionally lower. We strongly suspect that this is what is reflected in our results, not an influence of the accident itself.

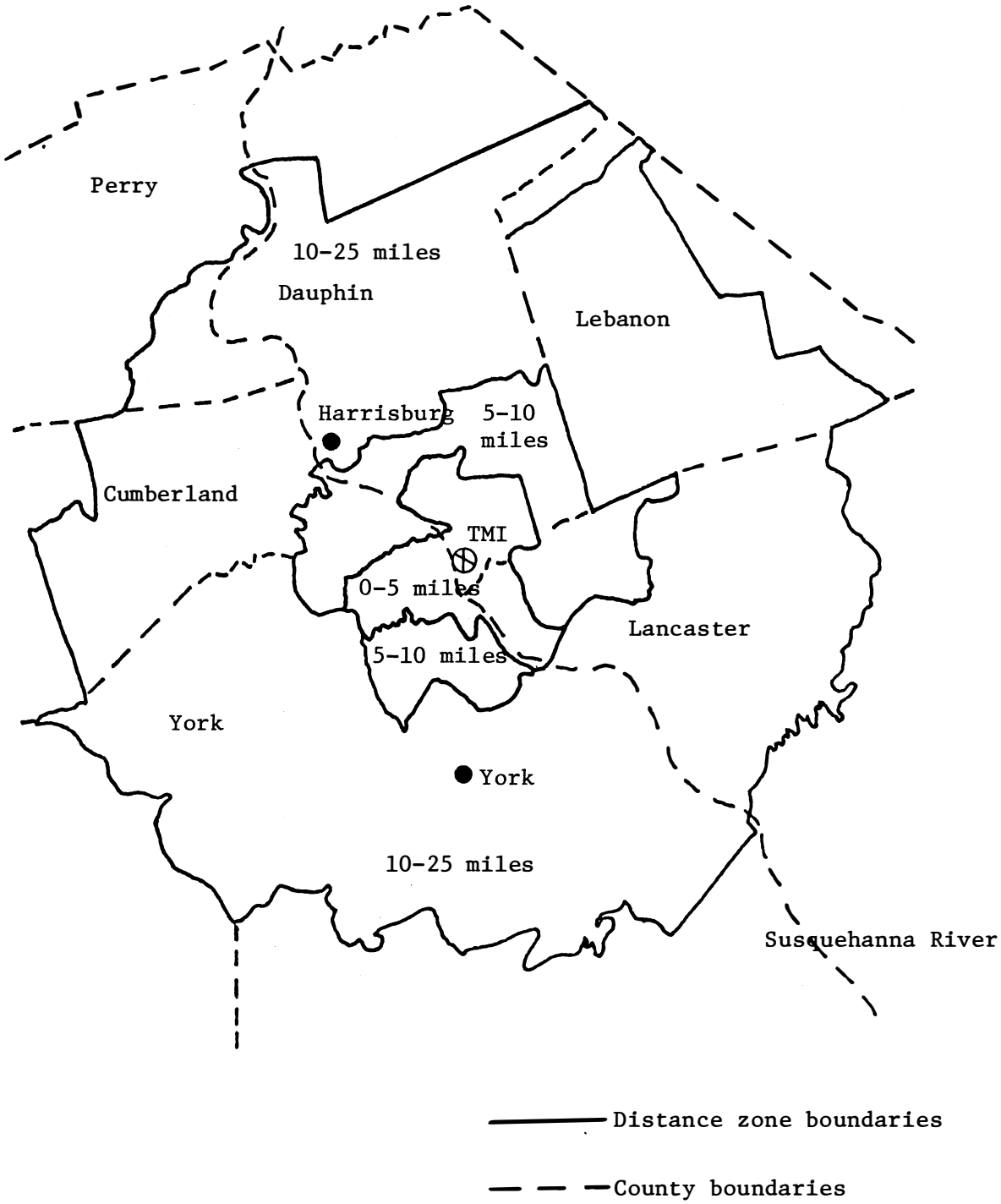

Figure 5.2 Delineation of distance zones, TMI study area.

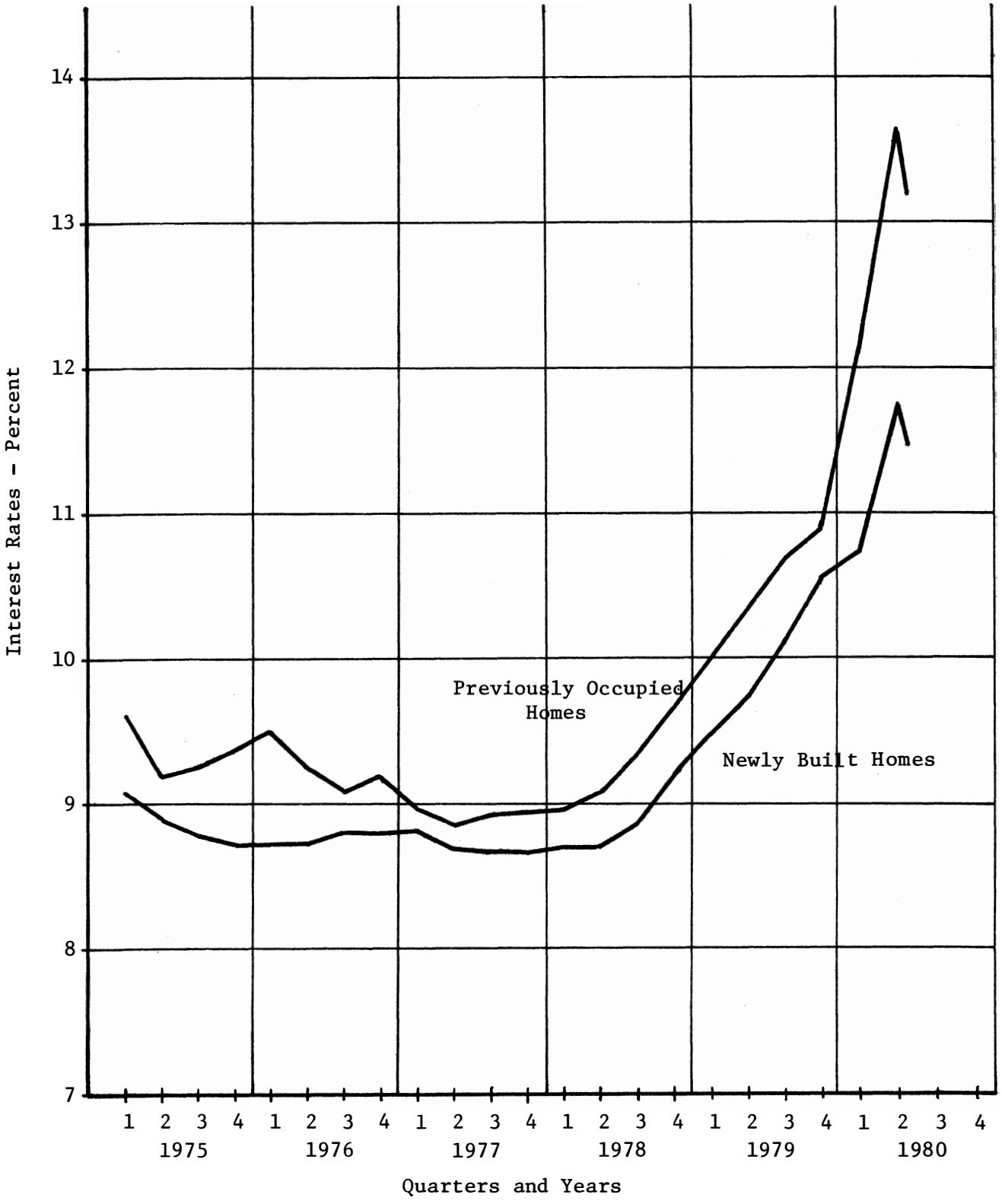

Figure 5.3 Effective Interest Rates for Conventional First Mortgage Loans on Single Family Homes, Philadelphia SMSA, 1975-1980 by Quarters.

instruments such as money market certificates. Banks and savings and loan offices then had to ration and limit new mortgages by raising substantially the amount of the down payment required or restricting new loans to properties on which they already had an instrument. The net effect was to drastically choke off demand for housing. This was as true in the Harrisburg area as it was in the rest of the country. We feel, however, that our analyses in Tasks D and E adequately take into account the effects of these economic conditions and enable us to show conclusions specific to the effects of the accident on the real estate market.

In the analyses that follow mean residential sales values are the average values for all valid sales that occurred in any specified time period and geographical area.

5.2 Mean Annual Residential Sales Prices

The mean annual residential sales prices and number of sales for the years 1975-1979 for the three distance zones in the TMI study area are shown in Table 5.1. It is quite obvious that communities in the 0-5 mile zone around the plant have traditionally contained lower value housing than the other two zones. In 1975, prices in the 5-10 and 10-25 mile zones were 29 percent and 6.7 percent higher, respectively, than prices in the 0-5 mile zone. In 1979 these prices were 27.4 percent and 12.1 percent higher, respectively, than those in the 0-5 mile zone.

It might be argued that these lower prices in the 0-5 mile zone reflect an influence of the plant itself on housing values, since the data are all ex post to the plant becoming operational. This was of real concern to us, also, in analyzing the results of the regression analyses in Tasks A and B. But three reasons can be advanced for rejecting the contention that the plant has had this influence on the local housing market. First, one needs only to drive around the area and observe the older and lower value housing that predominates here as compared to the Harrisburg area in general. Second, mean current sales prices for 1970, before the plant became operational but still under construction, show that the 0-5 mile area lagged the other two areas even more than in 1975 or 1979: prices in that year in the 5-10 and 10-25 mile zones were 40 percent and 42 percent higher, respectively, than in the 0-5 mile zone. This may have been due in part to the closing of the Olmstead Air Force Base in Middletown. Third, many realtors pointed out during the interviews (see Task F) that housing prices in the Middletown area have traditionally been considerably lower than in the rest of the Harrisburg area. Thus there appears little doubt but that TMI was constructed in an area of traditionally lower value housing than the greater Harrisburg area.

The percentage change in values during 1979 is of particular interest. All areas showed an increase in values, despite the fact that there

Table 5.1 Mean Annual Residential Prices and Number of Sales, 1975-1979.

	1975	1976	1977	1978	1979	75-79
Mean Annual Price						
0-5	$25,644 (12,081)*	$28,588 (13,779)	$31,375 (13,328)	$34,224 (15,668)	$36,473 (16,105)	
5-10	33,115 (15,044)	35,023 (15,661)	37,173 (15,529)	42,242 (17,998)	46,757 (19,833)	
10-25	27,360 (14,530)	30,856 (15,878)	33,737 (16,795)	36,861 (18,317)	40,873 (20,534)	
Williamsport	29,537 (14,545)	30,956 (14,272)	33,111 (15,756)	37,933 (16,337)	40,247 (17,536)	
Lehigh Co.	27,960 (15,492)	32,674 (16,556	35,858 (17,091)	39,454 (19,312)	43,409 (20,882)	
Percent Change in Mean Annual Price						
0-5		+11.5%	+9.7%	+ 9.1%	+ 6.6%	+42.2%
5-10		+ 5.8	+6.1	+13.6	+10.7	+41.2
10-25		+12.8	+9.3	+ 9.3	+10.9	+49.4
Williamsport		+ 4.8	+7.0	+14.6	+ 6.1	+36.3
Lehigh Co.		+16.9	+9.7	+10.0	+10.0	+55.3
Number of Sales						
0-5	351	561	597	415	406	
5-10	1,004	1,560	1,517	1,297	1,115	
10-25	7,485	9,969	11,314	11,103	9,996	
Williamsport	525	546	749	779	576	
Lehigh Co.	3,633	3,317	4,031	4,486	4,292	
Percent Change in Number of Sales						
0-5		+59.8%	+ 6.4%	-30.5%	- 2.2%	
5-10		+55.4	- 2.8	-14.5	-14.0	
10-25		+33.2	+13.5	- 1.9	- 9.9	
Williamsport		+ 4.0	+37.2	+ 4.0	-26.1	
Lehigh Co.		- 8.7	+21.5	+11.3	- 4.3	

* Standard deviations

were declines in number of sales that year.[1/] The proportionate increases in values in the 0-5 mile zone and in the Williamsport control area are very comparable, as are also the increases for the 5-10 and 10-25 mile zones and the Lehigh County control area. In the 1975-1979 percentage increase in values, however, Lehigh County exceeded the other areas, reflecting the high rate of population growth in that area. The Williamsport area had a somewhat lower rate of value increases from 1975 to 1979 than did the three zones in the Harrisburg area.

It is interesting to note that in 1978 while sales volume declined 30 percent in the 0-5 mile zone and increased 11 percent in Lehigh County, the percentage increase in mean values was approximately the same in both areas--9 and 10 percent, respectively. This probably reflects many sellers' attitudes when selling property; unless it is a "forced sale," they will hold the property until they get what they feel is a fair market price for it.

The mean sales values in Table 5.1 are plotted in Figure 5.4. The yearly increases in values in the 0-5 mile zone have been very steady. There is no evidence from these data, or from the mean sales data for the other areas, to indicate that there were any negative effects from the accident on the prices of residential property.

5.3 Mean Quarterly Residential Sales Prices

The Mean annual prices did not reveal any effects from the TMI accident, but this does not rule out the possibility that there may have been some effects of only short duration. Analysis of the data by computing mean quarterly residential prices may reveal effects that annual means have masked. Of particular interest would be the trend in second quarter 1979 means by distance zones, for this quarter was the first one following the accident.

Table 5.2 shows mean quarterly residential prices by distance zones and by years. These data are reproduced in graph form in Figures 5.5 and 5.6 where they are more easily interpreted. As can be seen, there is not much consistency in the quarterly data among the five areas. This reflects differences in local real estate markets and also differences in the number of observations used to compute the means. The 0-5 mile zone around the TMI plant and the Williamsport area, with significantly fewer number of quarterly sales, would be expected to show greater variation in their means.

The important quarterly means are those for the second quarter of 1979; April, May and June following the accident. For all three distance zones around TMI, second quarter mean sales prices were higher than the

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[1/] An analysis of number of sales is the subject of Task E. The number of sales is presented here so the reader has some feel for the number of observations used to calculate the means.

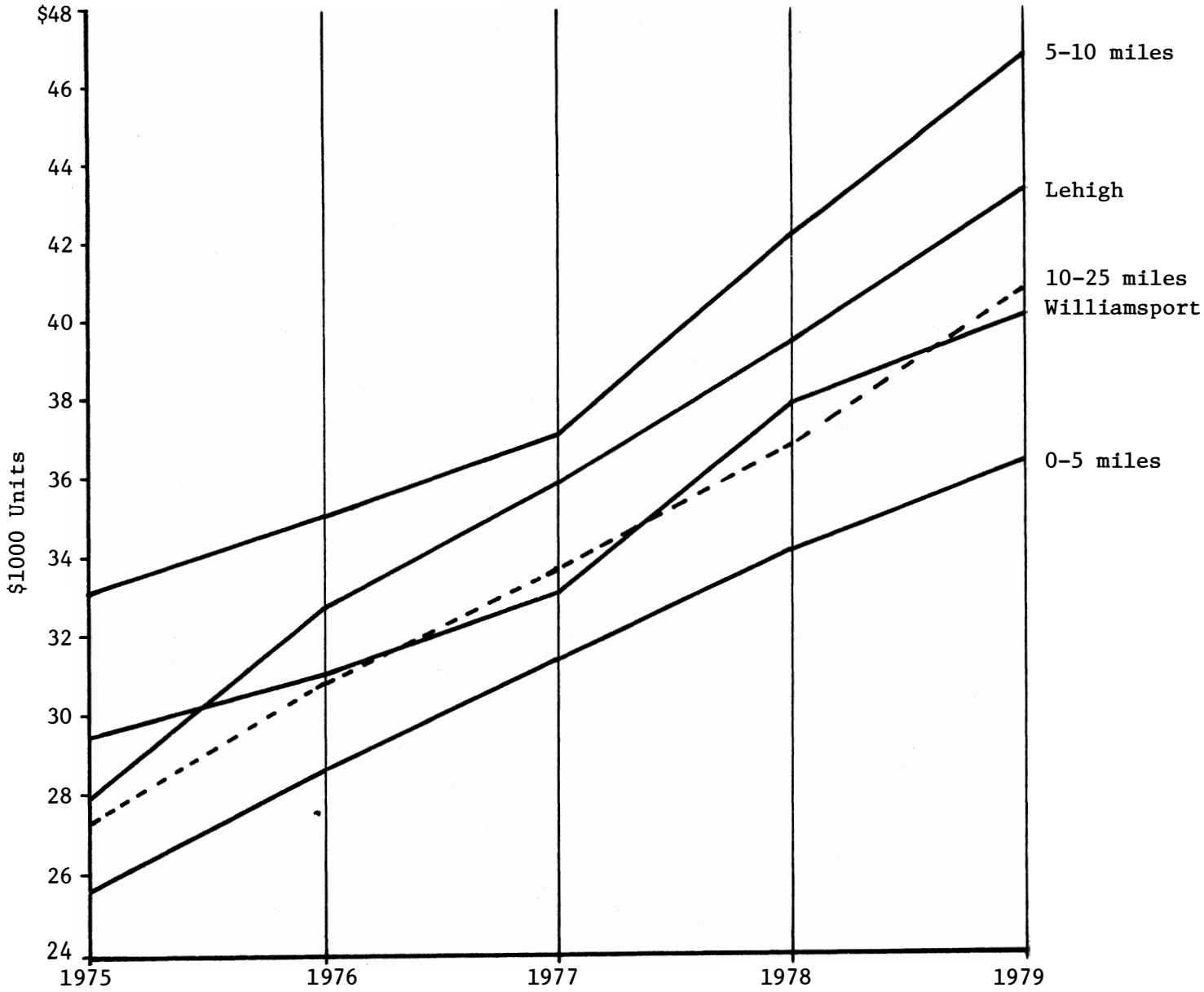

Figure 5.4 Mean Annual Residential Sales Prices, 1975-1979.

Table 5.2 Mean Quarterly Residential Sales Prices, 1975-1979.

Area	Year	Quarters 1	2	3	4
0-5 miles	1975	$25,468	$25,771	$25,840	$25,380
		(82)*	(105)	(96)	(68)
		(11,129)**	(12,460)	(12,914)	(11,347)
	'76	26,343	30,272	29,739	26,961
		(94)	(141)	(182)	(144)
		(12,652)	(13,252)	(13,531)	(14,880)
	'77	27,800	33,496	31,713	31,768
		(168)	(252)	(64)	(113)
		(13,117)	(12,858)	(12,480)	(14,021)
	'78	31,510	35,087	32,263	35,882
		(84)	(162)	(53)	(116)
		(15,350)	(15,515)	(15,092)	(16,015)
	'79	32,672	37,919	37,809	38,033
		(111)	(127)	(108)	(60)
		(15,508)	(14,909)	(17,386)	(16,088)
5-10 miles	'75	32,537	33,751	32,288	34,006
		(216)	(296)	(292)	(200)
		(15,402)	(15,261)	(13,687)	(16,094)
	'76	33,214	35,837	33,851	36,860
		(220)	(458)	(530)	(352)
		(33,661)	(16,286)	(14,941)	(16,754)
	'77	33,833	38,090	38,869	39,808
		(428)	(589)	(197)	(303)
		(15,475)	(17,741)	(15,004)	(18,155)
	'78	39,773	42,539	42,845	43,334
		(265)	(456)	(225)	(351)
		(16,083)	(18,429)	(18,465)	(18,323)
	'79	44,095	47,582	47,433	48,070
		(277)	(375)	(283)	(180)
		(18,324)	(19,888)	(20,019)	(21,238)
10-25 miles	'75	25,635	29,053	27,031	37,287
		(1788)	(2262)	(1921)	(1514)
		(13,912)	(15,029)	(14,201)	(14,630)
	'76	28,443	30,602	32,657	30,624
		(1837)	(2641)	(3139)	(2352)
		(15,301)	(15,520)	(16,304)	(15,859)
	'77	31,687	34,230	34,349	34,639
		(2682)	(3974)	(2296)	(2362)
		(15,692)	(16,769)	(17,202)	(17,448)
	'78	34,678	37,452	37,381	37,778
		(2600)	(3625)	(2356)	(2522)
		(17,694)	(18,725)	(18,251)	(18,883)
	'79	37,840	42,062	42,283	40,431
		(2498)	(3367)	(2713)	(1418)
		(19,442)	(20,657)	(20,522)	(21,539)

* Number of sales

** Standard deviation

(continued)

Table 5.2 (continued)

Area	Year	Quarters 1	2	3	4
Williamsport	1975	$31,364	$28,183	$30,000	$28,522
		(121)	(131)	(158)	(115)
		(15,677)	(12,789)	(15,425)	(13,679)
	'76	30,503	32,358	30,748	33,938
		(175)	(40)	(302)	(29)
		(14,706)	(10,915)	(14,120)	(16,672)
	'77	29,872	34,267	33,778	34,675
		(175)	(156)	(299)	(119)
		(14,287)	(14,688)	(16,946)	(15,403)
	'78	35,802	38,086	38,554	39,969
		(192)	(252)	(220)	(115)
		(16,655)	(15,732)	(16,301)	(16,783)
	'79	40,638	39,252	41,577	37,229
		(146)	(177)	(203)	(50)
		(16,880)	(16,989)	(18,679)	(15,875)
Lehigh Co.	'75	25,004	28,498	29,223	28,158
		(758)	(872)	(1291)	(712)
		(13,711)	(15,857)	(16,061)	(15,370)
	'76	30,317	33,076	33,530	33,539
		(734)	(1037)	(1069)	(441)
		(16,283)	(16,411)	(16,642)	(16,779)
	'77	33,820	36,727	35,944	36,490
		(840)	(1246)	(1099)	(846)
		(16,752)	(16,908)	(17,371)	(17,161)
	'78	36,737	40,585	40,337	39,104
		(952)	(1425)	(1389)	(720)
		(18,019)	(20,120)	(18,709)	(20,098)
	'79	39,558	44,461	44,402	44,896
		(978)	(1418)	(1107)	(789)
		(19,514)	(20,824)	(21,028)	(21,825)

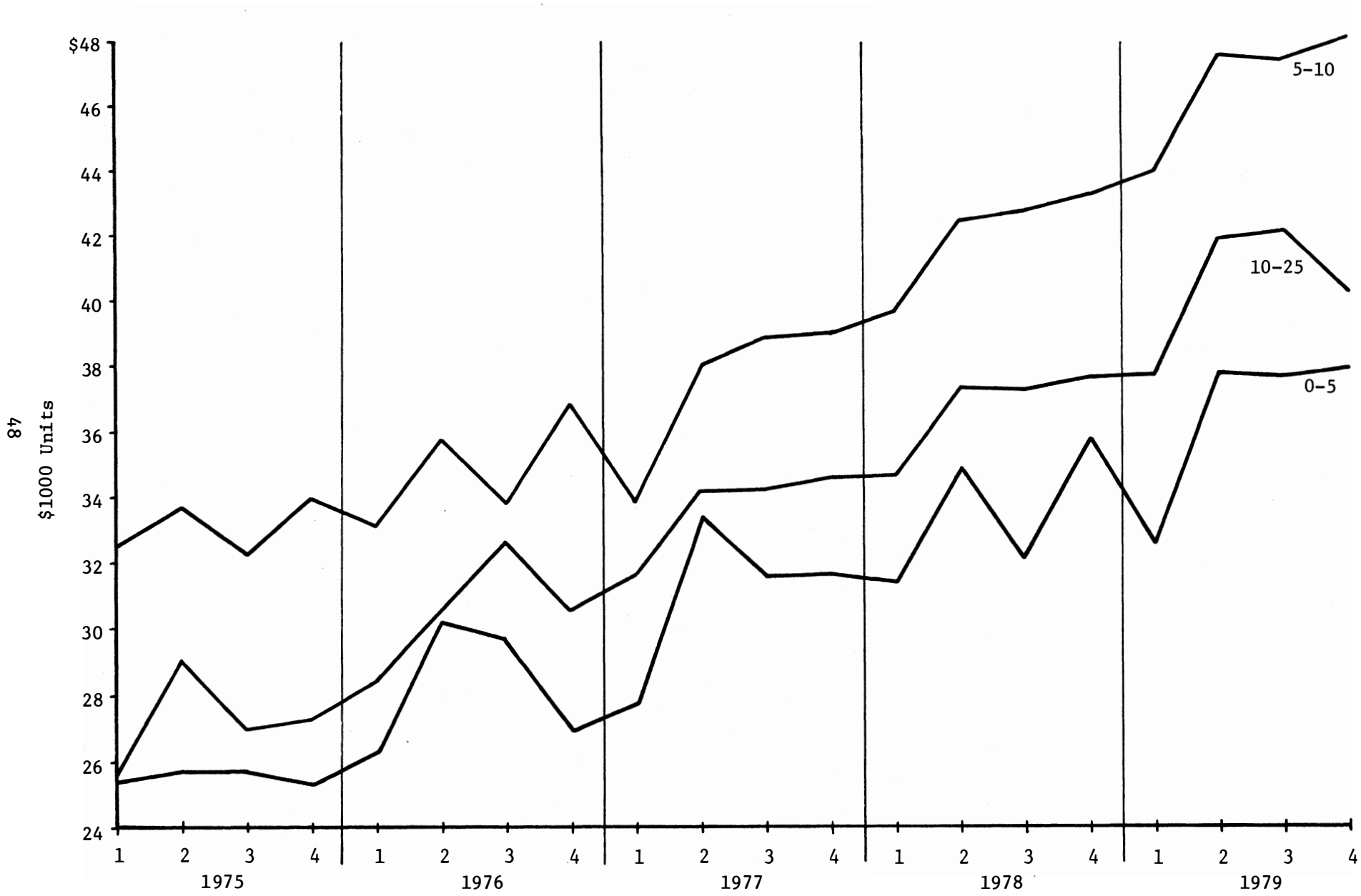

Figure 5.5 Mean Residential Sales Prices by Quarters, TMI Area, 1975-1979.

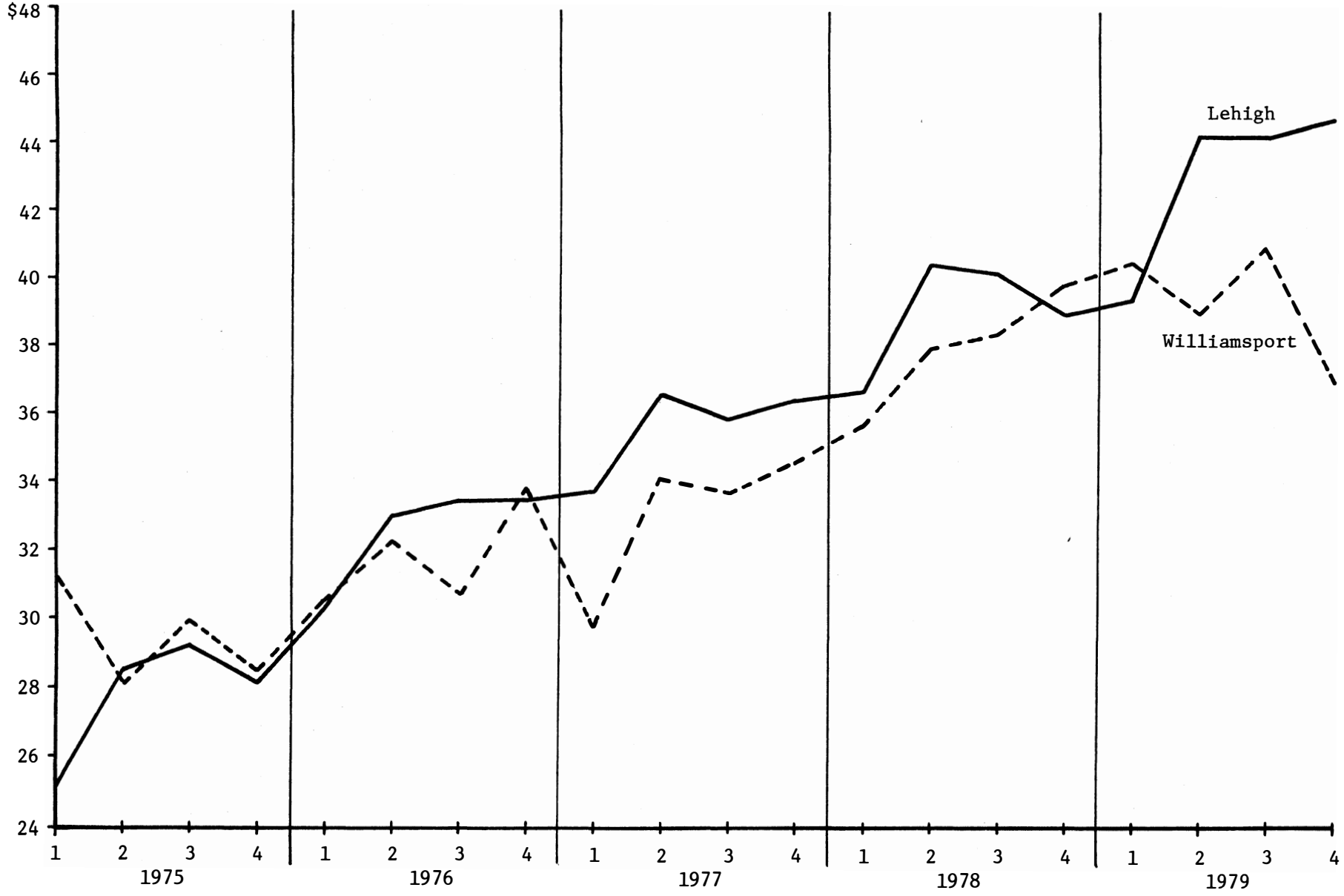

Figure 5.6 Mean Residential Prices by Quarters, Control Areas, 1975-1979.

first quarter means in every year, including 1979. Moreover, the proportionate increase in the 1979 second quarter means in those three zones was more pronounced than in any previous year, with the increases in the 0-5 mile zone being the largest of the three. Clearly, if the accident had any kind of a lasting adverse effect upon sales values it would be evident here. Except for fourth quarter sales in the 10-25 mile zone, third and fourth quarter means did not drop, as they did occasionally in previous years. The fourth quarter drop in the 10-25 mile zone mean in 1979 can hardly be rationalized by the accident, when there was no corresponding decrease in that quarter's means for the two zones closer to the plant.

The Lehigh County control area shows a trend in 1979 means quite similar to that of the 5-10 mile zone. The Williamsport 1979 quarterly means show a drop for both the second and fourth quarters, neither of which can logically be explained by the TMI accident which was so far away. Mortgage funds in the Williamsport market may have been tighter than in the other markets. This point was not investigated.

5.4 Predicting Quarterly Mean Residential Prices, 1979

An additional exercise that can be made to determine if the TMI accident affected property values is to predict what the 1979 quarterly means in the distance zones near the plant should have been based on 1975-1978 historical market trends and then statistically compare these predicted means to the actual means. If a control area is used as a data base to develop the historic market trends for the distance zones close to the plant, the analysis will be more valid.

Because of real estate market differences, particularly in 1979, in the Williamsport and Lehigh County control areas, these areas were not used as controls in this part of Task D. All the evidence to this point indicates that there were no price effects from the accident in the 10-25 mile zone around the plant. Therefore, 1975-78 mean prices in this zone were used as the historic base upon which the 1979 quarterly means in the 0-5 and 5-10 mile zones were computed. An added advantage in using the 10-25 mile zones as the control area is that any unusual effects in the greater Harrisburg real estate market area due to the general economic conditions prevalent in 1979 (high interest rates and availability of mortgage funds) would be accounted for.

To predict the mean sale prices in the 0-5 and 5-10 mile zones around TMI, we assumed that the 1979 annual means for those zones should have the same price ratios to the 10-25 mile zone mean as the ratios for the 1975-1978 base years' means. The following equation expresses this relationship:

(1) $$\underset{0-5}{1979 \text{ predicted mean}} = \begin{pmatrix} 1979 \text{ mean} \\ 10-25 \end{pmatrix} \times \left(\frac{1975-78 \text{ mean } 0-5}{1975-78 \text{ mean } 10-25} \right)$$

Substituting values in equation (1) we get:[2/]

$$40,873 \times \frac{29,958}{32,204} = 40,873 \times .9303 = \$38,022$$

The 1979 predicted mean for the 0-5 mile zone, $38,022, is $1,549 higher than the actual 1979 mean (36,473), or about 4 percent. Using the same formula, the 1979 predicted annual mean for the 5-10 mile zone is $46,818, or only $61 higher than the actual yearly mean. Thus it appears that there were no significant differences in the 1979 market in the two zones close to the plant relative to the greater Harrisburg market areas based on the previous trends over 4 years.

To predict the 1979 quarterly means for each of the distance zones, the following equation was used:

(2) $$\underset{1979 \text{ mean } 0-5}{\text{predicted 1st Quarter}} = \left(\frac{\begin{matrix} 1975-78 \text{ 1st quarter} \\ \text{mean } 0-5 \end{matrix}}{\begin{matrix} 1975-78 \text{ annual} \\ \text{mean } 0-5 \end{matrix}} \right) \times \begin{pmatrix} \text{predicted 1979} \\ \text{yearly mean } 0-5 \end{pmatrix}$$

Substituting values in the above we get:[3/]

$$\frac{27,780}{29,958} \times 38,022 = .9273 \times 38,022 = \$35,258$$

Table 5.3 shows these calculations for all distance zones and compares them to the actual 1979 quarterly means. Figure 5.7 depicts graphically the data in Table 5.3. In the 0-5 mile zone, actual mean values for the first two quarters were below the predicted means, although the rates of increase from the first to second quarter (slopes of the line) were nearly the same for both predicted and actual means. The predicted decrease in the third quarter mean did not materialize. Third and fourth quarter means for both predicted and actual values were very near alike.

For the 5-10 mile zone, first and second quarter means for predicted and actual values were almost identical. As was the case for the 0-5 mile zone, the third quarter actual means didn't decrease as much as predicted, while the fourth quarter mean did not increase quite as much as predicted.

Quarterly means for the 10-25 mile zones were predicted, although such predictions were not based on a yearly predicted mean as was the

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[2/] Simple means are used for the 1975-78 base years rather than means weighted by number of sales in each year. The four yearly means are merely summed and divided by 4. This reduces the magnitude of the effects that variation in the number of yearly sales would have.

[3/] Simple means were also used for the quarterly means.

Table 5.3. Comparison of Predicted and Actual mean residential prices by quarters, 1979, TMI area.

Zone		Quarters - 1979 1st	2nd	3rd	4th	Yearly Mean
0-5 miles	Actual $	32,672	37,919	37,809	38,033	36,473
	Predicted $	35,258	39,543	37,935	38,071	38,022
	Difference $	-2,586	-1,624	- 126	- 38	-1,549
	Difference %	- 7.33	- 4.11	- 0.33	- 0.10	- 4.07
	No. observations	111	127	108	60	406
5-10 miles	Actual $	44,045	47,582	47,433	48,070	46,757
	Predicted $	44,220	47,665	46,912	48,611	46,818
	Difference $	- 125	- 83	+ 521	- 541	- 61
	Difference %	- 0.28	- 0.18	+ 1.11	- 1.11	- 0.13
	No. observations	277	375	283	180	1115
10-25 miles	Actual $	37,840	42,062	42,283	40,431	40,873
	Predicted $	38,216	41,674	41,699	41,351	--
	Difference $	- 376	+ 388	+ 584	- 920	--
	Difference %	- 0.98	+ 0.93	+ 1.40	- 2.23	--
	No. observations	2498	3367	2713	1418	9,996

case for the two zones closer to the plant. The main purpose here was to see if there were any significant deviations in the quarterly means for the control zone. While the predicted and actual quarterly means in the 10-25 mile zone were reasonably consistent, the most noticeable feature is the greater decrease in the actual fourth quarter mean than what was predicted. We can only surmise that high interest rates and tight money were starting to be felt.

An important question that requires answering is: are the actual 1979 quarterly means significantly different from the predicted quarterly means? In particular, is the second quarter actual mean in the 0-5 mile zone significantly below the predicted mean (a $1624 difference)? If it is significantly lower, this might be related to the accident. If there are not significant differences in the quarterly means, then whatever differences do exist are due to normal random variations.

The null hypothesis (H_o) is that there is no statistically significant difference between the predicted and actual mean values. The alternative hypothesis (H_A) is that there is a statistically significant difference.

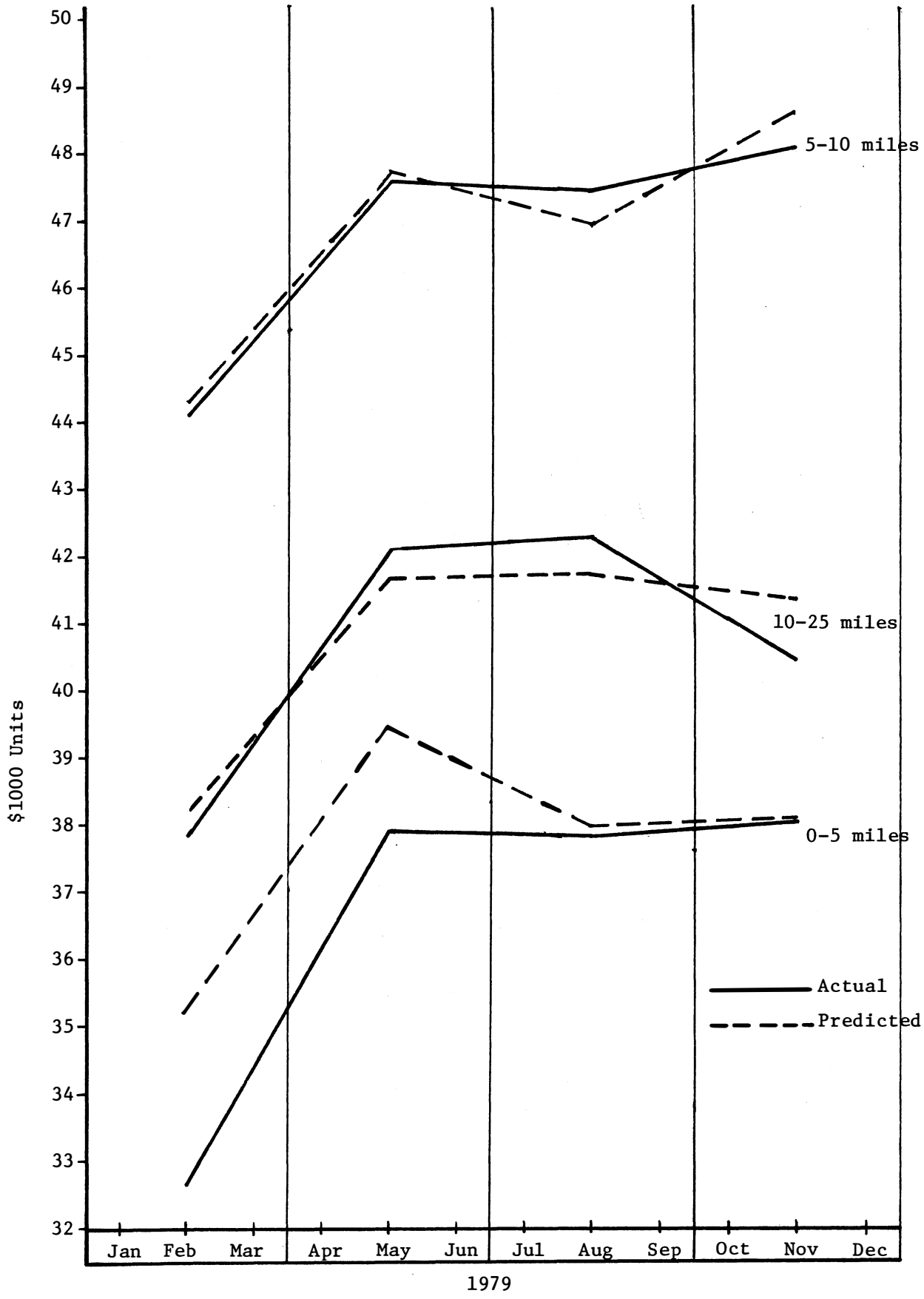

Figure 5.7 Predicted and Actual Quarterly Mean Residential Prices, 1979, TMI Area.

To test the differences in the mean values for significance, a two-tailed t-test is used. The statistic is given by (with n-1 degrees of freedom):

$$(3) \qquad t = \frac{\bar{X} - \mu}{S/\sqrt{n}}$$

where $\bar{X}$ is the actual mean, μ is the predicted mean, S is the standard deviation of the actual sales, and n is the sample size (number of observations).[4/] The denominator of the equation is also known as the standard error of the mean.

To illustrate the calculations, the calculated t value for the second quarter means in the 0-5 mile zone is:

$$t = \frac{37,919 - 39,543}{14,904/\sqrt{127}} = \frac{-1,624}{1,322} = -1.228$$

This t statistic in absolute value is less than the critical value of 2.625 (with 110 degrees of freedom) for the two-tailed test at the 99 percent confidence level. Therefore, the alternative hypothesis must be rejected and the null hypothesis accepted: There is no significant difference between the actual first quarter mean sales price and the predicted mean in the 0-5 mile zone based on 1975-78 market trends in the greater Harrisburg area. The t statistics for all quarters and for all zones are shown in Table 5.4.

Table 5.4 Tests of significance for differences in actual and predicted quarterly mean sales prices by distance zones, 1979.

Zone	Quarter	t values	Critical t values*
0-5 miles	1	- 1.757	2.625
	2	- 1.228	2.617
	3	- .075	2.625
	4	- .018	2.660
5-10 miles	1	- .114	2.576
	2	- .081	2.576
	3	+ .438	2.576
	4	- .342	2.576
10-25 miles	1	- .967	2.576
	2	+ 1.090	2.576
	3	+ 1.482	2.576
	4	- 1.608	2.576

* with n-1 degrees of freedom at the 99 percent confidence level.

[4/] We recognize that there is some sampling error associated with the predicted mean, μ, but because of the quite large number of observations we feel that it is a very reliable point estimate of the mean.

As can be seen in Table 5.4, there was not one quarter in 1979 in any of the three distance zones in which there was a statistically significant difference between the actual and predicted mean sales prices. The first quarter t value in the 0-5 mile zone is approaching significance, particularly if we would calculate the statistic at the 95 percent confidence level, and considering the possible sampling error in the predicted mean. However, this is a period before the accident and therefore bears no relation to the accident. We must conclude that the TMI accident had no lasting adverse effects on residential prices.

5.5 Predicting Monthly Mean Residential Prices, 1979

The quarterly analysis alone revealed no lasting effects on housing prices, but might there have been a negative effect of quite short duration, say a month or so, that would be masked by the quarterly data? This section of Task D explores this question.

Calculating the predicted monthly means for 1979 by distance zones was done in the same fashion as was used to calculate the predicted quarterly means, only monthly data were used in equation (2) instead of quarterly data. Because much fewer observations occur in any one month, an unusually low or high value sale of a property could affect the mean for that month, making interpretation of the results difficult.[5/] Therefore, the sales data were screened to eliminate extraordinarily high or low sales values where they existed. Individual sales that were below 14 percent or over 300 percent of the yearly mean for the respective distance zone were eliminated.[6/] For example, in 1979 the following sales were eliminated in each of the distance zones:

		Percent of Properties Eliminated
0-5 miles	< $5,000 and > $109,500	2.2%
5-10 miles	< 6,500 and > 138,600	1.8
10-25 miles	< 5,700 and > 122,600	4.1

[5/] Unusually low valued properties generally were for dwellings that were so deteriorated as to be uninhabitable. The sale of an unusually high valued property generally is infrequent, thus likely to distort the mean for that particular month.

[6/] Properties that sold in 1979 in the 0-5 mile zone for under $5,000 were found, upon field observation, to be dilapidated. This value is about 14 percent of the 1979 mean of this zone. We arbitrarily selected a value three times the 1979 mean for each zone as the cut-off value for unusually expensive properties.

Tables 5.5, 5.6, and 5.7 show a comparison of the predicted and actual monthly mean sales prices for the 0-5, 5-10, and 10-25 mile zones, respectively. Figures 5.8 and 5.9 plot the predicted and actual means in graph form to make them easier to interpret.

As is to be expected, the differences in the monthly predicted and actual means are greater for the 0-5 mile zone than they are for the other two zones. This is probably due to the fewer number of monthly sales, resulting in a larger standard deviation around the mean. The important months to examine in the 0-5 and 5-10 mile zones are April, May, and June, the months immediately following the accident. For the 0-5 mile zone, the April mean price was predicted to rise from $36,479 in March to $39,291. Instead, it dropped to $35,963; $3,328 less than predicted. After a slight decrease from April to May, which was predicated, the actual mean rose dramatically in June to $39,980, about $1,400 higher that the predicted June mean. For the 5-10 and 10-25 mile zones, the actual mean prices for April, May, and June were quite in line with the predicted means.

Is the $3,328 difference in predicted and actual means for April in the 0-5 mile zone a significant difference, which might imply some effect from the accident, or is it simply a statistical artifact? As was done in the previous section, two-tailed t tests were run on the monthly differences in the predicted and actual means to determine if they were significant. The results are shown in Table 5.8. For the month of April in the 0-5 mile zone, the t value of 1.683 is less than the critical t value of 2.680 at the 99 percent confidence level. This means that there is no significant difference in the means and that the $3,328 difference can be explained by normal variation in the market.

There is only one month in which there is a significant difference in the predicted and actual monthly means, and this is January for both the 0-5 and 5-10 mile zones. In the 0-5 mile zone, the actual mean price was significantly lower, while in the 5-10 mile zone the actual mean was significantly higher than the predicted means. We know of no explanation for these differences. Since they occurred before the TMI accident, they cannot be associated in any way with it.

Although none of the following differences are statistically significant, in 6 of the 9 months following the accident the actual means were higher than the predicted means in both the 5-10 and 10-25 mile zones, while in the 0-5 mile zone 3 months out of the 9 showed higher actual means than predicted. This occurred during a time of rapidly rising interest rates and tight supply of mortgage funds. There is no evidence from the analysis of monthly mean residential prices to support the belief that the TMI accident had any adverse effect on the prices of housing in the TMI area.

Table 5.5 Predicted and Actual Monthly Mean Residential Prices, 1979
0-5 miles

Month	No. Observations	Predicted	Actual	Standard Deviation	Difference	Percent
		$	$	$	$	%
Jan	31	34,795	26,279	13,608	-8,516	-24.5
Feb	37	34,200	32,520	12,617	+ 320	+ 0.9
March	43	36,479	37,410	17,548	+ 931	+ 2.6
April	49	39,291	35,963	13,839	-3,328	- 8.5
May	16	37,982	35,992	14,600	-2,060	- 5.4
June	62	38,577	39,980	15,740	+1,403	+ 3.6
July	29	36,256	32,241	15,305	-4,015	-11.1
Aug	39	36,999	35,282	14,082	-1,717	- 4.6
Sept	40	41,689	44,309	19,884	+2,620	+ 6.3
Oct	34	38,705	41,826	16,169	+3,121	+ 8.1
Nov	8	36,064	32,519	21,527	-3,545	- 9.8
Dec	18	37,481	33,339	11,561	-4,142	-11.1

Table 5.6 Predicted and Actual Monthly Mean Residential Prices, 1979
5 - 10 miles

Month	No. Observations	Predicted	Actual	Standard Deviation	Difference	Percent
		$	$	$	$	%
Jan	79	40,068	46,176	18,487	+6,108	+15.2
Feb	93	45,756	41,266	19,586	-4,490	- 9.8
March	105	44,349	45,035	16,866	+ 686	+ 1.5
April	149	47,154	47,060	18,139	- 94	- 0.2
May	69	45,663	45,783	20,202	+ 120	+ 0.3
June	157	48,329	48,865	21,313	+ 539	+ 1.1
July	80	46,038	47,065	18,202	+1,027	+ 2.2
Aug	102	46,293	43,769	20,250	-2,524	- 5.5
Sept	101	50,041	51,425	20,612	+1,384	+ 2.8
Oct	82	47,797	49,057	22,213	+1,260	+ 2.6
Nov	42	51,129	49,719	22,443	- 410	- 0.8
Dec	56	46,441	45,388	18,828	-1,053	- 2.3

Table 5.7 Predicted and Actual Monthly Mean Residential Prices, 1979
10 - 25 miles

Month	No. Observations	Predicted	Actual	Standard Deviation	Difference	Percent
		$	$	$	$	%
Jan	885	37,266	35,720	19,277	-1,546	-4.1
Feb	733	37,192	38,350	19,845	+1,158	+3.1
March	880	39,973	39,549	19,104	- 424	-1.1
April	1067	41,273	41,477	19,730	+ 204	+0.5
May	994	41,395	40,443	20,556	- 952	-2.3
June	1306	42,362	43,772	21,358	+1,410	+3.3
July	876	41,116	42,303	20,304	+1,187	+2.9
Aug	1021	42,456	42,854	20,801	+ 398	+0.9
Sept	816	40,221	41,546	20,482	+1,325	+3.3
Oct	599	41,879	41,180	20,730	- 699	-1.7
Nov	418	41,640	39,375	21,774	-2,265	-5.4
Dec	401	40,026	40,412	22,448	+ 386	+1.0

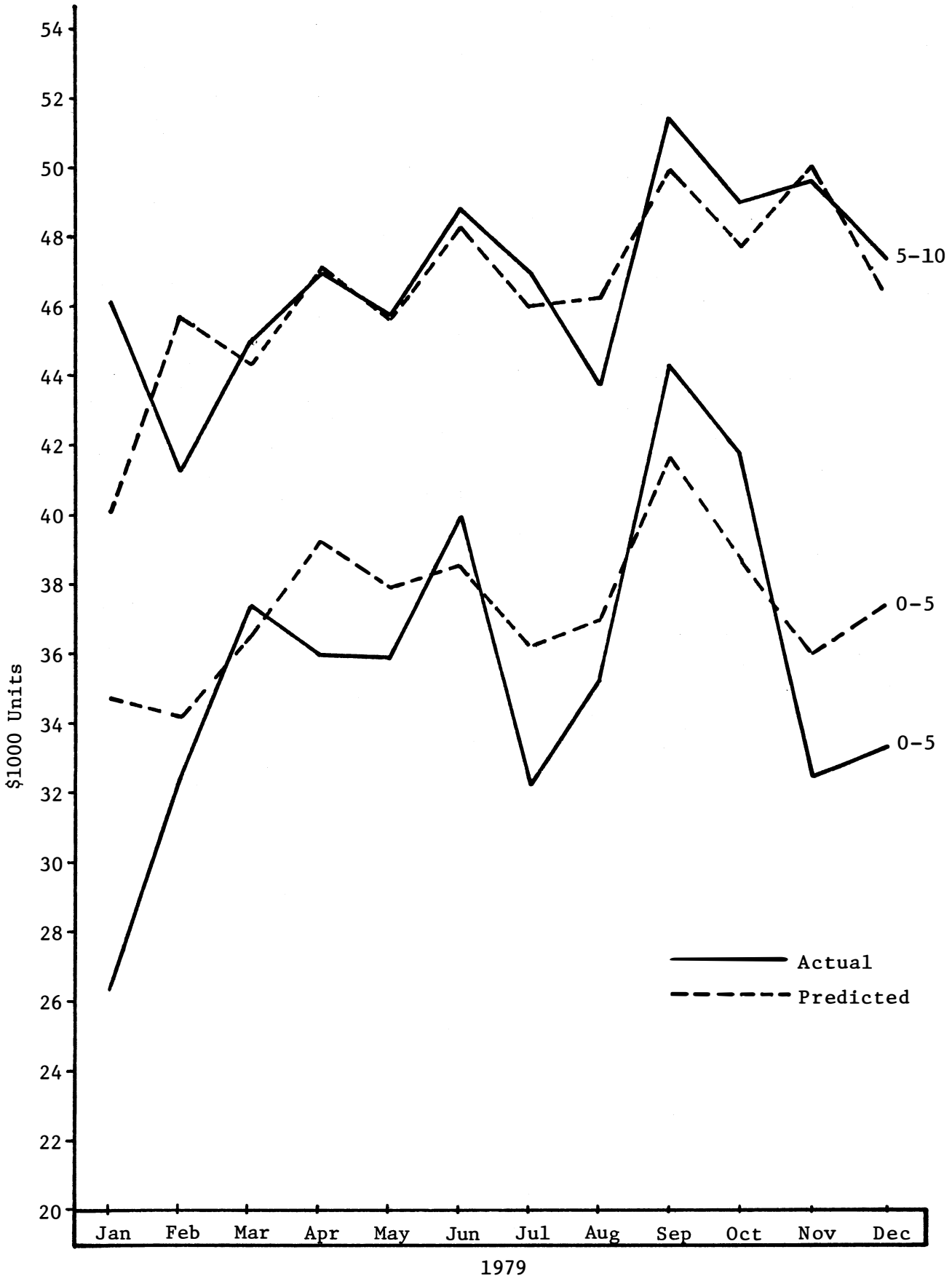

Figure 5.8 Actual and Predicted Monthly Mean Residential Prices, 1979.

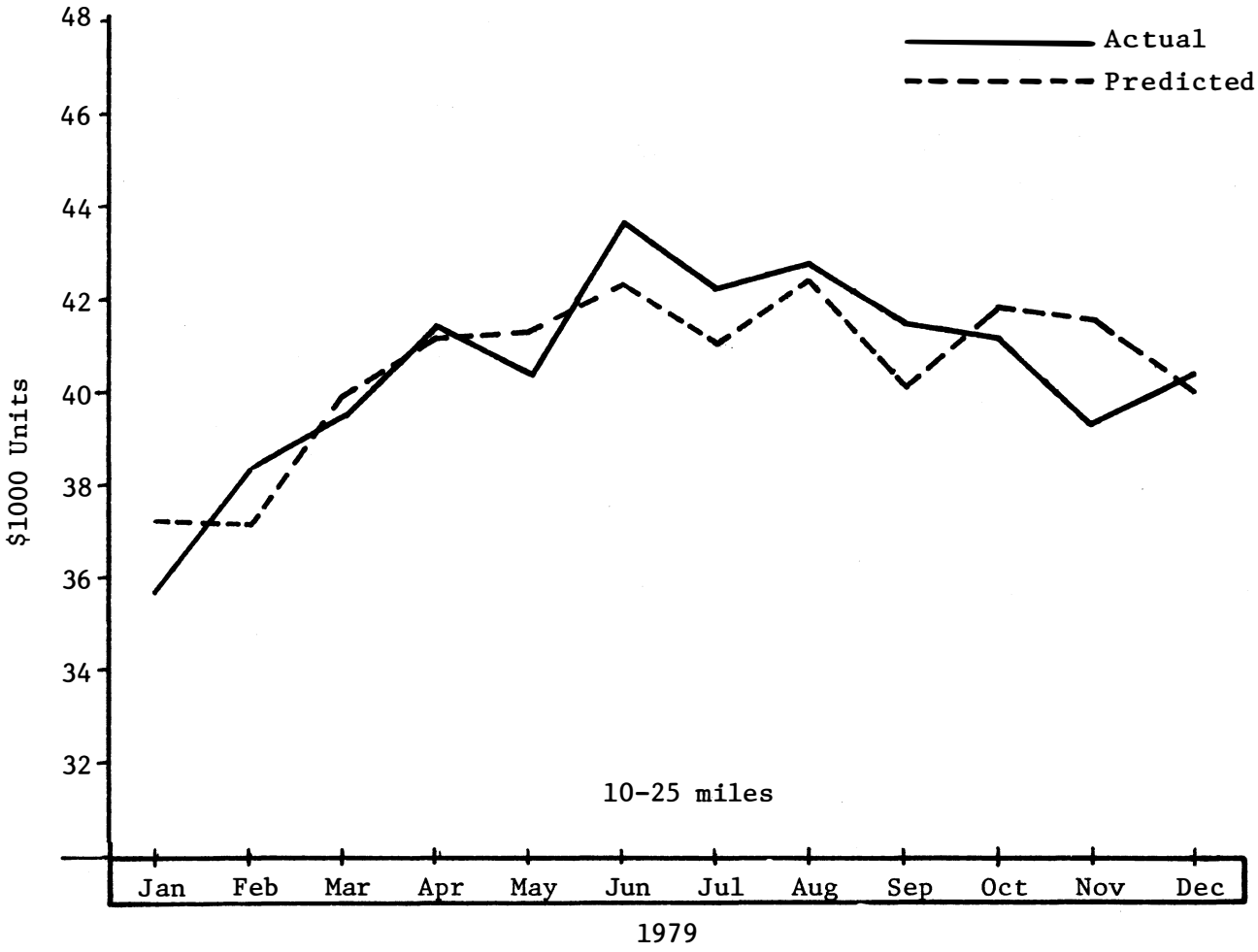

Figure 5.9 Actual and Predicted Monthly Mean Residential Prices, 1979.

Table 5.8 Tests of significance for differences in actual and predicted monthly mean sale prices by distance zones, 1979.

Month	0-5 miles		5-10 miles		10-25 miles	
	t values	critical t*	t values	critical t*	t values	critical t*
January	-3.484	2.750	+2.937	2.642	-2.386	2.576
February	+ .154	2.720	-2.211	2.629	+1.580	2.576
March	+ .348	2.698	+ .417	2.625	- .658	2.576
April	-1.683	2.680	- .063	2.576	+ .338	2.576
May	- .564	2.947	+ .049	2.647	-1.460	2.576
June	+ .702	2.658	+ .317	2.576	+2.386	2.576
July	-1.413	2.763	+ .505	2.640	+1.730	2.576
August	- .761	2.712	-1.259	2.625	+ .611	2.576
September	+ .833	2.699	+ .675	2.625	+1.848	2.576
October	+1.125	2.734	+ .514	2.637	- .825	2.576
November	- .466	3.499	- .118	2.701	-2.127	2.576
December	-1.52	2.898	- .419	2.669	+ .344	2.576

* with n-1 degrees of freedom at the 99 percent confidence level.

5.6 Conclusions

This task has analyzed the historic trend from 1975 to the end of 1979 of annual and quarterly mean residential prices in three distance zones around the TMI plant. Based on past trends, quarterly and monthly mean prices for 1979 in the three zones were predicted and statistically compared to the actual quarterly and monthly means. No significant differences occurred in any of the four quarters or in any months following the accident for the three distance zones. Based on this analysis, we must conclude that the TMI accident had no effects on single family residential prices during 1979.

VI. TASK E

6.1 Introduction

To gain greater insight into the effects, if any, of the TMI accident on the real estate market in the Harrisburg area, it is necessary to analyze the number or volume of sales as well as the sales prices. Even though the mean prices of housing may not show a significant effect, there may be significant changes of short duration in the number of properties sold in the market. This task, using the same data base as was used in Task D (all valid sales from 1975 through 1979 in the Harrisburg area and control areas), analyzes the effect of the accident on the number of sales in three distance zones around the plant: 0-5, 5-10, and 10-25 miles.

Perhaps a brief explanation of the real estate market would be helpful to understand why, in the short run, a significant change in demand may have little, if any, effect on price. For most normal kinds of goods, the interaction of supply and demand in the short run establishes a market price. While a single family house is a "normal" good in the economic meaning of the term, there are so many unusual aspects associated with it that the market in which they are bought and sold is a very special market. For most people, a house is the single most expensive purchase they make in their lifetimes. Few people have sufficient financial assets to purchase outright a home; therefore, the money must be borrowed and mortgage negotiations take time.

Purchasing real property involves the acquisition of a "bundle of rights" to the land, and these rights, along with the property survey should be investigated for their legality by the prospective buyer before purchase. Because housing characteristics vary so widely (not just the physical characteristics of the house and lot, such as number of rooms, floor plan, type of construction and lot size, but also the location in terms of streets, neighborhood, and urban center) prices vary widely and in most markets prospective buyers have a wide latitutde of choice. Moreover, sellers are usually not compelled to dispose of a property immediately. Most sellers can wait out temporary perturbations in the market, or hold on to their property within reasonable time limits, until a buyer comes along who is willing to negotiate a price. Because of these characteristics peculiar to the real estate market, there can be short periods of time in which mean housing prices change little but the volume of sales shows much greater variation.

High interest rates and the tightness in supply of mortgage funds acts as a constraint in the real estate market. Even though mortgage funds from financial institutions were severely constrained in the latter part of 1979, sales could still be consumated because in some cases sellers were willing to hold a first or second mortgage on their properties, or the buyer could assume the present mortgage. These kinds of negotiations tend to ease a credit crunch in the real estate market.

6.2 Number of Residential Sales by Quarters

Table 5.2 in the previous section shows the number of residential sales by quarters in the three distance zones and in the control areas for the years 1975-1979. These data are plotted in Figures 6.1 and 6.2. The most striking feature of these graphs is the wide seasonal variation in sales volume. In most years in the TMI study area and in Lehigh County sales volume peaks in the second quarter (April-May-June) of each year and then drastically falls off during the third (summer) quarter, although this latter trend is not so pronounced in Lehigh County.[1/] The three distance zones around TMI show remarkably similar quarterly trends in sales volumes, which is not surprising since they are all part of the greater Harrisburg real estate market.

If the TMI accident had a strong effect on the number of sales over at least a three-month period, one would logically expect this to show up in the second quarter data for the zone nearest the plant. Figure 6.1 shows that sales volume increased from the first quarter to the second quarter in the 0-5 mile zone, but the rate of increase (slope of the line) was not as high in 1979 for that quarter as it was for the same quarters in previous years. In the 5-10 and 10-25 mile zones, the second quarter 1979 rates of increase in sales volumes were about the same as in previous years. In the Lehigh control area the second quarter rates of increase were high in all years. There is some evidence here that the TMI accident may have had a slight adverse effect on the number of sales in the 0-5 mile zone during the second quarter of 1979, the quarter immediately following the accident. There is no evidence from those data that the accident affected sales volumes in the 5-10 and 10-25 mile zones. The rather drastic decrease in sales volumes the last two quarters of 1979 in the 10-25 mile zone, a rate of decrease greater than that for the 0-5 or 5-10 mile zones, is probably due to the economic conditions in the market at that time. This is also evident in the decrease in sales volumes for the last two quarters in the Lehigh County real estate market. The lesser rate of decrease in those two quarters in the 0-5 mile zone might be indicative of the influx of clean-up workers brought into the area by the utility.

In an approach similar to that used in Task D to predict mean quarterly sales prices, the number of quarterly sales by distance zones and control areas were predicted and compared to the actual number of quarterly sales. We assumed the 10-25 mile zone had no adverse effects from the accident and could serve as a control for the 0-5 and 5-10 mile zones, a not unreasonable assumption after examining the data in Figure 6.1. Based on the 1975-78 historic trend of the ratio of annual sales in the 0-5 and 5-10 mile zones to the number in the 10-25 mile zones, total sales volume for 1979 was first predicted for each of the two closer zones. Then, based on the 1975-78 historic trend of quarterly shares of annual sales volume in each of the two zones, sales volumes for each of the

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[1/] Monthly data were not reported for 1975 and 1976 in the Williamsport control area, so the adjustments from recording months to sales months could not be made.

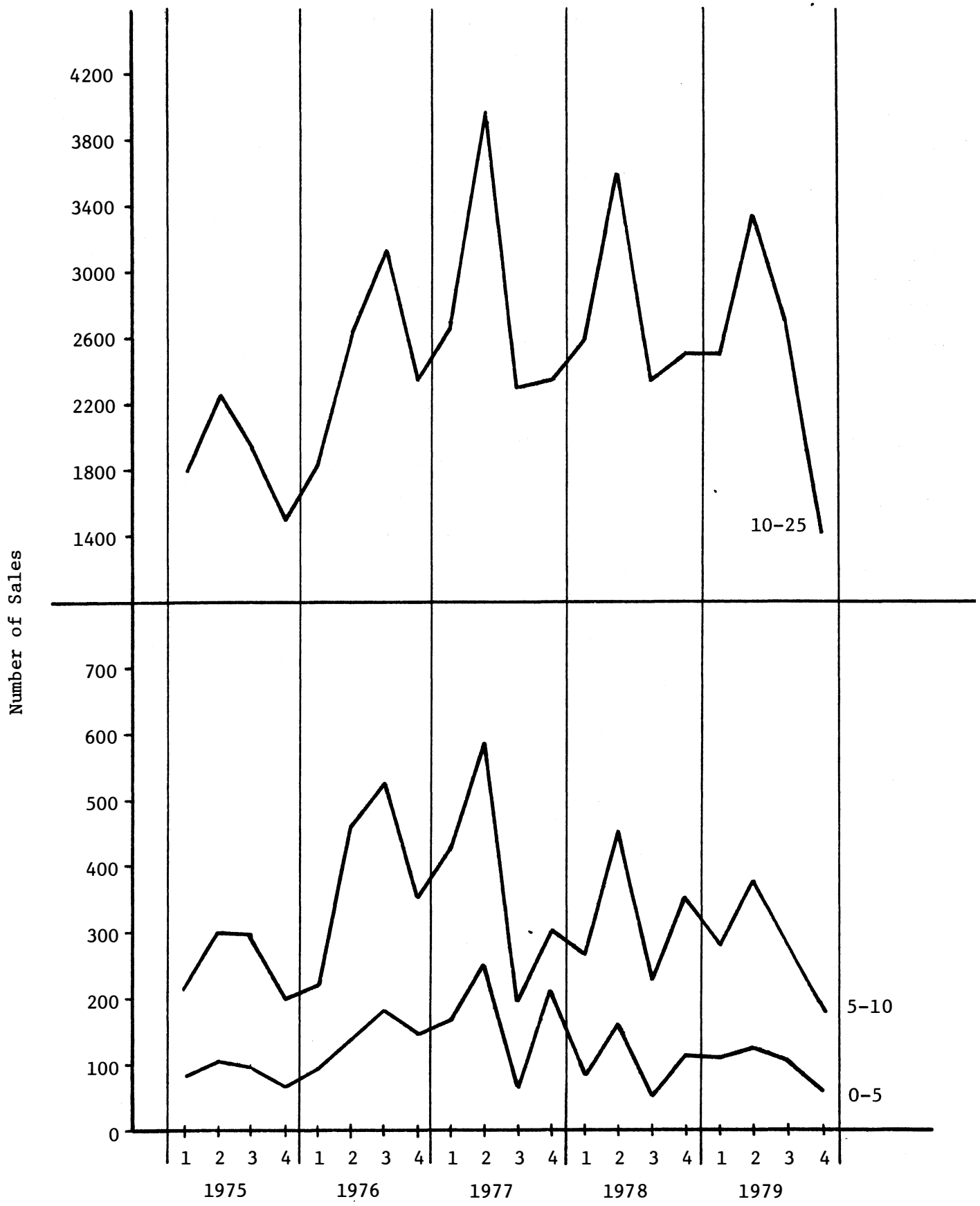

Figure 6.1 Number of Residential Sales by Quarters, 1975-79.

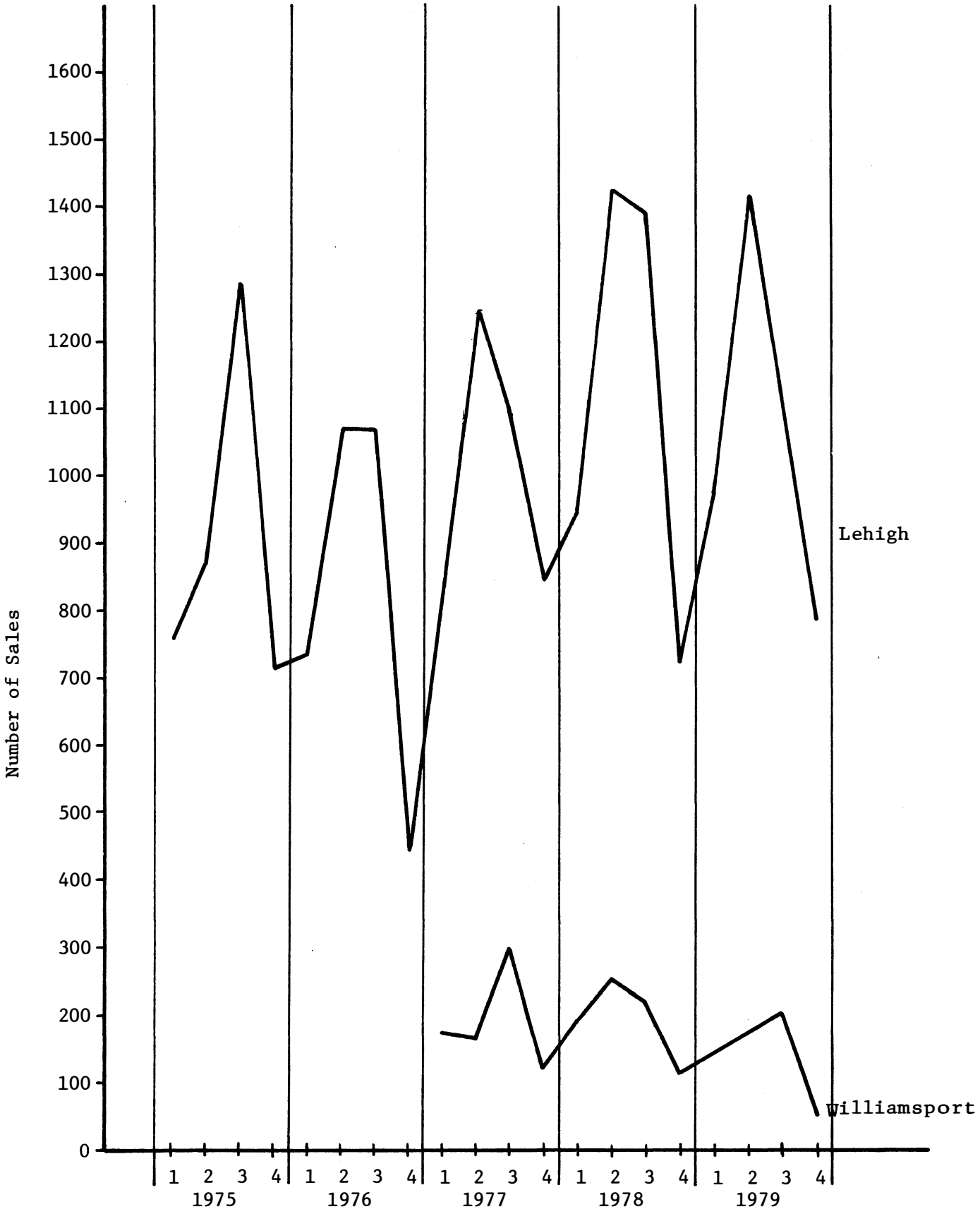

Figure 6.2 Number of Residential Sales by Quarters, 1975-79.

two zones, sales volumes for each of the 1979 quarters for each zone were predicted. Only the latter procedure was used for the control areas, since there was no attempt made to predict the yearly 1979 sales volumes for them. The quarterly predictions for the Williamsport control area are based on only two years of data, since we did not have quarterly data for 1975-76. The results are shown in Table 6.1.

Because of the inconsistency in the signs of the third and fourth quarter comparisons of predicted and actual sales volumes in the 10-25 mile zone, Lehigh County, and Williamsport areas, we decided to examine the quarterly sales volumes for all of Pennsylvania exclusive of the sales in the City of Philadelphia. These data are also shown in Table 6.1.

Table 6.1 Predicted and actual number of quarterly sales, 1979.

		Quarters			
		1	2	3	4
0-5	predicted	107	165	99	110
	actual	111	127	108	60
	difference	+ 4	- 38	+ 9	- 50
	% difference	+ 3.7	-23.0	+ 9.1	-45.5
5-10	predicted	283	451	312	302
	actual	277	375	283	180
	difference	- 6	- 76	- 29	- 122
	% difference	- 2.1	-16.9	- 9.3	-40.4
10-25	predicted	2233	3134	2435	2194
	actual	2498	3367	2713	1418
	difference	+ 265	+ 233	+ 278	- 776
	% difference	+11.9	+ 7.4	+11.4	-35.4
Lehigh	predicted	911	1281	1345	755
	actual	978	1418	1107	789
	difference	+ 67	+ 137	- 238	+ 34
	% difference	+ 7.4	+10.7	-17.7	+ 4.5
Williamsport	predicted	138	154	196	88
	actual	146	177	203	50
	difference	+ 8	+ 23	+ 7	- 38
	% difference	+ 5.8	+14.9	+ 3.6	-43.2
All PA less Phila.	predicted	23,958	33,631	33,942	25,887
	actual	22,937	38,682	29,752	26,013
	difference	-1,021	+5,051	-4,190	+ 126
	% difference	- 4.3	+15.0	-12.3	+ 0.5

To make interpretation of the data easier, they are plotted in Figures 6.3, 6.4, and 6.5. The percentage differences in predicted and actual quarterly sales are summarized in Table 6.2 and are shown in bar graph form in Figure 6.6.

Table 6.2 Summary of percentage differences in predicted and actual quarterly sales volumes, TMI and control areas, 1979.

	Quarters			
	1	2	3	4
	%	%	%	%
0-5	+ 3.7	-23.0	+ 9.1	-45.5
5-10	- 2.1	-16.9	- 9.3	-40.4
10-25	+11.9	+ 7.4	+11.4	-35.4
Lehigh Co.	+ 7.4	+10.7	-17.7	+ 4.5
Williamsport	+ 5.8	+14.9	+ 3.6	-43.2
All PA	- 4.3	+15.0	-12.3	+ 0.5

The most important quarter to examine is the second (April, May and June), for it is logical to expect that the most severe disruptions to the market, if they occurred, would have been felt over this time period. Second quarter 1979 actual sales volumes in the 0-5 and 5-10 mile zones were 23 and 17 percent, respectively, below the sales volumes one would expect to find based on the previous four-year historical trend in the 10-25 mile zone control area. In contrast, second quarter actual sales volumes were higher (by from 7 to 15 percent) than predicted sales in the four control areas. This appears to offer rather strong evidence that the accident did have somewhat of a disruptive effect on the real estate market within 10 miles of the plant, particularly since the adverse effect was stronger in the zone nearest the plant.

Third and fourth quarter differences in predicted and actual number of sales varied considerably between the areas, with no apparent pattern evident. The fact that third quarter actual sales in the 0-5 mile zones were higher in number than predicted leads one to conclude that if there were adverse effects in the second quarter they were of short duration (a conclusion that seems to be substantiated by the opinions of the majority of realtors and contractors that were interviewed--see Task F).

A strong decline in fourth quarter sales volume from that which was predicted is strikingly apparent in Figure 6.6 for the three zones around TMI and for the Williamsport control area. In contrast, the Lehigh and all Pennsylvania control areas had a slight excess of actual over predicted number of sales for that quarter. We do not feel that the fourth quarter decline in the greater Harrisburg area was related to the accident for two reasons: (1) the Williamsport area had an equally sharp decline,

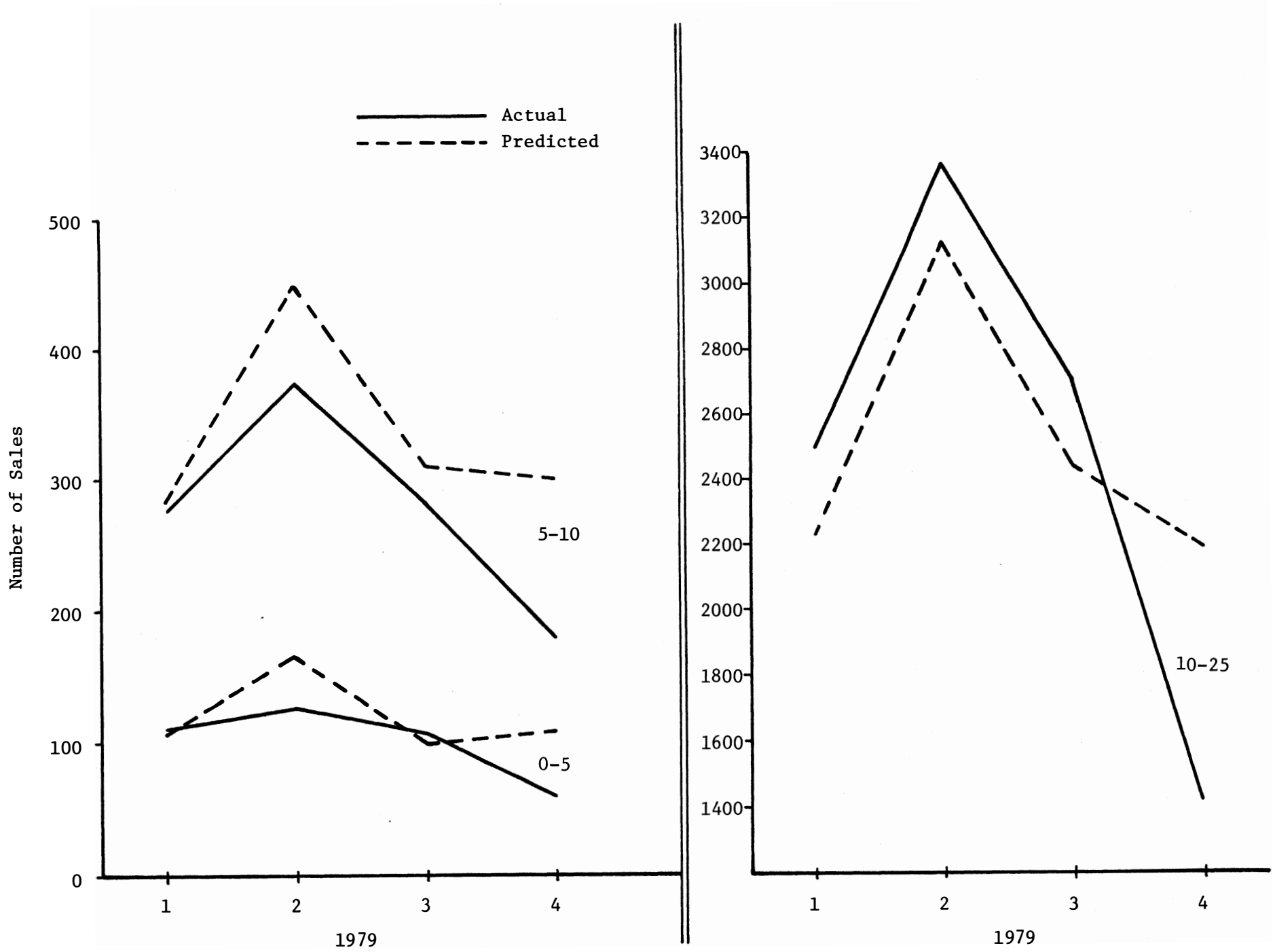

Figure 6.3 Predicted and Actual Number of Sales by Quarters, 1979, TMI Area.

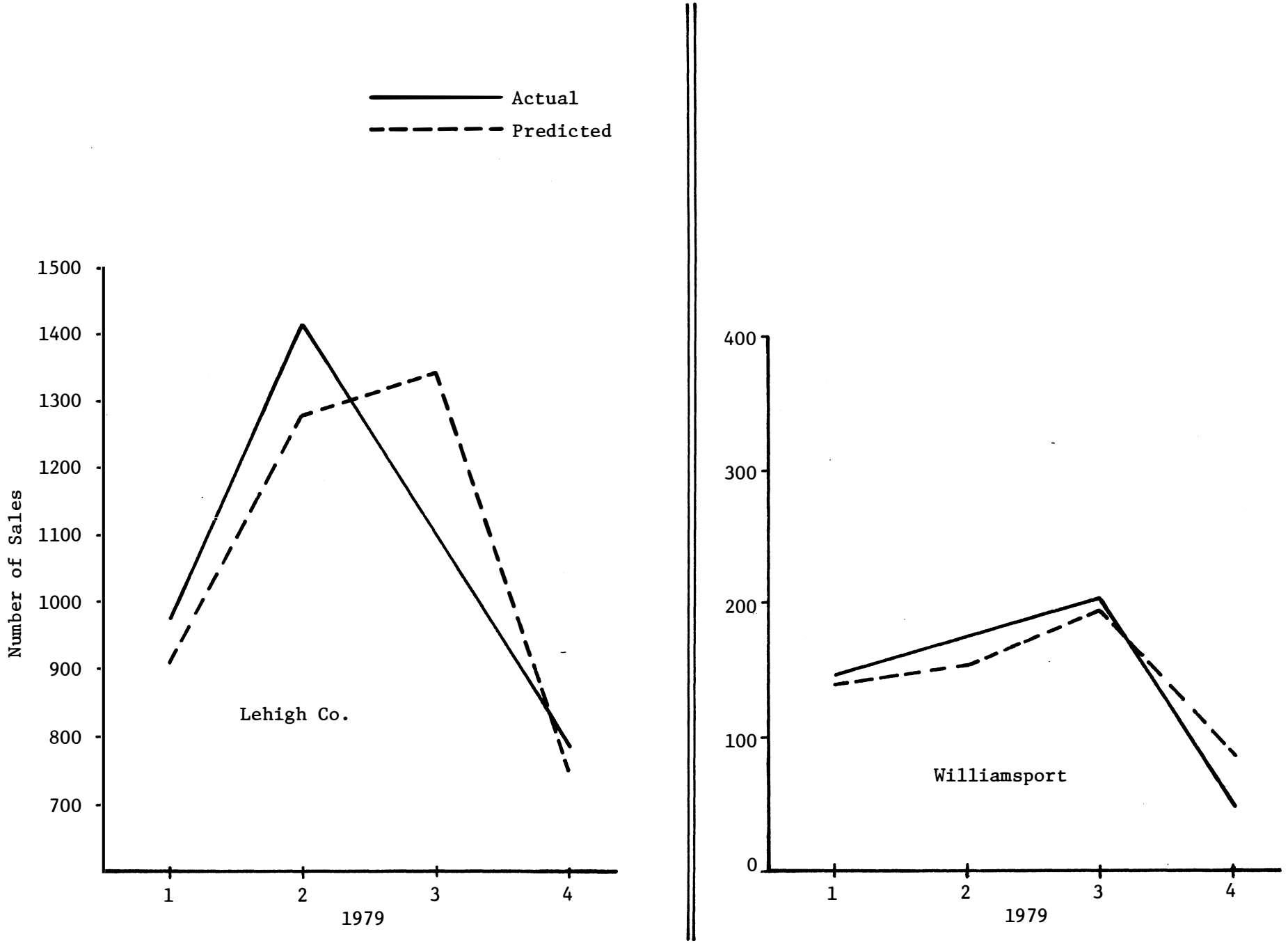

Figure 6.4 Predicted and Actual Number of Sales by Quarters, 1979, Control Areas.

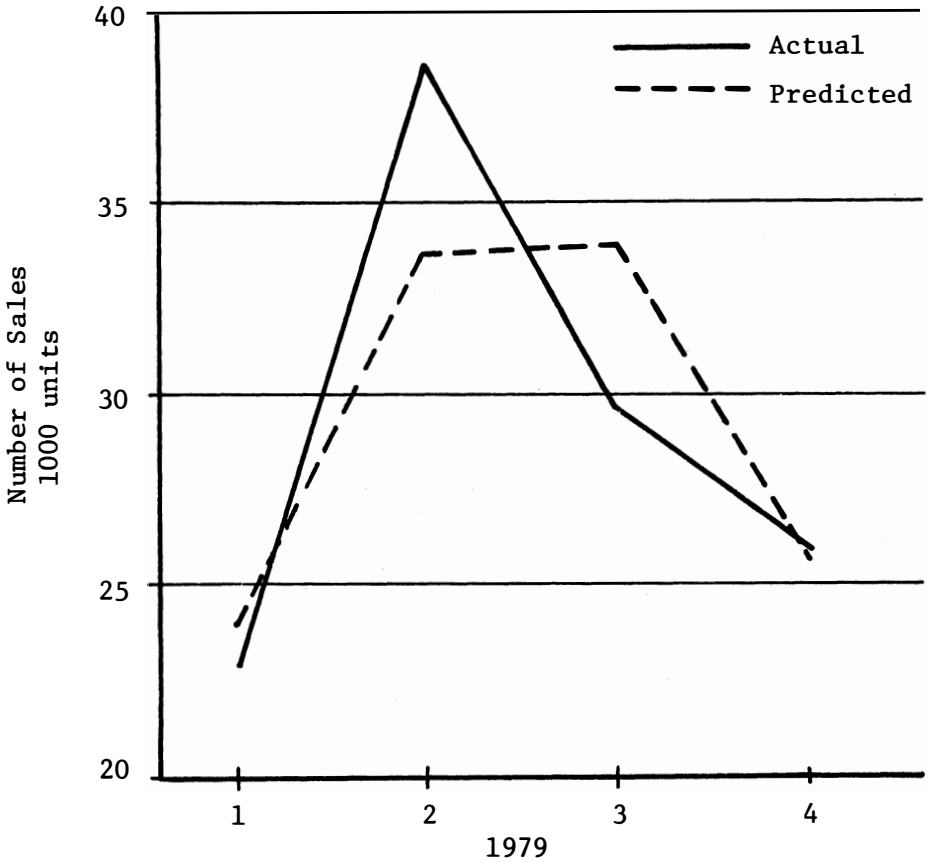

Figure 6.5 Predicted and Actual Number of Residential Sales by Quarters, 1979, all PA less Philadelphia.

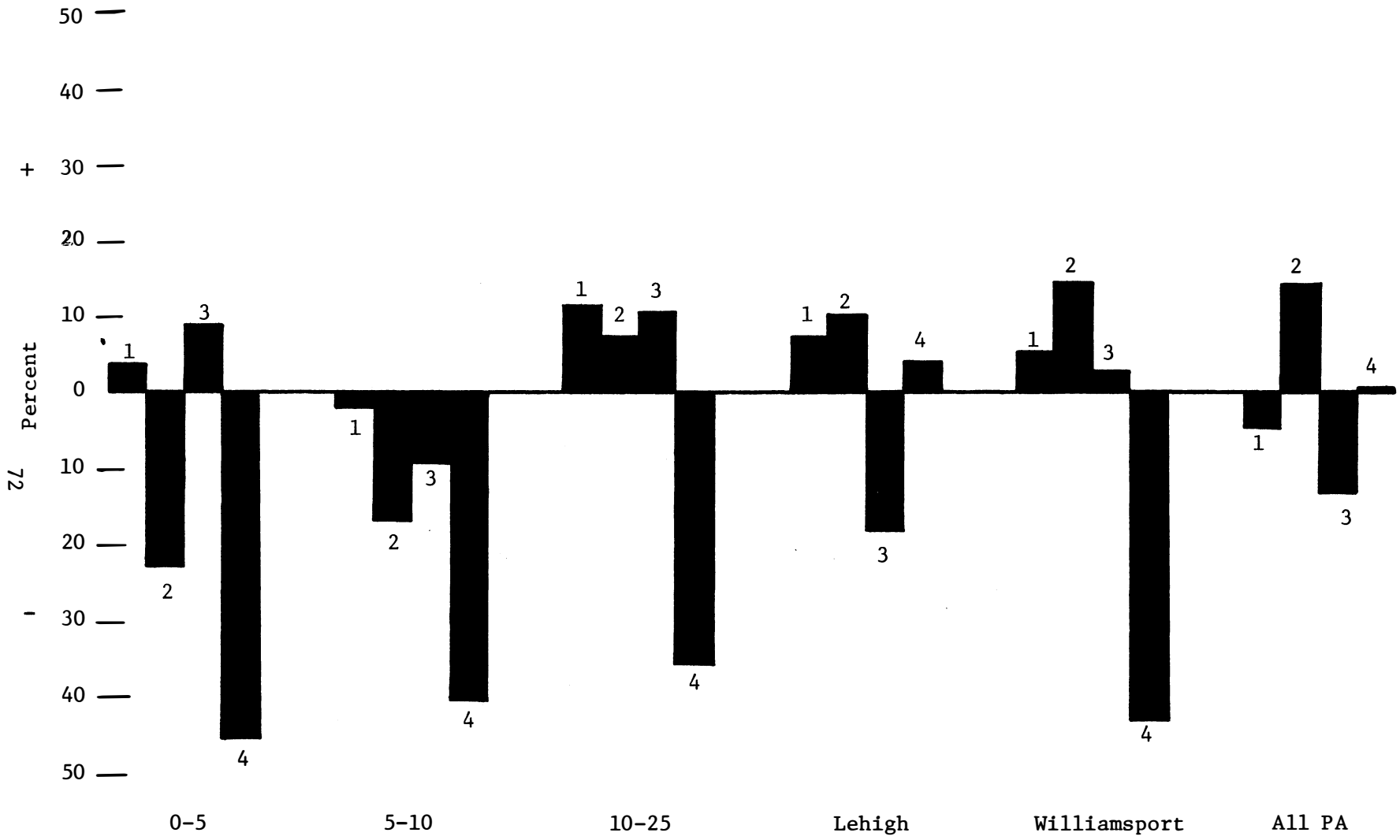

Figure 6.6 Percentage Differences in Predicted and Actual Quarterly Number of Sales, 1979.

and certainly this cannot be due to the accident; and (2) it is difficult to rationalize a fourth quarter decline in the 10-25 mile zone after three successive quarters in which actual exceeded predicted sales, the last two of which occurred following the accident. We believe the sharp fourth quarter declines in these four areas reflect economic conditions in central Pennsylvania at the time.

There are no useful statistical tests to determine the significance of the differences between actual and predicted number of sales, since we are not dealing with means here as we were in Task D with prices.

6.3 Number of Residential Sales by Month

Have quarterly sales volumes masked some significant variations in monthly sales numbers? This section will explore such a possibility.

Following the same procedure as in Task D to predict monthly mean sales prices, monthly sales volumes for 1979 were predicted for the three distance zones around TMI and for Lehigh County and all Pennsylvania (except Philadelphia).[2/] The predictions, together with a comparison to the actual monthly sales volumes, are shown in Table 6.3 and graphically portrayed in Figures 6.7, 6.8, and 6.9.

For April in the three TMI zones and Lehigh control area predicted and actual sales volumes were very close; only in the all Pennsylvania control was there a large divergency, where actual far exceeded predicted by 47 percent. In May, however, in the 0-5 and 5-10 mile zones the number of sales plummeted, falling 76 and 53 percent, respectively, short of the predicted number. In the remaining three areas actual sales fell slightly short of the predicted. We believe that this is quite firm evidence that the accident did have an adverse effect upon sales volume within 10 miles of the plant.

A relevant question at this point is why this adverse effect is showing up in May rather than in April, the month immediately following the accident? Two explanations might be advanced. First, our data show the month in which the sale was completed or became legal, that is, when final settlement takes place. But legal commitments to purchase real property often are made weeks or even months in advance, when "earnest money" is put down at the time an agreement of sale is negotiated. Such purchasers, not willing to relinquish their down payment by backing out of a sales agreement, consumated their sales in April despite the accident. The number of prospective buyers--those actively looking over the potential housing market--dropped off drastically right after the accident in April, but this phenomenon was not revealed by the data until May when April purchasing commitments would have been finally consumated. Second,

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2/ The Williamsport control area is not included in this section of the analysis because of lack of sufficient monthly data by STEB.

Table 6.3 Predicted and actual number of residential sales by months, TMI and Control Areas, 1979.

	J	F	M	A	M	J	J	A	J	O	N	D
0-5												
Predicted	32	40	36	50	67	48	30	47	22	48	31	32
Actual	31	37	43	49	16	62	29	39	40	34	8	18
Difference	- 1	- 3	+ 7	- 1	- 51	+ 14	- 1	- 8	+ 18	- 14	- 23	- 14
% diff.	- 3.1	- 7.5	+19.4	- 2.0	- 76.1	+ 29.2	- 3.3	-17.0	+81.8	- 29.2	-74.2	-43.8
5-10												
Predicted	84	97	102	154	147	150	93	150	69	146	80	76
Actual	79	93	105	149	69	157	80	102	101	82	42	56
Difference	- 5	- 4	+ 3	- 5	- 78	+ 7	- 13	- 48	+ 32	- 64	- 38	- 20
% diff.	- 6.0	- 4.1	+ 2.9	- 3.2	- 53.1	+ 4.7	- 14.0	-32.0	+46.4	- 43.8	-47.5	-26.3
10-25												
Predicted	727	729	778	1053	1081	1001	776	1086	574	971	562	622
Actual	885	733	880	1067	994	1306	876	1024	816	599	418	401
Difference	+ 158	+ 4	+ 102	+ 14	- 87	+ 305	+ 100	- 62	+ 242	- 372	- 144	- 261
% diff.	+21.8	+ 0.5	+13.1	+ 1.3	- 8.0	+ 30.5	+ 12.9	- 5.7	+42.2	- 38.3	-25.6	-39.4
Lehigh Co.												
Predicted	250	355	306	394	505	382	546	393	407	416	116	223
Actual	330	293	355	376	492	545	372	311	424	449	156	184
Differences	+ 80	- 62	+ 49	- 18	- 13	+ 163	- 174	- 82	+ 17	+ 33	+ 40	- 39
% diff.	+31.9	-17.6	+16.0	- 4.5	- 2.6	+ 42.7	- 31.8	-20.9	+ 4.2	+ 7.9	+34.5	-17.5
All PA less Phila.												
Predicted	9297	7090	7571	12,827	10,133	10,671	16,291	9606	8045	12,715	6874	6298
Actual	9061	6338	7538	18,883	9,208	10,591	13,566	9053	7133	18,228	4063	3722
Difference	- 236	- 752	- 33	+ 6056	- 925	- 80	- 2725	- 553	- 912	+ 5513	-2811	-2506
% diff.	- 2.5	-10.6	- 0.4	+ 47.2	- 9.1	- 0.7	- 16.7	- 5.8	-11.3	+ 43.4	-40.9	-39.8

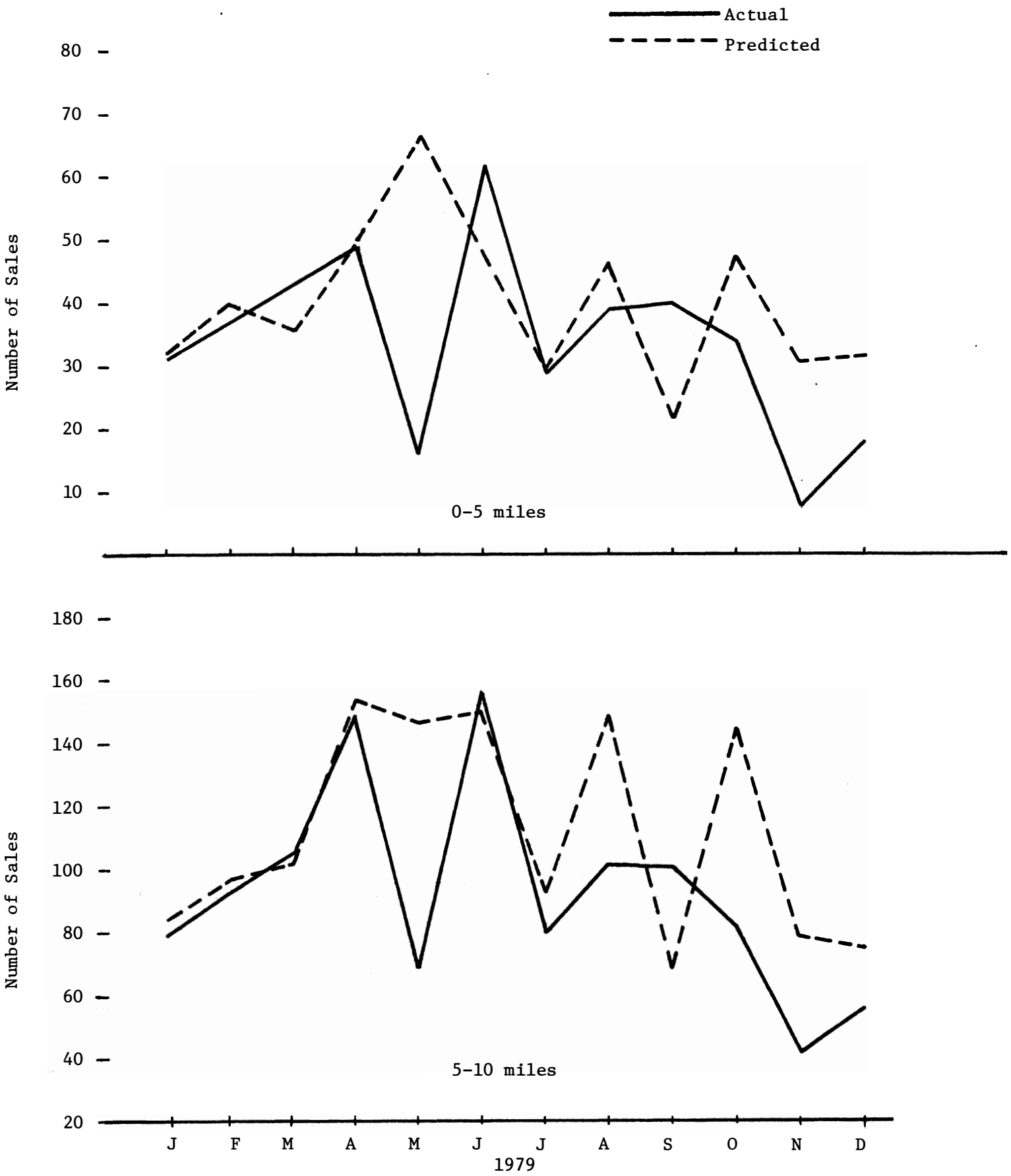


Figure 6.7 Predicted and Actual Number of Residential Sales by Months, 1979.

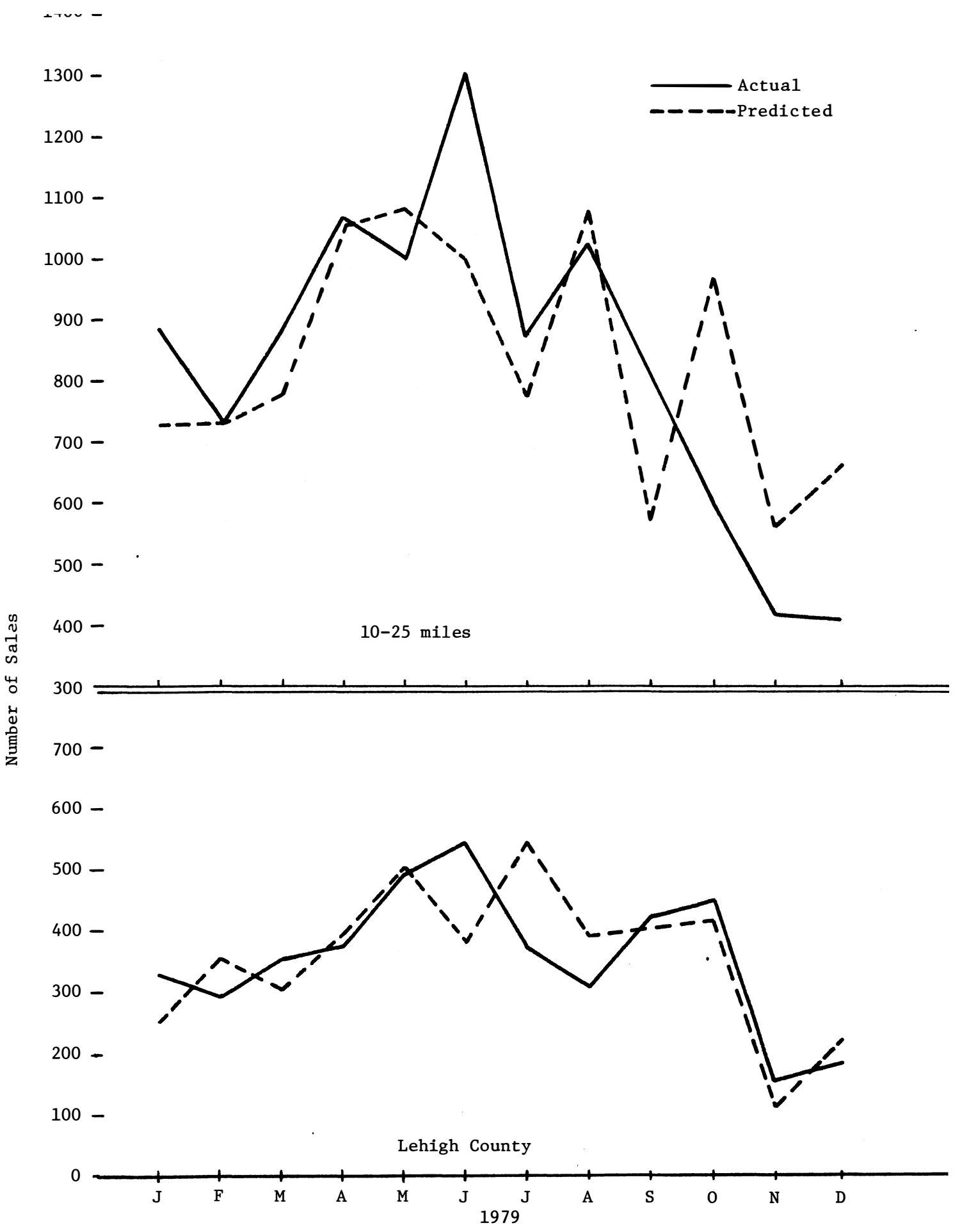


Figure 6.8 Predicted and Actual Number of Residential Sales by Months, 1979.

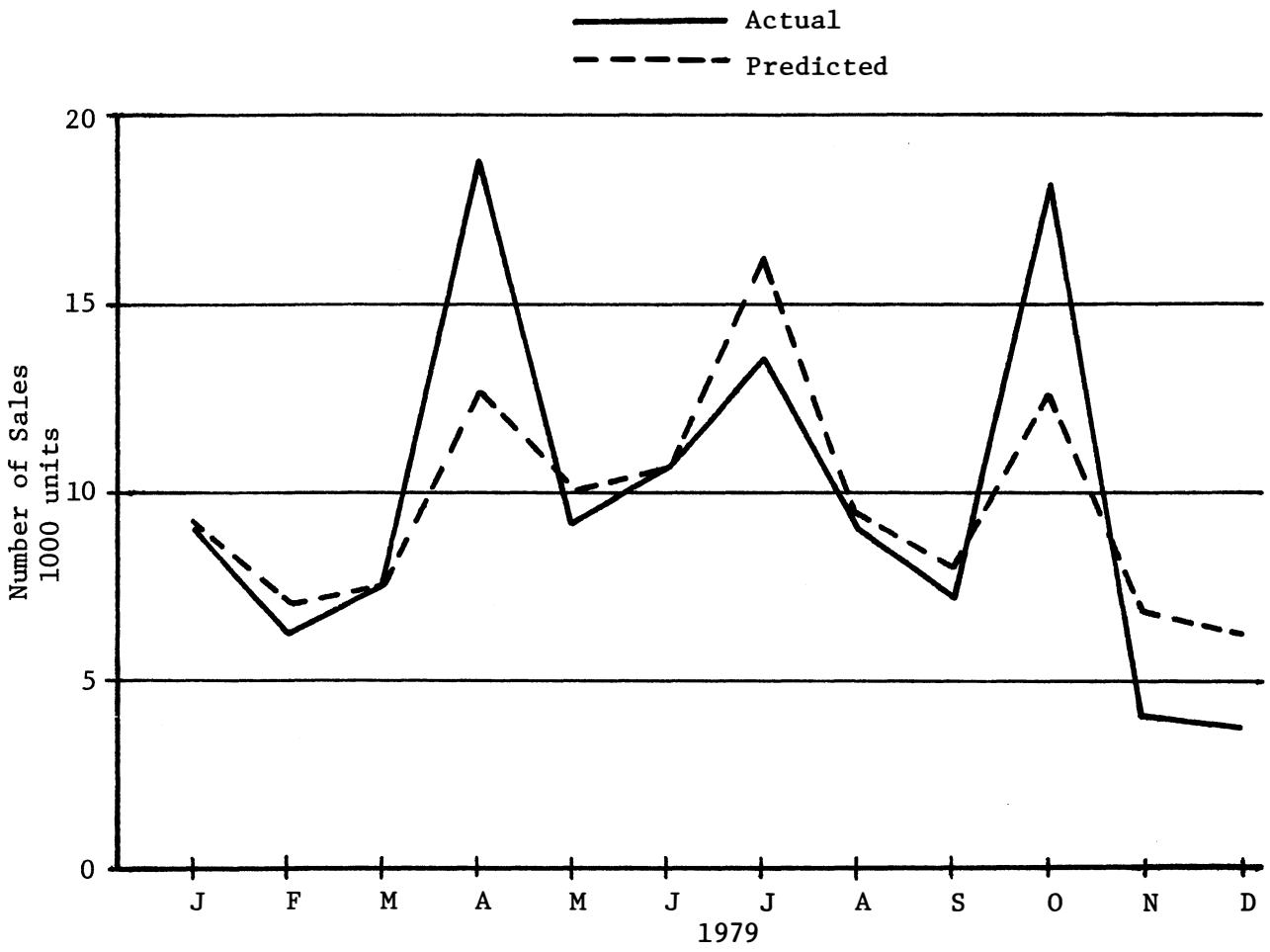


Figure 6.9 Predicted and Actual Number of Residential Sales by Months, 1979 - all PA except Philadelphia.

virtually all businesses in the Harrisburg area were quite severely disrupted right after the accident, with a significant proportion of the population temporarily leaving the area, and it took a while for things to return to normal. Possibly many realtors and lawyers delayed in delivering new sales documents to the respective Recorder of Deeds' offices in the court houses. Such delays could not be discerned in the STEB data.

In the 0-5 mile zone the number of sales shot back up dramatically in June of 1979, setting the highest monthly total for the year and being 29 percent above the predicted number of sales. The same trend also occurred in the 5-10 and 10-25 mile zones. In the latter zone, sales volume was 30 percent higher than predicted. Thus, it appears that the adverse effect in May lasted but a short time, the market recovering in a few weeks.

The quarterly data for the all PA control showed sales volume in the fourth quarter slightly higher than the predicted volume, whereas for all the other areas except Lehigh County actual volume was well below the predicted volume. Examining the monthly sales volume for all PA in Figure 6.9 shows that there was in fact a very sharp drop in sales the last two months, which was offset by a very high sales volume in October. Apparently the high interest rates and tight supply of mortgage funds was felt somewhat earlier in central Pennsylvania than in the rest of the state.

6.4 Sales Volume by Value Classes

The previous section revealed rather strong evidence that the TMI accident did have an adverse effect on sales volume for about one month following the accident. An important question can now be raised: Was the effect distributed rather evenly over different value classes of residential property, or was it concentrated in a certain value class? From our analyses in Tasks B, C and D we found no discernible effects on the mean sales values after the accident. Finding that there was a sharp drop in sales volume, however, we would like to know if this drop occurred in approximately equal proportions over the high, medium, and low value class properties, or if it was concentrated for example, in the medium valued class of properties. If it had been concentrated in either of the high or low value classes, the mean sales value should have reflected this.

The methodological approach taken in this section of the study was to construct a computer histogram of all sales in the 0-25 mile zone around TMI for the last 9 months of 1975, using the same STEB data base as was used in Tasks D and E. The reason that the last 9 months of 1975 were used rather than the full year is that the effects of the accident would only have been felt in the last 9 months of 1979, and we wanted any changes in sales volumes among value class over time to be on a comparable basis since historically first quarter sales, both in terms of numbers and mean values, diverge considerably from these data for the other three quarters of each year.

From the histogram, the number of sales from April-December, 1975, were divided into approximately three equal groups from lowest value to highest value. These three groups defined the low, medium, and high value classes that were used throughout the remainder of this phase of the study. The value ranges for the three classes are as follows:

low - 0 - $19,990

medium - $20,000 to $33,990

high - $34,000 +

To compute the proportionate shifts in the number of sales among the three value classes for each year from 1975 through 1979, deflators had to be derived for the years 1976-1979. If deflators were not used, then the proportion of sales in the low value class would certainly decline, while the proportion in the high value class would steadily rise to reflect the inflationary effects of the economy. With 1975 as the base year equal to 1.0000, the mean for each subsequent year for the 0-25 mile zone data was divided into the 1975 mean to obtain the deflator for a particular year.[3/] The 1975 value class parameters were then divided by the deflators for each year to establish mean value class parameters for each year. These are shown in Table 6.4.

Table 6.4 Annual deflators and value class parameters, 0-25 mile zone.

Year	Mean	Deflator	Value Class Parameters		
			Low	Medium	High
	$		$	$	$
1975	28,441	1.0000	0-19,990	20,000-33,990	34,000 +
1976	31,819	.8938	0-22,370	23,380-38,030	38,040 +
1977	34,747	.8185	0-24,420	24,430-41,530	41,540 +
1978	38,001	.7484	0-26,710	26,720-45,420	45,430 +
1979	42,263	.6730	0-29,710	29,720-50,510	50,520 +

[3/] The values defining the three value classes and the deflators used in this task are not the same as those used in Task C because of the difference in the years covered by each task which would influence the inflation rates.

Computer histograms for all sales in each of the 0-5, 5-10, and 10-25 mile zones for the April-December period in each year from 1975-1979 were then obtained. Using the parameters from Table 6.4, the number of sales in each value class were then tallied. The results are shown in Table 6.5, with the data plotted in Figure 6.10.

Several observations should be noted in Figure 6.10. The 0-5 mile zone has a higher proportion of medium value housing and a lower proportion of high value housing than either of the other two zones. The proportion of high value housing has steadily declined since 1976. While the trend in the share of low value housing has been declining over the 5-year period, there has been an increase in the last 2 years. There has been a noticeable increase in the proportion of medium value housing over the 5-year period in the 0-5 mile zone.

In the 5-10 mile zone, the proportion of low value housing is well below that of the other two zones. High value housing predominated in 1975, but since has declined to be replaced by medium value housing whose share increased noticeably over the 5-year period.

In the 10-25 mile zone, low value housing predominated in 1975, but has since declined somewhat. The increase in the proportion of medium value housing has now made it the predominate class. High value housing has changed little in its share of the housing market in this zone over the time period.

Over the last two years considering all three distance zones together, the proportionate share of high value housing has been decreasing while the share of low value housing has been increasing. There is no substantial evicence from the data to indicate that the accident had a differential effect on the number of housing sales in different value classes.

Let us turn our attention now to an analysis of any possible effects on value classes using quarterly data. The methodological approach was similar to that used above for the annual data, with one significant difference. If there were any effects from the accident, particularly using quarterly data by distance zones, then we should not use the 0-25 mile zone data base to compute deflators, otherwise the true effects among the value classes might be masked. Therefore, the data base for all Pennsylvania less the City of Philadelphia was used to compute the deflators. The 1975 all PA weighted mean sales values ($28,919) was the base value used (deflator = 1.000) and each quarterly mean sales value from 1975-1979 was then used to compute the quarterly deflators in the same manner as described previously. Table 6.6 shows the quarterly value class parameters, the 1975 value class base values remaining the same as in the previous analysis (i.e. 0-$19,990, $20,000-$33,990, and $34,000 +). From histograms for each quarter and distance zone, the number of sales in each value class were obtained and the percentages computed. The results for each of the three distance zones are shown in Figures 6.11-6.13.

Table 6.5 Number of sales by value classes as a percent of total residential sales in each distance zone, April-December, 1975-1979.

Distance zone	Year		Value Class Low	Medium	High
0-5	75	#	99	107	68
		%	36.1	39.1	24.8
	76	#	173	183	121
		%	36.3	38.4	25.4
	77	#	120	220	101
		%	27.2	49.9	22.9
	78	#	111	166	68
		%	32.2	48.1	19.7
	79	#	101	150	52
		%	33.3	49.5	17.2
5-10	75	#	177	290	342
		%	21.9	35.8	42.3
	76	#	293	536	538
		%	21.4	39.2	39.4
	77	#	257	427	431
		%	23.0	38.3	38.7
	78	#	216	454	384
		%	20.5	43.1	36.4
	79	#	179	368	305
		%	21.0	43.2	35.8
10-25	75	#	2202	1947	1770
		%	37.2	32.7	29.9
	76	#	2821	3075	2518
		%	33.5	36.5	30.0
	77	#	2869	3330	2705
		%	32.2	37.4	30.4
	78	#	2956	3407	2513
		%	33.3	38.4	28.3
	79	#	2660	2950	2199
		%	34.1	37.8	28.2

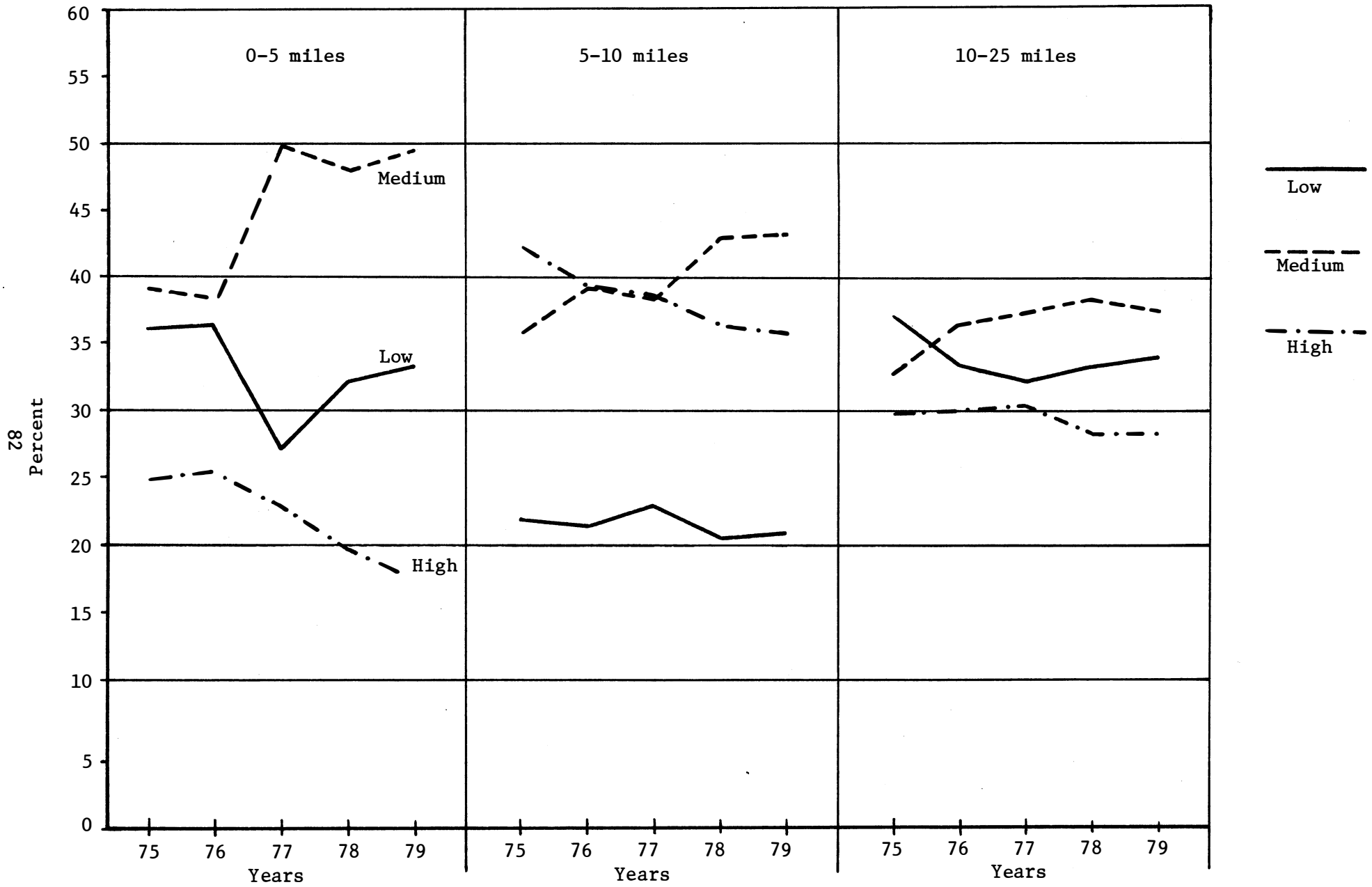


Figure 6.10 Residential Sales as a Percent of Number of Sales by Value Classes, April-December, 1975-1979.

Table 6. 6 Quarterly value class parameters, 1975-1979.

Year	Quarter	Value Class		
		Low	Medium	High
		$	$	$
1975	1	0-18,110	18,120-30,790	30,800 +
	2	0-20,150	20,160-34,260	34,270 +
	3	0-20,800	20,810-35,350	35,360 +
	4	0-20,520	20,530-34,890	34,900 +
1976	1	0-20,220	20,230-34,380	34,390 +
	2	0-22,560	22,570-38,350	38,360 +
	3	0-22,000	22,010-37,400	37,410 +
	4	0-23,390	23,400-39,760	39,770 +
1977	1	0-22,010	22,020-37,420	37,430 +
	2	0-24,060	24,070-40,900	40,910 +
	3	0-25,520	25,530-43,380	43,390 +
	4	0-25,000	25,010-42,500	42,510 +
1978	1	0-24,390	24,400-41,450	41,460 +
	2	0-26,690	26,700-45,380	45,390 +
	3	0-27,550	27,560-46,840	46,850 +
	4	0-28,090	28,100-47,750	47,760 +
1979	1	0-27,590	27,600-46,900	46,910 +
	2	0-30,480	30,490-51,820	51,830 +
	3	0-30,150	30,160-51,260	51,270 +
	4	0-31,440	31,450-53,450	53,460 +

If there were significant effects from the accident to be observed, they would most likely show in the second quarter in the 0-5 mile zone (Figure 6.11). In this quarter, the proportion of low value housing sales declined sharply, but it also declined in the same quarter in three previous years, even more sharply in 1976 and 1977 (as evidenced by the degree of slope of the line). The proportion of sales for medium and high value housing both rose in the second quarter in 1979. In both the 5-10 and 10-25 mile zones, there is nothing to indicate from examining the graphs that the accident had any noticeable effect.

Our conclusion for this part of the analysis is that while the accident did have an effect of short duration on the number of sales within 10 miles of the plant, the effect was not discernibly concentrated in either low, medium, or high value class housing, but rather was evenly distributed over all three value classes. Although there were some proportionate shifts over the 5 years in the number of sales by value classes, these could not have been accident induced.

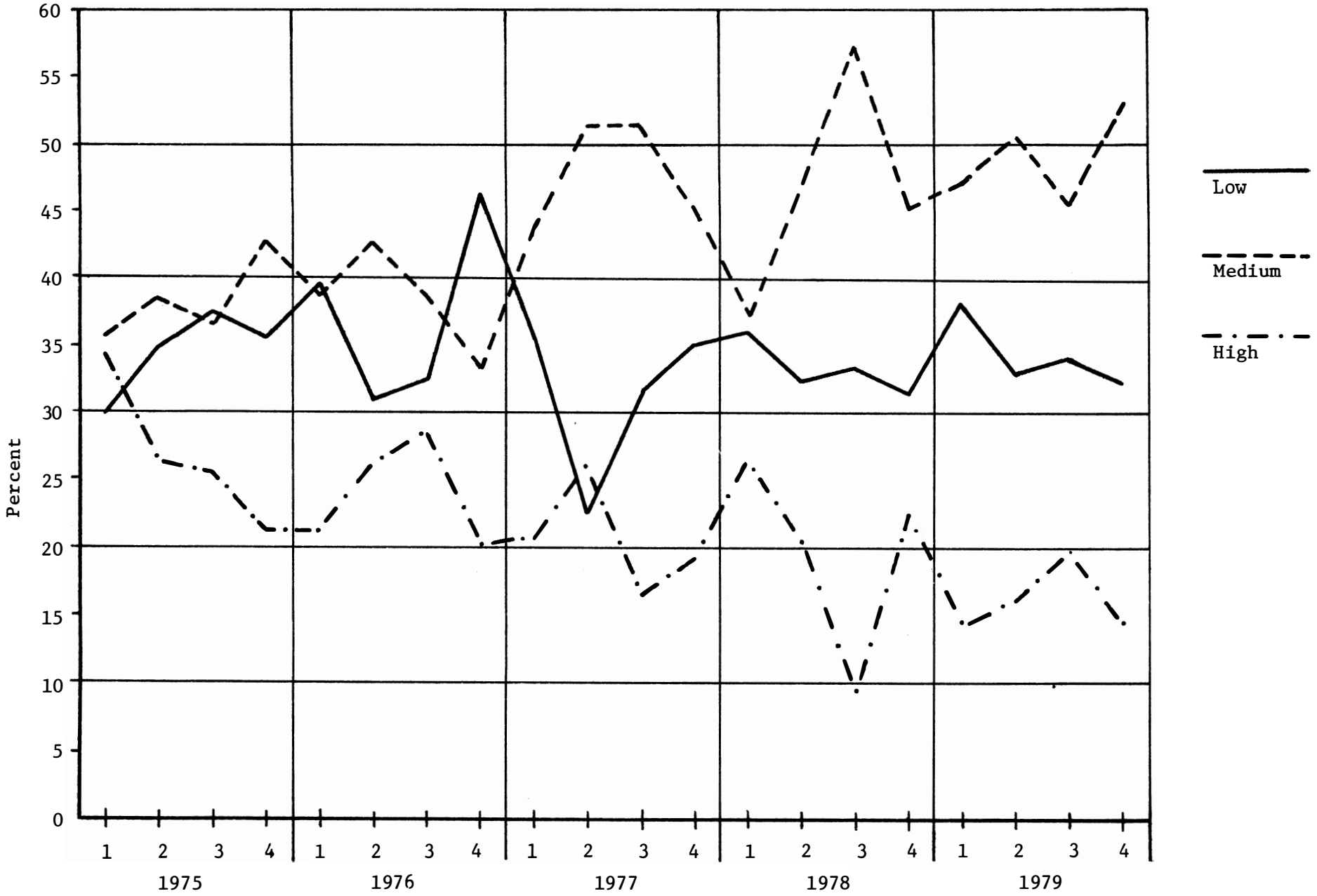


Figure 6.11 Quarterly Residential Sales as Percent of Number of Sales by Value Classes, 1975-79, 0-5 miles.

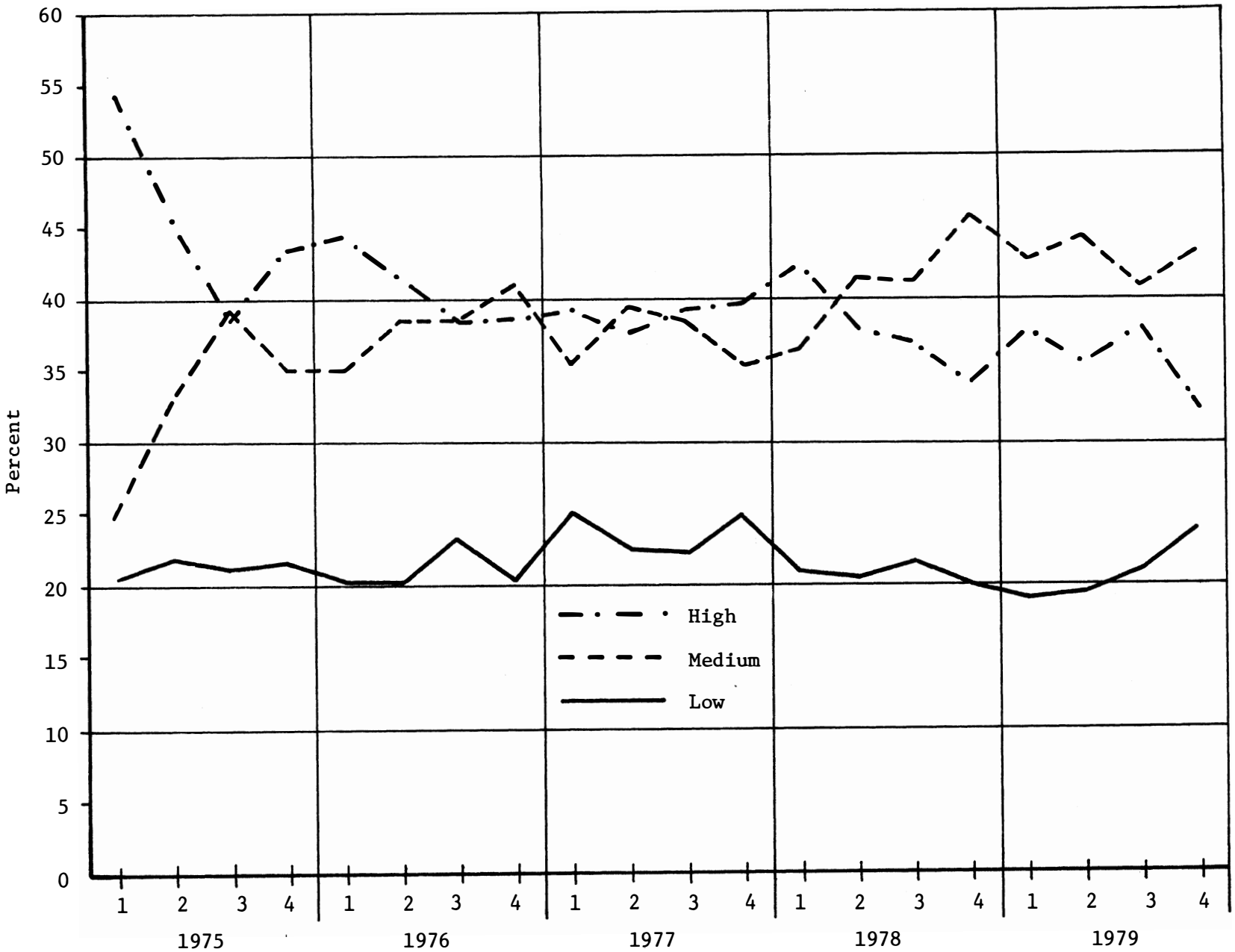


Figure 6.12 Quarterly Residential Sales as Percent of Number of Sales by Value Class, 1975-79, 5-10 miles.

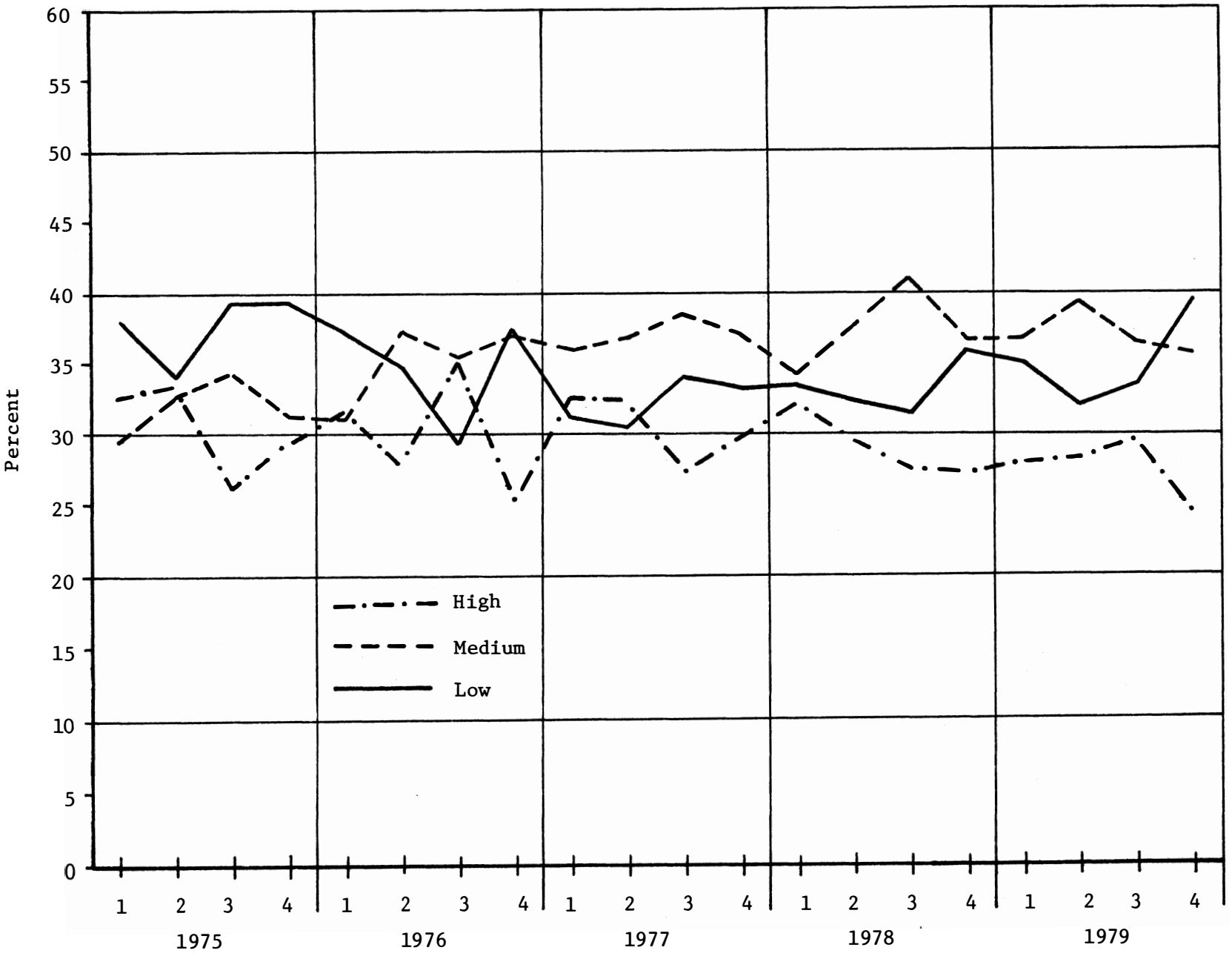


Figure 6.13 Quarterly Residential Sales as Percent of Number of Sales by Value Class, 1975-79, 10-25 miles.

VII. TASK F

7.1 Introduction

The purpose of this task was to gain further insight into any possible effects of the TMI accident on the housing market. People who deal with the market on a daily basis, such as realtors, appraisers, suppliers of mortgage loans, and building contractors certainly must have first hand knowledge of how the market reacted immediately following the accident and subsequent adjustments over the intervening months. Consequently, interviews were conducted with officials or owners of real estate and appraisal firms, banks and savings and loan institutions, and general contracting or building firms.

From the yellow pages of the most current Greater Harrisburg area telephone directory a master list was compiled of all firms in the above categories. The total number of firms in each category was: 71 real estate firms, 25 mortgage lending firms, and 135 general contractors. Because of the large number of firms, a selection was made of those to be interviewed. The selection process, the questions asked, and the results of the interviews are discussed below for each of the respective business categories.

In all cases, a formal questionnaire or interview form was not prepared or presented to the person being interviewed. The nature of the interview was one of informality, whether conducted in a person-to-person meeting or over the telephone. The primary interest was to elicit, by means of a general discussion, the individual's perception of what effects the accident has had over time on the housing market in the immediate vicinity of the plant and within the greater Harrisburg area.

7.2 Real Estate and Appraisal Firms

From the master list of 71 firms, all those who maintained offices in or near Middletown, PA (within about 5 miles of the plant) were interviewed. There were six of these. Of the remaining firms, those who had purchased additional blocks of advertisement space in the yellow pages were also selected. It was felt that in general the larger and more active real estate firms would be most likely to advertise in such a manner. In total, there were 28 real estate firms interviewed, of which 16 had handled sales of residential properties within 5 miles of the TMI plant since the accident. Of these 16 firms, 8 had licensed appraisers on their staffs. Out of the remaining 12 firms interviewed who conducted business in the greater Harrisburg area but had no sales near TMI, 8 had licensed appraisers.

In all but a very few cases the owner of the firm was interviewed; in his or her absence the senior broker or salesman was interviewed. Four of the interviews (all with firms with offices in the Middletown area) were person-to-person; the remaining were done by telephone. The principal investigator did all of the interviewing which was done during July of 1980. The researchers felt that to avoid possible bias in the responses, it would be best not to voluntarily disclose the sponsor of

the study. After being told that Penn State University was conducting the study, not one respondent pursued the matter further.

The interviewer asked the respondent for his or her views and opinions on what effects, if any, the accident of March, 1979, had on residential property sales, both immediately following the accident and during the subsequent year to 15 months. Attention was specifically directed to the effects in terms of selling price, number of sales, and duration of sale (time lapse from date when property was first offered on the market to final settlement). The same effects were asked for rental properties, commercial properties, improved lots, and undeveloped land.

All of the realtors remarked how difficult it was to separate the effects of the TMI accident from the effects of high mortgage interest rates and the tight supply of mortgage funds on the real estate market. Unfortunately, these events coincided and this fact has been a major problem facing this research. Most of the realtors felt sure that the high interest rates and lack of mortgage funds had a much greater effect on the local real estate market than did the accident.

Only 4 (14 percent) of the 28 realtors interviewed felt the accident had no effect at all on the market in terms of price, number of sales, or duration of sale. Of these 4 realtors, 2 were active in the Middletown area.

Conversely, 24 realtors (86 percent) felt the accident did adversely affect the market for single family homes, mostly in terms of number of sales and duration of sale. Only 4 realtors (14 percent) felt that sales prices were lower as a result of the accident, three of these saying the effect was of short duration (about one month) while only one realtor felt the effect lasted longer (almost 6 months). No realtors felt that sales prices were still adversely affected in July 1980, because of the accident. Four realtors felt that in July 1980, the effects on number of sales and duration was still evident. Table 7.1 summarizes the responses.

In addition to the responses summarized in Table 7.1, the following responses were also received:

Five realtors (18 percent) cited specific instances where they had either lost a sale or had experienced an unusually long delay before the sale was consumated. One realtor stated that a potential buyer "walked out" on a sale, but he sold the property a few weeks later to another buyer without any reduction in price. Nine realtors (32 percent) stated they still encounter some buyers who will not consider properties in close proximity to the plant, particularly if it is visible from the property. Only one realtor said he handled a sale where the family moved out due to the accident. Seven realtors (25 percent) stated that the large influx of clean-up workers hired by the utility had boosted the sales and rental markets over the past year.

No realtors felt that the accident had anything more than very temporary negative effects on the rental market for housing. Both the single and

Table 7.1. Summary of realtors' responses on effects of accident on the real estate market (n=28).

Responses	Number	Percent
No effect at all on market	4	14
Some effect on market	24	86
Some effect on prices	4	14
Short-run price effect (1 month)	3	11
Longer-run price effect (6 months)	1	3
Modest effects on number of sales and duration of sales (1 month)	13	47
Drastic effect on number of sales for 1 month, with rapid recovery	5	18
Effects on number of sales and duration lasted about 6 months	2	7
Effects still persist in proximity to plant	4	14

multi-family rental market by the summer of 1980 was tight in the Middletown area. No realtors felt there were any significant effects on the market for commercial properties.

The realtors had not handled enough industrial sales or sales of large unimproved land parcels in the past year to indicate any likely effects on these types of holdings. One of the 4 realtors who thought the effects still persist handles primarily sales of improved lots in subdivisions in the Middletown area. He experienced a large dip in number of sales over the past year, but was unsure how much of this decline was due to the accident and how much due to interest rates and mortgage money availability.

In summary, based on discussions with 28 realtors, a cross section of people whose line of work makes them very knowledgeable about the likely effects of the TMI accident on property values, it is quite apparent that the accident did have some effects on the market. The most noticeable effects, by far, were reflected in the number of sales and the time it takes to sell a property. These two effects were very noticeable immediately following the accident, but apparently did not last long,

perhaps one to two months at the most. It is probably correct to assume that within a few months following the accident most all of the properties that were on the market and that would have sold had there not been an accident, had been sold.

The accident probably adversely affected the selling price of a few properties within a few months after the accident, but the overall effect on selling price was not sufficiently strong to be readily discernible in market averages. As with number of sales and duration of sale, any slight effects on selling price that may have existed shortly after the accident were rapidly dissipated. Although even today there may be an occasional buyer who is reluctant to purchase a home close to the plant, there are sufficiently few of these relative to the overall market demand to significantly influence prices.

One might challenge the responses of realtors, in that a strong proclivity for bias may exist resulting from their desires to dispel fears about an unhealthy market situation. While this interviewer felt that such thoughts might have influenced the responses of a few realtors, the overwhelming majority seemed to be very straightforward, honest and sincere in their answers. The fact that the realtors' responses tend to agree with the results of the data analyses presented in previous sections of this report tend to support this observation.

7.3 Mortgage Lending Institutions

All of the major institutions supplying funds for residential mortgages in the greater Harrisburg area were interviewed. There were 15 of these, including 9 savings and loan associations and 6 banks. Of the 8 institutions that had offices in the Middletown, Steelton, and Hummelstown areas, 7 were personally visited; the remaining 8 institutions were contacted by telephone. In most cases the senior loan officer was the official interviewed. As was the case with the realtors, the respondent was asked for his or her views on what effects, if any, the accident had on residential property sales in terms of number of sales and selling price. In addition, information was sought on any change in bank policies to award mortgage loans on properties close to TMI.

Not one of the lending institutions felt that there have been any lasting effects on the real estate market. Four officers intimated that there might have been some effect on number of sales right after the accident, but if there was it was short lived. Most pointed to the difficulty of separating the TMI effects from the high interest rate and tight mortgage money supply effects. Not one institution has altered its lending policies, refused to accept mortgages on properties near the plant, lowered appraisal values for loan purposes, or discounted property values when a property was used for collateral on personal loans. The officers of a bank in Middletown volunteered that there was no abnormal withdrawal of accounts after the accident.

In summary, from discussions with loan officers representing 15 mortgage lending institutions in the Harrisburg area there is no evidence to suggest that the TMI accident has had any lasting effects on the real estate market for single family houses.

7.4 General Home Building Contractors

The original plan was to interview all contractors in the Middletown area and by means of random sampling (using a table of random numbers) choose a sample from the Harrisburg and West Shore areas. However, this did not prove feasible because too many firms either were no longer in business, were not operating in the Middletown area, or were not engaged in residential construction.

The strategy selected was to contact all available contractors in the Middletown area, which numbered 8. Then 8 firms in each of the Harrisburg and West Shore areas were contacted, having been selected by starting with "A" in the phone book and proceeding alphabetically until 8 interviews were complete with firms that met certain criteria. There is no *a priori* reason to believe that firm characteristics, such as size or type of construction performed, align themselves alphabetically; thus a random sample taken in this manner appears justified. In total then, 24 firms were interviewed.

The criteria for the firm selection were as follows:

1) Time. Firms had to be in operation at least one year prior to the March 1979 accident and continuing to the present. By using the May 1978, Harrisburg area phone book we were assured of getting firms that were in operation at the beginning of the time period.

2) Work location. The firm had to have done some work in the Middletown area. If not, the interview was terminated.

3) Nature of work. The firm had to be at least partially involved in residential work, either in terms of new home construction or remodeling of existing homes.

Table 7.2 summarizes the information gleaned from the contractors during the interviews.

As was the case with the realtors and mortgage lending institutions, the contractors found it difficult to assess the cause of poor market performance after the accident; i.e., whether it was due to the accident, to high interest rates or to some combination of both. Only 5 of the 24 contractors interviewed (21 percent) felt the accident had no effect whatsoever on the market; the majority felt it had only a slight effect (58 percent). Not all of those feeling there had been some or slight effects were willing to judge the duration of effect, but the majority who did express an opinion felt that whatever effects there were lasted only through the spring of 1979. Three contractors thought that the

Table 7.2 Summary of Contractors' Responses (n=24)

A. General Effects:	None	Slight	Some
TMI area contractors	1	4	3
West Shore contractors	2	5	1
Harrisburg contractors	2	5	1
Totals	5	14	5

B. Duration of Effects:	Several weeks	Through Spring '79	Through Summer '79	Through Summer '80
TMI area contractors	2	1	--	3
West Shore contractors	--	1	2	--
Harrisburg contractors	3	1	1	--
Totals	5	3	3	3

C. Location of Effects:	Within 5 miles	Within 10 miles	Beyond 10 miles
TMI area contractors	2	1	2
West Shore contractors	4	1	--
Harrisburg contractors	3	2	--
Totals	9	4	2

D. Difficulties in selling properties:	Problems	No Problems
TMI area contractors	2	4
West Shore contractors	1	3
Harrisburg contractors	1	5
Totals	4	12

E. General Outlook:	Pessimistic	Unsure	Optimistic
TMI area contractors	2	2	4
West Shore contractors	--	1	7
Harrisburg contractors	--	1	7
Totals	2	4	18

effects are still felt (summer 1980). Nine of the 15 contractors willing to express an opinion as to the spatial extent of the effects felt it was confined to within 5 miles of the plant. Only 2 felt the effects extended beyond 10 miles from the plant.

From the standpoint of difficulty in selling properties, 12 contractors specifically mentioned properties which they had built or renovated and experienced no problems in selling. Only 4 admitted to having problems selling homes in the TMI area. Of these 4, only one, a Middletown contractor, laid the blame directly on the accident; the other 3 felt they could not distinguish the effect of the accident from the influence of the economic conditions at that time.

In terms of the contractors' general outlook of the market, 15 (75 percent) stated they were having a good year despite any possible adverse effects from the accident. The four that were having some problems or were unsure related these to the current economic conditions rather than the TMI. Only two contractors (8 percent) expressed outright pessimism about their businesses and linked their bad times to TMI. Both of these contractors, located in Middletown, also felt the effects extended beyond 10 miles and through the summer of 1980.

7.5 Conclusions

Personal conversations during the summer of 1980 with owners or representatives of 28 real estate firms, 15 mortgage lending institutions, and 24 general contractors in the greater Harrisburg area leads one to conclude that the accident at TMI had very little, if any, effect on the market values of residential properties and that whatever market effects there might have been were of very short duration, probably not more than one month. There appeared to be a much more noticeable effect on the number of sales and time required to consumate a sale. Apparently in the Middletown area for about one month following the accident very few properties moved on the market. These effects dissipated rapidly in the late spring and early summer of 1979, abetted somewhat by an influx of clean-up workers and specialists brought in by the utility. Only a small proportion of the realtors and contractors (14 percent and 13 percent, respectively) felt that effects still persisted. No banks or savings and loan institutions made any changes in their lending policies or discriminated in any way against properties located close to the plant. Virtually all of those persons interviewed strongly expressed the opinion that it was extremely difficult to distinguish between the effects of the accident if any, and the effects on the market of high interest rates and tightness in supply of mortgage funds.

Despite the fact that realtors and contractors would seem to have a natural bias against expressing pessimism about their business prospects, it seems rather clear that the accident has had no lasting effects on the market values of residential properties, even those close to the plant. This does not imply, however, that even today one cannot find an instance where a prospective buyer may not choose a particular property because of its proximity to TMI. Another buyer will come along shortly who has no aversion to such a location. Apparently there are too few buyers with negative feelings towards the plant to measurably affect the demand and consequently the price of housing in the TMI area.

VIII. SUMMARY AND CONCLUSIONS

8.1 Summary

Following the accident of March, 1979, at the Three Mile Island nuclear power plant near Harrisburg, PA, concern was expressed over the possibility of a variety of health, economic, and environmental effects. One of the economic effects often mentioned was the lowering of real property values, particularly for residential properties near the plant. The purposes of this study were to determine if the accident did have an adverse effect on single family residential property values, and if so to determine if the effects were related to distance and direction from the plant, and if properties in different value calsses were affected dissimilarly.

The study area encompasses a zone 25 miles in radius around TMI. A primary control area in Lycoming County, PA, near the City of Williamsport (about 75 miles north of TMI) was selected based on similarities to the TMI area in population growth and density, per capita income, and other features. Regression analysis later showed little significant differences in the real estate markets for the two areas. Lehigh County was used as a secondary control area in one of the tasks.

The study was divided into six tasks as follows:

Task A: Determine if the plant (TMI) had any adverse effects on single family property values before the accident. A multiple regression model was used.

Task B: Determine if the accident had any adverse effects on single family property values by distance and direction from the plant and by property value classes (high, medium, and low) using multiple regression.

Task C: From property assessment data predict, by use of a simple regression model, property values after the accident and compare to actual market sales values according to distance zones and direction combined.

Task D: Analyze the quarterly and monthly trend in mean sales values over the five-year period 1975 to 1979 and compare to a control area to see if any adverse effects followed the accident.

Task E: Approximately the same procedure as in Task D, only analyze the number of sales by quarters and months.

Task F: Interview realtors, appraisers, officers in mortgage leading institutions, and contractors to ascertain their views of how the accident might have affected the real estate market and housing values.

Pennsylvania State Tax Equalization Board (STEB) data were the basic source of property sales information for Tasks A-E. In Tasks A, B and C, sampling of sales data was done for the zones more distant from TMI. In Tasks A and B properties selected were matched to property record cards in the various county tax assessment offices, which provided descriptive information on individual property characteristics, and when combined with information gathered from visual inspection of each property provided data for the independent variables. Originally about 75 variables describing house and lot characteristics were identified, but in the final regression analyses about 38 of these proved significant in explaining house price variations. A summary of each task follows.

8.1.1 Task A

The data base included 505 sales covering the three years 1977 to 1979. The first part of this task was to determine if there was any significant difference between the Lycoming Control area and the TMI area using multiple regression analysis. The data were divided into three time sets; before, after, and before and after the accident, and into two distance zones; 0-5 and 10-25 miles from TMI.

The regression results showed that there was a significant difference in the sale prices of single family homes between the control area and the 0-5 mile zone around TMI before the accident but not after the accident. Over the 27 months before the accident, single family homes close to TMI solid for about $1,860 less on the average than homes in the control area. Analysis of the data for the 10-25 mile zone arount TMI showed that housing prices here did not differ significantly from those in the Lycoming Control area, either before or after the accident.

To determine if the accident had any effects, positive or negative, on the value of homes before the accident, only the "before data" for the TMI study area were used (440 valid property sales over the 27 months preceding the accident). As in virtually all the regression equations, all the coefficients had the expected signs and their magnitudes were reasonable, with 70 to 80 percent of the variation in housing prices explained by the independent variables.

Two independent variables were important here: "distance to TMI" and "close to TMI" (0-5 miles). In one equation, the distance to TMI variable was significant (at the one percent level) with a value of +163 (see Table 8.1, column 1). This would indicate that housing values were expected to increase before the accident about $163 for each mile the property was located from the plant. Substituting the close to TMI variable for distance gave a negative coefficient of -$1,732 at the 5-10 percent level of significance. In the log-log forms of the equations rather than the linear (those just reported), the distance to TMI coefficient was significant at the 5 percent level while the close to TMI coefficient was not significant (at the 10 percent level).

Table 8.1 Summary of Results: TMI, accident, distance, and quadrant related variables.

Variable	Coefficients and Mean Differences									
	Before Accident	After Accident				Before and After Accident				
	2.5[1/]	3.1	3.2	4.3	4.4	3.1	North 3.2	East 3.2	South 3.2	West 3.2
	1	2	3	4	5	6	7	8	9	10
Distance to TMI	163	†				163				
After accident						†	†	†	†	†
0-5 miles	-1,732*	-2,950*		†		-2,136**	†	-2,459	-1,640*	-1,767*
After x distance						†				
After x 0-5 miles						†	†	†	†	†
6-10 miles				†						
11-20 miles				+ 728						
> 20 miles				+2,422						
North			†	-1,214			-3,026			
East			†	+1,686				†		
South			†	+2,198					2,321**	
West			†	+ 936						†
North x 0-5 miles			†		-1,776		†			
East x 0-5 miles			†		†			†		
South x 0-5 miles			-6,682*		†				†	
West x 0-5 miles			†		†					†
North x 6-10 miles					-2,627					
East x 6-10 miles					†					
South x 6-10 miles					+3,744					
West x 6-10 miles					†					
North x 11-20 miles					-1,284					
East x 11-20 miles					+2,157					
South x 11-20 miles					+2,024					
West x 11-20 miles					+ 653					

† Variable not significant at the 10 percent or less level of significance.
* Significant at the 5-10 percent level of significance.
** Significant at the 1-5 percent level of significance.
All other variables significant at the 1 percent or better level of significance.

1/ Refers to the table number in which the full regression results appear. Tables contain more than one regression equation; therefore, coefficients appearing in any one column alone may have come from more than one equation.

Based on these results one might conclude that before the accident the plant might have had an adverse effect on single family property values. Regression analyses, however, does not show cause and effect, only relationships between variables. All we can say from the regression results is that from the beginning of 1977 until March of 1979 housing aroung TMI was lower in value than elsewhere in the region. We know that housing in this area for decades has been lower than for the region as a whole, and we believe that the lower values near the plant reflect primariliy the historic trends in economic development that have occurred there. Data in Tasks B, C and D support this supposition.

8.1.2 Task B

Linear and log-log regressions were run on the "after" and "before and after" accident data. "After" sales numbered 143, while "before and after" sales for the 0-25 mile zone totaled 583. The independent coefficients displayed the expected signs and the equations explained 76 to 83 percent of the variation in selling prices.

The "distance to TMI" variable was not significant in the after accident data. When "close to TMI" was substituted for this variable it was significant at the 5-10 percent level with a coefficient of -$2,950 (column 2, Table 8.1). "Distance to TMI" was significant in the "before and after" data, with the same coefficients (+163) as reported for the "before accident" data (column 6, Table 8.1). When the binary variable "after the accident" was entered in the "before and after" equations, this variable was not at all significant. This indicates that there was no significant difference in the real price of housing between the two time periods. When "distanct to TMI" was interacted with "after accident," there was no significance in the coefficients of this interaction variable. Also, when "close to TMI" (0-5 miles) is interacted with "after accident" the new coefficient is not significant. These results support our contention that even though distance to TMI may be significant in explaining differences in housing prices, these differences are unrelated to the accident. It is difficult to rationalize the plant affecting housing prices before the accident, if the accident itself did not affect the prices.

Four directional quadrants (north, east, south, and west) were entered into the "after" and "before and after" regressions as binary variables, and were also interacted with "after accident" and "close to TMI" variable. The results are shown in Columns 3 and 7-10 in Table 8.1.

In the "after accident" data, none of the coefficients for the quadrant variables were significant. In the "before and after" accident data, with the " after accident" and quadrant each run as separate binary variables, none of the 4 "after accident" coefficients were significant. Likewise in the same data set when "quadrant" and "close to TMI" were interacted, and also when a three-variable interaction, (quadrant, close to TMI, and after accident) was performed, none of the coefficient were significant. There was some significance in the quadrant coefficients over the entire time period (1977-1979), but in light of the after accident findings just discussed these could not be due to the accident. However, in the "after

accident" data set the coefficient for the interaction variable "South x close to TMI" was -$6,682 and significant at the 5-10 percent level of significance. Because there were only 8 observations or sales in this geographical cell and there was not strong signficance, we are hesitant to say this resulted from the accident. Our findings show that when "South x close to TMI x after accident" was inserted in the "before and after" data set the coefficient was not significant (t value of only -0.04). This leads us to conclude that the coefficient of -$6,682 must be reflecting some other unexplained factor. This other factor might be a community of small and not well maintained houses converted from vacation to permanent dwellings and not served by public sewer. We must conclude that there is very little evidence to show that the accident had either positive or negative effects on property values in terms of their location with respect to direction from the plant. Within 5 miles to the south of the plant property values were lower, but there is no firm evdience that those were related to the accident.

To examine the data for possible differential effects by value classes of properties, the January, 1977, sales were divided into three groups, each containing an equal number of sales: low value (under $22,000), medium value ($22,100 - $35,000), and high value (over $35,000). In subsequent time periods these value parameters were adjusted for inflation so as to keep the value classes consistent with inflationary effects in the market.

Three regression equations were specified for each value class (before, after, and before and after the accident). Binary independent variables relating to the accident and to the plant were specified. A set of regressions were run for each value class.

In the "before accident" equations, none of the coefficients for the variable "close to TMI" (0-5 miles) were significant, indicating that apparently the plant had no effects on sale prices according to value classes. The same was true for the whole data set, "before and after accident." None of the coefficients for the three dummy variables in each value class equation were significant: "close to TMI," "after accident," and these two interacted "close to TMI x after accident."

However, we did find significance in the "close to TMI" coefficient for the high value class when only the "after accident" sales data were analyzed. This coefficient, -$4,589, was significant at the 1-5 percent level of significance, which is not in conformity with the results of the other equations just reported. Examining the other variables in this equation revealed that two had signs opposite to what we would expect and opposite to the results for those coefficients in most of the other regressions; namely, "public sewer" and "good house condition" were negative, although neither were significant. This indicates multicollinearity existed and thus the results of this equation must be considered much less reliable than the results for the "before and after" equation. For these reasons we must conclude that there is no strong evidence that the accident had any effects on the selling price of low, medium, or high value properties.

8.1.3 Task C

In this task we tried a new approach: we predicted the sales values of properties after the accident by distance zones and quadrants by means of a simple linear regression model in which equalized assessed values and effective tax rates were the only independent variables. We then compared the differences between the predicted values and the actual market values.

Property assessments should reflect all the "bundle" of variables that we used in the earlier regressions. But the quality of assessments varies among counties. Unfortunately, the quality of assessment as indicated by the dispersion coefficient was not good in most of the counties included in the study area. For this reason we feel that much less importance should be placed on the finding in this task.

The results indicated that within 10 miles of TMI the differences between the actual and predicted mean prices after the accident were not significant. Properties in the 11-20 mile zone around TMI sold somewhat higher than we predicted (+$728) while properties over 20 miles sold considerably higher (+$2,422), both differences were highly significant (column 4, Table 8.1). Mean differences for the whole quadrants were all highly significant, the north quadrant showing lower values than predicted (-$1,214) while the other 3 quadrants had higher values.

When the quadrants were segmented into distance zones to give us geographic cells (such as 6-10 miles east of TMI), the results were mixed (see column 5, Table 8.1). Only the north cell was significant in the 0-5 mile zone, -$1,776. All 4 directional cells were significant in the 11-20 mile zone, with the north cell the only one in which the actual values were lower then predicted (-$1,284). In the 6-10 mile zone, the east and west quadrant cell differences were not significant. In the north cell they were significantly lower (-$2,627), while in the south cell they were significantly higher (+$3,744).

The finding that housing prices north of the plant were lower than predicted is consistent with the earlier findings of this study, and tends to confirm our belief that it is the long run character of development in this area that is being reflected. In all the remaining cells, the actual mean sale prices were either higher than predicted, or the differences were not significant. Based on these findings, we must conclude that the accident had no adverse impacts, either downwind from the plant (to the east) or in any other direction.

8.1.4 Task D

In this task a time series comparison of mean annual, quarterly, and monthly residential prices from 1975 through 1979 was done by distance zones around TMI and for two control areas. The data base included all single family residential sales data from STEB, screened for invalid sales. The average number of yearly sales in the various areas were: (1) the TMI

study area: 11,738; (2) the Lycoming control area: 635; and (3) the Lehigh control area: 3,952. Within the TMI study area, the average number of yearly sales by the three distance zones were: (1) 0-5 miles; 466; (2) 5-10 miles: 1,299; and (3) 10-25 miles: 9,973. If we assume that the effects of the high interest rates and constraints on availability of mortgage funds on the real estage market in 1979 were felt about equally over the TMI and control areas, and we have no a priori reason to suspect that they were not, then the use of control areas should account for those effects in our analysis of the TMI data.

Mean sale prices for 1975, 1978, and 1979 and the percent increase for the various areas are as follows:

Areas	1975	1978	1979	Percent Change 75-79	Percent Change 78-79
	$	$	$	%	%
0-5 miles	25,644	34,224	36,473	42	6.6
5-10 miles	33,115	42,242	46,575	41	10.7
10-25 miles	27,360	36,861	40,873	49	10.9
Lycoming Control	29,537	37,933	40,247	36	6.1
Lehigh Control	27,960	39,454	43,409	55	10.0

It is apparent from the above data that prices in the 0-5 mile zone are consistently lower than prices in the two more distant zones around TMI. We investigated the 1970 prices and found this relationship existed then, which was before the TMI plant became operational. These data lend support to our interpretation of the regressions in the previous tasks where we felt that much of the explanation for some of the negative coefficients lay in the inherently lower value properties close to TMI. The percent change in 1978 to 1979 prices in the 0-5 mile zone and Lycoming control were very similar, as were the changes for the 5-10, 10-25, and Lehigh control areas.

Examining the time series data by quarterly means revealed no effects from the accident. The second quarter of 1979 (April, May and June) immediately followed the accident and should have revealed price effects if there were any. The percent change in mean quarterly prices from the first to the second quarter for the various areas are shown below:

	0-5	5-10	10-25	Lycoming	Lehigh
	%	%	%	%	%
Average 1975-78	+12.2	+7.8	+ 9.0	+4.2	-10.3
1979	+16.1	+7.9	+11.2	-3.4	+12.4

Within 5 miles of the plant, second quarter 1979 prices increased at a higher rate than in any of the other areas, and at a rate greater than the previous 4 year average rate for that quarter. For the last two quarters of 1979 prices continued to rise in the 0-5 mile area.

Our next step was to predict mean prices for the 4 quarters of 1979 in the 0-5 and 5-10 mile zones and statistically compare them to the actual means. All the evidence thus far indicates that there were no price effects from the accident in the 10-25 mile zone. Therefore, 1975-78 mean prices in this zone were used as the historic base upon which the 1979 quarterly means in the 0-5 and 5-10 mile zones were computed. The differences in the actual and predicted means (actual - predicted) by quarters for the two zones are as follows:

	1979 quarters			
	1	2	3	4
	$	$	$	$
0-5	-2,586	-1,624	-126	-1,549
5-10	-125	-83	+521	-61

None of the above differences are statistically significant based on a two-tailed t test at the 99 percent confidence level.

Although analysis of the quarterly data uncovered no evidence of effects from the accident on prices, perhaps there were very short lived effects that might show up in monthly data. Using the same prediction methodology as we did for the quarterly data, we predicted monthly means for 1979 for the two distance zones nearest TMI. Monthly differences (actual-predicted) for the three months following the accident in the two zones are as follows:

	April	May	June
	$	$	$
0-5	-3,328	-2,060	+1,403
5-10	-94	+120	+539

None of these monthly differences were significant, which means that the -$3,328 difference in April in the 0-5 mile zone can be explained by normal variation in the market. There was only one month in the data in which there were significant differences, and this was January when in the 0-5 mile zone the actual mean price was a surprising $8,516 below the predicted mean price and in the 5-10 mile zone the actual price was $6,108 higher than the predicted price. Since this was before the accident, these differences are obviously not accident related.

Based on the annual and quarterly trends in mean sales prices in the 3 distance zones around TMI and on the lack of significant differences in actual and predicted mean prices by quarters and months for the two nearest zones, we must conclude that the TMI accident had no effect on single family residential prices throughout 1979.

8.1.5 Task E

This task, using the same data base as the previous task, analyzed the possible effects of the accident on the number of sales by distance zones around TMI, and by three property value classes.

The quarterly data revealed that there might have been a slight effect in the second quarter of 1979 in the 0-5 mile zone. The usual increase in number of sales for that quarter in previous years was not apparent in 1979. In the 5-10 and 10-25 mile zones the second quarter 1979 rates of increase in sales volumes were about the same as in previous years. All three zones around TMI and the two control areas showed significant decreases in sales volumes toward the end of the year, probably a reflection of the adverse financial markets at that time.

Predicting quarterly sales volumes was done in much the same manner as was done in the previous task. In this part of Task E data on sales volumes for all of Pennsylvania, except the City of Philadelphia, were added to provide an additional base for comparison. Second quarter 1979 sales volumes in the 0-5 and 5-10 mile zones were 23 and 17 percent, respectively, below the sales volumes predicted based on the previous 4-year historical trend in the 10-25 mile zone. In contrast, actual second quarter 1979 sales volumes were higher (by from 7 to 15 percent) than predicted in the 10-25 mile zone, the two control areas, and all Pennsylvania. Thus there seems to be some evidence that the accident might have had some distruptive effects on the market.

Quarterly data might mask noticable effects on a monthly basis; therefore, we predicted montly sales volumes for 1979 for the three distance zones around TMI and for Lehigh County and all Pennsylvania. The differences in the actual and predicted (actual-predicted) for 4 months in 1979 are as follows:

	March %	April %	May %	June %
0-5	+19	- 2	-76	+29
5-10	+ 3	- 3	-53	+ 5
10-25	+13	+ 1	- 8	+31
Lehigh County	+16	- 5	- 3	+43
All Penna.	--	+47	- 9	- 1

Sales volumes in the 0-5 and 5-10 mile zones plummeted in May, falling 76 and 53 percent, respectively, short of the predicted number. It is apparent that sales volumes recovered rapidly in June, particularly in the 0-5 mile zone, but the data indicate that the accident did have an adverse impact on sales volume within 10 miles of TMI.

Was the decrease in sales volume reported above felt equally among the low, medium and high property value classes? Establishing value class parameters and deflating values in much the same manner as was done in Task C, we

analyzed the trends in quarterly sales volumes among the three value classes over the 5-year period. The analysis showed that there were some proportionate shifts over the 5 years in the number of sales by value class. The proportions of sales in the medium sales class tended to go up over the 5-year period, while the proportion in the low and high value classes decreased somewhat. This was true for all three distance zones around TMI. However, there were no discernible effects from the accident on these proportions; the sharp decline in May sales appeared to be evenly distributed among all three value classes.

8.1.6 Task F

The final task of this study elicited information from individuals in firms active in the real estate and housing market in the Harrisburg area. Persons were contacted either personally or by telephone and their views and perceptions obtained about how the housing market reacted immediately following the accident and the subsequent adjustments that occurred over the intervening months. Officials associated with real estate and appraisal firms, banks and savings and loan institutions, and general contracting and building firms were contacted. A sampling procedure was used for all the the financial institutions.

Based on discussions with 28 realtors and appraisers, it was quite apparent that the accident did have some effects on the market. The most noticeable effects were in the number of sales right after the accident and in the time it took for properties to sell, with 24 realtors (86 percent) volunteering this observation. Only 4 realtors (14 percent) felt the accident had no effect whatsoever on the market.

Four realtors felt that sales prices were adversely affected by the accident, three observing that it was of short duration (about one month) while one thought the effect lasted almost 6 months. In July of 1980, at the time of interviewing, 4 realtors thought the effect on sales volume was still evident, although they admitted that it was very difficult to separate the accident effects from the financial market effects (high interest rates and shortage of mortgage funds).

Five realtors cited specific instances where they had either lost a sale or had experienced an unusually long delay before the sale was settled. Nine realtors stated they still encounter (July, 1980) some buyers who will not consider properties close to TMI, particularly if the plant is visible. Five realtors (18 percent) observed a drastic effect on the number of sales right after the accident; "the market virtually collapsed for about one month." This view seems to be supported by our findings in Task E for the May, 1979, sales volume. No realtors felt the accident had anything more than very temporary effects on the rental market for housing and none felt it adversely affected the market for commercial properties. Seven realtors (25 percent) stated that the large influx of clean-up workers hired by the utility had helped boost the house sales and rental markets over the past year.

Fifteen financial institutions supplying funds for residential mortgages were contacted. Not one of the officers interviewed felt there were any lasting effects on the market. Four officers felt there was a small, short lived, effect on sales volume right after the accident. Not one institution altered its lending policies, refused to accept mortgages on properties near the plant, lowered appraised values for loan purposes, or discounted property values when a property was used for collateral on personal loans.

Twenty-four contractors were interviewed, all of whom had done some work in the Middletown area. Nineteen (79 percent) felt the accident had some effect on the market, only three of whom felt the effects still persisted. In terms of the contractors' general outlook on the market, 15 stated they were having a good year despite any possible effects from the accident. Four stated they were having some problems but related these to the then economic conditions rather than to TMI. Only 2 contractors (8 percent) expressed outright pessimism and linked their bad times to TMI, both of whom were located in the Middletown area.

8.2 Conclusions

Based on (1) extensive statistical analysis of market sales data from 1975 through 1979 for the area within 25 miles of TMI and for two control areas, and (2) interviews with realtors, banks and savings and loan officials, and contractors, we conclude that:

1. The accident at TMI in March, 1979, had no measurable effects, either positive or negative, on the value of single family residential properties close to the plant, within a 25-mile radius of the plant, or in any direction from the plant.

2. The TMI plant had no measurable effects on single family residential property values from 1977 up to the time of the accident.

3. There were no discernible price effects related to low, medium, or high value classes of residential property.

4. Immediately following the accident there was a sharp decline in the number of residential sales within 10 miles of the plant, with the real estate market returning within 4-8 weeks to near normal conditions, considering the financial market situation at that time. Most of the properties that were on the market during this period were subsequently sold at a price that probably would have prevailed in the absence of the accident.

5. Residential properties within 5 miles of TMI, and those generally to the north, are lower in value than residential properties in the greater Harrisburg area. This has been true since before the plant existed, and is due to the trend and character of housing development in the area over time.

6. There may be an occasional prospective buyer who, even today, may not choose a particular property because of its proximity to TMI. Apparently there are too few of these buyers in the market at any one time to measurably affect the demand for and consequently the price of housing in the TMI area. However, this means that some properties may remain on the market longer, thus increasing the holding costs for some sellers. This situation was not investigated in this study.

7. There is a possibility that the large number of clean-up workers employed by the utility following the accident had a positive effect on the real estate market, counteracting about equally a negative effect and resulting in a net effect of near zero. It is this net effect, of course, that our data are measuring. In terms of the concern of current property owners over the effects of the accident on their property values, it is the net effects of the accident that are relevant, not one or the other of any possible individual effects. We are inclined to believe that neither positive nor negative individual effects exist. Our rationale for this view is based on our conviction that very few, if any, clean-up workers would locate west of the plant, across the Susquehanna River, where the only access to the plant requires driving northward to the nearest bridge crossing near Harrisburg. If this is true, then no positive effect from the clean-up workers occurred here to balance any possible negative effects, and the results of our analyses for areas to the west of TMI must reflect, therefore, the singular negative effect, if any, of the accident itself. The results, however, showed no effects on prices. To accept the existence of counteracting effects, all negative effects must have been concentrated to the north or east of the plant (most of the area to the south of the plant is also across the Susquehanna River with even more difficult access to TMI). We find it difficult to believe that potential buyers would discriminate against properties close to TMI only when they were located north or east of the plant. However, if the influx of clean-up workers did have a positive influence on the housing market east of the plant, then the possibility exists that after clean-up operations are complete their exodus from the area might have a depressing effect; a long delayed reaction of the accident. At this point in time this must be considered very conjectural, predicated on the supposition that there were in fact two opposite effects working in the housing market over the 9 months following the accident.

APPENDIX A

Cross Section Analysis: Sources and Processing of Data, Selection of Variables, and Construction of the Regression Model.

Table $A_p 1$:

CROSS-SECTIONAL DATA SOURCES (CSDS)

1. The Pennsylvania State Tax Equalization Board sales files for 1977-1978-1979 and form STEB-1 from or equivalent for Adams, Cumberland, Dauphin, Lancaster, Lebanon, Lycoming, Perry, and York Counties.

2. Property record cards and tax maps from the following counties of Pennsylvania: Adams, Cumberland, Dauphin, Lancaster, Lebanon, Lycoming, Perry, and York.

3. Aircraft noise impacts for Harrisburg International and Capital City airports, Department of Transportation, Commonwealth of Pennsylvania, Bureau of Advance Plannning, Statewide Studies Division, February 1972.

4. 1978 county, local and school property tax rates for boroughs, cities, and townships. Commonwealth of Pennsylvania, Department of Commerce, Bureau of Statistics, Research and Planning, Harrisburg, 1979.

5. County Planning Commission reports and flood plain maps prepared by the Lancaster, Lycoming Tri-county Regional (Cumberland, Dauphin, and Perry) and York Planning Commissions.

6. Alexander Drafting Co., Arrow, and Visual Encyclopedia, street maps, and municipal maps of Harrisburg and vicinity, Lancaster, Lebanon, and York Counties as well as the PA State Department of Transportation Type 10 highway maps, as well as the Planning Commission map of Williamsport and vicinity.

7. Distances to limited access highways and state parks were from the official transportation map, Pennsylvania Department of Transportation.

In addition, on-site inspection was made of every property included in the analysis.

The characteristics selected to describe the house and lot were based on appraisal techniques, a number of property value studies related to accessibility and environmental factors (noise and air pollutants), and land economic principles. Prior to data collection, it is impossible to identify all of the characteristics that will ultimately be useable as variables in the regression equation. For example, in warm climates houses with central air conditioning sell for more than similar houses without it. In this study, only 5 houses had central air conditioning, precluded its use as a variable because of too few observations. The computer program used eliminates variables having constant or near constant values and ones with too few observations.

Six different types of houses were identified in the study areas as follows:

1. Split level
2. Ranch
3. Raised ranch
4. Cape Cod
5. Slab
6. Multi-story.

Three different typse of garages were identified as follows:

1. Internal garage -- enclosed within the main walls and roof of the house.
2. Attached garage -- a common wall between the house and the garage.
3. Detached garage -- a separate structure.

Number of garage spaces refers to the number of cars the garage was built to accommodate.

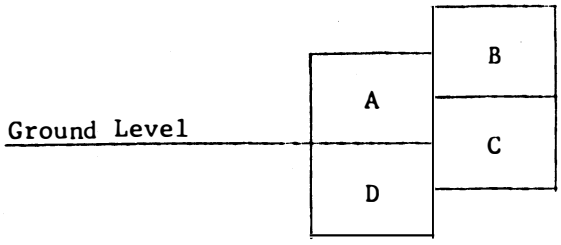
House basements were handled by four configurations:

1. Houses on a slab, including houses built on piers, were listed as "house on slab," a dummy variable.
2. Houses with an unfinished basement, with dirt floor, were included in the constant term.
3. Houses with a full basement with cement floor, is "full basement floor finished," a dummy variable.
4. Houses with a finished basement were shown as "area finished basement," and the area in square feet entered.

The first floor of a house was considered to be the floor which one entered from the main or front entrance, and the floor which usually included the living room and kitchen. A dummy variable covered houses with attics. Since only a few houses contained four floors, the fourth floor was not counted.

Split level houses are more difficult to evaluate in terms of floors and living area. In Figure A.1, Area A is considered to be the first floor; Area B the second floor; Area C the finished basement, which often contains an internal garage; and if Area D is finished as a basement it is included along with Area C. If Area D does not exist, the house is considered to be on a slab, so that the variables are additive.

Figure A.1. Split level house diagram, front view.



Tax data used in the cross-section analysis are applicable to the municipality in which the house sales occurred. These data are taken from (CSDS), No. 4.

The variable numbers, from 1 to __ are the same as those used in the regression equations. When an original variable was subsequently replaced by a new variable, the original number is identified with the letter A following the number.

Table A-1 describes, for each of the __ variables, a number of characteristics that should enable the reader to get a better understanding of the variables and see how they were used in the regression equations. The following guide refers to Table A_p-1:

Column 1: The name and number of the variable, how it is measured (dummy, months, miles, feet^2, spaces, etc.).

Column 2: Study groups: (1) 0-5 miles before the accident; (2) 0-5 miles after the accident; (3) 6-25 miles before the accident; (4) 6-25 miles after accident; (5) Control area Lycoming County

Column 3: The number of observations in each group having the characteristic.

Column 4: The value for the characteristic shows: minimum; mean (for a dummy variable the mean is the proportion of observations having the characteristics); the standard deviation; and maximum (where the values are not available or are meaningless, they are not shown).

Column 5: Source: PRC - Property record card data

OSI - On-site insepction

TM - Assessment office tax maps

RM - Official transportation Pennsylvania road map

DNA - Data not available

TD - Town data

CODE - Codes used

1-2-3-4-5-6-7 - Refers to Cross-Sectional Data Sources Numbers

Column 6: Construction: Examples

6 x 70 - means variable 6 times variable 70.

44 (Dummy) - means the variable is a dummy variable, 0 or 1 derived from the code variable 44.

None - means actual value of the variable is used.

Column 7: Limitation: Observations excluded from the sample because the value was greater or less than the value given in this column.

None - means no limitations.

Column 8: Effect: Hypothesized effect on the dependent variable.
(+) means an increase in the value.
(-) means a decrease in value.
(?) effect is undetermined bedause the variable could have different effects on the dependent variable.

Tried - means the variable was tried in trial equations and had no effect on the dependent variable and thus another variable was put in its place.

None - means the variable is hypothesized to have no effect on the dependent variable and was collected for data housekeeping reasons only.

Used - means the variable was used to construct other variables.

Column 9: Class: (1) - House characteristics

(2) - Lot characteristics

(3) - Accessibility characteristics

(4) - Locational characteristics

(5) - Public sector characteristics

(6) - Transfer characteristics

(7) - Interaction variables

Table A_p1. Description of variables used in cross-section regression equations.

Variable Number and Name		No. Observations	Values: Minimum	Mean	Standard Deviation	Maximum	Source	Construction	Limitation	Effect	Class
(1) Built before 1914 (Dummy)	1	68	0	.337		1	PRC	44 (Dummy)	None	?	1
	2	27	0	.386		1					
	3	59	0	.248		1					
	4	19	0	.260		1					
	5	26	0	.232		1					
(2) Built 1915-1933 (Dummy)	1	30	0	.148		1	PRC	44 (Dummy)	None	?	1
	2	9	0	.129		1					
	3	41	0	.172		1					
	4	8	0	.109		1					
	5	19	0	.164		1					
(3) Built 1934-1946 (Dummy)	1	9	0	.045		1	PRC	44 (Dummy)	None	?	1
	2	3	0	.043		1					
	3	14	0	.059		1					
	4	4	0	.055		1					
	5	3	0	.027		1					
(4) Built 1947-1967 (Dummy)	1	46	0	.228		1	PRC	44 (Dummy)	None	?	1
	2	14	0	.208		1					
	3	52	0	.218		1					
	4	16	0	.219		1					
	5	38	0	.339		1					
(4A) Sale Price	1	202	5500	30,966	12,852	54,000	PRC	None	< 5,000 >100,000	USED (43)	6
	2	70	5000	35,119	14,842	70,000					
	3	238	6966	37,767	18,454	95,000					
	4	73	6000	42,965	26,137	94,900					
	5	112	6200	38,045	15,525	93,500					
(5) Built after 1967	1	49	0	.243		1	PRC	44 (Dummy)	None	?	1
	2	17	0	.243		1					
	3	72	0	.303		1					
	4	26	0	.356		1					
	5	26	0	.232		1					
(5A) Date of Sale (Month) Recording Date	1	202	1	6.0		12	PRC	None	None	USED (42)	6
	2	70	6	8.6		12					
	3	238	1	6.3		12					
	4	73	6	8.8		12					
	5	112	1	7.3		12					
(6) Year of Sale (Year) Recording Date	1	202	77	77.7		79	PRC	None	77 79	+ USED (42)	6
	2	70	79	79.0		79					
	3	238	79	77.0		79					
	4	73	79	79.0		79					
	5	112	77	78.4		79					
(7) Lot Frontage (feet)	1	202	13	81.1	59.7	350	PRC TM OSI	None	13 400	+ USED (66)	2
	2	70	16	80.7	63.7	400					
	3	238	14	69.8	55.1	400					
	4	77	15	74.6	59.8	335					
	5	112	20	88.8	55.4	300					
(8) Lot Depth (feet)	1	202	50	161.4	63.1	537	PRC TM OSI	None	27 550	+ USED (66)	2
	2	70	30	149.7	73.6	550					
	3	238	51	142.4	58.3	550					
	4	73	27	146.5	64.2	386					
	5	112	50	153.3	56.1	400					
(9) Lot on a surfaced road	1	196	0	.970		1	OSI	None	None	+	5
	2	67	0	.957		1					
	3	232	0	.974		1					
	4	69	0	.945		1					
	5	101	0	.901		1					
(10) Traffic Volume	1	202	1			3	OSI TM	None	None	USED (27,28)	4
	2	70	1			3					
	3	238	1			3					
	4	73	1			3					
		112	1			3					

Table A_p1. (continued)

Variable Number and Name		No. Observations	Values				Source	Construction	Limitation	Effect	Class
			Minimum	Mean	Standard Deviation	Maximum					
(12) Poor Grade House (Dummy)	1	14	0	.069		1	PRC OSI	60 (Dummy)	None	--	1
	2	7	0	.100		1					
	3	7	0	.029		1					
	4	4	0	.055		1					
	5	13	0	.116		1					
(13) Lot with Public Sewer (Dummy)	1	102	0	.564		1	PRC OSI	None	None	+	2
	2	29	0	.414		1					
	3	198	0	.831		1					
	4	53	0	.753		1					
	5	68	0	.607		1					
(14) Good Grade House (Dummy)	1	4	0	.019		1	PRC OSI	60 (Dummy)	None	+	1
	2	1	0	.014		1					
	3	9	0	.038		1					
	4	5	0	.068		1					
	5	7	0	.063		1					
(15) Outstanding view (Dummy)	1	2	0	.010		1	OSI	None	None	+	2
	2	0	0	.000		0					
	3	3	0	.012		1					
	4	0	0	.000		0					
	5	1	0	.008		1					
(16) Noise Aircraft (Dummy)	1	40	0	.198		1	OSI	None	None	-	4
	2	10	0	.142		1					
	3	1	0	.004		1					
	4	0	0	.000		0					
	5	0	0	.000		0					
(17) House is a duplex (Dummy)	1	11	0	.054		1	PRC OSI	None	None	?	1
	2	10	0	.143		1					
	3	31	0	.130		1					
	4	13	0	.178		1					
	5	0	0	.008		0					
(18) View from house (Dummy)	1	11	0	.054		1	OSI	None	None	?	1
	2	10	0	.143		1					
	3	31	0	.130		1					
	4	13	0	.178		1					
	5	0	0	.008		1					
(19) Nuisance near lot (Dummy)	1	13	0	.064		1	OSI	None	None	-	4
	2	3	0	.043		1					
	3	6	0	.025		1					
	4	5	0	.068		1					
	5	7	0	.062		1					
(20 Favorable slope for development (Dummy)	1	183	0	.906		1	OSI	None	None	+	2
	2	67	0	.957		1					
	3	202	0	.848		1					
	4	62	0	.849		1					
	5	95	0	.848		1					
(21) Trees on lot (Dummy)	1	141	0	.699		1	OSI	None	None	+	2
	2	39	0	.557		1					
	3	143	0	.600		1					
	4	45	0	.616		1					
	5	74	0	.660		1					
(23) House is a row house (Dummy)	1	10	0	.049		1	OSI	None	None	-	1
	2	3	0	.042		1					
	3	37	0	.155		1					
	4	5	0	.068		1					
	5	1	0	.008		1					

Table A_p1. (continued)

Variable Number and Name	Group	No. Observations	Values				Source	Construction	Limitation	Effect	Class
			Minimum	Mean	Standard Deviation	Maximum					
(24) Two family house (Dummy)	1	3	0	.014		1	OSI	None	None	+	1
	2	4	0	.057		1					
	3	8	0	.033		1					
	4	2	0	.027		1					
	5	0	0	.000		0					
(25) Flood plain (Dummy)	1	12	0	.059		1	OSI	None	None	-	4
	2	4	0	.057		1	5				
	3	3	0	.013		1					
	4	3	0	.040		1					
	5	2	0	.018		1					
(26) Two house sale (Dummy)	1	7	0	.035		1	PRC	None	None	-	6
	2	1	0	.014		1	OSI				
	3	2	0	.008		1					
	4	0	0	.000		0					
	5	1	0	.009		1					
(27) Underground electric (Dummy)	1	18	0	.089		1					
	2	4	0	.057							
	3	31	0	.130		1					
	4	13	0	.178		1					
	5	1	0	.008		1					
(29) House condition poor (Dummy)	1	39	0	.193		1	PRC	61	None		1
	2	15	0	.214		1	OSI	(Dummy)			
	3	30	0	.126		1					
	4	11	0	.150		1					
	5	25	0	.223		1					
(30) House condition good (Dummy)	1	20	0	.099		1	PRC	61	None	+	1
	2	6	0	.086		1		(Dummy)			
	3	23	0	.096		1					
	4	15	0	.205		1					
	5	21	0	.187		1					
(31) Distance to TMI (Miles)	1	202	1	3.4	1.2	5	2,6,7	None	None	?	4
	2	70	1	3.4	1.1	5					
	3	238	6	15.8	6.0	26					
	4	73	6	15.4	5.6	26					
	5	112	71	76.5	2.8	80					
(37) Distance to nearest big employer (Miles)	1	202	6	9.63	2.0	15	2,6,7	None	None	+	3
	2	70	6	10.64	1.9	14					
	3	238	0	6.48	6.5	26					
	4	73	0	7.16	6.2	23					
	5	112	1	8.36	5.7	24					
(38) Distance to limited access highway (Miles)	1	202	0	2.42	1.6	8	2,6,7	None	None	+	3
	2	70	1	3.11	2.1	8					
	3	238	0	2.55	2.2	12					
	4	73	0	3.11	2.8	14					
	5	112	0	2.20	2.2	9					
(39) Distance to nearest state park (Miles)	1	202	5	15.2	4.6	26	2,6,7	None	None	+	3
	2	70	5	14.8	5.5	25					
	3	238	3	17.9	7.5	32					
	4	73	2	18.5	9.2	36					
	5	112	21	31.4	3.3	37					
(40) Abut light traffic (Dummy)	1	150	0	.743		1	OSI	16	None	?	4
	2	58	0	.828		1	6,7	(Dummy)			
	3	171	0	.718		1					
	4	49	0	.671		1					
	5	87	0	.777		1					
(41) Abut heavy traffic (Dummy)	1	14	0	.069		1	OSI	10	None	?	4
	2	2	0	.028		1	6,7	(Dummy)			
	3	25	0	.105		1					
	4	11	0	.150		1					
	5	15	0	.134		1					

Table A_p1. (continued)

Variable Number and Name	Group	No. Observations	Values Minimum	Mean	Standard Deviation	Maximum	Source	Construction	Limitation	Effect	Class
(42) Month of sale Base 12/77 (Month)	1	202	1	14.7		29	PRC 1	5-6	None	?	6
	2	70	30	32.6		36					
	3	238	1	14.7		29					
	4	73	30	32.8		36					
	5	112	1	23.9		36					
(43) Deflated selling price (Dollars)	1	202		27,916.4	11,418.9		PRC	42-4 .007 per month Base 1/77	See 4		Dependent Variable
	2	70		27,955.8	11,716.7						
	3	238		34,053.6	16,536.3						
	4	73		34,157.3	16,681.8						
	5	112		32,178.9	13,170.6						
(44 Year built	1	202	1850	1932	35	1979	PRC OSI	None	1858 1979	USED 1-2-3-4-5	1
	2	70	1856	1933	34	1979					
	3	238	1850	1939	31	1979					
	4	73	1850	1942	33	1979					
	5	112	1880	1942	29	1979					
(45) Number of floors (Floors)	1	202	1	1.6	.5	2	PRC OSI	None	None	+	1
	2	70	1	1.6	.5	2					
	3	238	1	1.6	.5	2					
	4	73	1	1.6	.5	2					
	5	112	1	1.5	.5	2					
(46) Number of bathrooms (Rooms)	1		0	1.31	0.61	4	PRC	None	None	+	1
	2		0	1.28	0.51	3					
	3	238	1	1.51	0.64	3					
	4	73	1	1.42	0.55	3					
	5	112	1	1.33	0.52	3					
(47) Area first floor, ($feet^2$)	1	202	326	852.1	270.6	1779	PRC OSI	None	< 2100	+	1
	2	70	468	881.9	277.4	1800					
	3	238	392	885.8	294.4	2094					
	4	73	450	901.7	350.9	1989					
	5	112	400	975.7	308.6	1800					
(48) Area 2nd floor, ($feet^2$)	1		0	381.9	381.6	1779	PRC OSI	None	None	+	1
	2		0	471.0	380.2	1613					
	3		0	455.3	373.0	1476					
	4		0	391.8	327.1	1232					
	5		0	354.8	399.6	1420					
(49) Area finished basement ($feet^2$)	1		0	44.6	163.6	1003	PRC OSI	None	None	+	1
	2		0	46.0	132.4	500					
	3		0	71.6	196.6	900					
	4		0	74.6	199.2	924					
	5			119.4	300.3	1300					
(50) House on slab (Dummy)	1	19	0	.094		1	PRC OSI	None	None	?	1
	2	2	0	.028		1					
	3	21	0	.088		1					
	4	6	0	.082		1					
	5	18	0	.160		1					
(51) Full basement floor, finished (Dummy)	1	95	0	.470		1	PRC OSI	None	None	+	1
	2	38	0	.542		1					
	3	135	0	.567		1					
	4	44	0	.602		1					
	5	31	0	.276		1					
(52) House has an attic (Dummy)	1	65	0	.321		1	PRC OSI	None	None	+	1
	2	17	0	.242		1					
	3	77	0	.323		1					
	4	11	0	.151		1					
	5	22	0	.196		1					
(53) Attached garage (No. spaces)	1		0	.237		2	PRC OSI	None	None	+	1
	2		0	.186		2					
	3		0	.361		3					
	4		0	.315		2					
	5		0	.285		2					

Table A_p1. (continued)

Variable Number and Name		No. Observations	Values Minimum	Mean	Standard Deviation	Maximum	Source	Construction	Limitation	Effect	Class
(54) Detached garage (No. spaces)	1		0	.208		3	PRC	None	None	+	1
	2		0	.157		2	OSI				
	3		0	.222		3					
	4		0	.192		3					
	5		0	.402		3					
(55) Fireplace (Number)	1		0	.203		2	PRC	None	None	+	1
	2		0	.243		2	OSI				
	3		0	.382		2					
	4	25	0	.342		1					
	5		0	.206		2					
(56) Central heating (Dummy)	1	193	0	.955		1	PRC	None	None	+	1
	2	67	0	.957		1	OSI				
	3	234	0	.983		1					
	4	71	0	.973		1					
	5	110	0	.982		1					
(57) Central air conditioning (Dummy)	1	2	0	.009		1	PRC	None	None	+	1
	2	1	0	.014		1	OSI				
	3	18	0	.075		1					
	4	5	0	.068		1					
	5	1	0	.008		1					
(58) Modern kitchen (Dummy)	1	129	0	.638		1	PRC	None	None	+	1
	2	37	0	.528		1	OSI				
	3	146	0	.613		1					
	4	46	0	.630		1					
	5	67	0	.598		1					
(59) Stone facing on house (Dummy)	1	79	0	.391		1	OSI	None	None	+	1
	2	29	0	.414		1					
	3	163	0	.685		1					
	4	42	0	.575		1					
	5	34	0	.303		1					
(60) House grade (Grade)	1	202	1	1.95		3	PRC	None	> 1 < 3	Used 12,14 Constant	1
	2	70	1	1.91		3	OSI				
	3	238	1	2.00		3					
	4	73	1	2.01		3					
	5	112	1	1.95		3					
(61) House condition (Code)	1	202	1	1.90		3	PRC	None	> 1 < 3	Used 29,30 Constant	1
	2	70	1	1.87		3	OSI				
	3	238	1	1.97		3					
	4	73	1	2.05		3					
	5	112	1	1.96		3					
(63) Town tax rate (Rate per 1000)	1	202	14.07	18.77		24.61	6	None	None	--	5
	2	70	14.07	18.67		24.61					
	3	235	13.80	24.97		48.03					
	4	73	13.80	23.43		48.03					
	5	112	11.07	18.57		22.23					
(65) Bedrooms (Number)	1	202	1	3.08		6	PRC	None	> 1 < 8	+	1
	2	70	2	3.20		6	OSI				
	3	238	1	3.19		8					
	4	73	2	3.14		8					
	5	112	1	2.97		5					
(66) Lot area (feet^2)	1	202	819	14,418	15,987	105,000	PRC	7 x 8	See 7 and 8	+	2
	2	70	660	14,624	23,371	160,000	OSI				
	3	238	960	11,702	17,888	165,000	TM				
	4	73	1008	13,331	19,426	129,310					
	5	112	2750	15,030	15,367	90,000					
(70) Water frontage (Dummy)	1	5	0	.024		1	OSI	None	None	+	4
	2	0	0	6.000		0					
	3	0	0	6.000		0					
	4	0	0	6.000		0					
	5	1	0	.008		1					

Table A_p1. (continued)

Variable number and name	Group	No. Observations	Values Minimum	Mean	Standard Deviation	Maximum	Source	Construction	Limitation	Effect	Class
(74) Swimming pool (Dummy)	1	1	0	.004		1	PRC OSI	None	None	+	1
	2	2	0	.028		1					
	3	1	0	.004		1					
	4	0	0	.000		0					
	5	1	0	.008		1					
(77) Garage internal (Dummy)	1		0	.143		2	PRC OSI	None	None	+	1
	2		0	.114		1					
	3		0	.168		2					
	4		0	.470		2					
	5		0	.196		2					
(78) Lycoming Control area (Dummy)	1	0	0	.000		0	2,6,7	31 Dummy	None	?	4
	2	0	0	.000		0					
	3	0	0	.000		0					
	4	0	0	.000		0					
	5	121	1	1.000		1					
(79) After accident (Dummy)	1	0	0	0.000		0	PRC 1	42 Dummy	None	?	6
	2	70	1	1.000		1					
	3	0	0	.000		0					
	4	73	1	1.000		1					
	5	47	0	.419		1					
(80) 0-5 miles to TMI (Dummy)	1	202	1	1.000		1	2,6,7	31	None	?	4
	2	70	1	1.000		1					
	3	0	0	0.000		0					
	4	0	0	0.000		0					
	5	0	0	0.000		0					
(81) After accident x (0-5 miles, Dummy)	1	0	0	0.000		0	2,6,7 PRC 1	79 x 80 Dummy	None	?	7
	2	70	1	1.000		1					
	3	0	0	0.000		0					
	4	0	0	0.000		0					
	5	0	0	0.000		0					
(82) After accident x Distance to TMI	1	0	0	0.000		0	2,6,7 PRC 1	31 x 79 Miles	None	?	7
	2	70	1	3.400		5					
	3	0	0	0.000		0					
	4	73	6	15.400		26					
	5	0	0	0.000		0					
(83) Quadrants N-E-S-W	1		See Table A_p2 Quadrant Variables								
	2										
	3										
	4										
	5										
(84) Close x Quadrants N-E-S-W	1		See Table A_p2 Quadrant Variables								
	2										
	3										
	4										
	5										
(85) After x close + Quadrant N-E-S-W	1		See Table A_p2 Quadrant Variables								
	2										
	3										
	4										
	5										
(87) Lycoming control area x after accident (Dummy)	1	0	0	0.000		0	2,6,7 PRC	78 x 79 Dummy	None	?	7
	2	0	0	0.000		0					
	3	0	0	0.000		0					
	4	0	0	0.000		0					
	5	47	0	0.419		1					
	1										
	2										
	3										
	4										
	5										

Table A_p2. Quadrant Variables

Variable number and name	Group	No. Observations	Values: Minimum	Mean	Standard Deviation	Maximum	Source	Construction	Limitation	Effect	Class
(83N) Quadrant North	1	109	0	.534		1	1,2,6,7 PRC	None	None	?	4
	2	34	0	.485		1					
	3	66	0	.270		1					
	4	25	0	.342		1					
	5	0	0	.000		0					
(83E) Quadrant East	1	47	0	.233		1	1,2,6,7 PRC	None	None	?	4
	2	13	0	.185		1					
	3	70	0	.294		1					
	4	19	0	.260		1					
	5	0	0	.000		0					
(83S) Quadrant South	1	5	0	.024		1	1,2,6,7 PRC	None	None	?	4
	2	8	0	.114		1					
	3	56	0	.210		1					
	4	19	0	.260		1					
	5	0	0	.000		0					
(83W) Quadrant West	1	40	0	.198		1	1,2,6,7 PRC	None	None	?	4
	2	15	0	.214		1					
	3	12	0	.218		1					
	4	10	0	.137		1					
	5	0	0	.000		0					
(84N) Close x Quadrant North	1	109	0	.539				83N x 80	None	?	7
	2	34	0	.485							
	3	0	0	.000		0					
	4	0	0	.000		0					
	5	0	0	.000		0					
(84E) Close x Quadrant East	1	47	0	.233				83E x 80	None	?	7
	2	13	0	.188							
	3	0	0	.000		0					
	4	0	0	.000		0					
	5	0	0	.000		0					
(84S) Close x Quadrant South	1	5	0	.024				83S x 80	None	?	7
	2	8	0	.114							
	3	0	0	.000		0					
	4	0	0	.000		0					
	5	0	0	.000		0					
(84W) Close x Quadrant West	1	40	0	.198				83W x 80	None	?	7
	2	15	0	.214							
	3	0	0	.000		0					
	4	0	0	.000		0					
	5	0	0	.000		0					
(85N) After x Close x Quadrant North	1	104	0	.539				84N x 79	None	?	7
	2	0	0	.000							
	3	0	0	.000		0					
	4	0	0	.000		0					
	5	0	0	.000		0					
(85E) After x Close x Quadrant East	1	47	0	.233				84E x 79	None	?	7
	2	0	0	.000							
	3	0	0	.000		0					
	4	0	0	.000		0					
	5	0	0	.000		0					
(85S) After x Close x Quadrant South	1	5	0	.024		0		84S x 79	None	?	7
	2	0	0	.000							
	3	0	0	.000		0					
	4	0	0	.000		0					
	5	0	0	.000		0					
(85W) After x Close x Quadrant West	1	40	0	.198				84W x 79	None	?	7
	2	0	0	.000							
	3	0	0	.000		0					
	4	0	0	.000		0					
	5	0	0	.000		0					

Table A_p3:

Within the constant term in the regression equations are many variables which are dummy variables, that is, they are designated as a one or a zero. The one indicates that the characteristic is present and the zero inticates its absence. Table A-2 gives a description of these variables that are reflected in the constant term. The table shows the name and number of the variable and number of the non-constant variable from which it was constructed. The table also shows for each variable the number of observations having the variable characteristic, the mean value, how the variable was constructed, and the hypothesized effect on the dependent variable.

Regression mathematics dictate that when dummy variables are used, all observations cannot be in the equation simultaneously; one or a group must be omitted, otherwise the sum of all variables is one. For example, the years the houses were built were divided into 5 time periods (5 dummy variables), but only 4 of these were entered in the equation. The 5th dummy, built between 1947 and 1967, was omitted; therefore, it was reflected in the constant term. A number of the dummy variables used in this analysis were constructed from numeric variables.

When the non-constant variable does not appear as one of the independent variables, then the constant term does not contain observations on this variable. For example, when the dummy "houses with fireplace" is not in the equation, then the constant term does not reflect houses without fireplaces.

Table A_p3. Description of variables reflected in the constant term of the regression equations.

Variable Number and Name	Group	Number Observations	Mean	Construction	Effect
(9) Lot on non-surfaced road (Dummy)	1	6	.030	None	-
	2	3	.043		
	3	6	.025		
	4	4	.055		
	5	11	.098		
(12-14) Average grade house (Dummy)	1	184	.911	60 (Dummy)	?
	2	62	.885		
	3	222	.932		
	4	64	.877		
	5	92	.821		
(16) Non-noise aircraft (Dummy)	1	162	.802	None	+
	2	60	.878		
	3	237	.988		
	4	73	1.060		
	5	112	1.000		
(21) No trees on lot (Dummy)	1	61	.302		-
	2	31	.443		
	3	95	.400		
	4	18	.384		
	5	38	.340		
(24) Non multi-family house (Dummy)	1	199	.986	None	?
	2	66	.943		
	3	230	.967		
	4	71	.973		
	5	112	1.000		
(25) Non-flood plain (Dummy)	1	190	.941	None	+
	2	66	.943		
	3	235	.987		
	4	70	.960		
	5	110	.982		
(29,30) House condition - average (Dummy)	1	143	.708	61 (Dummy)	+
	2	49	.706		
	3	185	.777		
	4	47	.644		
	5	66	.589		
(49,50,51) House with a dirt basement (Dummy)	1			None	-
	2				
	3				
	4				
	5				
(52) House with no attic (Dummy)	1	137	.679	None	-
	2	53	.758		
	3	161	.677		
	4	62	.849		
	5	90	.804		
(53,54,77) House with no garage spaces (Spaces)	1			None	-
	2				
	3				
	4				
	5				
(55) House with no fireplace (Dummy)	1			None	-
	2				
	3				
	4	48	.658		
	5				
(57) House with no air conditioner (Dummy)	1	200	.991	None	-
	2	69	.986		
	3	220	.925		
	4	68	.932		
	5	111	.992		

Table A_p3. (continued)

Variable Number and Name	Group	Number Observations	Mean	Construction	Effect
(58) House without a modern kitchen (Dummy)	1	73	.362	None	-
	2	33	.472		
	3	92	.387		
	4	27	.370		
	5	45	.402		
(59) House with no stone front (Dummy)	1	123	.609	None	-
	2	41	.586		
	3	75	.315		
	4	31	.425		
	5	78	.697		
(78) House not in Lycoming control area (Dummy)	1	202	1.00	31 (Dummy)	?
	2	70	1.00		
	3	238	1.00		
	4	73	1.00		
	5	0	0.00		
(79) House sales before TMI accident (Dummy)	1	202	1.00	42 (Dummy)	?
	2	0	0.00		
	3	238	1.00		
	4	0	0.00		
	5	65	1.00		
(80) House not 0-5 miles to TMI (Dummy)	1	202	1.00	31 (Dummy)	?
	2	70	1.00		
	3	0	0.00		
	4	0	0.00		
	5	0	0.00		
	1				
	2				
	3				
	4				
	5				

APPENDIX B

Municipalities in study area by distance zones.

0-5 Mile Radius

Dauphin County

Highspire Borough
Middletown Borough
Royalton Borough
Londonderry Township
Lower Swatara Township

Lancaster County

Conoy Township

York County

Goldsboro Borough
York Haven Borough
New berry Township

5-10 Mile Radius

Cumberland County

New Cumberland Borough

Dauphin County

Hummelstown Borough
Paxtang Borough
Steelton Borough
Conewago Township
Derry Township
South Hanover Township
Swatara Township

Lancaster County

Elizabethtown Borough
Mount Joy Township
West Donegal Township

York County

Lewistown Borough
Manchester Borough
Mount Wolf Borough
Conewago Township
East Manchester Township
Fairview Township

10-25 Mile Radius

Adams County

Abbottstown Borough
East Berlin Borough
York Spring Borough
Berwick Township
Hamilton Township
Huntington Township
Latimore Township
Reading Township

Cumberland County

Camp Hill Borough
Carlisle Borough
Lemoyne Borough
Mechanicsburg Borough
Mount Holly Spring Borough
Shiremanstown Borough
West Fairview Borough
Wormleysburg Borough
East Pennsboro Township
Hampden Township
Lower Allen Township
Middlesex Township
Monroe Township
Silver Springs Township
South Middleton Township

Dauphin County

Harrisburg City
Dauphin Borough
Halifax Borough
Penbrook Borough
East Hanover Township
Halifax Township
Jefferson Township
Lower Paxton Township
Middle Paxton Township
Reed Township
Susquehanna Township
Rush Township
Wayne Township
West Hanover Township

10-25 Mile Radius (continued)

Lancaster County

Lancaster City
Columbia Borough
East Petersburg Borough
Lititz Borough
Manheim Borough
Marietta Borough
Millersville Borough
Mount Joy Borough
Mountville Borough
Washington Borough
East Donegal Township
East Hempfield Township
Elizabeth Township
Lancaster Township
Manheim Township
Manor Township
Penn Township
Rapho Township
Warwick Township
West Hempfield Township

Lebanon County

Lebanon City
Cleona Borough
Cornwall Borough
Jonestown Borough
Mount Gretna Borough
Palmyra Borough
Annville Township
East Hanover Township
Heidelberg Township
North Annville Township
North Cornwall Township
North Lebanon Township
North Londonderry Township
South Annville Township
South Lebanon Township
South Londonderry Township
Swatara Township
Union Township
West Cornwall Township
West Lebanon Township

Perry County

Duncannon Borough
Marysville Borough
New Buffalo Borough
Penn Township
Rye Township

York County

York City
Crossroads Borough
Dallastown Borough
Dillsburg Borough
Dover Borough
East Prospect Borough
Felton Borough
Franklintown Borough
Hallam Borough
Jacobus Borough
Jefferson Borough
Loganville Borough
New Salem Borough
North York Borough
Red Lion Borough
Seven Valleys Borough
Spring Grove Borough
Wellsville Borough
West York Borough
Windsor Borough
Winterstown Borough
Wrightsville Borough
Yoe Borough
Yorkana Borough
Carroll Township
Chanceford Township
Franklin Township
Hellam Township
Jackson Township
Lower Windsor Township
Manchester Township
Monaghan Township
North Codorus Township
North Hopewell Township
North York Township
Paradise Township
Spring Garden Township
Springettsbury Township
Springfield Township
Warrington Township
Washington Township
West Manchester Township
Windsor Township
York Township

Control - Lycoming County

Duboistown Borough
Hughesville Borough
Montgomery Borough
Montoursville Borough
Muncy Borough
South Williamsport Borough
Armstrong Township
Clinton Township
Fairfield Township
Loyalsock Township
Mill Creek Township
Muncy Township
Old Lycoming Township
Susquehanna Township
Upper Fairfield Township
Wolf Township
Woodward Township

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16. ABSTRACT (200 words or less)

This study examined the effects of the accident at Three Mile Island on residential property values and number of sales within a 25-mile radius of the plant. Regression analyses, using data on 583 actual market sales of single family homes from 1977 through 1979, examined the effects before and after the accident on the basis of distance and direction from the plant and on three different property value classes. All valid single family property sales between 1975 and 1979 within the 25-mile area were examined in a time series analysis. Interviews were conducted with realtors, financial instituion officials and building contractors in the area. The accident had no measurable effects, positive or negative, on the value of single family residential properties within a 25-mile radius of the plant, or in any direction from the plant, or on low, medium, or high value properties. The plant had no measurable effects on residential property values for the 2 years prior to the accident. Immediately following the accident there was a sharp decline in the number of residential sales within 10 miles of the plant, but the real estate market returned to near normal conditions within 4-8 weeks. The interviews basically confirmed the above findings.

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