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Demand, Supply and Spatial Distribution of Second Homes in the Northeast

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DEMAND, SUPPLY AND SPATIAL DISTRIBUTION OF SECOND HOMES IN THE NORTHEAST

Robert Sim and Marvin Kottke[1/]

I. INTRODUCTION

A. The Problem

The increasing affluence of consumers in the Northeast has led to considerable growth in the market for second homes.[2/] However, this growth has not been uniform throughout the Northeast and the resulting changes in the distribution of second homes cause different types of economic impacts among rural areas.

Some popular outdoor recreation locations may find that a slower rate of second home development depresses the local economy. Other areas that were previously underdeveloped may begin experiencing a rapid influx of second homes with their attendant economic benefits (for example, greater consumer expenditures and tax revenues), as well as environmental costs (for example, congestion, pollution and an increase in the demand for public services).

1/ Robert Sim was formerly Graduate Assistant and Marvin Kottke is Professor, University of Connecticut. This report is based on research reported in a Ph.D. thesis by Sim [24]. The helpful suggestions made during the research project by William Levedahl and Dennis Heffley are gratefully acknowledged. Mal Bevins, University of Vermont provided the mailing list and information for the "Owners of Second Homes in Vermont" survey and Richard Stammer, Rutgers University, cooperated in conducting a supplemental survey of "Owners of Second Homes in New Jersey."

2/ For the purpose of this study second homes are defined as homes other than the primary place of residence which individuals or households reserve for seasonal or occasional use. Other terms, such as vacation home, leisure home and recreation home, have been used to describe this type of recreation lodging.

While efforts are being made to ensure that second home development continues in an environmentally harmonious way and that sufficient public utilities are provided, lack of information on second home trends could leave some communities unprepared and unready for proper planning.

Vacation lodgings constitute a large proportion of recreation expenditures. For example, Foster and Dahlfred [13, p. 2] found that lodging accounted for fifty-one percent of recreation expenditures in New Hampshire in 1967. Kottke [15] reports that second homes account for over half the days spent in recreational lodgings[1/] and Catherwood [4, p. 2] found that, "seasonal homes constitute a significant contribution to the economy of vacation-recreation oriented regions."

The Northeast region has traditionally had a large share of second homes. In 1960, for example, 39 percent of second homes in the United States were located in the Northeast region (U.S. Census of Housing [32]).[2/]

B. Objectives

The objectives of this study were as follows:

1. To estimate and project participation in the second home market by the residents of the Northeast region.

1/ It was estimated that in 1976 about fifty percent of households in the Northeast took recreational trips and of these, half used motels and lodges, while the other half were equally divided between those using a second home (either owned or rented) and those using camping equipment. However, the intensity of use is four times greater for second homes than for the alternative forms of lodging, (over sixty days per year as opposed to fifteen days). Thus, approximately fifty-seven percent of the days spent in recreational lodgings are in second homes.

2/ The Northeast region consists of Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, Pennsylvania, New Jersey, Delaware, Maryland, and West Virginia.

2. To estimate and project the supply capacity of the stock of second homes in each state in the Northeast.

3. To determine the origin-destination distribution of second home use in the Northeast.

4. To examine the potential impacts of an energy crisis on the origin-destination distribution of second home use in the Northeast.

C. Hypotheses

The following general hypotheses were tested:

1. If expected changes in relevant socio-economic variables would occur, then participation in the second home market by the residents of the Northeast would increase and participation by renters would increase at a faster rate than by owners.[1/]

2. If the factors affecting the supply of second homes would continue their current trend, then the stock of second homes in the Northeast would increase but there would be intraregional deviations from the regional trend.

3. If the energy shortage would continue and travel expenses would increase, then the use of second homes would be greater in states located closer to the primary residence of future owners of second homes.

D. Procedure

In order to achieve the objectives and to test the hypotheses of this study it was necessary to develop participation models, a demand model and a spatial distribution model.

1/ Details of the expected changes are described in the section on model construction where sub-hypotheses of the study are discussed.

The procedure involved four steps as follows:

1. Estimation of the number of participants. Whether or not a household participated in the second home market was related to explanatory variables by use of logit functions, one for owners and one for renters. The logit functions were used to estimate the number of 1976 participants and to project the number of potential participants in 1982.

2. Estimation of the frequency of participation. Regression analysis was used to isolate the factors underlying the frequency of second home use (visitor days per year) and to project the potential degree of participation for 1982.[1/]

3. Estimation of demand. The estimated number of participants and the estimated frequency of use were combined to give the demand (in visitor days per year) for second home services by the residents of the Northeast.

4. Estimation of the origin-destination distribution of second home use. The locational pattern showing where owners and renters live and where they use second homes was developed first for a 1976 benchmark situation, then for a 1982 projected situation and finally for a 1982 "least-cost travel" situation. The latter was constructed by utilizing a linear-programming transportation model which minimized the aggregate mileage traveled by second home users while fulfilling

1/ Participation in the second home market in this study is defined as consumption of second home services. As such, participation is the ex-post demand for second home services. It is measured in visitor days; for example, a household that uses the home for 50 days per year, consumes 50 visitor days of second home service. For this report, the "visitor" unit is a household which consists of an average of 3.69 persons.

all demands and not exceeding the supply capacities of the individual states. The minimum mileage distribution was then compared with the benchmark distribution to indicate distributional shifts that may result from an energy shortage.

E. Data Sources

Empirical application of the models required collection of original data on the use of second homes in the Northeast since relevant data were lacking from secondary sources. A major source was a region-wide survey of a sample of households in the Northeast (hereafter referred to as the 1976 Northeast Recreational Lodging Survey or NRLS) which was conducted as one of Connecticut's contributing studies in a cooperative regional project.[1/] Information from a total of 927 residents was obtained and the data provided a basis for regional aggregation. For estimation of the "frequency of participation" regression model it was necessary to obtain additional data. This was accomplished with supplemental surveys of owners of second homes (the 1977 Owners of Second Homes in Vermont Survey and the 1977 Owners of Second Homes in New Jersey Survey).

F. Previous Work

This study is one of a series of projects on the economics of outdoor recreation conducted by the Department of Agricultural Economics

1/ This study was, in part, a contribution to Regional Research Project NE-100, "Recreational Marketing Adjustments in the Northeast," [20]. A major objective of which was "To determine the extent to which perceived recreation marketing adjustments are taking place and how they relate to changing socio-economic conditions." This study also contributed to Regional Research Project W-133, "Determinants of Recreational Choice."

and Rural Sociology. In 1970, Allbee [1] studied the state-administered salt water recreation. This was followed from 1972 to 1974 with research by Kottke [16] on campground operations and Kottke-Gardner [17] on camping demand in studies connected with regional project NEM-42, "Economic Analysis of the Campground Market." In 1973, Farrish [11] began investigating problems related to marine recreation. Extending the scope of research into other recreational activity markets, Kottke and Libera [18] in 1975 analyzed the effect of potential energy constraints on the distribution of skiing in New England. With golf courses constituting a major outdoor recreation market in Connecticut, surveys of golf courses were taken (1971 and 1974) and reported in 1978 by Kottke [19]. Meanwhile in 1975, the Department joined regional project NE-100 to study on-going and expected changes in outdoor recreation demand and supply and also joined regional project W-133 to study energy-related factors affecting recreational demand.

Within the Northeast region, some pioneering work on second homes was completed in 1975 by Gamble, Cole, Bevins, Derr and Tobey [14] for regional project NE-65, "Economic Analysis of Environmental Quality Effects Associated with Seasonal Homes." About the same time, Payne, Gannon and Irland [21] published a concise report for the Bureau of Outdoor Recreation on the extent of second homes in the Northeast. Perhaps the most comprehensive and detailed work on second homes to date was done by Ragatz [22] as a Ph.D. thesis at Cornell University in 1969. He also published several reports giving extensive information on second homes including a 1974 report published for the U.S. Department of Commerce [23].

Among a variety of other second home studies done throughout the U.S., the works of Fine and Werner [12], Tobey [25], Tombaugh [26], Burby [3], David [8] and Conner, et.al. [7] provide good examples of available information on socio-economic characteristics, location factors and capacity estimates pertaining to second homes.

While a considerable amount of second home research has been accomplished in recent years, there is a lack of quantitative analysis using demand-supply models and spatial allocation models. Moreover, economic analysis of renting second homes has been neglected. In this study, an attempt was made to fill some of the gaps in information and to test the applicability of demand and spatial allocation analytical tools to a study of the second home market.

II. PARTICIPATION RATES AND THE DEMAND FOR SECOND HOMES

Decisions on participation in outdoor recreation tend to be made within the framework of the household rather than on an individual basis.[1/] For second homes this is particularly true since decisions regarding ownership and occupancy are made within the household.

A. A Two-Stage Decision Process

Demand for second homes by households in the aggregate is composed of two parts of which the first deals with the probability of participating and the second deals with the frequency of participation.[2/] The

1/ Following the U.S. Census, a household comprises all persons who occupy a housing unit, that is, a house, an apartment, or other groups of rooms.

2/ For a discussion of the analytical rationale for a two-part demand estimation procedure see Ciccetti, Seneca and Davidson [6, pp. 78-86].

overall demand including that for both owners and renters may be stated as follows:

$$Q_d = (H \times PO \times VO) \times (H \times PR \times VR) \quad (1)$$

where Q_d = Visitor days of using second homes per year by households in the aggregate.

H = Total number of households in the region.

PO = Probability of owning a second home (proportion of all households owning a second home).

VO = Visitor days per year per household by owners.

PR = Probability of renting a second home.

VR = Visitor days per year per household by renters.

The two parts of demand can be viewed as a sequential process which is estimated one stage at a time. In the first stage, users of second homes are distinguished from non-users in terms of their socio-economic characteristics. Then, in the second stage, the frequency of use is determined by relating use to realized or actual costs of participation.

B. Probability of Participation

Previous studies have suggested that the recent boom in the second home market was correlated with a rise in household income and leisure time. For this study, use of second homes was hypothesized to continue rising in the future. However, it was further hypothesized that the use of second homes is not a linear function of time. That is, use is expected to increase at a decreasing rate rather than a constant rate.

Empirical Results

The number of households owning second homes is $HO = PO \times H$ and the number renting second homes is $HR = PR \times H$. In order to obtain

HO and HR it was necessary to estimate the probabilities of owning and renting (PO and PR). This was done using the following logit function first for PO and subsequently for PR:

$$PO = \frac{1}{1 + e^{-Z}} \qquad (2)$$

and $Z = f(X_1, X_2, X_3, X_4)$

where X_1 = number of days off from work (household head),

X_2 = number of children in household under 22 years of age,

X_3 = age of household head,

X_4 = household income.

Regression analysis was used to estimate the equation for Z and the results were[1/]

$$Z = \underset{(9.39)}{-4.9962} + \underset{(2.46)}{0.0034}\, X_1 + \underset{(1.63)}{0.0896}\, X_2 + \underset{(2.18)}{0.0177}\, X_3 + \underset{(4.65)}{0.3377}\, X_4 \qquad (3)$$

Chi-square = 46.8 (4 degrees of freedom).

The proportion (PO) of Northeastern households owning second homes in 1976 was estimated by using Equation (3) and applying mean values of the independent variables for Northeast region. Table 1 gives the mean values of the relevant socio-economic characteristics for the Northeast population. Calculation of Equation (3) gives a value for Z which

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1/ The number in parentheses under the coefficient estimates are asymptotic t values and they indicate levels of significance of 95 percent for X_1, X_3, X_4 and 90 percent for X_2.
Chi-square, which indicates the strength of the relationship between PO and X_1, X_2, X_3 and X_4, is significant at the 99 percent level.

Table 1. Mean Values for Socio-Economic Characteristics of the Population, Northeast Region, 1976.

Variable	Socio-economic Characteristic	Mean Value for the Northeast
X_1	Days off-work	123.58 1/
X_2	Number of children per household (< 22 years of age)	1.109 2/
X_3	Age of Household Head (years)	43.74 3/
X_4	Household Income ($)	14,459 4/
	Household Income (coded value)	3.892

1/ A weighted average of vacation days, holidays and days off-work during the week (usually weekends). Retired persons were assumed to have had 365 days off and unemployed persons 0 days off. The former assumption was based on the reasoning that retired people have little committed time while those out of work are generally committed to seeking employment.

2/ Estimated from Statistical Abstract of the U.S., 1977, [28, p. 39, Table 50].

3/ Current Population Reports, No. 276, [27, p. 20]. The mean figure for age of household is for 1974.

4/ Current Population Reports, No. 104, [27, p. 60].

when applied to Equation (2) gives a mean ownership rate of 0.0676. The number of households in the region was 19,285,000 in 1976.[1/] Therefore the number of households in the Northeast owning second homes in 1976 was estimated to be:

$$HO = 19,285,000\ (0.0676)$$
$$= 1,302,856. \qquad (4)$$

1/ The number of households in the Northeast in 1976 was estimated by extrapolating the 1970-1974 trend in households per state given in the Statistical Abstract of the U.S., 1976, [18, p. 41, Table 54].

Distribution of second homes among the 12 Northeastern states was determined from the results of the 1976 Northeast Recreational Lodging Survey. The estimated total of 1,302,856 owners in the Northeast was distributed among the states according to the percentage distribution given by the survey results (Table 2). Notice that Vermont has the highest ownership rate while New Jersey has the lowest.

By using the same logit estimating procedure, the probability of renting was obtained. In this case, one more independent variable was used in the regression equation. Again the logit function was:

$$PR = \frac{1}{1 + e^{-Z}} \tag{5}$$

and $Z = f(X_1, X_2, X_3, X_4, X_5)$

where X_1 = vacation days of household head per year,

X_2 = number of children in the household under 22 years of age,

X_3 = age of household head,

X_4 = household income,

X_5 = 1 if the household owns a second home or 0 if the household does not own a second home.

Results of the regression estimates for Z were as follows:[1/]

$$Z = \underset{(4.11)}{-1.8749} + \underset{(1.80)}{0.0024}\, X_1 + \underset{(2.72)}{0.1893}\, X_2 - \underset{(2.48)}{0.0231}\, X_3 + \underset{(1.95)}{0.1692}\, X_4 - \underset{(1.64)}{0.5885}\, X_5 \tag{6}$$

Chi-square = 19.7 (5 degrees of freedom).

1/ Asymptotic t values are given in parentheses. X_2 and X_3 are significant at the 99 percent level. X_1, X_4 and X_5 are significant at the 90 percent level.

Table 2. Households Owning Second Homes by State, Northeast Region, 1976.

State	Households Owning Second Homes		Households Owning as a Percentage of Total Households in the State	
	(number)	(rank)	(percent)	(rank)
Maine	55,997	6	15.7	2
New Hampshire	30,352	9	10.8	3
Vermont	28,412	10	17.7	1
Massachusetts	141,655	4	7.1	7
Rhode Island	17,501	12	5.6	10
Connecticut	50,292	8	4.8	11
New York	442,367	1	6.9	8
Pennsylvania	190,470	2	7.3	6
New Jersey	182,318	3	4.7	12
Delaware	18,585	11	9.6	4
Maryland	92,925	5	6.7	9
West Virginia	51,982	7	8.4	5
Northeast Total	1,302,856		6.8	

By applying the mean values of the socio-economic variables for the Northeast population to Equation (6) a value of Z was obtained which, in turn, was applied to the logit function to obtain the percent of Northeast households renting second homes.[1/] The result was 0.1082 which when multiplied by the total number of households in the Northeast gives an estimate of 2,086,174 households as renters of second homes in 1976.

Just as with owners, there was considerable variation among states in the proportion of state's residents renting second homes. Again the 1976 NRLS results on distribution of renters was used to determine the distribution of 2,086,174 renters among the 12 states.

As shown in Table 3, Rhode Island has the highest rentership rate, while Connecticut has the lowest. These rates give an indication of the variation in intensity of demand for renting second homes among the Northeastern states.

C. Frequency of Participation

The second stage in the sequential decision process for owners and renters of second homes deals with frequency of use (as measured in visitor days per year). By way of background information, the 1976 NRLS revealed that owners spent an average of 70 days per year, and renters an average of 17 days per year, in their second homes in 1976. In the next step of the analysis, the relationship between frequency rates and socio-economic variables was examined in order to have a means of projecting future frequency rates.

1/ The mean values of the socio-economic variables were:
$X_1 = 27.4$, $X_2 = 1.109$, $X_3 = 43.74$, $X_4 = 3.192$, $X_5 = 0.0676$.

Table 3. Renters of Second Homes by State, Northeast Region, 1976.

State	Households Renting Second Homes		Households Renting as a Percentage of Total Households in the State	
	(number)	(rank)	(percent)	(rank)
Maine	37,266	9	10.46	7
New Hampshire	18,291	12	6.51	10
Vermont	16,958	10	10.60	6
Massachusetts	259,455	4	13.08	4
Rhode Island	79,500	7	25.24	1
Connecticut	56,730	8	5.40	12
New York	556,030	1	8.69	9
Pennsylvania	464,578	2	11.42	5
New Jersey	391,667	3	15.79	3
Delaware	18,939	11	9.81	8
Maryland	83,352	6	6.04	11
West Virginia	103,408	5	16.68	2
Northeast Total	2,086,174		10.82	

Frequency of use of a second home is largely determined by householders' tastes, income and availability of discretionary time. Inadequate amounts of the latter two factors could constrain second home use. However, the anticipated rise in household income and discretionary time in the future leads to the hypothesis that the frequency of use of second homes will increase in the future.

Empirical Results--Owners

Regression analysis was used to establish systematic relationships between the frequency of use and a set of independent variables. The full model that was used for testing the hypothesis for owners of second homes was as follows:

$$VO = f(C, T, Y, L) \quad (7)$$

and

$$T = f(S, A, B) \quad (8)$$

where VO = visitor days per year that a second home is used by owners,

C = cost per day of use of owning a second home,

T = number of trips to the second home per year,

Y = household income,

L = leisure or off-work time (days) per year of household head,

S = number of seasons per year in which the second home is used,

B = the number of years that the household has owned the second home,

A = automobile costs per trip to the second home.

At first ordinary least squares was used to fit days of use and number of trips as linear functions of the variables. However, with that method, both equations had very little explanatory power, as measured by the coefficient of determination, R^2. Examination of the residuals indicated that the model was inadequate and that the relationships were non-linear.[1/] Consequently, double-logarithmic transformations of the variables were then made and an examination of the resulting residuals indicated that they were normally distributed with mean zero and variance σ^2. By using double-log transformations the following fitted equations were obtained:

$$\text{LOG VO} = 1.3681 - \underset{(15.43)}{0.6067}\ \text{LOG C} + \underset{(12.85)}{0.4354}\ \text{LOG T} + \underset{(6.81)}{0.5761}\ \text{LOG Y} + \underset{(4.90)}{0.3019}\ \text{LOG L} \qquad (9)$$

$$R^2 = 0.67 \qquad \bar{R}^2 = 0.66$$

and

$$\text{LOG T} = 1.6 + \underset{(9.74)}{1.1158}\ \text{LOG S} - \underset{(5.85)}{0.3322}\ \text{LOG A} - \underset{(3.84)}{0.2904}\ \text{LOG B} \qquad (10)$$

$$R^2 = 0.43 \qquad \bar{R}^2 = 0.42$$

Generally the equations are satisfactory since the coefficient signs are correct in the sense of agreeing with the expected sign, the t values (in parentheses under the coefficient estimates) indicate high levels of significance and the R^2's are reasonable for cross-section studies.[2/]

1/ See N. R. Draper and H. Smith, [10, pp. 86-103] for a discussion of residual analysis.

2/ R^2 = coefficient of determination. $\bar{R}^2$ = adjusted coefficient of determination.

Empirical Results--Renters

The model used for testing the relation between frequency of participation by second home renters and socio-economic variables was as follows:

$$VR = f(A, W, E, Y) \tag{11}$$

where VR = number of visitor days per year that renters spend in a second home,

A = per trip automobile costs,

W = vacation days per year of household head,

E = per day rental cost of second home,

Y = household income.

Single and double log transformations were used to test the relationship for non-linearity. However, this did not lead to any improvement and the linear form was chosen. Application of regression analysis gave the following estimating equation:

$$VR = -14.0667 + \underset{(8.43)}{0.0641}\ A + \underset{(2.88)}{0.068}\ W - \underset{(1.42)}{0.0024}\ E^2 + \underset{(1.85)}{13.4082}\ Y - \underset{(1.75)}{1.6585}\ Y^2 \tag{12}$$

$$R^2 = 0.46 \qquad \bar{R}^2 = 0.43$$

The initial estimates indicated that per day rent was not significantly related (at the 95 percent level) to the number of days that renters spend in their second home. Squaring the per day rent variable gave greater significance than the original rent variable and therefore it was included in the regression. Automobile costs per trip proved to be more significant than either time or miles as a measure of the influence of

distance. The sign on the automobile costs coefficient was positive, which indicates that the greater the amount spent on travel the longer the household will rent the home. Inclusion of income squared led to greater significance for the income variable. This suggests that there is a non-linearity between days of use and income. The signs of the coefficients indicate that days of use by renters increases at a decreasing rate with income.

D. Demand for Second Home Use

Once the estimating equations for number of participants and frequency of participation were completed, it was then possible to estimate participation volume for the Northeast region.

Participation volume may be used to represent a facet of the "demand"[1/] for second home services (visitor days per year) by renters and owners and is given by

$$Q_d = (\overline{HO} \times \overline{VO}) + (\overline{HR} \times \overline{VR}) \qquad (13)$$

where Q_d = participation volume (visitor days per year) by Northeastern households in 1976,

$\overline{HO}$ = the number of second home owners in the Northeast in 1976,

$\overline{HR}$ = the number of second home renters in the Northeast in 1976,

$\overline{VO}$ = the average number of days that owners spent in their second homes in 1976.

$\overline{VR}$ = the average number of days that renters spent in second homes in 1976.

1/ "Demand" is used here to mean the estimated aggregate quantity of second home services that householders would be willing to take at a given "price" and for specified values of a set of socio-economic variables at a specified point in time.

Applying the estimates obtained from the logit and regression equations to Equation (13) gives the following:

$$\begin{aligned} Q_d &= (1{,}302{,}856 \times 70.4) + (2{,}086{,}174 \times 16.93) \\ &= 91{,}721{,}062 + 35{,}318{,}925 \\ &= 127{,}039{,}980 \end{aligned} \tag{14}$$

Owners constituted 72 percent and renters 28 percent of the total demand. Therefore, in studies of the economic impacts of second homes on rural communities, renters should not be ignored. The estimated demand of over 127 million visitor days by households is a starting point for evaluating the total impact of second homes in the region. However, it must be remembered that some of this demand will be satisfied by use of second homes outside the region. Furthermore, some residents from outside of the region use second home services within the Northeast.

E. Projected Demand

In order to project the total number of visitor days that will be demanded in the future, it is necessary to project the individual components of Equation (13). Thus, projected demand is given by:

$$Q_d = (\hat{\hat{HO}} \times \hat{\hat{VO}}) + (\hat{\hat{HR}} \times \hat{\hat{VR}}) \tag{15}$$

where $\hat{\ }$ denotes projected variables.

The projections of number of owners and renters and frequency of use made in this study were based on projected changes of the independent variables (Table 4). The demand projections made in this study assumed that the underlying structure established in the demand model would not be altered over the projection period and the lead time chosen for the projections was six years.

Table 4. Number of Households and Mean Values of Variables Associated with Second Home Use, Northeast Region, 1976 and 1982.

Variable	Source	Benchmark 1976	Projected 1982
Households in the Northeast (no. in thousands)	A	19,285	21,394
		(Mean Values of Variables)	
Days off-work for household head	B	123.58	129.5
Children per household (no.) (under 22 years old)	A	1.11	0.91
Age of household head (yrs.)	C	43.74	42.8
Household income:[1/]			
All Northeast Households (1976 $)	C	14,459	15,550
All Northeast Households (coded value)	C	3.192	3.355
Second Home Owners (coded value)	B	4.183	4.392
Second Home Renters (coded value)	B	3.863	4.038
Cost of 2nd home ownership per day of use ($)	D	52.04	52.04
Trips per year (no.)	E	16.6	16.4
Seasons of use per year (no.)	B	3.36	3.36
Years of ownership (no.)	D	10.45	11.77
Automobile costs per trip by renters ($)	B	104.76	104.76
Vacation days per year (no.)	B	27.4	30.9
Per day rental cost ($)	B	26.61	26.61

Sources:
A = Statistical Abstract [18, 28].
B = 1976 Northeast Recreational Lodging Survey.
C = Current Population Reports [27].
D = 1976 Survey of Owners of Second Homes in Vermont.
E = Calculated with estimating equation.

1/ See Appendix Table 2 for income codes.

All of the independent variables that determine the number of renters and owners were assumed to change over the period 1976 to 1982, thereby changing the number of owners and renters. The average annual rate of change in these variables was expected to continue at the rate observed for the past years 1964 to 1976.

Except for cost of owning, cost of renting and seasonality of use, all of the variables affecting the frequency of use by owners and renters were projected on the basis of their past trends. The cost of ownership and renting were both expected to rise over the projected period. However, it was assumed that increases in income would be sufficient to offset the cost of increases, therefore the costs were held constant. Income projections are in terms of 1976 dollars.

The results of the demand projections are given in Table 5. It should be borne in mind that they are conditional upon the assumed shifts in the independent variables. The overall picture for second home demand is one of growth in the Northeast, and therefore, the estimates support the first hypothesis. The percentage of households owning homes was projected to grow faster than the percentage of households renting. However, the days that renters spend was projected to grow at a faster rate than the days that owners spend, which gives a faster rate of growth in visitor days by renters than by owners.

III. THE SUPPLY OF SECOND HOMES

For this study the supply of second homes is defined as the use-capacity of the observed stock of second homes in the Northeast region

Table 5. Estimated Growth in Demand for Second Homes, Northeast Region, 1976-1982.

Variable	Benchmark 1976	Projected 1982	Percent Change 1976-1982
Proportion of Northeast households owning second homes	0.0676	0.0693	2.5
Proportion of Northeast households renting second homes	0.1082	0.1099	1.6
Number of Northeast households owning second homes	1,302,856	1,481,577	13.7
Number of Northeast households renting second homes	2,086,174	2,333,926	11.9
Mean visitor days per year by owners	70.4	73.1	3.8
Mean visitor days per year by renters	16.93	18.84	11.3
Total visitor days by owners	91,721,062	108,303,279	18.1
Total visitor days by renters	35,318,925	43,971,165	24.5
Total visitor days by second home users	127,039,980	152,274,435	19.9

at a given point in time.[1/] In order to evaluate whether or not the projected 20 percent growth in demand could be met, it was necessary to estimate the use-capacity of existing second homes and the projected stock of second homes.

A. Types of Second Homes

The characteristics of second home structures throughout the Northeast are summarized in Table 6. The predominance of chalets in Vermont and cottages in New Jersey suggests that types of structure vary according to the area in which they are located. Vermont's second homes are located primarily in mountainous environments. In contrast, New Jersey's second homes are located mostly along the ocean shoreline.

B. Growth in the Number of Second Homes

The number of second homes by states has been recorded according to various definitions in three successive Housing Censuses since 1950. The estimates for 1950, 1960 and 1970 are given in Table 7 together with the estimates for 1976 made in this study.

There have been interstate variations in the pattern of second home development throughout the Northeast since 1950. Table 8 gives the average annual rate of growth in second home numbers by state for the periods 1950 to 1960 and 1960 to 1976.

1/ The supply concept used in this study is not a price-dependent supply function, but rather a stock of second homes for a given year for which the use-capacity of the homes represents the quantity of visitor days that suppliers are willing to provide in that year.

Table 6. Characteristics of Second Home Structures, Northeast Region, 1976.

Item	Households with Second Homes in		
	Northeast	Vermont	New Jersey
		(percent)	
Type of Structure			
Chalet	2	47	5
Cottage	28	9	67
Cabin	12	11	10
Farmhouse	8	11	2
Condominium	8	11	0
House	42	11	16
Total	100	100	100
Kind of Location			
Mountains	26	36	2
Lake(s)	20	8	12
Ski Area	3	47	0
Farm Country	13	9	27
Seashore	38	0	59
Total	100	100	100
Reason for Buying Second Home			
Retirement	24	13	26
Recreation	55	65	51
Investment	21	22	23
Total	100	100	100

Table 7. Growth in the Number of Second Homes in the Northeast, 1950-1976.

Location	Number of Second Homes in Year			
	1950[1/]	1960[2/]	1970[3/]	1976[4/]
Maine	37,754	60,592	82,013	139,809
New Hampshire	24,184	31,326	46,796	67,321
Vermont	10,582	16,379	27,679	33,809
Massachusetts	56,916	79,853	79,441	112,413
Rhode Island	11,024	13,594	14,440	14,748
Connecticut	22,658	28,001	24,538	29,042
New York	161,474	223,290	247,956	292,877
Pennsylvania	43,071	74,774	117,726	199,763
New Jersey	78,320	112,245	120,357	152,082
Delaware	3,031	6,049	9,117	10,878
Maryland	18,071	20,694	34,732	59,167
West Virginia	4,267	10,455	28,164	62,760
Northeast	471,352	677,252	832,959	1,174,669
U.S.	1,050,466	1,742,465	2,762,227	4,716,134

1/ U.S. Census of Housing 1950, [29, Table 17], "Seasonal Dwelling Unit."
2/ U.S. Census of Housing 1960, [30, Table 3], "Seasonal Vacant" minus "Vacant for Migratory Workers."
3/ U.S. Census of Housing 1970, [31, Table 3], "Vacant Seasonal," "Vacant Held for Occasional Use" and "Other Vacant."
4/ 1976 Northeast Recreational Lodging Survey, University of Connecticut.

Table 8 indicates that the Northeast region's growth in second homes lagged behind that for the United States in both the periods 1950 to 1960 and 1960 to 1976 with the difference being more marked after 1960. All states have increased in number of second homes; however, in Southern New England, New Jersey, New York and Delaware the numbers have grown at a decreasing rate.

Maine, Vermont, New Hampshire, Pennsylvania, Maryland, and West Virginia had the greatest growth rates in second homes since 1960. The change in trends between 1950-60 and 1960-76 indicates a shift and that the most likely growth areas of the future in the Northeast are the less densely populated states. In particular, the more remotely situated states that are endowed with scenic natural resources are undergoing an expansion in second home supply.

C. Factors Associated with Location of Second Homes

It is clear that there exists a wide difference among the states in number of second homes located in each state. For example, New York and Pennsylvania, have far more second homes than states such as Rhode Island and Vermont. However, part of the difference between states is due to differences in size of states. In order to standardize for geographical size, the data were placed on a "per square mile" basis then compared in terms of several pertinent factors. As shown in Table 9, Massachusetts, Rhode Island and New Jersey are the most intensively developed states when the number of second homes are standardized for land area. At the other extreme, Vermont, Pennsylvania and West Virginia are the least developed in that respect.

Table 8. Average Annual Rate of Growth in Second Homes in the Northeast, 1950-1960 and 1960-1976.

State	Average Annual Percent Growth 1950-1960	Average Annual Percent Growth 1960-1976
Maine	6.1	8.2
New Hampshire	3.0	7.2
Vermont	5.5	6.7
Massachusetts	4.0	2.6
Rhode Island	2.3	0.5
Connecticut	2.4	0.2
New York	3.8	2.1
Pennsylvania	7.4	10.4
New Jersey	4.3	2.1
Delaware	10.0	5.0
Maryland	1.5	11.6
West Virginia	14.5	31.3
Northeast Region	4.4	4.6
United States	6.6	10.7

Table 9. Density of Second Homes by States and the Rank Correlation Between Second Home Distribution and Location Factors, Northeast Region, 1976.

State	Density of Second Homes	Factors Associated with Location of Second Homes					
		Population	Seashore	Lakes	State Parks	Ski Lifts	Camp Sites
	No. per sq. mi.	No. persons	Miles	Sq. Mi.	Sq. Mi.	No.	No.
		(Units per square mile of land area)					
Me.	4.5	34	.12	.07	.007	.002	.5
N.H.	7.5	91	.02	.03	.004	.013	1.6
Vt.	3.6	51	0	.04	.013	.018	.8
Mass.	14.4	745	.22	.05	.029	.014	1.4
R.I.	14.1	884	.40	.14	.010	.007	1.9
Ct.	6.0	637	.13	.03	.009	.007	1.2
N.Y.	6.2	379	.04	.04	.060	.007	1.4
Pa.	4.4	263	.002	.01	.007	.002	.8
N.J.	19.8	973	.26	.04	.031	.004	1.5
De.	5.5	292	.21	.04	.007	0	.6
Md.	6.0	292	.33	.06	.004	0	1.4
W.Va.	2.6	75	0	.005	.003	.002	.3
Rank Correlation Coefficient		.80	.73	.49	.53	.28	.83

Sources:
(1) Statistical Abstract of the U.S. 1976, [28, pp. 11, 179, 180 & 217], for the following: Land Area; Population (Table 10); Shoreline (Table 303), State Parks (Table 357).
(2) M. W. Kottke, Unpublished study of the ski market in the Northeast 1976, for Ski Lifts.
(3) Bond, et. al., [2, p. 4], for Camp Sites.

Several factors thought to be associated with the location of second home development were examined by first standardizing them in terms of land area, then ranking them in terms of density and finally calculating a rank correlation coefficient for each of them.[1/] Population density was highly correlated (p = .8, Table 9). Apparently there is a desire to have a second home "away from it all" and yet have it sufficiently nearby to minimize travel. Another factor that is highly correlated is seashore which had a rank correlation coefficient of .73. Previous studies have found that the presence of seashores and lakes are of great importance in the selection of second home locations. Of course, the eastern seaboard states (particularly, R.I., Md., N.J., and Mass.) rank high in seashore density. Lake density was only moderately correlated with second home density (p = .49).

Availability of state parks and ski resorts would suggest the presence of recreational attractions. State park density was only moderately correlated while ski lift density had little correlation.[2/] Campgrounds as substitutes for second homes were highly correlated which suggests that locations which are preferable for camping are also preferred for second homes.

1/ Spearman's Rank Correlation Coefficient (p) is a measure of the relation between two ranked variables and is obtainable from the following formula:

$$p = 1 - \frac{6\Sigma d^2}{N(N^2-1)}$$

where d = the difference between the 2 ranks of the same item.
N = total number of items ranked.

The criterion is that a value of +1 indicates perfect positive correlation and a value of -1 indicates perfect negative correlation. A value of zero indicates the two ranks are independent.

2/ While ownership of second homes was weakly correlated with ski lift density, renting of second homes was highly correlated. Moreover, for certain states both ownership and renting would probably be correlated with the presence of ski lifts.

These density estimates, besides showing how several factors correlate with the extent of second home development by states, may also imply which states are reaching or have reached their full potential for development and which states have room for further growth in second home development. New Jersey at one extreme may be near its potential while West Virginia at the other extreme may have room for extensive growth in the future, although the latter lacks intensity in one of the important resource attributes associated with second homes, namely, water (i.e., lakes and seashore).

D. The Projected Number of Second Homes for 1982

Growth in the number of second homes as shown in Table 10 actually represents the outcome of both demand and supply forces. However, for lack of an alternative method of estimating the supply side of the market, it was decided to use the growth in the stock of homes as a proxy measure of the supply side. Under the assumption that the average annual rate of growth of 4.6 percent would continue during the period 1976 to 1982, the projected number of second homes for the Northeast would be 1,498,173 for 1982 (an increase of 27.5 percent over the 1976 figure). A comparison of this figure with the projected 13.7 percent increase in demand for second homes located in the Northeast, suggests that either supply would grow faster than demand or residents from states outside the Northeast region would increase second home ownership in the Northeast substantially.

Table 10. The Projected Supply of Second Homes, Northeast Region, 1982.

State	Projected Number of Second Homes in 1982		Increase in Second Homes 1976-1982
	(number)	(percent)	(percent)
Maine	193,414	12.9	38.3
New Hampshire	90,490	6.0	34.4
Vermont	45,395	3.0	34.4
Massachusetts	130,940	8.7	16.5
Rhode Island	17,678	1.2	19.9
Connecticut	32,211	2.2	10.9
New York	339,037	22.6	13.5
Pennsylvania	277,462	18.5	38.9
New Jersey	169,743	11.3	11.6
Delaware	13,933	0.9	28.1
Maryland	86,594	5.8	46.4
West Virginia	101,276	6.8	61.4
Northeast	1,498,173	100.0	27.5

E. Total Supply in Terms of Use-Capacity

In order to have a quantity for supply that is comparable to the quantity estimated for demand, it is necessary to take into account the potential days of use offered by owners of the homes. Accordingly, the total supply capacity for the region is given as:

$$Q_S = (S \times DO) + (S \times POR \times DR) \quad (16)$$

where Q_S = visitor days of second home use per year available to all households in the region,

S = number of second homes in the region,

DO = visitor days per year available to owners of second homes,

DR = visitor days per year available to renters of second homes,

POR = proportion of owners renting-out their homes.

Unfortunately, from the standpoint of supply estimation, the number of days of availability is very elusive. It may range from very few days to 365 days per year. Some homes are not habitable year-round. Inclement weather may make use of homes uninviting for days or weeks, and most homes were purchased with the intention of using them mainly on weekends and vacation periods. The following assumptions were made based on data from the 1976 Northeast Recreational Lodging Survey:

1. DO = 159. Based on 104 weekend days, 9 holidays and 14 vacation days for self use and 32 days availability for friends and relatives.
2. DR = 140. Based on average days rented by those who rented-out.

3. POR = .15. Based on the proportion of owners who reported they rented-out (13 percent) plus 2 percent for potential additional rentals.

Given the above data, the supply capacity for 1976 was estimated as

$$\begin{aligned} Q_s &= (1,174,669 \times 159) + (1,174,669 \times .15 \times 140) \\ &= 186,772,370 + 24,668,000 \\ &= 211,440,370 \end{aligned} \tag{17}$$

Thus the supply capacity offered in the Northeast exceeds the demand by Northeastern households by 84.4 mil. visitor days (211.4 - 127.0). In other words, Northeast households use 60 percent of the region's second home use-capacity. An obvious conclusion is that the aggregate of second homes offers much more capacity than is demanded. This is even more apparent when one considers that 11 percent of the region's second home owners have their second homes located outside of the Northeast (1,302,856 owned overall vs. 1,174,669 located in the Northeast).

The supply capacity projected for 1982 was estimated as

$$\begin{aligned} Q_s &= (1,498,172 \times 159) + (1,498,173 \times .15 \times 140) \\ &= 283,209,500 + 31,461,633 \\ &= 269,671,133 \end{aligned} \tag{18}$$

In other words, assuming constant rates of use and the same proportion renting-out, the supply capacity was estimated to increase by the same percent, 27.5, as the number of second homes was projected to increase. With demand projected to increase 20 percent, the percent of

supply capacity used by Northeast households was projected to decline from 60 percent to 56 percent.

Obviously another element involved, but not yet incorporated in the models, is the interregional and interstate flows of ownership and rentals. This aspect is included in the next section on spatial distribution.

IV. SPATIAL DISTRIBUTION OF SECOND HOME USE

Investigation of demand separately and supply separately gives some insight as to the extent of second home ownership and rentals. However, the separation leaves unanswered questions on where and how far from home people locate their second homes. Do New Yorkers stay in New York and Vermonters stay in Vermont or is there something resembling trade between states? Do renters choose certain locations to a greater degree than other locations? Would a future energy crisis alter the locational pattern of second home use? In order to answer these questions and to test the third hypothesis (i.e., that an energy shortage would affect the use of second homes locationally) it is useful to bring demand and supply together in a spatial allocation framework.

Five spatial distributions are presented in this section. The first is the 1976 owners' use and the second is the 1976 renters' use. A third distribution brings the owners and renters together for a benchmark of combined use for 1976. Then a fourth spatial distribution shows a 1982 projected level of combined use assuming the 1976 spatial pattern would continue. Finally, a fifth spatial distribution shows the "least travel" pattern for 1982 owner-renter combined use.

A. The Distribution Pattern of Owners' Use

The distribution matrix in Table 11 indicates that owners stayed largely within their state of residence in 1976.[1/] Approximately 58 percent of owners with residences in the Northeast located their second homes in their home state. This compares with a figure of 66 percent for the Northeast in 1966 reported by the U.S. Census [32, p. 4]. Thus, during the period 1966 to 1976 there appears to have been a trend towards greater distance between residence and second home. Nevertheless, movements away from home states tend to stay within neighboring states. For example, New England residents stay mostly in New England. On the other hand, some of the residents of the region's southern states have second homes in New England.

B. The Distribution Pattern of Renters' Use

A distribution matrix for households who rented second homes in 1976 was established in the same way as the matrix for owners. The distribution for renters, given in Table 12, was based solely on data from the

1/ The 1976 Northeast Recreational Lodging Survey provided data on the state of residence and the state of second home location. Secondary data, from studies dealing with the origin of second home owners, were utilized to adjust and support the 1976 NRLS data. Supplementary data were obtained as follows: (1) For Delaware, from D. L. Chicoine, [5, p. 134]. (2) For Pennsylvania, from an unpublished study by Hays Gamble. (3) For New Jersey, from an unpublished study by Richard Stammer, Rutgers University. (4) For Vermont, from D. M. Tobey [25, p. 8].

The 1976 NRLS provided information on the residents of the region who owned second homes outside the Northeast but not on residents from outside the region who owned homes in the Northeast. It was estimated that residents from outside the region owned 12.4 percent of the second homes in the Northeast in 1970 and it was assumed that this percent remained unchanged between 1970 and 1976.

Table 11. Spatial Distribution of Second Home Use by Owners, Northeast Region, 1976.

Origins	Destinations[1/]													Totals by Origin
	Me.	N.H.	Vt.	Ma.	R.I.	Ct.	N.Y.	Pa.	N.J.	Del.	Md.	W.Va.	Other	
	Visitor Days (000)													
Me.	3,391	141	70	71									269	3,942
N.H.	283	1,608	42	71									133	2,137
Vt.	170	170	1,073	70			332						175	1,990
Ma.	2,132	2,122	202	3,819	212	15		199	636				636	9,973
R.I.	86			520	424	71							131	1,232
Ct.	410	71	319	408	282	1,639							408	3,537
N.Y.	1,256	212	281	1,680		71	16,800	1,468	972				8,403	31,143
Pa.	829	71	71	71				9,742	865	141	71		1,517	13,378
N.J.	71	71	124				732	1,780	7,791		71	28	2,196	12,864
Del.	28	14	14					598	99	372	71		140	1,336
Md.	372	14	14						99	170	3,271	654	1,963	6,557
W.Va.								71	71	14	71	3,045	398	3,670
Other	815	246	168	1,202	120	250	3,175	199	232	69	612	691	--	7,779
Totals by Destination	9,843	4,740	2,378	7,912	1,038	2,046	21,039	14,057	10,765	766	4,167	4,418	16,369	99,538

1/ Origin refers to the state of residence and destination is the state in which the second home is located.

Table 12. Spatial Distribution of Second Home Use by Renters, Northeast Region, 1976.

Origins	Destinations													Totals by Origin
	Me.	N.H.	Vt.	Ma.	R.I.	Ct.	N.H.	Pa.	N.J.	Del.	Md.	W.Va.	Other	
	Visitor Days (000)													
Me.	210												421	631
N.H.		310												310
Vt.			287											287
Ma.	1,236	274	137	2,471									274	4,392
R.I.		224		336	672	112								1,344
Ct.	37	69	106	218	177	353								960
N.Y.	722	181	543	362			3,987		360				3,259	9,414
Pa.	82	327	573					2,291	3,283			327	981	7,864
N.J.	632	79	552	947	316		316		2,210				1,579	6,631
Del.										98	160		63	321
Md.								282	282		564	282		1,410
W.Va.									438			875	438	1,751
Other	596	230	501	812	280	72	872	522	1,335	24	147	301		5,692
Totals by Destination	3,515	1,694	2,699	5,146	1,445	537	5,175	3,095	7,908	122	871	1,785	7,015	41,007

1976 NRLS owing to the lack of secondary sources on the renters of second homes. It was noted earlier that the average travel time of renters tends to be considerably longer than that of owners. This is reflected in a comparison of the distribution matrices for owners and renters. Only 40 percent of renters rent in their home state whereas 58 percent of owners own in their home state.

Renters come mostly from the densely populated states of Ma., N.Y., Pa. and N.J. and they go mainly to Northern New England, N.Y., N.J. and outside of the Northeast. One of the most popular states for second home renting outside of the region is Florida.

C. 1976 Benchmark Spatial Distribution of the Combined Use

Table 13 shows the 1976 benchmark spatial distribution of the combined use of second homes by renters and owners and provides a basis of comparison for the projections made for 1982.

Combining the owners' and renters' use also gives a measure of relative importance of the two types of uses in each state as shown in Table 14. While use by renters averages 29 percent of total visitor days for the region, it varies from only 14 percent in Delaware to 58 percent in Rhode Island. A high rate of rentals raises Vermont's volume of visitor days to 5.1 mil. and New Jersey's to 18.7 mil. Massachusetts' high proportion of rentals probably is influenced largely by renting on Cape Cod.

D. 1982 Projected Spatial Distribution Patterns

The demand projections and the supply projections were brought together to estimate the spatial distribution for 1982. This section

Table 13. 1976 Benchmark Spatial Distribution of Combined Use of Second Homes by Owners and Renter , Northeast Region.

Origins	Destinations													Totals by Origin
	Me.	N.H.	Vt.	Ma.	R.I.	Ct.	N.Y.	Pa.	N.J.	Del.	Md.	W.Va.	Other	
	Visitor Days (000)													
Me.	3,601	141	70	71									690	4,573
N.H.	283	1,918	42	71									133	2,447
Vt.	170	170	1,360	70			332						175	2,277
Ma.	3,368	2,396	339	6,290	212	15		199	636				910	14,365
R.I.	86	224		856	1,096	183							131	2,576
Ct.	447	140	425	626	459	1,992							408	4,497
N.Y.	1,978	393	824	2,042		71	20,787	1,468	1,332				11,662	40,557
Pa.	911	398	644	71				12,033	4,148	141	71	327	2,498	21,242
N.J.	703	150	676	947	316		1,048	1,780	10,001		71	28	3,775	19,495
Del.	28	14	14					598	99	470	231		203	1,657
Md.	372	14	14					282	381	170	3,835	936	1,963	7,967
W.Va.								71	509	14	71	3,920	836	5,421
Other	1,411	476	669	2,014	400	322	4,047	721	1,567	93	759	992		13,471
Totals by Destination	13,358	6,434	5,077	13,058	2,483	2,583	26,214	17,152	18,673	888	5,038	6,203	23,384	140,545

Table 14. Relative Importance of Second Home Renting by Destination States, Northeast Region, 1976.

Destination State	Number of Visitor Days		Share of Total Visitor Days by Renters
	Total	Renters	
	(mil.)		(percent)
Me.	13.4	3.5	26
N.H.	6.4	1.7	26
Vt.	5.1	2.7	53
Ma.	13.1	5.1	39
R.I.	2.5	1.4	58
Ct.	2.6	.5	21
N.Y.	26.2	5.2	20
Pa.	17.2	3.1	18
N.J.	18.7	7.9	42
Del.	.9	.1	14
Md.	5.0	.9	17
W.Va.	6.2	1.8	29
Other	23.3	7.0	30
Total	140.5	41.0	29

fulfills a major aim of this study, namely, to investigate the potential effects of an energy shortage on the second home market. Thus, a "trend" distribution pattern was projected by assuming a continuation of the 1976 spatial pattern and a "least-travel" pattern was estimated by assuming that second home users would strive to minimize the aggregate distance traveled. The latter distribution, the "least-travel" solution, represents the pattern that users may tend towards if there is a prolonged energy shortage with substantial increases in gasoline prices sometime in the future. A comparison between the "least-travel" distribution and the "trend" distribution is intended to reveal the potential distributional impacts of an energy shortage.

Travel costs have a significant effect on the use of second homes and choice of location depends on travel time. Therefore, increased travel expenses in the future may bring about a shift in ownership of second homes with owners purchasing or relocating second homes closer to their residences.[1/] An alternative adjustment is for owners' to remain in their present location and for them to make fewer visits, of longer duration, in order to reduce travel expenses. Renters would also be influenced by such increases in travel expenses and this, in turn, would cause an impact on owners through a shift in demand for rental housing.

Kottke and Libera [18, p. 4] point out, the least-travel distribution, "...does not represent what might actually happen, however, the travel

1/ Such a shift would entail a heavy volume of transactions with some people selling their more-distantly located second homes and buying closer to home. Obviously, a large volume of transactions would occur over a long run period. This study assumes that the real estate market would accomodate such a shift and there would be sufficient mobility among buyers and sellers to permit a major shift in the ownership pattern.

pattern would probably tend to move in the direction of the 'optimal pattern' if constraining conditions similar to those specified in the model were actually to occur." Thus the least-travel distribution matrix can be considered an extreme distribution toward which locations may tend in the future if there are significant increases in travel costs.

1. Formulation of the linear programming travel minimization model

The least-travel distribution of second home owners between their primary residence (state i) and second home location (state j) was estimated by means of a linear program.[1/] The objective function was:

Minimize

$$A = \sum_{i=1}^{N} \sum_{j=1}^{N} M_{ij} X_{ij} \qquad (19)$$

subject to

$$\sum_{i=1}^{N} X_{ij} \leq HO_j$$

$$\sum_{j=1}^{N} X_{ij} = HO_i$$

where A = aggregate miles traveled by second home owners,

M_{ij} = miles traveled from population center i to second home area j.

X_{ij} = number of second home owners with primary home in i and second home in j.

HO_j = number of second homes located in j.

HO_i = demand in i as represented by the number of second home owners with primary homes in i.

The linear programming model minimized aggregate mileage that would allow second home owners to distribute their use of homes among the

1/ For the application of linear programming to the transportation problem, see, Dorfman, Samuelson and Solow, [9, pp. 106-9].

12 states (and outside the region) such that the entire demand from i was met and the capacity of j was not exceeded. Then the visitor days were calculated by multiplying the number of second home owners by the projected average visitor days (73.1) for each origin-destination cell in the matrix.

A similar least-travel linear programming model was developed for renters and the same procedure was used to convert the solution to number of visitor days.

2. Market area demarcation

The areas of analysis in this study are states, (i, j = 1, 2, ... 11, 12). Any location outside the Northeast was designated by i or j = 13. The population centers used in this study were selected on the basis of their size and their geographical location relative to other population centers in the state. Thus Worcester was chosen to represent the population centers of Massachusetts because of its position relative to the population centers of the eastern part of the state (Boston and its environs) and the western part of the state (Springfield). The choice of second home location was based on information from Ragatz [23, pp. 460 -474] on the counties in each state in which most second homes were located and the town in the county with the largest number of second homes was selected as the point of destination. The points of origin (i), destination (j) and the matrix of distances, M_{ij}, used in generating the least travel solution are given in Appendix Table 1.

3. Results

Table 15 gives the 1982 projected "trend" distribution of visitor days and Table 16 gives the 1982 "least-travel" distribution. An indication of the potential impact of an energy shortage is obtained by comparing the distributions in Table 15 and 16. The "least-travel" distribution of visitor days is far more concentrated within states of primary residence and neighboring states than is the projected "trend" distribution.

A more striking comparison can be seen in terms of aggregate miles traveled (one-way mileage). If the projected "trend" distribution would occur in 1982, then the aggregate miles traveled by second home users from the Northeast and other states to the region would increase 46 percent over that for the 1976 benchmark situation (Table 17). On the other hand, if a "least-travel" situation would occur in 1982 then aggregate miles traveled would increase only 25 percent.

Since demand was projected to increase 20 percent while supply was projected to increase 27.5 percent between 1976 and 1982, the slack in demand was taken up by second home users originating outside of the Northeast region. Because of the longer distances from states outside the region, the aggregate miles increased more than that represented by the increase in demand by Northeast households.

By excluding the mileage of second home users from outside the region, it is possible to make a more pertinent comparison. Table 17 shows that if second home users from only the Northeastern states are

Table 15. 1982 Projected "Trend" Spatial Distribution of Combined Use of Second Homes by Owners and Renters, Northeast Region..

Origins	Destinations													Totals by Origin
	Me.	N.H.	Vt.	Ma.	R.I.	Ct.	N.Y.	Pa.	N.J.	Del.	Md.	W.Va.	Other	
	Visitor Days (000) 1/													
Me.	4,102	167	83	83									841	5,276
N.H.	334	2,285	50	83									157	2,909
Vt.	200	200	1,625	83			392						207	2,707
Ma.	4,056	2,847	409	7,586	250	17		235	751				1,092	17,243
R.I.	102	279		1,033	1,338	143							155	3,050
Ct.	529	170	509	756	553	2,375							484	5,376
N.Y.	2,382	476	986	2,434		83	24,798	1,733	1,599				13,979	48,470
Pa.	1,081	491	797	83				14,356	5,168	167	83	441	3,012	25,679
N.J.	870	181	834	688	393		1,257	2,102	11,899		83		4,558	22,865
Del.	33	17	17					707	116	560	283		245	1,978
Md.	439	17	17					351	468	200	4,565	1,124	2,318	9,499
W.Va.								83	628	4	83	4,658	1,015	6,471
Other	4,227	1,596	1,352	2,658	557	325	4,776	4,567	1,708	226	2,316	3,377		27,685
Totals by Destination	18,355	8,726	6,679	15,487	3,091	2,943	31,223	24,134	22,337	1,157	7,413	9,600	28,063	179,208

1/ Based upon projected average visitor days for 1982 of 73.10 for owners and 18.84 for renters.

Table 16. 1982 Projected "Least-Travel" Spatial Distribution of Combined Use of Second Homes by Owners and Renters, Northeast Region.

Origins	Destinations													Totals by Origin
	Me.	N.H.	Vt.	Ma.	R.I.	Ct.	N.Y.	Pa.	N.J.	Del.	Md.	W.Va.	Other	
	Visitor Days (000) 1/													
Me.	5,441													5,441
N.H.	2,868	41												2,909
Vt.			2,707											2,707
Ma.	6,526	6,804	1,637	580	1,292									16,839
R.I.	2,953				178									3,131
Ct.				3,957		127								4,084
N.Y.	345		2,017	11,358		2,355	30,795		1,638					48,508
Pa.								19,258		1,154			4,833	25,245
N.J.					1,609	598			13,289				7,863	23,359
Del.										42	1,944			1,986
Md.											187		9,254	9,441
W.Va.												2,315	6,269	8,584
Other							990	5,468	7,160		5,398	9,391		28,407
Totals by Destination	18,133	6,845	6,361	15,895	3,079	3,080	31,785	24,726	22,087	1,196	7,529	11,706	28,219	180,641

1/ Based on a projected average visitor days for 1982 of 73.10 for owners and 18.84 for renters.

Table 17. Aggregate Miles Traveled Involving Trips to Second Homes by Owners and Renters Combined, Northeast Region, Benchmark 1976 and Projected 1982. (One-Way Mileage).

Situation	By Households from Northeastern and Other States		By Households from Northeastern States Only	
	Aggregate Miles Traveled One-Way (No. in mil.)	Change from 1976 (percent)	Aggregate Miles Traveled One-Way (No. in mil.)	Change from 1976 (percent)
Benchmark 1976	10,121		7,069	--
Projected 1982				
a. "trend" distribution	14,782	46	8,463	20.0
b. "least-travel" distribution	12,681	25	7,116	.7

taken into account, then aggregate miles increased at the same rate as demand (20 percent) for the projected "trend" distribution assumption. However, if the projected "least-travel" distribution assumption is taken into account, then aggregate miles traveled stayed practically the same (.7 percent) as for the 1976 benchmark situation. Obviously, this means that with a 20 percent projected increase in demand and with aggregate mileage remaining almost constant, there would have to be a significant re-distribution of origin-destination patterns by second home users. This is basically what Tables 15 and 16 show and the principal effect of a redistribution is that users' origins and destinations are drawn closer together, meaning that many users would move toward using second homes located closer to their primary residence. This movement would be most feasible and especially appropriate for renters. Thus, an energy shortage would, at least, tend to offset the general trend of second home users moving outward and traveling greater distances as growth in the second home market continues.

V. SUMMARY AND IMPLICATIONS

Second home developments are spreading throughout the country with some areas more affected than others. The typically rural states, such as West Virginia and Maine, have experienced relatively faster growth rates in second homes in recent years than the more urbanized states such as Massachusetts and New York. Such changes in the distribution of second homes can have important economic impacts on outdoor recreation-oriented communities.

The objectives of this study were to estimate and project the demand for and the supply of second homes in the Northeast region, to examine the potential impacts of an energy crisis on the use of second homes and to evaluate the prospects of new second home developments for various locations in the Northeast.

It was hypothesized that participation in the second home market by the residents of the Northeast would continue to increase and that participation by renters would increase at a faster rate than by owners. Using primary data from the 1976 Northeast Recreational Lodging Survey, an estimate of demand for second home use (in visitor days) was made. The demand was estimated by a two-stage sequential process in which the first stage utilized a logit function to estimate the proportion of households in the Northeast who either rented or owned a second home in 1976. The proportion of households in the Northeast that owned a second home in 1976 was estimated to be 6.8 percent (or 1,302,856 households) and the proportion who rented was estimated to be 10.8 percent (or 2,086,174 households). The second stage of the sequential process utilized regression analysis to isolate the factors that influenced the number of days per year that users spent in their second homes. The mean days of occupancy in 1976 were estimated to be 70 days for owners and 17 days for renters. The product of the number of users and their average days of use gave a total of 127,039,980 visitor days in 1976.

Next the demand for second home services in the Northeast was projected to 1982 by projecting independent variables in the logit and regression

equations. The results were 6.9 percent (or 1,481,577 households) would own and 11 percent (or 2,333,926 households) would rent second homes in 1982. The projected average days of occupancy was 73 days for owners and 19 days for renters. Multiplying number of users by days of use gave a total of 152,274,435 visitor days for 1982, which is a 20 percent increase over that for 1976. Renter participation was estimated to increase 25 percent while owner participation would increase 18 percent. Thus, the first hypothesis was supported by the results.

It was further hypothesized that the stock of second homes in the Northeast would increase but that there would be important intraregional variations in growth rates. The supply of second homes, measured in terms of use-capacity of the second home stock, was estimated for each state in the Northeast for 1976. The results showed that New Jersey, Massachusetts and Rhode Island were the most popular locations for both owners and renters, and that factors affecting location most were shoreline, lakes, campsites and accessibility. The supply of second homes in the region was projected to 1982 on the basis of the past trend in supply. Within the region, the states with the highest projected growth rates in supply were West Virginia, Maryland, Maine, New Hampshire and Vermont. The states with the lowest projected growth rates were Connecticut, New Jersey, Rhode Island, Massachusetts and New York. On the basis of these results the second hypothesis was also supported.

Finally, it was hypothesized that increased travel expenses, brought about by an energy shortage would induce households to use second homes

closer to their primary residence. The demand for second homes in each state in the Northeast and the available supplies were joined in a matrix that linked the origins of second home owners (their states of primary residence) and their destinations (the states in which their second homes are located). A similar spatial distribution matrix was constructed for second home renters. A comparative analysis was done by setting up a 1976 benchmark and two probable situations, namely, a 1982 projected "trend" spatial distribution and a 1982 "least-travel" spatial distribution.

The results showed that, the "least-travel" situation significantly reduced the amount of aggregate mileage involved in trips to second homes. For example, when the mileage of second home users coming from outside the region was excluded, the estimated aggregate mileage increased at the same rate as demand (20 percent) for the 1982 projected "trend" situation, but only increased .7 percent for the 1982 projected "least-travel" situation. When the mileage of second home users coming from outside the region was included, the comparison was similarly striking with a 46 percent increase for the "trend" projection vs. a 25 percent increase for the "least-travel" projection.

Two major implications can be made on the basis of the results. One is that if the Northeast supply of second homes grows faster than the region's demand from 1976 to 1982, as estimated in this study, then the slack in demand could be filled by either an increase of users from outside the region or an increase in the volume of rentals or both. An increase in rentals appears to be a likely development of the future.

A second implication is that if an energy shortage would take place in the future, there would likely be an important re-distribution of origin-destination patterns by second home users. Such a situation would tend to offset the present trend of second home users moving toward the more remote areas and traveling greater distances as the second home market continues to grow.

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Appendix Table 1. Travel Distances Used in the Least Travel Model (Miles--One-Way).

Origin Points	DESTINATION POINTS												
	Augusta ME	Conway NH	Brattleboro VT	Plymouth MA	Newport RI	New Haven CT	Liberty NY	Stroudsburg PA	Atlantic City NJ	Ocean City MD	Lewes DE	Elkins WVA	Other
	(Number of Miles--One-Way)												
Augusta, ME	49	130	248	215	239	302	410	445	505	615	604	810	1600
Concord, NH	149	22	74	107	131	141	245	301	401	526	493	645	1600
Rutland, VT	250	163	15	264	275	227	100	253	353	473	445	597	1600
Worcester, MA	222	67	98	92	70	102	228	251	300	432	399	664	1350
Providence, RI	211	240	138	50	36	96	228	235	447	406	372	592	1400
Hartford, CT	450	240	200	59	60	43	155	162	367	349	314	535	1300
Albany, NY	388	255	254	176	209	150	98	210	120	390	355	615	1100
Harrisburg, PA	536	600	375	412	345	275	218	76	133	209	108	135	1050
Trenton, NJ	600	445	350	260	190	119	163	102	74	196	146	373	1000
Dover, DE	495	483	391	404	351	238	248	158	90	20	100	296	1100
Baltimore, MD	600	536	424	437	384	271	281	120	225	138	108	152	1000
Charleston, WVA	910	817	725	738	685	572	582	491	640	525	539	72	600
Other	1600	1600	1600	1400	1400	1300	1100	1050	1050	1100	1100	1100	

Appendix Table 2. Household Income of Sample Respondents, Northeast Region, 1976.

Household Income Per Year		Percent Distribution of Respondents			Household Income Reported by the U.S. Census
Code	Dollars	All Households	Owners of Second Homes	Renters of Second Homes	
1	Under 6,000	5.7	7.8	6.5	
2	6,000-9,999	8.9	6.1	6.5	
3	10,000-14,999	23.7	17.4	22.2	
4	15,000-24,999	34.2	23.5	32.4	
5	25,000-34,999	17.2	19.1	22.2	
6	35,000 & Above	10.3	26.1	10.2	
	Total	100.0	100.0	100.0	
Code Value Mean		3.792	4.183	3.863	3.192
Adjusted Code Value Mean[1/]		4.492	4.883	4.583	3.892
Dollar Value Mean		19,920	23,820	20,830	14,459

1/ In order to adjust for technical differences between code value means and dollar value means, a constant value of .7 was added to the code value means. Then the dollar value means were calculated from the adjusted code value means for the sample data. For example 4.492 = 15000 + (.492 x 10,000) = 19,920. The U.S. Census' income was in dollar value which was converted to a coded value.