5-1979

Demand for Motel Lodging and Outdoor Recreational Trips to Rural Environments by Northeastern Households

Brian Gould
University of Connecticut - Storrs

Marvin Kottke
University of Connecticut - Storrs

RESEACH REPORT 53, MAY 1979

10

Demand for Motel Lodging and Outdoor Recreational Trips to Rural Environments by Northeastern Households

By Brian Gould and Marvin Kottke
Department of Agricultural Economics and Rural Sociology

STORRS AGRICULTURAL EXPERIMENT STATION
COLLEGE OF AGRICULTURE AND NATURAL RESOURCES
THE UNIVERSITY OF CONNECTICUT, STORRS 06268

The research reported in this publication was supported in part by Federal funds made available through the provisions of the Hatch Act.

Received for publication February 13, 1979.

The Storrs Agricultural Experiment Station is an Equal Opportunity/Affirmative Action Agency.

Research Report 53

September 1978

DEMAND FOR MOTEL LODGING AND OUTDOOR RECREATIONAL TRIPS TO RURAL ENVIRONMENTS BY NORTHEASTERN HOUSEHOLDS

by

Brian Gould and Marvin Kottke

Storrs Agricultural Experiment Station
College of Agriculture and Natural Resources
The University of Connecticut
Storrs, Connecticut

TABLE OF CONTENTS

	Page
INTRODUCTION	1
The Problem	1
Objectives	2
Hypotheses	2
Data Source	3
Procedure	3
Trends in Recreational Travel	4
DEMAND FOR RECREATIONAL MOTEL LODGING	6
Number of Households Participating in Recreational Motel Use	6
Annual Rate of Recreational Motel Use by Participants	10
Aggregate Demand for Recreational Motel Use	15
SPATIAL DISTRIBUTION OF RECREATIONAL TRIPS INVOLVING MOTEL USE	17
Origins and Destinations	17
The 1976 Benchmark Spatial Distribution Pattern	19
The 1981 Projected "Trend" Spatial Distribution Pattern	20
The 1981 Projected "Least Travel" Spatial Distribution Pattern	22
Comparison of the 1981 Projected Estimates with the 1976 Benchmark Estimates	28
SUMMARY AND CONCLUSIONS	31
LITERATURE CITED	34
APPENDIX	36

DEMAND FOR MOTEL LODGING AND OUTDOOR RECREATIONAL TRIPS TO RURAL ENVIRONMENTS BY NORTHEASTERN HOUSEHOLDS

by

Brian Gould and Marvin Kottke[1/]

INTRODUCTION

The Problem

Demand for outdoor recreation has grown impressively in recent years, but the supply of facilities and resources has not always, in all places, accompanied the growth in demand. As a consequence, over-use of resources and over-crowded conditions frequently occur especially during peak periods.

Lodging is one of the facilities usually required on outdoor recreation excursions.[2/] Recreational motels are used to a greater extent than any other type of lodging and are the focus of this report.[3/]

Changes in the demand for recreational lodging can have a profound effect on rural communities. The recent energy crisis is an example of a

---

1/ Brian Gould was formerly Graduate Assistant and Marvin Kottke is Professor, University of Connecticut. This report is based on research reported by Gould [6] in an M.S. thesis. William Levedahl and Robert Leonard made helpful suggestions during the research project.

2/ Recreational lodging includes motels, lodges, second homes and campers. In this study, the term recreational motel refers to any motel or lodge used on a trip taken for the purpose of outdoor recreation. About 50 percent of the Northeast households using recreational lodging in 1976 stayed in motels or lodges, 25 percent stayed in second homes and 25 percent used tents or campers (Kottke [8]).

3/ Three other reports on recreational lodging are available from this Department. One focuses on campgrounds [9], one focuses on second homes [16], and one gives the overall recreational lodging picture [11].

possible event or condition that could alter the economy of a recreation-oriented community. How would an energy shortage change travel patterns and, consequently, the use of recreational motels? Would a change in socio-economic variables change the demand for recreational motels? Answers to these questions could be useful to decision-makers such as rural residents, town planners, motel owners, recreational advisors, environmental planners and others concerned with land-use and the economic development of rural communities. The aim of this study was to obtain and analyze information that would help provide answers to such questions.

Objectives

The basic objectives of this study were:

1. To measure the relative influence of selected socio-economic variables on the demand for recreational motels by Northeastern households and to estimate the current and projected demand.[1/]

2. To estimate the effects of possible future travel restrictions on such demand.

Hypotheses

Given the above problem and objectives, it was hypothesized that:

1. If relevant socio-economic variables change according to the current trend, then the proportion of the Northeast households using recreational motels would increase between 1976 and 1981.

1/ For this study the Northeast is composed of the following states: Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, and West Virginia.

2. If relevant socio-economic variables change according to the current trend then the annual use of recreational motels by individual participants and the aggregate would increase between 1976 and 1981.

3. If travel constraints would increase, then a relatively greater increase in intraregional than in interregional recreational motel-using travel would occur between 1976 and 1981.

Data Source

The primary source of the data used in this study was the 1976 Northeast Recreational Lodging Survey (NRLS).[1/] This survey was undertaken as a part of regional projects W-133, "Determinants of Choice in Outdoor Recreation" and NE-100, "Recreation Marketing Adjustments in the Northeast." A total of 927 Northeastern households responded to the mail survey with useable information. The names and addresses of the heads of households were obtained from published telephone directories and were selected on a random basis.

Procedure

Estimation of the demand for recreational motel use was formulated as a two stage sequential process. First, the probability of using or not using such facilities was estimated. For this, a logit function was used and probability estimates for both a 1976 benchmark situation and for a 1981 projected situation were obtained. Then the probabilities were used to estimate the number of Northeast households using motels for both of these situations.

1/ A summary of the 1976 Northeast Recreational Lodging survey results is available in a publication by Kottke [11].

In a second phase, the amount of annual use by households was estimated. A regression analysis was used for this purpose. After that, the aggregate was calculated to get a total yearly demand by Northeast households.

A linear programming model was used to investigate the effects of an energy shortage on the spatial distribution of demand and supply. Several different types of structural changes were set up to test the potential effects upon recreational motel use.

Trends in Recreational Travel

According to the U.S. Travel Data Center, 89 percent of all person-nights spent on recreational trips in 1976 involved the use of recreational lodging, while 11 percent were spent in the homes of friends or relatives. The report also stated that the proportion of all person-trips in the U.S. for recreational purposes had grown from 25 percent in 1972 to 33 percent in 1976.[1/] Table 1 indicates the types of accommodations used on recreational trips and that, even though the percentage of trips taken for recreational purposes has been increasing relative to other types of trips, the distribution of person-nights by type of accommodation remained relatively stable with commercial lodging (motels) taking approximately 50% of the market.

1/ "Recreational purposes" were defined as outdoor recreation and entertainment. A trip was defined as "each time a person travels at least 100 miles from home and returns." A person-trip is the number of persons on a trip multiplied by the number of trips. 1976 National Travel Survey [12, p. 2].

Table 1. Distribution of Person-Nights Spent on Recreational Trips by Type of Accommodation, U.S., 1972 and 1976.

Type of Accommodation	Person-Nights Spent on Recreation Trips	
	1972	1976
	(Percent)	
Home of Friends and Relatives	11.5	11.2
Commercial Lodging	50.3	49.5
Other Accommodations[a/]	38.2	39.3

a/ Other accommodations include cabins, trailers, second homes, tents, campers, etc.
Source: 1976 National Travel Survey [12, p. 9].

DEMAND FOR RECREATIONAL MOTEL LODGING

Number of Households Participating in Recreational Motel Use

1. The Probability of Participation in 1976

It was hypothesized that the probability of a household participating in the use of a recreational motel would increase between 1976 and 1981. To test this hypothesis, a model was formulated as follows:

$$P_m = f(X_1, X_2, X_3, X_4) \quad (1)$$

where P_m = the probability of a household participating in use of a recreational motel,

X_1 = age of the household head,

X_2 = age of the household head squared,

X_3 = number of children under 21 years of age,

X_4 = grouped off-work days.[1/]

A logit procedure was applied to data from the sample population with results as follows:[2/]

$$P_m = \frac{1}{1 + e^{-Z}} \quad (2)$$

where e = the base of natural logarithms

and $$Z = -2.9784 + \underset{(.009)}{.1231}\, X_1 - \underset{(.002)}{.0017}\, X_2 - \underset{(.146)}{.1004}\, X_3 + \underset{(.004)}{.0039}\, X_4$$

(Chi-square = 21.8 with 4 df. Numbers in parentheses refer to significance levels.)

The above probability model shows how three variables (age, size of family and vacation time) influence the probability of participation. For

1/ The number of vacation and holidays available in a continuous period of more than 2 days.

2/ For a discussion of the logit procedure see Nerlove and Press [13].

example, the signs of the coefficients in the Z component of Equation 1 tell whether a variable has a positive or negative effect. The coefficients give a measure of the effect and are used to estimate the value of Z.

The household head's age was found to have a non-linear relation with participation. With the sign of the X_1 coefficient being positive and X_2 being negative, the nature of the effect obviously changes over the range of ages.

The non-linear effect of the household head's age can be seen by taking the first derivative of the Z function as follows:

$$\frac{\partial Z}{\partial \text{ Age}} = .1231 - .0034 \text{ Age} \qquad (2)$$

According to this derivative, the effect of age is positive up to age 36, and after age 36 the effect is negative; that is, with increasing age, the probability of participating in motel use decreases.

Number of children (under 21 years of age) had a negative sign, indicating that as the size of family increases the probability of using a recreational motel decreases. It may be that motel lodging becomes too expensive for large families, especially when compared to the cost of using alternative forms of lodging. By comparison, Sim-Kottke [16] found that the number of children under 21 years of age was positively related to the probability of owning or renting second homes. For the use of tents or mobile campers, a positive relationship also existed.[1/]

1/ Gould's thesis [6] includes a discussion of the use of other recreational lodging.

The results show a positive relationship between the availability of grouped off-work days and the probability of recreational motel use. With the average number of nights per stay at a recreational motel being 5.9, this result was not surprising. The positive relationship and the size of the average number of nights per stay lends support to the hypothesis that extended (vs. day or weekend) trips are the more important type as far as the demand for recreational motels is concerned.

By using Equation 1 and applying the mean values of the independent variables to the estimating equation, one calculates the mean probability for the Northeast. Table 2 gives the mean values of the socio-economic variables for the Northeast population.

Table 2. Means of the Socio-Economic Variables Influencing Participation in Use of Recreational Motel Lodging, Northeast Region, 1976 and 1981.

Socio-Economic Variable		1976 Benchmark	1981 Projected
X_1	Age of household head	43.7	43.0
X_2	Age of household head squared	1909.47	1849.0
X_3	Number of children under 21 years of age	1.109	1.039
X_4	Grouped off-work days	63.5	70.4

Sources:
Age--U.S. Statistical Abstract [21, Table 50, p. 31].
Grouped Off-Work Days--Consists primarily of vacation days except that retired persons were alloted 365 days off and unemployed persons, 0 days off. The number of vacation days for those individuals who worked was obtained from Moore and Hedges [12].
Number of Children--U.S. Bureau of the Census [19].

Given the mean population values of the relevant independent variables, the probability for 1976 was estimated as follows:

$$Z = [-2.9784 + .1231(43.7) - .0017(1909,7) - .1004(1.109) + .0039(63.5)] \quad (3)$$

$$= -.709$$

and

$$P_{m76} = \frac{1}{1 + e^{.709}}$$

$$= .33$$

According to this result, the probability of any one household in the Northeast using a recreational motel in 1976 was 33 percent. With a 1976 regional household population of 19,207,000, the number of households using recreational motels in 1976 was estimated to be 6,334,448.

2. The Probability of Participation in 1981

In order to test the hypothesis concerning the projected change in the number of recreational motel-using participants for 1981, it was necessary to use the logit function again. This time, however, the projected 1981 mean values of the socio-economic variables for the Northeast were applied (Table 2). The probability of any one household using a recreational motel in 1981 was:

$$Z = [-2.9784 + .1231(43.0) - .0017(1849.0) - .1004(1.039) + .0039(70.4)] \quad (4)$$

$$= -.6581$$

and

$$P_{m81} = \frac{1}{1 + e^{.6581}}$$

$$= .34$$

By multiplying this probability to the projected 1981 Northeast household population, an estimate of the number of households which would participate in using a recreational motel in 1981 was obtained.[1/] The estimated number of motel-using households for 1981 was 6,785,758, which represents a 7.1 percent increase over the 1976 estimated number. Results of the logit analysis gives support to the hypothesis that the proportion of the regional households using recreational motels would increase between 1976 and 1981. Since population was projected to increase by 3.6 percent during the period, it can be said that population growth would contribute over 50 percent as a factor influencing the estimated increase in motel-using participants.

Annual Rate of Recreational Motel Use by Participants

1. Factors Influencing the Rate of Motel Use

It was hypothesized that if the relevant socio-economic variables were to continue changing according to the current trend, then use of recreational motels would increase between 1976 and 1981 both at the individual household and aggregate levels. The model used to test this hypothesis was formulated as follows:

$$PN = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8) \qquad (5)$$

where

PN = total person-nights of recreational motel-use per year by a participating household,

1/ The 1981 Northeast household population was estimated as 19,893,749. This estimate was obtained by a linear extrapolation of the trend in household numbers.

X_1 = average per day trip costs,[1/]

X_2 = annual household income (coded),[2/]

X_3 = average one-way distance traveled per trip (miles),

X_4 = one plus the percent of family members under 17 years of age,[3/]

X_5 = number of trips involving use of recreational motels,

X_6 = number of activity days spent in non-home based recreation activities,[4/]

X_7 = number of activity days spent in home-based recreation activities,

X_8 = grouped off-work days.

This equation was estimated by use of the ordinary least squares method. The best functional form was found to be a double-log transformation similar to the Cobb-Douglas production function.[5/] Therefore, Equation 5 was expressed as follows:

1/ Trip costs (C) were calculated as follows:

$$C = R + A/N$$

where

R = average daily room rate per trip.
A = average one-way transportation cost per trip.
N = number of nights of recreational motel use.

Cost of operating an automobile was $.0947 per mile. This was obtained from Costs of Owning and Operating an Automobile, [22, p. 2, Table 1]. The costs per mile traveled by air was $.0707 and was computed as the total revenue received from sales of domestic passenger tickets divided by the total domestic passenger miles traveled for all airlines in 1976. Revenue figures were obtained from Aircraft Financial Statistics, [3, p. 1]. Passenger mile figures were obtained from Air Carrier Traffic Statistics, [4, p. 1].

2/ See Appendix for the coding of this variable.

3/ This variable was computed as follows: 1 + [number of children under 17 ÷ (parents + children under 21)].

4/ An activity day was defined as being equal to 1 if the respondent participated any part of a day in some outdoor recreation activity. Non-home based recreation involves an overnight stay away from home. In contrast, home-based recreation involves the use of nearby recreation sites not involving an overnight stay.

5/ "Best" in terms of correctness of hypothesized signs, significance of coefficients, and explanatory power. See Chiang [2, pp. 407-410].

$$PN = \alpha X_1^{b_1} X_2^{b_2} X_3^{b_3} X_4^{b_4} X_5^{b_5} X_6^{b_6} X_7^{b_7} X_8^{b_8} e^{\mu_t} \quad (6)$$

where

α = a constant

μ_t = the error term

e = the base of natural logarithms

b_j = the slope coefficient of the j^{th} variable.

Use of the Cobb-Douglas function for fitting a relationship from the NRLS data gave the following result:[1/]

$$PN = 4.4745\ X_1^{-.6813}\ X_2^{.4852}\ X_3^{.3056}\ X_4^{2.3096}\ X_5^{.5154}\ X_6^{.1209}\ X_7^{-.0654}\ X_8^{.1364} \quad (7)$$

As in any demand study, it was hypothesized that the quantity demanded was inversely related to its price. Price in the present study was represented by the per day trip expenses (X_1) incurred by a motel user. The results support the hypothesis as evidenced by the price variable being significant and negatively related to total person-nights.

With the coefficient for income (X_2) being positive, the relation implies that as income increases the rate of motel use increases. However, the income elasticity of .4852 is relatively low, implying that changes in income do not affect the annual amount of motel use greatly.[2/]

Equation 7 also suggests that the farther a household travels on a trip the greater the total person-nights of use. After a certain distance, the disutility associated with travel to a recreation area is greater

1/ The logarithmic form of this equation is presented in the Appendix.
2/ With a double-logarithmic form of the demand equation, the coefficient may be interpreted as the elasticity of the dependent variable with respect to the particular independent variable being considered.

than the disutility associated with the costs of a prolonged stay at that location while using a recreational motel. The distance variable (X_3) entered into the solution process before any other variable and contributed most of the explanatory power of the equation.[1/]

The presence of children under 17 years of age in a household (X_4) was positively related to the amount of person-nights of recreational motel use. Apparently, the added costs associated with taking children of this age on a trip are not prohibitive once the decision has been made to participate in motel-using recreation trips.

The influence of the other variables was as follows: As the number of trips (X_5) increased, the amount of motel use increased. As expected, the greater the amount of non-home based recreation (X_6), the slightly greater amount of motel use, whereas participation in home-based recreation activities (X_7) had a slightly negative effect.

2. Estimates of the Rate of Motel Use for 1976 and 1981

By applying the mean values (shown in Table 3) of the independent variables to Equation 7, the annual rates of motel use were estimated. For 1976, the estimated rates of use were obtained as follows:

$$PN_{76} = 4.4745\ [(38.62)^{-.6813}\ (3.835)^{.4852}\ (634.43)^{.3056}\ (1.164)^{2.3096}\ (1.305)^{.5154}\ (31.75)^{.1209}\ (45.6)^{-.0654}\ (62.1)^{.1364}] \quad (8)$$

$$= 17.12$$

and

1/ A step-wise procedure was used where the variable that adds the most to the explanatory power in terms of R^2 enters the solution process first.

$$PN_{81} = 4.4745\ [(44.9)^{-.6813}\ (4.02)^{.4852}\ (704.79)^{.3056}\ (1.154)^{2.3096}\ (1.305)^{.5154}\ (32.54)^{.1209}\ (44.51)^{-.0654}\ (68.85)^{.1364}] \quad (9)$$

$$= 16.46$$

The 1981 estimate represents a 4.3 percent decrease from the 1976 estimate. Thus part of the hypothesis concerning annual rate of motel use was not supported. That is, the rate of use by individual households would not increase between 1976 and 1981, and the result can be explained largely by the projected increase in trip costs and a decrease in family size.

Table 3. Means of Socio-Economic Variables Influencing the Annual Rate of Motel Use by Northeastern Households, 1976 and 1981.

Variable		1976	1981
X_1	Average per day trip costs ($)	38.62	44.90
X_2	Annual household income (coded)	3.835	4.02
X_3	Average one-way distance per trip (mi.)	634.43	704.79
X_4	One-plus the percent family members under 17 years of age	1.164	1.154
X_5	Number of trips involving use of recreational motels	1.305	1.305
X_6	Activity days spent in non-home based recreation	31.75	32.54
X_7	Activity days spent in home-based recreation	45.65	44.51
X_8	Grouped off-work days	62.10	68.85

Sources:
Trip costs--1981 means were obtained by weighting the 1976 means by the Consumer Price Index for Services, Handbook of Labor Statistics, [7].
Income--Obtained by multiplying the 1976 means by the average annual increase in income, U.S. Statistical Abstract, [21].
Distance--The 1981 mean equaled 1976 mean multiplied by the annual increase in average miles traveled on such trips, U.S. Travel Data Center, [14, p. 14].
Percent under 17--Household and Family Characteristics, [20].
NHBR and HBR--Means were obtained by multiplying the 1976 means by the average annual increase (or decrease) in these types of activities, Adams, et.al., [1].

Aggregate Demand for Recreational Motel Use

Aggregate regional demand was estimated as follows:

$$APN = PN \times P_m \times H \quad (10)$$

where

APN = aggregate person-nights by participating Northeastern households,

P_m = probability of participating,

PN = person-nights of motel use by a participating household,

H = households in the Northeast region.

$$APN_{76} = 17.12 \times .3298 \times 19{,}207{,}000 \quad (11)$$

$$= 108{,}901{,}830$$

$$APN_{81} = 16.46 \times .3411 \times 19{,}893{,}749 \quad (12)$$

$$= 111{,}693{,}580$$

The 1981 aggregate demand level represents an increase of 2,791,750 person-nights or 2.6 percent over the 1976 level. Therefore the hypothesis concerning the increase in regional demand was supported. Although motel use per household per year was estimated to decrease, overall regional demand was projected to increase. This can be largely attributed to a 3.6 percent projected increase in population with an increasing percentage of households using this type of lodging. Thus, population growth is apparently one of the main factors explaining growth in regional demand.

Most of the projected decrease in individual household demand can be explained by an expected increase in trip costs and a decrease in family size. It should be noted that this estimate assumed a constant gasoline price level between 1976 and 1981, therefore, the increase in

trip costs would be largely from higher lodging rates and other trip costs. The projected percentage of household members under 17 years of age is expected to decrease by 6 percent between 1976 and 1981. Because this variable had a relatively high elasticity (2.3096) demand would have decreased about 12 percent if all other variables remained constant.

SPATIAL DISTRIBUTION OF RECREATIONAL TRIPS INVOLVING MOTEL USE

A spatial distribution model was used to estimate the effects of possible travel restrictions on the future dispersion of the growing demand for recreational motel use.

Origins and Destinations

Through the use of the information obtained from the 1976 NRLS, an estimate was made of the 1976 distribution of recreational trips involving motel use by states of origin (Table 4).[1/] The largest number of trips originated in N.Y. and the smallest number originated in Delaware and New Hampshire. Obviously demand originates largely in the densely populated states with not much difference among the states in terms of propensity to take recreational trips.

In contrast to the locational sources of demand, the destination areas are mostly in the less densely populated states where more natural environments exist. Table 5 shows the regional distribution of trips by destination area.[2/] Only 62 percent of the trips originating in the Northeast remained in this region and 28 percent of the trips were to the Middle and South Atlantic states. Florida, as a destination for 8 percent of the trips, attracted the largest proportion to states outside the Northeast. Most of the 10 percent that traveled to "Other U.S." areas went to Western states with California the most popular destination.

1/ According to the results of the logit analysis, 6,334,448 households took at least one trip involving an over night stay at a recreational motel in 1976. This number was multiplied by the average number of trips taken per household (1.3) to obtain 8,268,985 as the total number of trips taken. Then this total was distributed among the states on the basis of the percentage distribution obtained from the 1976 NRLS.

2/ In order to reduce disparity in the size of destination areas, the 12 states of the Northeast region were grouped into six destination areas as defined in Table 5.

Table 4. Distribution of Recreational Trips Involving Motel Use Taken by Northeastern Households, by State of Origin, 1976.

State of Origin	Recreational Trips Taken	
	(Number)	(Percent)
Maine	269,990	3
New Hampshire	101,253	1
Vermont	185,638	2
Massachusetts	1,113,781	14
Rhode Island	337,513	4
Connecticut	928,152	11
New York	1,940,682	23
Pennsylvania	1,603,171	20
New Jersey	793,146	10
Delaware	101,253	1
Maryland	556,893	7
West Virginia	337,513	4
Total	8,268,985	100

Table 5. Distribution of Recreational Trips Involving Motel Use Taken by Northeastern Households, by Destination Areas, 1976.

Destination Area[a/]	Recreational Trips Taken	
	(Number)	(Percent)
Northern New England	1,459,646	18
Southern New England	822,035	10
New York	903,308	11
Pennsylvania	696,391	8
New Jersey	662,569	8
Middle Atlantic	549,983	7
South Atlantic	1,740,838	21
Other U.S.	860,959	10
Outside U.S.	573,250	7
Total	8,268,978	100

a/ The areas are defined as follows: Northern New England = ME, NH, VT. Southern New England = MA, CT, RI. Middle Atlantic = DE, MD, WVA. South Atlantic = VA, NC, SC, GA, FL. Other U.S. = states not located in the above. Outside U.S. = foreign destinations.

The 1976 Benchmark Spatial Distribution Pattern

By bringing the origin and destination distributions together in matrix form, one is able to present a more comprehensive assessment of the flow patterns of travel among states and areas. Such a matrix for 1976 provides a benchmark with which to compare the results of projections into the future. A benchmark is based on observed data and, as in this case, usually represents a recent situation.

The 1976 benchmark spatial distribution of recreational trips as shown in Table 6 is dispersed somewhat characteristically along a diagonal from the upper left to the bottom of the Middle Atlantic column. This means that within the Northeast region most trips are intra-state or intra-area. A notable exception is Northern New England which receives a heavy influx of recreation travelers from outside of Maine, New Hampshire, and Vermont. The Middle Atlantic area and New Jersey also receive large numbers of recreation travelers from other states.

The South Atlantic area is the most popular destination area outside of the Northeast with people from Maine, New York, Maryland and West Virginia in particular, choosing that area.

Connecticut households take most of their recreational trips to places outside of Southern New England. Their most popular destination area is Northern New England with other favorite areas being New York and the South Atlantic area.

The spatial distribution matrix shows that there is an exchange of recreation travel among states. For example, 49,572 trips are taken to New York by New Jersey households and, in turn, 135,071 trips are taken to New Jersey by New York households. Such an exchange, implies that any change in the development of recreational lodging in one area could have a pronounced counter-effect on another area.

The 1981 Projected "Trend" Spatial Distribution Pattern

The 1981 projected "trend" spatial distribution assumed constant gasoline prices, the same spatial pattern of recreational travel as observed in 1976 and the same number of trips per household as in 1976.

Table 6. The 1976 Benchmark Spatial Distribution of Recreational Trips Involving Motel Use, Taken by Northeastern Households.

Origin States	Destination Areas: Northern New England	Southern New England	New York	Pennsylvania	New Jersey	Middle Atlantic	South Atlantic	Other U.S.	Outside U.S.	Total by Origin
	(Number of Trips)									
Me.	84,372		16,874	16,874			101,446	16,814	33,611	269,990
N.H.	84,384							16,869		101,253
Vt.	50,622	16,874		16,874			50,622	33,627	17,013	185,638
Ma.	472,578	270,092	50,677		16,929		118,283	67,254	117,968	1,113,781
R.I.	151,879	118,129		16,876	16,876		16,876	16,876		337,512
Ct.	232,038	198,903	182,289	66,270		16,614	165,768	33,136	33,135	928,152
N.Y.	151,956	151,956	472,556	151,955	135,071	50,652	506,324	134,826	185,386	1,940,682
Pa.	49,057	32,705	114,466	278,150	278,150	196,229	261,637	278,217	114,560	1,603,171
N.J.	132,138	16,497	49,572	115,641	181,790	16,497	148,635	94,554	37,822	793,146
Del.		16,879			16,879		16,879	33,744	16,872	101,253
Md.	50,622		16,874		16,874	185,612	185,612	84,416	16,883	556,893
W.Va.				33,751		84,379	168,756	50,627		337,513
Total by Destination	1,459,646	822,035	903,308	696,391	662,569	549,983	1,740,838	860,959	573,250	8,268,985

The basic differences between this distribution and the 1976 benchmark were an increased probability of a household using a recreational motel and a larger Northeast population.

According to the logit analysis presented in the previous section, an estimated 6,785,758 households would use recreational motels in 1981. Based on this estimate, the calculated number of recreational motel trips was 8,858,129 for 1981. Table 7 shows the spatial distribution of those trips for 1981. Because of the assumptions made for this situation, the pattern of recreational travel would remain the same as for 1976; only the magnitude of recreational travel would change.

The 1981 Projected "Least-Travel" Spatial Distribution Pattern

In order to achieve the second objective it was decided to use a linear programming transportation model as the testing framework.[1/] Such a model enables one to test potential changes in recreational travel patterns such as those that might be caused by increased cost of travel due to shortages of fuel supplies. If gasoline prices should rise, would the demand for recreational motel use shift to nearer locations and would Northeastern households change their travel patterns? Assuming that people would strive to minimize their travel and conserve resources under such conditions, the model was formulated with an objective to minimize the aggregate mileage traveled by Northeastern households on trips involving

1/ For application of spatial allocation models in outdoor recreation research see Sim-Kottke [16], Schlette [15], Kottke-Libera [10], and Tadros-Kalter [17].

Table 7. The 1981 Projected "Trend" Spatial Distribution of Recreational Trips Involving Motel Use, Taken by Northeastern Households.

Origin States	Destination Areas: Northern New England	Southern New England	New York	Pennsylvania	New Jersey	Middle Atlantic	South Atlantic	Other U.S.	Outside U.S.	Total by Origin
	(Number of Trips)									
Me.	89,965		17,993	17,993			107,960	17,993	35,986	287,890
N.H.	90,065							18,004		108,069
Vt.	54,109	18,037		18,037			54,109	36,087	18,043	198,422
Ma.	504,392	288,274	54,089		18,069		126,246	71,888	125,803	1,188,761
R.I.	162,238	126,184		18,026	18,026		18,026	18,026		360,526
Ct.	247,584	212,230	194,503	70,710		17,727	176,875	35,355	35,355	990,339
N.Y.	162,023	162,024	503,865	162,023	144,020	54,008	539,869	143,759	197,668	2,069,259
Pa.	53,426	35,617	124,660	302,920	302,920	213,702	284,937	302,993	124,762	1,745,937
N.J.	143,981	18,019	53,972	126,046	197,953	18,019	161,999	89,973	35,989	845,951
Del.		18,015			18,015		18,015	36,016	18,008	108,069
Md.	54,029		18,010		18,010	198,106	198,107	90,098	18,020	594,380
W.Va.				36,053		90,131	180,263	54,079		360,526
Total by Destination	1,561,812	878,400	967,092	751,808	717,013	591,693	1,866,406	914,271	609,634	8,858,129

recreational motel use. Written in concise form, the objective was to:

$$\text{Minimize} \qquad M = \sum_i \sum_j C_{ij} X_{ij} \tag{13}$$

$$\text{Subject to} \qquad X_{ij} = \overline{X}_{ij} \quad \text{when} \quad i = j$$

$$\sum_j X_{ij} = T_i$$

$$\sum_i gX_{ij} \leq R_j$$

$$C_{ij} X_{ij} \geq M_{ij} \quad \text{when} \quad i \neq j$$

$$X_{ij} \geq 0$$

where

M = aggregate mileage by Northeastern households on recreational trips involving motel use,

C_{ij} = distance from origin i to destination j (miles)[1/],

X_{ij} = number of recreational trips with origin i and destination j,

T_i = annual trip demand by the households in state i,

g = average number of room-nights per trip demanded by users of recreational motels,

$\overline{X}_{ij}$ = 1981 projected "trend" number of intrastate recreational trips involving the use of motels,

R_j = annual supply of room-nights available in recreational motels,[2/]

M_{ij} = minimum number of miles traveled from origin i to destination j (based on the travel constraint under test).

1/ See Appendix, Table 1 for the matrix of distances used in the linear program model.

2/ See Appendix, Table 2 for the number of room-nights available in recreational motels by states.

The first constraint states that the magnitude of intrastate travel should not exceed the 1981 projected "trend" level. One reason for including this constraint was to avoid unrealistic "clustering along the diagonal," which commonly occurs with travel-minimization models. Another reason is that many people take recreational trips in order to "get away" from one's familiar environment and to enjoy the outdoors. Clawson and Knetsch [5, p. 33] comment that many individuals receive a recreational benefit directly from travel to a recreational site. It seems reasonable to assume that an extreme intensification of intrastate trips would not maintain a high level of satisfaction by people taking recreational trips.

The second constraint states that the total number of trips originating from each state must be entirely allocated among destination areas.

The third constraint states that the total number of room-nights demanded per year must be less than or equal to the yearly amount of room-nights available.[1/]

The fourth constraint provided a means for testing the effect of changes in gasoline prices on recreational travel patterns. This constraint states that the number of miles traveled from i to j must be greater than a specified level of M_{ij} which was determined through the use of elasticity estimates with respect to the effects of increases in the

1/ It should be noted that g converts yearly trip demand into yearly room demand as follows:

$$g = (PN/TY)\ .5$$

where

g = the number of room-nights demanded per trip,
PN = total yearly demand per household as measured in person-nights,
TY = the number of trips per year involving the use of recreational motels,
$.5$ = the number of rooms per person.

relative price of gasoline on the number of miles traveled by automobile. Wildhorn, et.al., [21, p. 62], estimated the price elasticity of gasoline to be -.37 (a 30 percent increase in gasoline prices results in an 11.1 percent decrease in vehicle miles traveled). Thus, in testing the effect of a 30 percent increase in gasoline price, the mileage constraint took the following value:

$$M_{ij} \geq .889\ C_{ij}\ X_{ij}$$

In making this test it was assumed that the following conditions would apply: (1) The number of trips taken per household would not change. (2) The effect on air travel would be the same as the effect on automobile travel.[1/] (3) All other factors would remain constant.

Table 8 shows the results of implementing the linear programming test of a 30 percent increase in the real price of gasoline on travel patterns. If one compares the 1981 "least-travel" pattern with that for the 1981 "trend" pattern, differences in the flow of trips among states and areas can be detected. While the overall patterns are similar, they differ in the distribution of trips among individual states. The tendency is toward fewer trips taken to distant locations and more trips taken to nearby locations in the 1981 "least-travel" distribution. For example, Connecticut households would switch most of their recreational trips from Northern to Southern New England. Also New York and South Atlantic area visits would be cut 11 percent each.

1/ Only 9.2 percent of the trips for outdoor recreational purposes were made by air. 1976 National Travel Survey, [14, p. 15].

Table 8. 1981 Projected "Least-Travel" Spatial Distribution of Recreational Trips Involving Motel Use, Taken by Northeastern Households, Based on 30 Percent Increase in Gasoline Price.

Origin States	Destination Areas and Regions: Northern New England	Southern New England	New York	Pennsylvania	New Jersey	Middle Atlantic	South Atlantic	Other	Total by Origin
	(Number of Trips)								
Me.	111,915		15,996	15,996			95,976	47,987	287,890
N.H.	88,065	3,998						16,006	108,069
Vt.	48,103	16,035	22,012	16,048			48,103	48,122	198,422
Ma.	526,359	310,274	48,085		16,063		112,232	175,747	1,188,761
R.I.	144,229	152,196		16,025	16,025		16,025	16,025	360,526
Ct.	225,532	293,170	172,913	62,861		15,759	157,242	62,861	990,339
N.Y.	194,514	267,322	503,865	144,038	128,034	48,012	479,943	303,530	2,069,259
Pa.	47,496	31,664	110,823	302,920	372,713	246,740	253,310	380,274	1,745,937
N.J.	127,999	16,019	47,981	163,295	197,953	36,707	144,017	111,980	845,951
Del.		16,015			28,011		16,015	48,027	108,069
Md.	48,032		16,011	80,005	16,011	194,108	160,107	80,106	594,380
W.Va.				32,051		86,129	194,269	48,076	360,526
Total by Destination	1,562,244	1,106,693	937,686	833,239	774,810	627,451	1,677,239	1,338,741	8,858,129

Comparison of the 1981 Projected Estimates with the 1976 Benchmark Estimates

One of the purposes of comparing the projected distributions with the benchmark distribution is to note the potential consequences of alternative growth situations. Earlier it was stated that demand for the use of recreational motels was estimated to grow between 1976 and 1981. Now the question is: How would that growth in demand manifest itself among the various areas of the country taking certain supply and travel constraining conditions into account?

Based on the 1981 projected "trend" conditions, the growth in demand would be distributed in such a way that all destination areas would have about a 7 percent increase in recreational trips (Table 9). That is, the 1981 spatial distribution pattern would remain the same as it was in 1976. This result was specified by the assumptions made for the "trend" situation and as such it serves as a standard for comparison.

On the other hand, based on the 1981 projected "least-travel" conditions, growth in demand would be distributed in quite different proportions among the destination areas. Southern New England's share of the trips would increase the most while South Atlantic and "Other" areas would experience a decrease in trips. Again, the essence of the results, is that recreation travel involving motel use would concentrate more heavily in the more urbanized states if a situation leading to travel constraints should occur, but, more importantly, the solution helps identify which locations would be most affected.

Table 9. Projected Changes in Number of Recreational Trips Involving Motel Use Between 1976 and 1981, Taken by Northeastern Households.

Destination Area	Percent Change in Number of Trips Between the 1976 Benchmark Situation and	
	1981 Projected "trend" situation	1981 Projected "least-travel" situation
Northern New England	+7	+7
Southern New England	+7	+35
New York	+7	+4
Pennsylvania	+8	+20
New Jersey	+8	+17
Middle Atlantic	+8	+14
South Atlantic	+7	-3
Other	+6	-6
Total	+7	+7

The effect of the assumed travel constraint can be seen in the increase in the number of intraregional trips shown in Table 10. Based on the "least-travel" situation, intraregional trips would increase 15 percent over the benchmark level.

Table 10. Intraregional Recreational Trips Involving Motel Use, Taken by Northeastern Households, 1981.

1981 Projected Situation	Number of Intraregional Trips	Percent Change from 1976	Percent of all 1981 Trips
"trend" with no gasoline price increase	5,467,822	+7	61.7
"least-travel" with a 30% gasoline price increase	5,842,149	+15	66.0

Perhaps the most important measure of the potential effect of a travel constraint is the reduction in aggregate mileage that could occur. The objective of the linear programming testing procedure was to determine the minimum aggregate mileage subject to the demand and supply conditions specified in the model. The results of the tests showed that, with a 30 percent gasoline price increase and an objective of travel minimization, Northeast households would decrease aggregate mileage by 2.3 percent compared to the 1976 level (Table 11). Otherwise, according to the 1981 projected "trend" estimate, aggregate mileage would increase 7.5 percent to a total of approximately 5.5 billion miles (one-way).

Table 11. Aggregate Miles Traveled on Recreational Trips Involving Motel Use, Taken by Northeastern Households, 1976 and 1981.

Situation	Aggregate Miles Traveled 1/	Percent Change from the 1976 Benchmark Level
1976 Benchmark	5,105,089,800	--
1981 Projected "trend"	5,489,503,100	+7.5
1981 Projected "least-travel"	4,989,235,800	-2.3

1/ One-way mileage.

SUMMARY AND CONCLUSIONS

People in the United States have been traveling greater distances on recreational trips in recent years, and a factor making long distance travel possible is the availability of recreational lodging. Changes in demand for recreational lodging can have a profound affect on rural communities. This study was concerned with the prospects that future energy shortages or similar events could possibly alter the economies of recreation-oriented communities. In order for rural communities to do land use and developmental planning, it is useful for decision makers to anticipate such changes in demand and evaluate the probable economic impact on affected areas.

The objectives of the study were (1) to identify the factors affecting the demand for recreational motels by the Northeastern households and to estimate the current and projected demand and (2) to estimate the effects of possible future travel restrictions on such demand.

The source of data for this study was the 1976 Northeast Recreational Lodging Survey which was conducted to obtain information on recreational lodging and the socio-economic factors related to the use of lodging by Northeastern households.

The first hypothesis tested was: If the socio-economic variables change according to the current trend, then the proportion of the Northeast households using recreational motels would increase between 1976 and 1981. A logit function was used to estimate the probability of a household using a recreational motel. Among the socio-economic variables, "availability of vacation time" had a positive effect on the probability

of participation. "Number of children under 21 years of age" had a negative effect and "age of the household head" was positive for household heads 36 years of age and under but was negative above age 36. According to the results, an estimated 33 percent of the Northeast households used recreational motels in 1976. By applying projected data to the logit function it was estimated that the proportion of households using a recreational motel would increase to 34 percent in 1981. Thus the first hypothesis was supported.

The second hypothesis tested was: If socio-economic variables change according to the current trend, then the annual use of recreational motels by individual participating households and at the aggregate level would increase between 1976 and 1981. A regression equation was used to estimate and project the rate of motel use. Household demand was positively related to "distance traveled," "percent of household members under 17 years of age," "number of trips taken," "household income," "availability of vacation time," and "preference for non-home based recreation." Variables that affected motel use negatively were "average per day costs" and "preference for home based recreation."

The estimated average rate of motel use for 1976 was 17.2 person-nights per participating household and the estimated aggregate use was 108,901,830 person-nights. For 1981, the estimates were 16.5 person-nights for individual households and 111,693,580 person-nights in the aggregate for the Northeast. With an estimated decrease in annual use by individual participants, part of Hypothesis 2 was not supported. However, the hypothesized increase in aggregate use between 1976 and 1981 was supported.

The third hypothesis tested was: If travel constraints would increase, then a relatively greater increase in intraregional than interregional motel-using recreational travel would occur between 1976 and 1981. It was shown that with a 30 percent gasoline price increase, the proportion of intraregional trips would increase. In a 1981 projected "trend" spatial distribution, assuming no gasoline price increase, intraregional trips accounted for 62 percent of all recreational motel-using trips taken. By comparison, when a 1981 projected "least-travel" situation was computed, assuming a 30 percent gasoline price increase, intraregional trips accounted for 66 percent of the total. This and other measures of the effect of the assumed travel constraint supported the third hypothesis.

It is concluded that if the current trend in demand for recreational motel lodging continues, areas such as Northern New England and South Atlantic states are likely to continue as the most popular destinations of Northeastern households seeking rural environments for outdoor recreation. On the other hand, if travel constraints prevail in the future, demand is likely to shift somewhat toward Southern New England, Pennsylvania, New Jersey and Middle Atlantic locations. The net effect of uncertainty as to which situation will prevail, may lead to a tempering of the growth trend in recreational travel and motel lodging with the more remote rural areas continuing to experience the throngs of seasonal visitors but at a more stable rate. Such a situation would imply that a moderate expansion of recreational motel lodging may be warranted in the future, especially in areas that would be least likely to be adversely affected by a development of more stringent travel constraints.

LITERATURE CITED

[1] Adams, Robert L., Robert C. Lewis and Bruce H. Drake, Outdoor Recreation, A Legacy for America: Appendix A, An Economic Analysis, U.S. Dept. of the Interior, Bureau of Outdoor Recreation, Washington, D.C., 1973.

[2] Chiang, Alpha C., Fundamental Methods of Mathematical Economics, 2nd edition, New York, McGraw-Hill, 1974.

[3] Civil Aeronautics Board, Aircraft Financial Statistics, Government Printing Office, Washington, D.C., December 1976, p. 1.

[4] Civil Aeronautics Board, Air Carrier Traffic Statistics, Government Printing Office, Washington, D.C., December 1976.

[5] Clawson, Marion and Jack L. Knetsch, Economics of Outdoor Recreation, Baltimore, Johns Hopkins Press, 1971.

[6] Gould, B., An Analysis of the Use of Motels and Lodges on Outdoor Recreational Trips, unpublished M.S. thesis, University of Connecticut, 1978.

[7] Handbook of Labor Statistics, U.S. Printing Office, Washington, D.C., 1977.

[8] Kottke, M. W., "Economic and Environmental Impacts of Outdoor Recreation Growth on Natural Resource Endowed Communities," Research for Connecticut, Storrs (Conn.) Ag. Exp. Sta., Research Report 47, September 1977.

[9] Kottke, M. W., Operational Analysis of Commercial Campgrounds in Connecticut, Storrs (Conn.) Ag. Exp. Sta., Bull. 432, November 1974.

[10] Kottke, M. W. and S. Libera, Effect of Travel Constraints on the Distribution of Skiing in New England, Storrs (Conn.) Ag. Exp. Sta., Research Report 45, November 1975.

[11] Kottke, Marvin, A Survey of Recreational Lodging and Outdoor Recreation by Northeastern Households, Storrs (Conn.) Ag. Exp. Sta., Report (submitted for publication), 1978.

[12] Moore, G. H. and J. H. Hedges, "Trends in Labor and Leisure," Monthly Labor Review, February 1971, pp. 3-11.

[13] Nerlove, M. and J. S. Press, "Univariate Log-Linear and Logistic Models," Rand Corporation, Monograph, R-1306-EDA/NIH, Santa Monica, Cal., December 1973.

[14] 1976 National Travel Survey, U.S. Travel Data Center, Washington, D.C., 1977.

[15] Schlette, Theodore, Spatial Determinants of Urban Swimming Participation, unpublished M.S. thesis, University of Connecticut, Storrs, 1978.

[16] Sim, R. and M. Kottke, Spatial Distribution of Second Homes in the Northeast, Storrs (Conn.) Ag. Exp. Sta. (submitted for publication 1978).

[17] Tadros, M. E. and R. J. Kalter, "A Spatial Allocation Model for Projected Outdoor Recreation Demand," Search, Vol. 1, No. 5, Cornell Ag. Exp. Sta., Ithaca, N.Y., January 1971.

[18] U.S. Bureau of the Census, Census of Selected Industries, Volume 1, Summary and Supplemental Statistics, U.S. Government Printing Office, Washington, D.C., 1972.

[19] U.S. Bureau of the Census, Current Population Reports, Series P-25, U.S. Government Printing Office, Washington, D.C., February 1977.

[20] U.S. Bureau of the Census, Household and Family Characteristics, U.S. Government Printing Office, Washington, D.C., March 1975.

[21] U.S. Bureau of the Census, Statistical Abstract of the U.S., 1977 edition, Washington, D.C., 1977.

[22] U.S. Department of Transportation, Costs of Owning and Operating an Automobile, Government Printing Office, Washington, D.C., 1976, p. 2, Table 1.

[23] Wildhorn, S., B. K. Burright, J. Enns and T. F. Kirkwood, How to Save Gasoline: Public Policy Alternatives for the Automobile, Santa Monica Rand Corp., R-1560-NSF, 1974.

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

Origin States	Destination States																	
	ME	NH	VT	MA	RI	CT	NY	PA	NJ	DE	MD	WV	VA	NC	SC	GA	FL	Other
	(Number of Miles One-Way)																	
ME	100	148	190	202	208	266	302	533	421	526	575	951	701	856	1066	1226	1573	2000
NH	148	88	117	78	109	142	154	419	297	400	443	817	577	732	942	1102	1449	2000
VT	190	117	75	183	223	204	162	474	352	457	498	872	632	787	997	1157	1504	2000
MA	202	78	183	70	41	64	134	341	219	279	365	739	499	654	864	1024	1371	2000
RI	208	109	223	41	25	70	167	349	225	324	371	747	502	657	867	1027	1374	2000
CT	266	142	204	64	70	47	103	280	158	263	304	678	438	593	803	963	1310	2000
NY	302	154	162	134	167	103	143	279	195	300	334	677	474	629	839	999	1346	2000
PA	553	419	474	341	349	280	279	140	146	135	76	398	492	647	857	1017	1364	2000
NJ	421	297	352	219	225	158	195	146	67	105	144	442	280	435	645	805	1152	2000
DE	526	400	437	279	324	263	300	135	105	46	70	407	194	349	559	709	1066	2000
MD	575	443	498	365	371	304	334	76	144	70	59	397	134	289	499	659	1006	2000
WV	951	817	872	739	747	678	677	398	442	467	397	101	312	350	360	539	935	2000

Appendix Table 2. Supply of Motel Rooms Available to Northeastern Households on Recreational Trips.

State	Number Available Room-Nights 1976 1/	Number Available Room-Nights 1981 2/
Maine	2,833,190	3,045,679
New Hampshire	4,403,464	4,733,724
Vermont	3,594,131	3,863,691
Massachusetts	4,762,322	5,119,496
Rhode Island	613,385	659,388
Connecticut	903,108	970,841
New York	7,654,535	8,228,625
Pennsylvania	5,339,219	5,739,660
New Jersey	4,492,971	4,829,944
Delaware	387,935	417,030
Maryland	2,412,995	2,593,970
West Virginia	1,227,434	1,319,492
Virginia	5,146,337	5,532,312
North Carolina	5,679,804	6,105,789
South Carolina	4,365,182	4,692,591
Georgia	6,884,839	7,401,202
Florida	26,188,625	28,152,772
Other (U.S.)	83,988,767	87,646,825

1/ Estimated from 1972 Census of Selected Industries, [16].
2/ Assumes a constant 1.5% annual growth rate.

Appendix Table 3. Means of Selected Variables, Users and Non-Users of Recreational Motels, Northeastern Households, 1976.

Variable	Users	Non-users
Age of Household Head	42.93	45.37
Education of Household Head (coded)[a/]	3.33	3.20
Total Number of Children of Household Head	1.60	1.81
Total Number of Children 21 Years of Age or Less	1.03	1.18
Total Household Income (coded)[b/]	3.83	3.37
Tenure of Primary Residence (coded)[c/]	.258	.260
Grouped Off-Work Days	62.11	96.98
Time Spent on Recreation (Hours)	270.53	229.98
Home Based Recreation (Activity Days)	45.65	46.16
Non-Home Based Recreation (Activity Days)	32.62	31.14

a/ Grade School = 1
High School = 2
Technical School = 3
College = 4

b/ Under $6,000 = 1
$6,000 - $9,999 = 2
$10,000 - $14,999 = 3
$15,000 - $24,999 = 4
$25,000 - $34,999 = 5
$35,000 + = 6

c/ Own primary residence = 0
Rent primary residence = 1

APPENDIX NOTE ON EQUATION 7

In logarithmic form, Equation 7, the rate of motel use estimating equation, is stated as follows:

$$\begin{aligned} Ln(PN) = 1.4984 &+ \underset{(.034)}{.3056}\ln(X_3)^{**} + \underset{(.234)}{2.3096}\ln(X_4)^{**} \\ &- \underset{(.100)}{.6813}\ln(X_1)^{**} + \underset{(.109)}{.5154}\ln(X_5)^{**} + \underset{(.092)}{.4852}\ln(X_2)^{**} \\ &+ \underset{(.033)}{.1364}\ln(X_8)^{**} + \underset{(.043)}{.1209}\ln(X_6)^{**} - \underset{(.023)}{.0654}\ln(X_7)^{**} \end{aligned}$$

$$R^2 = .519 \qquad \bar{R}^2 = .494 \qquad F_{258}^{8} = 33.62^{**}$$

(** indicates significance at the .01 level of confidence. The numbers in parentheses are the standard error of the estimated coefficients.)

The F-statistic was significant at the .01 significance level which indicates significant explanatory power in at least one of the variables used in the equation. Such a large F-statistic was a result of all the variables being significant at the .01 level of significance.

It was recognized that the R^2 and $\bar{R}^2$ values were relatively low when compared to other types of demand studies. Interest in this study was not specifically in obtaining high R^2 values (although desirable) but rather in reliability of the estimated structural parameters.