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Demand for Boating in Selected Counties of Northern Utah

Harold D. Morris
Utah State University

DEMAND FOR BOATING IN SELECTED COUNTIES OF NORTHERN UTAH

by

Harold D. Morris

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INTRODUCTION AND JUSTIFICATION OF THE RESEARCH

Each year many new families enter the recreational boating force. Boat ownership throughout the nation has increased over the past few years until it no longer appears to be a status symbol, but merely a very popular means of increasing family enjoyment of the great out-of-doors.

About 90 percent of American adults participated in one or more outdoor recreational activities during 1962 and the percentage is increasing. (ORRC 1962 #2) The growing affluence of American society, notably evidenced by the spread of automobile ownership, shorter working hours, larger incomes, and diminishing requirements for physical effort on the job, is a probable explanation for the great increase in outdoor recreation.

The impact on society of this increase in recreational activity is of economic significance. Casual observation is all that is needed for one to realize that vast amounts of money are being spent annually in the pursuit of various types of outdoor recreation.

Water-based recreation has come into particular focus in the last 15 or 20 years and most popular outdoor areas usually include some water recreational facilities (Clawson, 1963).

Several recent publications have treated the problem of valuing outdoor recreation. It is generally accepted that one major problem stems from the fact that no market price exists for this commodity.[1] This lack of market price as such, however, does not mean that recreation is any less an economic good. In fact, it fits the definition of an economic good in that it is inherently useful, appropriable, and relatively scarce.

The problem then in valuing outdoor recreation is to develop a value indicator to be used in lieu of market price. The idea that the value of the experience is reflected in the cost of consumption is consistent with appraising the value of conventional market priced goods. Though no price tag is attached, there is nevertheless an expense which must be met to extract utility from the recreational experience. A suitable value indicator would reflect this expense.

It is intended that the present study will in some measure make use of empirical application of the foregoing proposal in estimating the demand for one outdoor recreational activity, boating, and then use this estimate to suggest a means of valuing the resource itself.

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[1]For example, see the following recent publications:

Fulcher, Glen D., Methods of Economic Evaluation of Outdoor Recreational Uses of Water . . . , (Unpublished Ph.D. dissertation, University of Wisconsin, 1961).

Clawson, Marion, Methods of Measuring the Demand For and Value of Outdoor Recreation, Reprint #10, Resources for the Future, Washington, D. C., February, 1959.

Knetsch, Jack L., "Outdoor Recreation Demands and Benefits," Land Economics, Vol. 39, No. 4, November, 1963.

Trice, Andrew H. and Samuel E. Wood, "Measurement of Recreation Benefits," Land Economics, Vol. 34, 1958.

REVIEW OF LITERATURE

Although very little has been written relative to the factors that influence the amount of or the demand for boating, there have been various studies conducted which were concerned with recreation in general.

Some of these studies are in many ways similar to the present study and a review of the literature concerning them is helpful in analyzing and understanding some of the problems involved.

Of particular interest was a paper presented by Marion Clawson (1959) at the University of Wisconsin. Clawson made use of data concerning the number of park visitors and their places of origin to construct an "approximation to a demand curve" for a recreational area. This curve related the cost per trip to the number of trips per 100,000 population.

Three distance zones (population centers) contained all the park visitors. Entrance to the park was free. Costs of visits from the three zones, i.e., travel, lodging, food, etc. varied with the distance traveled and represented the independent variable. The dependent variable, number of visits per 100,000 population, was found in general to vary inversely with the distance traveled.

Clawson indicated that three assumptions underlie this demand curve:

1. It is a static concept in that population, incomes, tastes, means of travel, etc. remain unchanged.

2. The marginal value of money remains constant no matter how much of the product an individual purchases.

3. Price alone is the limiting factor which determines the volume (number of visits).

On this basis, people will use outdoor recreation to the extent to which they believe their satisfactions are exactly equal to the total costs involved.

Clawson suggests that in addition to a demand curve for the total recreation experience it is desirable to describe the demand for the particular recreation opportunity. This he derives from the mathematical expression of the first demand curve.

Using the data for the total recreation experience and varying the costs per visit, he estimated a demand curve for the site. If entrance fees were raised, the number of visits per 100,000 population would decrease. Also, an increase in fees resulted in a relatively greater decrease in number of visits from the distance zones near the site than from those more distant. The demand curve thus derived measures the relation between the number of visits and the various entrance fees. Clawson contends that this is the best approximation of the true demand curve for the site since it measures the relation between price per unit and number of units taken.

Two assumptions were made in considering the demand curve for the site:

1. Users would view an increase in fees rationally.

2. The experience of users from one location zone provides a measure of what people in other location zones would do if costs in money and time were the same.

A study of significant value to the present effort was made by Trice and Wood (1958) in connection with the proposed development of the Upper

Feather River Basin in California. Several of the reservoirs in the proposed project would have primarily recreational value.

They suggest that primary benefits from recreation are personal and varied and are therefore not readily measurable in dollar terms, and that this "fundamental tenet" is concurred in by virtually all who have given the problem careful consideration. They outline the characteristics necessary to a useful method of measuring recreation benefits as follows:

1. It must be in terms of a standard unit of time and be expressed in dollars.

2. It must be representative of recreation enjoyment for which there is no expenditure by the recreationist and for which the state is not directly reimbursed.

3. It must be independent of the cost of providing the recreation facilities.

4. It must consist of a single figure which applies to recreationists, in the area being studied, as a group without regard to the form of recreation being enjoyed or to differences among individuals as to capacity to enjoy recreational benefits.

5. It must be peculiar to the area under consideration.

6. It must be reaonable in amount and subject to tests based upon judgment values by informed people.

Trice and Wood reject the total expenditure approach for measuring the intangible values to the person enjoying recreation. In the first place, many so-called recreational expenditures are normal expenditures under slightly different circumstances; for example, food and clothing.

Secondly, even those expenditures over and above normal living costs are not necessarily measures of recreational enjoyment, but are the prices paid for goods and services for which a market is established. They conclude that "dollars spent in pursuit of recreation appear to be more significant as indicators of secondary benefits to the business community than as measures of primary recreational benefit."

The study made by Trice and Wood applies the "fixed cost per mile traveled" method of measuring recreation benefits.

Data were collected for this area and two similar areas on the Truckee River.

A demand curve was drawn using travel costs per visitor day as the independent variable and number of visitor days per time period as the dependent variable.

To estimate the value of a day in the recreation area, consumer surplus was estimated. This was done by setting a bulk line market value at the 90th percentile point of travel costs. At this point it was determined that recreation in the Feather River area had a per visitor day market value of $3.14. The "meridian" travel cost (50th percentile) was taken as average for the group, a difference or "free benefit" of $2.09 results. This $2.09 was consumer surplus and represented the value per day received from the recreation facility. The consumer surplus for the other two areas was $1.99 and $2.09.

Gray and Anderson (1964) conducted a study in the Ruidosa area of New Mexico involving general recreationists, fishermen, cabin owners, and race track patrons.

They estimated the demand for recreation by comparing trip costs with the number of man days per party. Trip costs included travel, lodging, cost of food over and above normal cost at home, equipment and horse rental, license fees, baits and lures, other fees, etc.

Points were plotted on a graph with cost on the ordinate and man days on the mantissa. The first point represented the party having the highest cost per man day. A point was then plotted for the party having the next highest cost per man day. This point was located on the mantissa at the sum of the first two parties. Points for each other party were plotted and in each case the number of man days were added to those already plotted. A line through these points was called the demand curve.

An interesting study using an outdoor sport was reported by William G. Brown (1964).

Brown plotted the relationship between average variable cost per day and the number of days taken per unit population by five distance zones in connection with salmon-steelhead fishing in Oregon.

This curve corresponded to what Clawson called the demand curve "for the recreation experience as a whole" and was, according to Brown, an oversimplification as there may have been factors other than cost which affected the number of per capita visits in the more distant areas. For example, time, alternate sites, etc.

He then projected the number of salmon-steelhead fishing days taken by fishermen from the five zones using a graduated scale of prices. He plotted increased fishing costs per day against thousands of fishing days taken per time period. This curve corresponded to Clawson's derived demand for visits to national parks at various assumed fees. The assumption made in this case was that the main reason for the difference in number of salmon-steelhead fishing days taken by near zones, as compared to those farther away, was the extra travel cost of the more distant zones.

To identify other variables, the zones were subdivided according to family income and it was found that this variable exerts a significant influence on per capita salmon-steelhead fishing days taken. Other variables were measured but showed no significant effect. Distance alone was not significant due to the inability to separate money cost and time cost of travel.

> Total expenditures by salmon-steelhead anglers in 1962 were estimated at $15 to $21 million. Therefore the 1962 gross economic value was between $15 and $21 million. . . . "Net economic value" will be our best estimate of the monetary value of the sport fishery resource which might exist if the resource were privately owned and a market existed for the for the opportunity to fish for salmon and steelhead. This net economic value would approximate the value of the resource to a private owner who could charge sport anglers for his permission to fish. . . . (Brown 1964. p. 13)

Brown made use of the concept suggested by Crutchfield (1963) that a measurement of "net economic value" can be best represented by selecting a point on the demand curve which reflects the price a non-discriminating monopolist would charge to maximize his profits.

Many of the recent studies concerning outdoor recreation have made use of suggestions taken from a letter to the National Park Service (1949) written by Professor Harold Hotelling of the University of North Carolina. His "method" included:

1. Analysis of national park patronage to discover origin of recreationists;

2. Grouping of visitors geographically into distance zones about the park;

3. Determination of average travel cost from each zone to the park;

4. Establishing a bulk line, set by cost of travel from the most distant zones; (This bulk line shows the value of recreation provided by the park.)

5. Summation of the difference between the bulk line cost and that from each other zone to show the free recreation value to those who travel shorter distances; and

6. The assumption that all people who visit the parks get an equal amount of enjoyment from the experience. This means that those who travel farthest establish the value of the park, as a recreational facility, to everyone. Since all others receive the same benefit, though they travel shorter distances, they get the recreation afforded by the park at bargain rates.

Worthy of consideration are criticisms offered by James A. Crutchfield (1963) concerning the various methods.

He brands the Trice and Wood technique as being weakest of all. The objection here is mainly that it involves an entirely arbitrary assumption as to individual valuation of resource use at a particular site, indicating that this is too dependent upon a broad geographic dispersion of users to be practical.

He criticizes Clawson and Hotelling for their use of consumer surplus in estimating total benefits, contending that this is neither essential nor desirable.

Problems he points out concerning the fixed travel cost method are:

1. The assumption that people in more distant areas will use a resource to the extent of those close at hand if the latter were charged a fee equal to the travel cost.

2. A number of people may have settled close to the area of recreation just because of its being there.

3. Attempts to derive a demand function from differential travel are not valid whenever all users are concentrated in a single area.

4. The apparent assumption that all benefits from the resource are complementary since they must all be lumped together to get the benefits offered by the area; whereas many are competitive such as fishing vs. water skiing. This means different aggregate benefits would result from different types of development.

5. That some economic yield which should be credited to a water resource will show up as added value of land which is located nearby.

Crutchfield suggests that no over-all formula for determining the net economic yield or capitalized value of a recreation facility can be devised. He makes four suggestions as to what is needed:

1. A uniform set of evaluation principles, suggesting that it seems desirable to value individual components of outdoor recreation separately wherever possible.

2. Reasonably accurate estimates of man days of resource use and numbers of individuals involved.

3. Determination, on a sample basis, of the distribution of recreationists.

4. The use of differential fees on a trial basis to provide information on the elasticity of demand for this particular type of recreation.

Gardner (1962) emphasizes the applicability of traditional economic theory to problems involving the analysis and measurement of multiple resource use. He suggests that "the fault is not with our models but in our inability to develop data which may be used in our models."

Within this framework he developes demand curves for both resident and non-resident deer hunting in Utah. This is done by correlating real prices of licenses and permits per hunter day with hunter days per capita.

Carey (1963) lists four principle variables which determine the amount of outdoor recreation that will be taken: 1) leisure time, 2) mobility, 3) population, and 4) income. An increase in one or more of these has caused the demand for outdoor recreation to rise.

He suggests two avenues to meet the urgent need for research in this area: 1) final incidence of benefits and costs, and 2) a price system for the use of recreation facilities.

Knetsch (1963) makes use of Clawson's method to derive a demand for recreation. He then describes the area under the demand curve as the value of the resource as a recreational facility, i.e. the total worth of the output of the resource to all who use it. The demand curve defines how many individuals will use the resource at each level of price. The value represented by the sum of these price-quantity relationships is that which would be captured by a perfectly discriminating monopolist. This, he concludes, is an appropriate measure of the economic returns to the area served by the resource and such an evaluation would lead to an efficient commitment of resources to recreational purposes.

The possibility of double counting is suggested due to appreciation of land adjacent to developed recreational facilities, e.g. some people will buy proximity to the recreational resource. Then the total value of the resource would equal user benefits plus the extra value capitalized in the land nearby.

Another issue Knetsch considers is that of time constraint. Time has a value and must be given up to visit a recreation site; therefore, it should be counted as a cost. Other things equal, people will visit areas requiring less travel time in larger numbers than areas demanding more time. However, the value of time is difficult to measure. Pleasant travel routes would mean less cost per unit of time because some benefit would be derived from the enjoyment of travel. Also, the time restraint is no different from time needed to consume any number of goods that are marketed in the economy. It is the dollar value of time and not the amount of time which needs to be considered.

THEORETICAL MODELS AND CONCEPTUAL SOLUTIONS

Much of the disparity between evaluation of recreation and other more conventional commodities could be eliminated by finding a substitute for market price. The theoretical model must show some measurable factor or factors correlated with quantity in much the same way as is monetary price in the market. This done, traditional economic analysis can be used to determine the demand for recreation and the value of recreational resources.

The model used here is one developed by Dr. E. Boyd Wennergren (1964) the general hypothesis being "that individual user costs of travel to and from a particular boating site, plus the added on-site expenditures, constitute a 'price' for boating, and as such, are the principal determinants of the quantity that will be taken. It is also the variable trip costs and not the total boater expenditures which generate an appropriate statement of value." The logic of this hypothesis is the framework within which this study has been conducted.

Assumptions basic to the formulation of the model are:

> First, the boater spends his income and other resources in such a way as to maximize his total derived utility or satisfaction. Second, the boater has perfect knowledge or at least acts on his expectations as though he had such knowledge regarding the various costs of boating and the utility or satisfaction that he receives from the different quantities that may be taken. Third, the boating experience generates a total utility function which at some point encounters diminishing marginal utilities. . . . Fourth, the units of utility and cost are equivalent and a net utility can be derived. Fifth, major decisions pertaining to individual boating trips are made prior to departure, and the boating activity is the causal agent in the individual's decision to undertake the outdoor experience. (Wennergren 1964, p. 305)

Rationale presented by Wennergren basic to this study is outlined here in brief.

1. Outdoor recreation is not properly placed in a peculiar category by virtue of its aesthetic nature.

2. The real problem in valuing outdoor recreation is the absence of the traditionally used "value indicator," market price.

3. The cost involved in the consumption of boating is the constraint which places it in competition with all other goods and services for the consumer's income and time resources.

4. It is the marginal (travel and on-site) costs which determines the number of boating trips which will be taken during the season. Equipment costs and annual expenditures (taxes, license, insurance, etc.) have, at this point, become fixed.

5. Based on the assumption of diminishing marginal utility associated with the boating experience, a boater will take that number of boating trips such that the marginal value of the utility derived is just equal to the marginal cost of the last trip. At this number of trips, net utility is zero for the last trip. He will not take a greater number of trips because beyond this number marginal costs would exceed marginal utility.

6. Each boater, acting rationally, will allocate his total boating experience among sites in such a way that the ratio of marginal value utility to marginal cost for each site will be equal to that for each other site. If his resources are unlimited, he will take a number of trips to each site such that the net marginal utility is zero for the last trip to each site and the ratios for all sites will be equal to each

other and to one.

Represented symbolically:

$$\frac{MVU_a}{P_a} = \frac{MVU_b}{P_b} = \ldots = \frac{MVU_i}{P_i} = 1.0$$

Where:

$MVU_{a \ldots i}$ = value of the marginal utility realized by the boater at sites (a to i),

$P_{a \ldots i}$ = travel and on-site costs associated with each site (a to i).

Under conditions of restraint, the number of trips taken are allocated among sites so that the ratios are equal, but since the total number of trips desired are not taken, the marginal value of the utility derived from the marginal trip is greater than the marginal cost and the ratio is greater than unity. Using the same symbols:

$$\frac{MVU_a}{P_a} = \frac{MVU_b}{P_b} = \ldots = \frac{MVU_i}{P_i} > 1.0$$

In the situation of no restraint, where MVU equals P, the trip costs become an expression of marginal utility.

In the case where MVU is not equal to P, however, the costs of the trip will be less than the value of the utility received. If P, in this instance, were used to express the value of marginal utility, the value would be underestimated because MVU is greater than MC.

In either case, the net values of marginal utility are equated and satisfaction is maximized.

7. Individual boater demand: The relationship between marginal trip costs and the value of the marginal utility received can be expressed

for an individual boater by the use of a demand curve. For each boater a demand curve exists for boating at each site available to him. This function defines conceptually the number of trips he would take to a particular site at alternative prices. In Figure 1 theoretical demand curves for an individual having four sites available are shown by d_1, d_2, d_3, and d_4; d_4 being the nearest and d_1 the most distant. The demand of the individual for boating is a function of travel and on-site costs (MC) shown in Figure 1 as the price variable -- P_1, P_2, P_3, P_4. The quantity variable is the number of trips taken during one boating season -- Q_1, Q_2, Q_3, Q_4.

The number of trips the boater will take to a particular site will be sufficient to equate travel and on-site costs (MC) with the marginal value of the utility (MVU) he receives. If the price is P_1, he will take Q_1 trips to site 1. Demand schedule d_1 expresses this relationship.

For the individual boater, however, the entire demand function cannot be developed. Empirical observation is limited to what he did. What he would have done at alternative prices would be conjecture. Therefore, only one point on his demand curve can be empiricised. This is the point of maximum satisfaction where MC equals MVU.

8. Site demand: The total demand for a particular boating site could conceivably be arrived at by horizontal summation of the individual demand functions. However, since only one point is observable on each individual demand curve, an average individual demand function provides our best estimate of site demand.

The average demand for a particular site may be derived in three steps as follows:

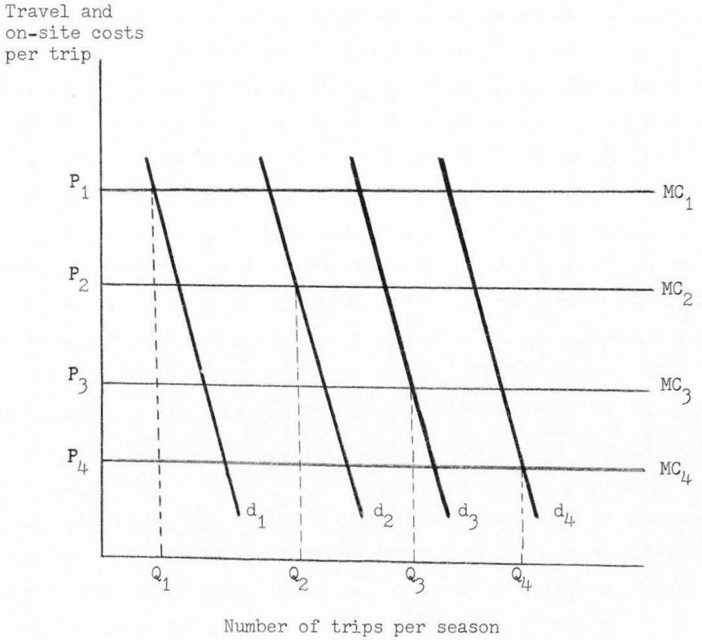

Figure 1. Theoretical individual boater demand for four sites at different distances.

1. Calculate average prices per trip and average number of trips per capita per time period by boaters from various points of origin.

2. Using these averages, plot a scatter of points, Figure 2.

3. Fit a mathematical function (D_i) through these points.

This function is the average demand for the site of individuals from various points of origin. In other words, at average price P_1 the average number of trips taken would be Q_1 (Figure 2).

This site demand is meaningful so long as there is reasonable homogeneity among origins with respect to such demand determinants as income, leisure time, desire for boating, site preference, etc. Referring to Figure 2 and assuming homogeneity among origins, boaters from any origin would take Q_1 trips to a particular site if the price were P_1.

The aggregate demand for boating at the site may be ascertained by multiplying the average individual demand function by the total number of individuals. It defines the total number of trips which would be taken by all boaters to a specific site at each of various alternative price levels.

9. Origin demand: The demand of boaters from a common point of origin to various sites can be derived in the same general manner as the site demand. In this instance average prices and number of trips per capita are again used as the variables, except that the quantity variable is the number of trips per capita to various sites from a particular origin instead of from various origins to a particular site. (The present study is primarily concerned with the origin demand. It is, in the main, an investigation of a method to determine possible application of the aforementioned site demand techniques to origin demand for boating and

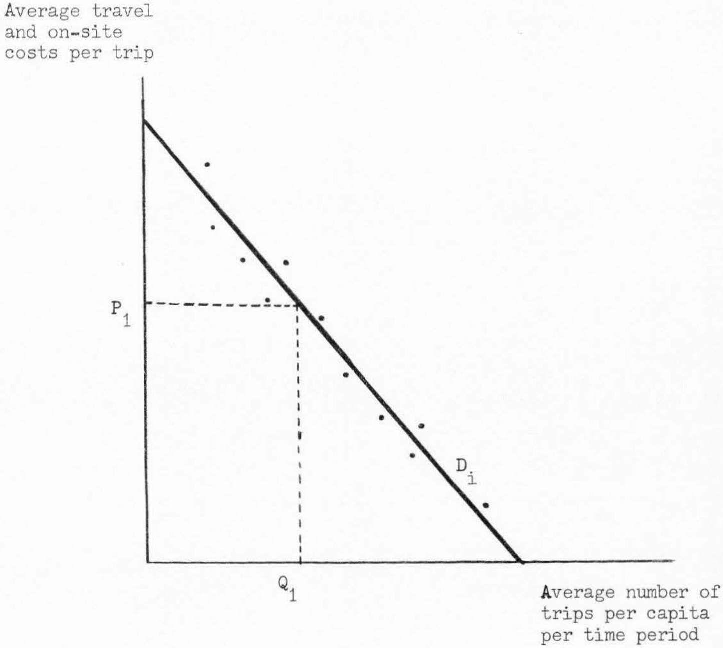

Figure 2. Average boater demand for a particular site.

to point up some of the problems that may be encountered.)

10. Valuation of the resource: The statistical demand function based on ex post observation of boater activity throughout the season furnishes a means of estimating the value of the boating resource. The theoretical demand curve (D_i in Figure 3) defines the number of trips per capita that were taken to various sites by boaters from a specific origin depending on the average marginal costs of the trips. This demand curve becomes a quantitative estimate of the value of the marginal utility generated by the resource when, according to our previous assumption, boaters push the ratio of the value of marginal utility to marginal costs to one. The area under the demand curve, then, represents an estimate of the total value of the boating experience.

Stated another way, the cost of the marginal boating trip is equal to the satisfaction or utility derived. The boater will therefore take no additional trips since the cost would be greater than the utility. On the other hand, all trips except the marginal one were worth more in terms of utility to the boater than their cost.[2] Thus a surplus utility was captured on all except the marginal trip. The consumer surplus extracted by boaters from a specific origin estimates the net economic value generated by the resource. If this value is aggregated among all origins, a statement of total net economic value is estimated.

Consumer surplus is demonstrated empirically in Figure 3 where:

$P_{1,2,3}$ = marginal cost or travel and on-site cost per trip,

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[2] This reasoning is subject to the assumption of diminishing marginal utility of boating and a demand elasticity of less than infinity.

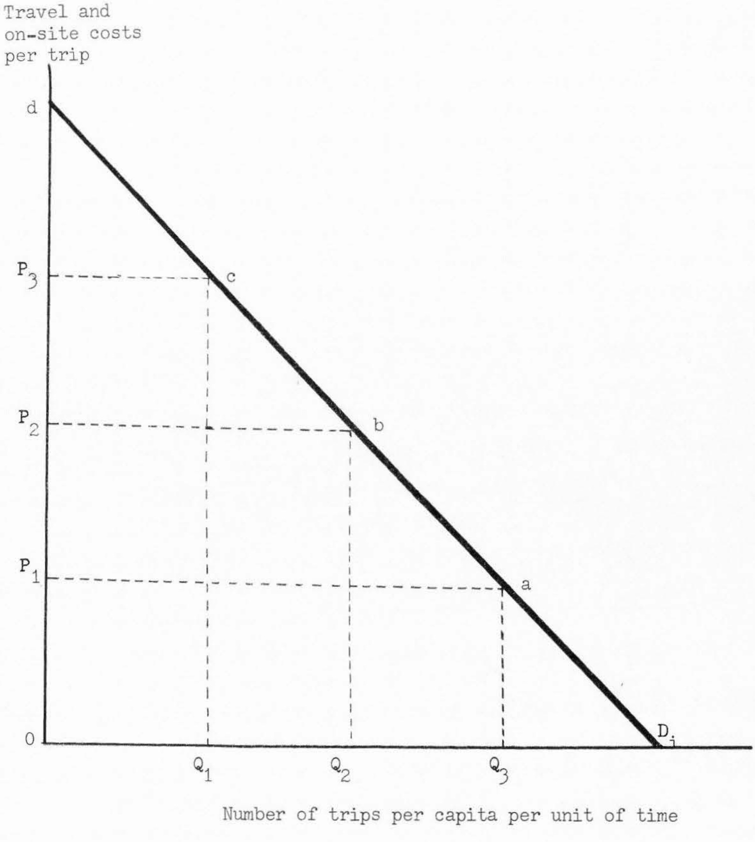

Figure 3. Theoretical demand schedule.

$Q_{1,2,3}$ = number of trips per capita per unit of time, and

D_i = demand function expressing the ex post relationship between P and Q.

Net consumer surplus is the difference between the total value of the experience and the costs incurred to undertake the experience. Geometrically, consumer surplus is represented by the total area under the demand curve to the left of the line representing number of trips taken, minus the area represented by the variable costs. For example, the total value for a boater with price P_1 and trip quantity Q_3 would be the area OQ_3ad. Area OP_1aQ_3 is the area representing the costs, leaving area P_1ad as the consumer surplus. Area P_1ad multiplied by the total number of boaters at the origin gives the total consumer surplus for the origin. Add to this the surplus from all other origins and a statement of total value of the resource for boating is generated.

OBJECTIVES OF THE STUDY

The objectives of this study were:

1. To derive a statistical demand schedule for boating in the area studied.

2. To estimate the economic value to a group of users of a water resource used for pleasure boating.

Involved in both of these objectives is the consideration of boater demand from an area or origin to all sites visited rather than that for a particular site.

The estimate of resource value is the annual net boating value which boaters living in a specified area derive from the use of all the various sites they visit. This annual value could be used as the basis for calculating a capitalized boating value of the resource to the area.

The validity of the origin demand function is dependent upon the assumption of homogeneity among sites as to boater preference and within the group of boaters as to income, leisure time, etc. This is probably a much more unrealistic assumption than that basic to site demand (homogeneity among origins) but appears somewhat less heroic in light of the other basic assumption that boating and not the associated experiences, which might be due to site quality, etc., is the commodity being purchased and that it is variable costs which generate a measure of the value of the activity. Site preference, along with the other demand determinants, is held constant as a simplifying condition.

AREA OF STUDY AND SELECTION OF SAMPLE

The study area included the boating population of Cache and Box Elder Counties in Northern Utah. In 1962, there were 548 boats registered in Cache County and 542 in Box Elder County.[3] From these a sample of 100 boaters, 50 from each county, was selected for the 1963 study.

A sample was desired which would be representative of the entire area and which would show distance differential in travel costs. It was necessary to divide each county into approximate distance intervals from some point to achieve this, thus departing somewhat from complete randomization.

Cache County was divided into four subareas at various distances from Hyrum Dam which is the major local boating site. Box Elder County was similarly divided into three subareas with reference to Mantua Reservoir. The number of boaters in each subarea included in the sample was determined as a percentage of the total sample for the county. This corresponds approximately with the ratio of boat population in each subarea to the total county boat population (Appendix A).

Total county boat population, for the purpose of sample selection, was defined as all boat owners residing in the county whose boats were registered in that county in 1962. This represented 64.6 percent of the total number of boats registered in Cache County and 64.4 percent of boats registered in Box Elder County. The other boats registered in the two counties were owned by people living outside of the counties or by those

[3]List of registered boaters was furnished by the Utah Parks and Recreation Commission.

who were only temporarily residing therein. Use of the restricted population would not materially affect the sample because in both counties the percentage of outsiders was virtually the same. Exclusion of transient boat owners probably avoided some substitution which might have been necessary had the balance of the registered boat population been included.

The period of study was the 1963 boating season. All boating trips made by the respondents during the calendar year were included. Actual boating activity began early in March and continued through October. Previous year registration lists were used for sample selection because 1963 lists were not available at the beginning of the study. Any boater selected whose boat was not registered again in 1963, however, was eliminated and a substitution drawn. This was done subsequent to the first contact with the boater.

Respondents within each county subdivision were selected by use of a list of random numbers. Substitutions, where necessary, were made by repetition of the same procedure.

For the purpose of this study, a boater is defined as a boat owner living in Cache or Box Elder County whose boat was registered in Utah for use in the 1963 boating season. Two substitutions were made because the original sample included individuals whose boats were registered in 1962 but were left idle in 1963.

Other substitutions were made for various reasons, the most common being that prospective respondents had moved. Also, if, for obvious reasons, the upcoming season would be atypical for a boater, he was eliminated and a substitute selected. Three boater families planned practically no boating during the season because of young babies. One family had experienced a fatal water skiing accident and did not expect to undertake the usual amount of boating. Two parties from the originally drawn sample declined to cooperate.

DATA COLLECTION AND ANALYSIS

Each boater was interviewed with the aid of a prepared questionnaire. Information was obtained concerning his boating equipment, annual expenses, and personal data such as family income, type of occupation, and length of work week (Appendix B, Form 1). Also an arrangement was made with the respondent whereby he would complete and return by mail a trip questionnaire for each boating trip taken throughout the season. The trip questionnaire included a description of recreational activities, distance traveled, amount of boating, length of stay, number of people involved, costs incurred, and other items pertinent to the trip (Appendix B, Form 2).

Respondents were contacted throughout the season, a minimum of once each month, as a follow-up to make sure all trips were reported and to pick up any changes that might affect the study, e.g. purchases of additional equipment, etc.

Averages were calculated from these data and used in statistical examination of the sample. Regression analysis was used in developing demand curves and involved comparison between average boater trips per capita and average marginal costs per trip.

Characteristics of the Sample

The sample selected represented roughly 9.2 percent of the total number of registered boats in the two county area. Area coverage was accomplished by stratification into subareas; the number of boaters in each being selected on the basis of percentage of boat population (Appendix A). Boaters ranged from late teens to retirement age and in most cases boating was a family recreation. Family income ranged from $3,500 to $100,000 per year with an average of $8,969 per family. Of the 100 respondents, 44 were employed in positions which called for a definite work schedule while 56 had employment such that they managed their own leisure time. The latter group included farmers, retired businessmen, and professional people.

Statistical Procedure

The demand curve

The accomplishment of objective 1 (to derive a statistical demand schedule for boating in the area studied) involved the regression of the average number of trips per capita of the sample of boaters per time period (the quantity variable) on the average travel and on-site costs per boating trip (the "price" variable).

The dependent variable is referred to hereafter as "trips per capita" since the sample is assumed to be representative of the boating population of the area under study. Using the number of trips per boat eliminates the effect of population differences within the area.

The independent variable, average travel and on-site costs per trip, represents the average total variable costs per boating trip, all other costs being considered fixed in accordance with the theoretical model.

A scatter of points was generated by plotting these two variables for the total sample comprising the area of Cache and Box Elder Counties. This was repeated for each of the counties separately for comparison. Each point represents the two variables with respect to a distance zone. Distance zones are 10 mile round trip intervals and were measured by distance without regard to sites visited.

It was evident from the scatter diagram that a curvilinear function would fit the data more closely than a straight line.[4] Therefore, a logarithmic transformation of the data was used to derive the estimating equation. Using this formula, values of the dependent variable were calculated for the various values of the independent variable. The antilogs of these values were plotted through the scatter to estimate the demand curve for boating.

One advantage of using logarithms is that the regression coefficient is also directly interpretable as the price elasticity of demand; also the equation of the curvilinear function becomes linear when expressed in logs. In general the demand equation can be expressed thus:

$$\log_e \hat{Y} = \log_e a + b \log_e x$$

Where:

$\hat{Y}$ = the calculated value of the dependent variable (trips per capita),

a = the Y intercept,

b = the regression coefficient, and

x = the independent variable (trip costs).

This function is an expression of the average individual demand curve and is equivalent to the theoretical demand curve D_i in Figure 3.

<u>Value of the resource</u>

Estimation of the economic value of the resource to boaters in the

---

[4]This is borne out by statistical comparison.

area studied (the second objective) makes use of the demand function in estimating the consumer surplus associated with the boating experience. This study is not concerned with the value of a particular site, but with estimating the value generated by boaters from a given origin visiting various sites.

The area under the demand curve is determined by integration of the demand function.

The demand curve is represented by Figure 4 where:

P = average cost per trip for a given distance interval,

P' = average trip cost to the most distant interval,

t_0 = average number of trips taken by boaters to the most distant interval,

t_1 = average number of trips per boat capita associated with P_1,

D and E = points on the demand curve established by various trip costs and corresponding numbers of trips, and

D_i = the statistical demand estimate.

The function is curvilinear and is asymptotic to both axes because of the logarithmic equation. Since the curve approaches the cost axis as a limit, the area under the curve at point t_1 could be determined as the improper integral of the regression equation. It is unrealistic, however, to assume, by extrapolation, that as costs per trip continue to increase beyond the limits of the data, some trips would still be taken.

A somewhat more realistic alternative is to accept the highest cost trip of the sample as the upper limit of trip costs and thus the lower limit of the number of trips per capita. This lower limit is represented by t_0 (Figure 4) and the integral is taken from t_0 to t_1 (number of trips

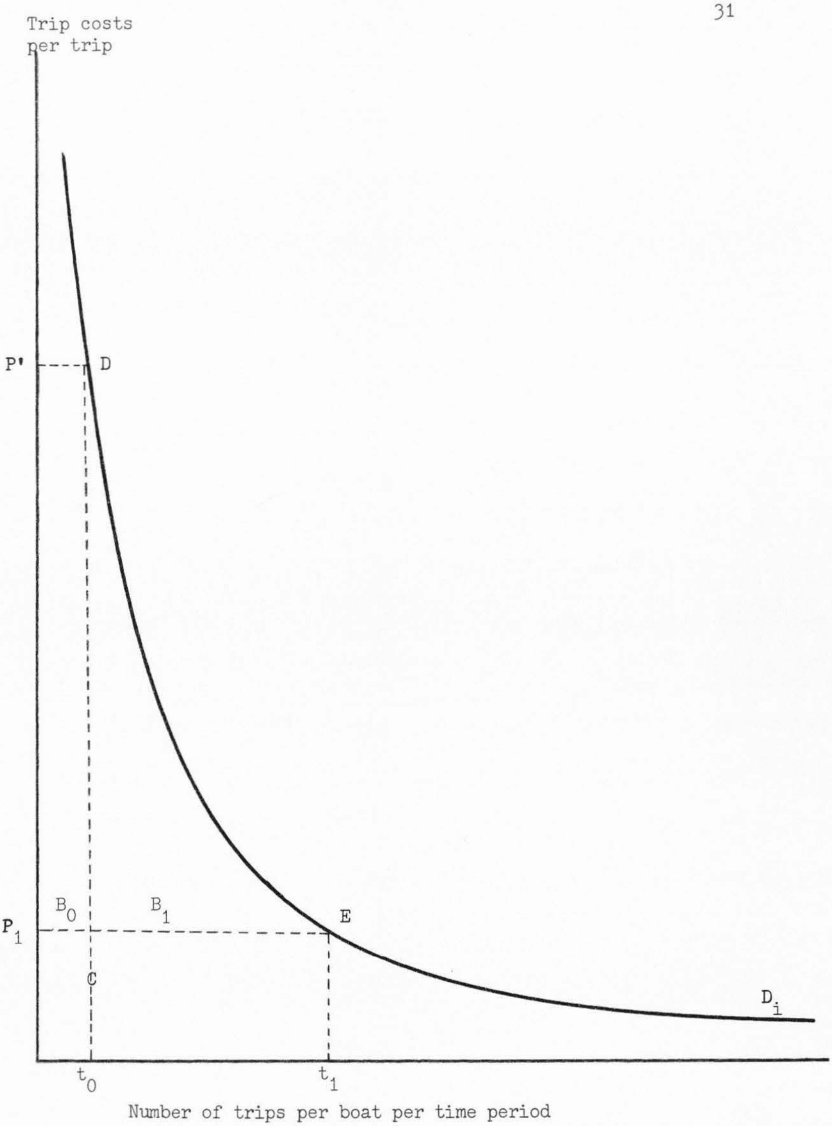

Figure 4. Consumer surplus using logarithmic curve.

at P_1) under the curvilinear part of the curve.

The area thus determined is added to the area from 0 to t_0 (rectangle $0t_0DP'$) to get the total area under the curve at t_1 ($0t_1EDP'$).

The surplus area is the total area under the curve minus the cost area or $0t_1EDP' - 0t_1EP_1 = P_1EDP'$. This is the consumer surplus for a boater whose costs per trip are P_1 and who takes the quantity of trips t_1. Area P_1EDP' multiplied by the total number of boaters with the same average cost and number of trips gives the total consumer surplus for a particular distance interval. Add to this the total surplus for all other distance intervals and a statement of the total value of the resource is generated. This illustration and discussion is equivalent to the theoretical model (Figure 3, p. 21).

Definitions

Trips per capita

"Trips per capita" refers to the number of trips per boat rather than per unit population.

Distance intervals

Distances were grouped into intervals of ten miles, round trip, and travel costs per trip represent an average among all boaters who traveled distances within the range of each interval. The distance interval of 10 miles was chosen because a substantial number of trips involved short distances. A greater interval of, say, 30 miles would have included more trips per interval and thus given more observations upon which to base individual points along the demand curve. This, however, would have grouped a great percentage of total trips together in the very short intervals and differential travel cost would have been less meaningful. The weakness of using 10 mile intervals shows up at the greater distances where fewer trips were taken. In a few cases where an interval involved only a few trips made by a small number of boats, the representative value of the average cost and average number of trips may be questioned. This weakness seemed less serious than the alternative since the more commonly-used sites were nearby.

Costs

Costs of boating were broken down into three categories; equipment costs, annual costs, and trip costs.

Equipment costs represent investment in boat, motor, trailer, and boating accessories.

Annual costs include taxes on the boat, interest on boat loan, insurance, equipment repairs, storage, depreciation on boating equipment, and car depreciation charged to boating. The method used to estimate car and equipment depreciation is explained in Appendix C.

Trip costs include the cost of travel to and from the boating site plus all expenditures at the site such as boat gas and oil, launching fees and overnight lodging or camping fees. Cost of food was not included since most respondents reported no extra cost over and above normal food cost for the time period.

The cost of time was not included in the calculations.

A variable travel cost of 3 cents per mile was used for all boaters. Calculation of travel costs were based on average estimated car fuel and oil consumption reported by respondents. These estimates were checked with figures furnished by boat marinas and one fleet operator. Calculation was as follows:

Average car mileage pulling a boat - 12 M.P.G.

Average oil consumption - 6 quarts per 2,000 miles

Average cost of gasoline - 34 cents per gallon

Average cost of oil - 50 cents per quart

$$\text{Gas cost per mile} = \frac{\$.34}{12} = 2.83 \text{ cents}$$

$$\text{Oil cost per mile} = \frac{\$3.00}{2000} = 0.15 \text{ cents}$$

Total gas and oil per mile = 2.98 cents (approximately 3 cents)

Depreciation, insurance, and other costs were not included because of their fixed nature. It is argued in the theoretical model that decisions to take boating trips are based on marginal costs. Exclusion of these fixed costs is therefore consistent with the model.

Boating season

The boating season considered was the annual licensing period. The season of actual boating activity begins in early spring and continues until cold weather in the fall.

Boating trip

A trip away from home by a boater for the express purpose of boating recreation was considered one boating trip. A one-day trip or several days vacation were given comparable consideration.

RESULTS OF THE STUDY

General Findings and Background Information

Boating trips

The 100 boaters in the study sample took 856 boating trips during the 1963 season. This was an average of 8.6 trips per boater. Total trip costs averaged $59.62 per boater for the season and the average total cost per trip was $6.93. A breakdown of average travel and on-site costs shows that the greatest expenditure was made for boat operating expense. Travel cost was next highest and costs of overnight lodging and launching fees were relatively small (Table 1).

The earliest boating trip of the season was taken on the 13th of March, 1963, and the last trip of the season was on October 29, 1963. Of the 856 boating trips, 308 or about 36 percent were taken in June. July was second with 246 trips or 29 percent. This represents more than half of the total trips taken for the season (Table 2).

More trips were taken on Saturday (266 of the 856) than any other day of the week. Sunday was second (196) and Wednesday third (126). Monday had fewest trips (49) and Tuesday and Thursday were about equal with 65 and 62 respectively. Number of trips and trips per capita are shown in Table 3.

Length of stay

Eighty-seven percent of all boating trips from the test area were one-day trips (743 out of 856). Forty-six percent (52 trips) of the remaining 113 trips involved only one night away from home (Table 4).

Table 1. Number of trips and trip expenditures for the 100 respondents, 1963

	Sample	Average per boater for the season	Average per trip
Number of boaters	100		
Number of trips	856	8.6	
Total spent for travel	$1,846.25	$18.46	$2.16
Total spent for lodging	803.00	8.03	.94
Total spent for boat gas and oil	3,162.58	31.62	3.69
Total spent for launching fees	115.75	1.15	.14
Total spent for all travel and on-site costs	$5,927.58	$59.28	$6.93

Table 2. Number of boating trips by months

Month	No. trips taken by boaters in sample	Avg. no. trips per capita (sample)	No. trips taken by all boaters in area (projected)
January	--	--	--
February	--	--	--
March	6	.06	73
April	16	.16	196
May	107	1.07	1,308
June	308	3.08	3,764
July	246	2.46	3,006
August	137	1.37	1,674
September	28	.28	342
October	8	.08	98
November	--	--	--
December	--	--	--
Total	856		10,461

Table 3. Number of boating trips by days of the week

Day	No. trips taken by boaters in sample	Avg. no. trips per capita (sample)	No. trips taken by all boaters in area (projected)
Sunday	196	1.96	2,395
Monday	49	.49	599
Tuesday	65	.65	794
Wednesday	126	1.26	1,540
Thursday	92	.92	1,124
Friday	62	.62	758
Saturday	266	2.66	3,251
Total	856		10,461

Table 4. Length of stay at boating sites in days

Number of trips	Number of days or part days
743	1
52	2
18	3
20	4
15	5
2	6
1	8
1	9
2	10
1	11
1	15

The effect of on-site costs on length of stay was examined by correlation analysis. Regressing average number of hours at the site per trip on average on-site costs per hour (Appendix D, Table 20, columns 3 and 4) gave a coefficient of determination (r^2) of 17 percent. For the 38 observations (distance intervals) this was barely significant at the 1 percent level.

When travel costs were included with on-site costs as the independent variable and correlated with length of stay in the same manner, the r^2 was only 14 percent which was not statistically significant. This indicates that the time spent per trip at the boating site was probably not influenced greatly by trip costs.

Table 5 shows length of stay at boating sites in hours. Most frequent were trips involving four hours at the site (172 trips). There were 171 trips with a stay of three hours and on 168 trips, boaters stayed two hours. The shortest time at the site was one hour (29 trips) and one party stayed 70 hours at the boating site. The average length of stay was five hours.

<u>Number in party</u>

Sixty-five percent of all trips taken included family members only; two people being the most frequent number per family boating party. The remaining 35 percent of all trips were taken by the boat owner family plus at least one other person. The 100 boaters (boat families) made a total of 4,832 person trips in 1963 and the average number of persons per trip was 5.6 (Table 6).

Table 5. Length of stay at boating sites in hours

Number of trips	Number of hours
29	1
168	2
171	3
172	4
105	5
64	6
38	7
34	8
12	9
11	10
12	11
5	14
5	15
5	16
5	18
2	19
5	20
1	22
2	24
1	25
1	26
1	28
2	30
1	35
1	50
1	56
1	70

Boating sites visited and distances traveled

Boaters traveled from their homes to boating sites which ranged in distance from less than a mile to 530 miles one way. The average one-way distance was 22.1 miles. Distances traveled from the 18 towns of origin in the area studied to the various sites visited are given in Table 7.

Table 6. Number of boating trips involving family members and others, 1963

Trips made by	Number of trips
1 family member only	122
2 family members only	193
3 family members only	144
4 family members only	113
5 family members only	106
6 family members only	66
7 family members only	66
8 family members only	12
9 or more family members only	37
Family members only	381
Family members plus 1 other	117
Family members plus 2 others	115
Family members plus 3 others	69
Family members plus 4 others	52
Family members plus 5 others	23
Family members plus 6 others	25
Family members plus 7 others	16
Family members plus 8 others	11
Family members plus 9 or more others	47
Most frequent number of family members per trip	2
Most frequent number of others per trip	1
Average number of people per party	5.6
Total number of people (in the sample) who went boating, 1963	4,832

Table 7. Distance traveled from selected towns to various sites (miles one way)[a]

Site	Brigham	Corinne	Cove	Deweyville	Elwood	Fielding	Hyrum	Lewiston	Logan	Mantua	Mendon	Newton	Providence	Richmond	Smithfield	Tremonton	Trenton	Willard
	Town																	
Bear Lake:																		
Blue Water	68				63	63	50	66	43	75		60	46		50	65		76
Fish Haven	69				64	64	51	67	44	76			47		51	66		77
Garden City	65				60	60	47	63	40	72			43		47	62	60	73
Holiday	67				62	62	49	65	42	74			45		49	64		75
Ideal	68				63	63	50	66	42	75			46		50	65		76
Lakota	67				62	62	49	65		74			45		49	64		75
Marina	66				61	61	48	64	41	73			44		48	63		74
North End	81				76	76	63	79	56	81			59		63	78		89
Bear River (Ballards)									8						10			
Bear River, (W. of Brigham)	7																	
Blackfoot Res. Idaho	123								98									
Bridger State Park, Wyoming	124																	
Corinne	5								30						38			
Flaming Gorge							300		301									
Fremont Lake, Wyo.	240																	
Green & Colo. Rivers	289						308		314									
Hebgen Lake, Montana	292								267							267		
Hyrum	18	32		23	35		1		7		12		5		14	26	26	30
Island Park, Idaho	257								232						225			
Lake Meade, Nevada									530							530		
Lake-O-The-Woods, Wyo	256															255		
Lamont Res., Idaho								16							22			
Lewis Lake, Idaho									311									
Logan River, (Valley View)									5				8					
Mantua	6	15		30	18				20	1					27	33		13
Naughton Lake, Wyo									97						104			
Newton					29			12	20			3	23		13	26	6	
Palisades Res. Wyo	170								145							169		
Pineview Res.	29								54							47		22
Porcupine Dam									33							40		
Strawberry Res.		142							157									
Swan Lake, Idaho																70		
Treasureton, Idaho					64													
Twin Lakes, Idaho	62	70	25			24		24							30	61		
Yellowstone Lake, Wyo	331						312		306						299	306		
Bear Lake (Gus Rich)	69								44									
Jackson Lake, Wyo	237						218		212						217	241		

[a]Blanks indicate no trips were taken.

Each site was visited at least once and the greatest number of visits to any one site was 333 to Hyrum Dam. Mantua was second with 182 visits and Bear Lake, with eight boating resorts, was third with 139. Hyrum and Mantua are located within the study area and Bear Lake is 41 miles from the nearest point and an average travel distance of 52 miles (estimated). Table 8 shows a breakdown of the number of trips from each town to each of the sites.

Trips per boater capita from these same towns to the various sites ranged from .08 to 4.44 (Table 9).

Choice of sites

Respondents were asked to tell why they chose the sites they visited. Reasons given in order of frequency were:

Reason	Number of times given	Percent of total
1. Close to home	479	35.2
2. Good skiing	369	27.1
3. Good fishing	254	18.7
4. Launching facilities	76	5.6
5. New or interesting trip	57	4.2
6. Planned club activity or party	51	3.8
7. Plenty of room on lake	31	2.3
8. Clear water and beaches	24	1.8
9. Good picnic and camping facilities	19	1.3
Total number of reasons given	1,360	100.0

In most cases two reasons were given for each trip and in cases where boaters gave more than three reasons for visiting a particular site, only

Table 8. Trips from selected towns to various sites

Site	Town																		Total trips to site
	Brigham	Corinne	Cove	Deweyville	Elwood	Fielding	Hyrum	Lewiston	Logan	Mantua	Mendon	Newton	Providence	Richmond	Smithfield	Tremonton	Trenton	Willard	
Bear Lake:																			
Blue Water	1								4			1			3				9
Fish Haven													1						1
Garden City	15				1	3	2		31				1		11	9		2	75
Holiday	6								1										7
Ideal	4						1		8						2		1		16
Lakota	2								3						1			1	7
Marina									2										2
North End							1		4	1									6
Bear River (Ballards)									3						7				10
Bear River (W. of Brigham)	2																		2
Blackfoot Res. Idaho	1								2										3
Bridger State Park, Wyoming	1																		1
Corinne	5								3						3				11
Flaming Gorge							1		1										2
Fremont Lake, Wyo.	1																		1
Green & Colo. Rivers	1						2												3
Hebgen Lake, Montana	3								1							1			5
Hyrum	59	5		10	2		40		110		12		34		28	22	1	10	333
Island Park, Idaho	8														3				11
Jackson Lake, Wyo.	4						1		1						1				7
Lake Meade, Nevada									1										1
Lake-O-The-Woods, Wyo.	1																		1
Lamont Res., Idaho								1							2				3
Lewis Lake, Idaho																			0
Logan River (Valley View)									26				1						27
Mantua	91	1		2	4				7	38					1	8		31	183
Naughton Lake, Wyo.									1						2				3
Newton					1				2			3	1		21	3	6		37
Palisades Res. Wyo.	1								2										3
Pineview Res.	1								1							1		3	6
Porcupine Dam									1										1
Strawberry Res.		1	3						1										5
Swan Lake, Idaho																9			9
Treasureton, Idaho					1														1
Twin Lakes, Idaho	10	1				1		2							4	17			35
Yellowstone Lake, Wyo.	3						2		3						1	4			13
Bear Lake (Gus Rich)	1								3						12				16
Total trips	221	8	3	12	9	4	50	3	222	39	12	4	38		102	74	8	47	856

Table 9. Trips per capita from selected towns to various sites

Site	Brigham	Corinne	Cove	Deweyville	Elwood	Fielding	Hyrum	Lewiston	Logan	Mantua	Mendon	Newton	Providence	Richmond	Smithfield	Tremonton	Trenton	Willard
	Town																	
Bear Lake:																		
Blue Water	.04								.16			1			.30			
Fish Haven													.25					
Garden City	.60				1	3	.50		.13				.25		1.10	.64		.50
Holiday	.25								.12									
Ideal	.21						.25		.16						.20		1	
Lakota	.04								.04						.10			.25
Marina									.12									
North End							.25		.16	.50								
Bear River (Ballards)									.16						.70			
Bear River (W. of Brigham)	.08																	
Blackfoot Res., Idaho	.04								.08									
Bridger State Park, Wyoming	.04																	
Corinne	.21								.12						.30			
Flaming Gorge							.25		.08									
Fremont Lake, Wyo.	.04																	
Green & Colo. Rivers	.04						.50											
Hebgen Lake, Montana	.13								.04							.07		
Hyrum	2.36	2.50		10	2		10		4.44		12		6		2.80	1.57	1	2.50
Island Park, Idaho	.33														.30			
Jackson Lake, Wyo.	.17						.25		.04						.10			
Lake Meade, Nevada									.04									
Lake-O-The-Woods, Wyo.	.04																	
Lamont Res., Idaho								.50							.20			
Lewis Lake, Idaho																		
Logan River (Valley View)									1.00				.25					
Mantua	3.71	.50		2	4				.36	.19					.10	.43		7.75
Naughton Lake, Wyo.									.04						.20			
Newton					1				.08			3	.25		2.10	.21	6	
Palisades Res. Wyo.	.04								.08									
Pineview Res.	.04								.04							.07		.75
Porcupine Dam									.04									
Strawberry Res.		.50							.04									
Swan Lake, Idaho																.57		
Treasureton, Idaho					1													
Twin Lakes, Idaho	.42	.50	3					1							.40	1.21		
Yellowstone Lake, Wyo.	.13						.50		.12						.10	.29		
Bear Lake (Gus Rich)	.04								.12									

the first three given were recorded.

Costs

Although equipment and annual costs were not used in estimating the demand curve for boating, they were considered important as background information. Equipment costs were tabulated by origin according to current (1963) value (Table 10). The average amount spent for a boat was $489.99; for a boat motor, $334.70; for a trailer, $114.65; and $81.65 for accessories making an average investment per boater in boating equipment of $1,020.99.

Depreciation of equipment for the current (1963) year was calculated by depreciating each item according to its estimated useful life (Appendix C). Average cost for the year for a boat was $64.49; for a motor, $59.92; for a trailer, $17.47; and for accessories, $24.30. Average total equipment expense charged to 1963 was $166.18 per boater (Table 11). Other annual (1963) expenses included $8.19 for taxes, $.77 for interest on equipment loans, $5.85 for insurance, $24.26 for equipment repairs, $.36 for boat storage, $10.80 for car depreciation charged to boating, and $166.18 for boating equipment depreciation. Average total annual (1963) expense was $216.41 per boater. A summary of average annual expenses per boater was tabulated by town of boater origin (Table 12).

Travel and on-site costs per trip ranged from an average of $1.83 for boaters traveling round trip distances of less than 10 miles to $254.20 for the longest trip, which was 1,060 miles. On-site expenditures accounted for a major portion of total trip costs, ranging from an average of 79 percent for distances of less than 50 miles (round trip) to 48 percent for trips of more than 500 miles (Appendix D, Table 20). A breakdown of

Table 10. Summary of average equipment costs (1963 value) per boater by origin

Origin	Sample population	Boat	Motor	Trailer	Accessories[a]	Average total/boater
		dollars	dollars	dollars	dollars	dollars
Brigham	24	486.75	401.36	118.58	80.69	1,087.38
Corinne	2	378.21	292.52	124.00	118.00	912.73
Cove	1	337.11	146.25	105.60	13.29	602.25
Deweyville	1	586.64	60.00	106.64	91.50	844.78
Fielding	1	421.00	518.91	125.00	81.80	1,146.71
Hyrum	5	1,123.76	496.99	245.60	64.19	1,930.54
Lewiston	2	377.60	129.03	54.80	76.00	637.43
Logan	25	531.13	418.03	105.91	82.20	1,137.27
Mantua	2	315.98	458.00	72.25	53.00	889.23
Mendon	1	500.00	400.00	50.00	64.45	1,014.45
Newton	1	680.00	120.00	200.00	121.50	1,121.50
Providence	4	245.00	242.17	50.25	60.57	597.99
Richmond	1	192.32	192.32	54.12	55.50	494.26
Smithfield	10	589.49	447.00	162.47	114.43	1,313.39
Tremonton	15	605.14	560.09	142.25	124.50	1,431.98
Trenton	1	457.12	416.76	85.80	121.50	1,081.18
Willard	4	502.55	390.39	145.70	92.85	1,131.49
Avg. cost/boater	--	489.99	334.70	114.65	81.65	1,020.99

[a] Accessories included fire extinguishers, life jackets, flares, bailing equipment, first aid kits, water skis and tow ropes.

Table 11. Summary of average 1963 equipment depreciation[a]

Origin	Sample population	Boat	Motor	Trailer	Accessories	Average total/ boater
		dollars	dollars	dollars	dollars	dollars
Brigham	24	58.17	78.50	17.47	25.95	180.09
Corinne	2	27.59	62.11	12.85	32.10	134.65
Cove	1	24.07	29.25	6.60	4.65	64.57
Deweyville	1	73.33	20.00	13.33	29.07	135.73
Fielding	1	42.10	74.13	25.00	25.80	167.03
Hyrum	5	191.36	122.14	43.27	21.60	378.37
Lewiston	2	39.80	35.53	6.25	23.67	105.25
Logan	25	48.42	88.76	14.77	24.60	176.55
Mantua	2	29.67	61.38	7.50	13.66	112.21
Mendon	1	50.00	40.00	5.00	20.35	115.35
Newton	1	170.00	30.00	50.00	30.41	280.41
Providence	4	31.88	30.19	6.13	20.64	88.84
Richmond	1	48.08	48.08	16.03	17.17	129.36
Smithfield	10	86.13	80.07	23.94	31.14	221.28
Tremonton	15	64.16	90.46	16.60	30.56	201.78
Trenton	1	28.57	69.44	6.60	37.25	141.86
Willard	4	83.07	58.54	25.20	24.80	191.61
Avg. cost/boater	--	64.49	59.92	17.47	24.30	166.18

[a]The method of depreciation is in Appendix D.

Table 12. Summary of average annual expenses (excluding travel and on-site expenditures) per boater by origin

Origin	Taxes	Interest on boat loan	Insur-ance	Equip-ment repairs	Storage	Car deprec. charged to boating	Average boating equipment depreciation	Average total annual expenses per boater
	dollars	dollars	dollars	dollars	dollars	dollars	dollars	dollars
Brigham	11.87	3.96	22.69	19.82	.83	20.86	180.09	260.12
Corinne	7.25	--	--	26.50	--	6.28	134.65	174.68
Cove	10.18	--	--	8.00	--	6.00	64.57	88.75
Deweyville	6.00	--	--	18.83	--	19.14	135.73	179.70
Fielding	6.32	--	--	20.00	--	16.46	167.03	209.81
Hyrum	14.72	--	10.00	22.90	--	16.47	378.37	442.46
Lewiston	2.78	--	6.00	15.25	--	3.75	105.25	133.03
Logan	9.38	--	10.73	27.80	.80	14.44	176.55	239.70
Mantua	12.50	--	--	28.00	--	18.03	112.21	170.74
Mendon	5.79	--	--	--	--	4.41	115.35	125.55
Newton	3.01	--	--	53.00	--	1.89	280.41	338.31
Providence	6.51	--	11.38	32.39	--	4.08	88.84	143.20
Richmond	8.00	--	--	6.00	--	--	129.36	143.36
Smithfield	11.96	6.60	21.10	31.08	4.00	21.17	221.28	317.19
Tremonton	9.25	2.50	9.32	25.00	.50	14.73	201.78	263.08
Trenton	7.07	--	--	60.00	--	6.08	141.86	215.01
Willard	6.60	--	8.20	17.80	--	9.85	191.61	234.06
Avg. cost/boater	8.19	.77	5.85	24.26	.36	10.80	166.18	216.41

trip costs shows boat gas and oil as the highest item with travel cost second. Lodging and launching fees were of minor importance over all (Table 13) since only 32 trips involved any lodging costs and launching fees were paid on only 42 trips. The average lodging cost per trip for those trips involved was $25.09. Launching fees averaged $1.81 per boat except for three parties who participated in the "Friendship Cruise" on the Green and Colorado Rivers whose fees were $15.00 each.

The Demand for Boating (1963)

The average number of trips per boat taken in 1963 and average costs per trip from all origins in Cache and Box Elder Counties were calculated from the data gathered and tabulated by 10 mile distance intervals (Table 14). Average number of trips per capita per time period (column 4) and average travel and on-site costs per trip (column 7) are the data which were used in developing a statistical estimate of demand.

Average number of trips per capita per time period (column 4) was calculated by dividing the total number of trips (column 2) taken at each distance interval (column 1) by the sample boat population (column 3). Average travel and on-site costs per trip (column 7) is the sum of average travel costs per trip (column 5) based on a variable cost of 3 cents a mile and average on-site costs per trip (column 6).

By employing an electronic computer and using logarithmic transformation of the data, regression of the average number of trips per capita per time period on travel and on-site costs per trip gave a demand equation for the two county area of:

$$\text{Log}_e \hat{Y} = 1.969 - 1.206 \log_e X$$

Table 13. Cost data by origin, Cache and Box Elder Counties

Origin	No. of trips	Travel costs	Lodging	Boat gas & oil	Launching	Total trip costs	Average cost/ trip
		dollars	dollars	dollars	dollars	dollars	dollars
Brigham	221	619.50	526.00	912.07	52.25	2,114.07	9.57
Corinne	8	23.22		19.06	2.00	44.28	6.04
Cove	3	4.14		3.07		7.21	2.40
Deweyville	12	17.40		31.41		48.81	4.07
Elwood	9	21.00		20.60		41.60	4.62
Fielding	4	8.82		14.40		23.22	5.81
Hyrum	50	121.20	50.00	158.82	34.00	361.02	7.22
Lewiston	3	2.34				2.34	.78
Logan	222	458.99	160.00	893.97	14.50	1,495.47	6.74
Mantua	39	6.51		66.24		72.75	1.87
Mendon	12	8.64		38.75		47.39	3.95
Newton	4	4.14		18.76		22.90	5.73
Providence	38	17.34		146.71		163.97	4.32
Richmond[a]							
Smithfield	102	195.48	51.00	387.57	4.00	638.05	6.26
Tremonton	74	270.69	16.00	344.67	8.00	630.36	8.52
Trenton	8	7.32		20.39	1.00	29.19	3.65
Willard	47	59.52		95.09		154.61	3.29
Totals	856	1,846.25	803.00	3,162.58	115.75	5,897.24	6.89

[a]No trips were taken by the one boater in Richmond.

Table 14. Total trips and average number of trips per capita (boat population) to 10 mile (round trip) distance intervals from all origins in Cache and Box Elder Counties and average costs per trip

(1) Distance interval miles	(2) Total no. trips	(3) Sample boat pop.	(4) Average no. trips/ capita/ time period	(5) Average travel cost/trip	(6) Average on-site cost/trip	(7) Average travel & on-site cost/trip
				dollars	dollars	dollars
0 - 9	93	17	5.47	.05	1.78	1.83
10 - 19	278	54	5.15	.43	2.78	3.21
20 - 29	99	15	6.60	.78	2.36	3.14
30 - 39	60	26	2.31	1.07	3.03	4.10
40 - 49	28	47	.60	1.32	2.17	3.49
50 - 59	34	51	.67	1.57	3.36	4.93
60 - 69	35	57	.61	1.87	3.20	5.07
70 - 79	3	10	.30	2.28	3.57	5.85
80 - 89	53	29	1.82	2.52	5.05	7.57
90 - 99	16	33	.48	2.87	7.07	9.94
100 - 109	7	39	.17	3.07	5.78	8.85
110 - 119	4	25	.16	3.36	4.58	7.94
120 - 129	33	22	1.50	3.66	5.13	8.79
130 - 139	38	24	1.58	3.99	15.00	18.99
140 - 149	12	21	.57	4.24	2.90	7.14
150 - 159	2	8	.25	4.53	5.55	10.08
160 - 169	1	2	.50	4.86	5.20	10.06
190 - 199	3	25	.12	5.86	4.67	10.53
200 - 209	2	10	.20	6.24	10.30	16.54
240 - 249	2	24	.08	7.41	7.08	14.49
280 - 289	2	2	1.00	8.52	4.78	13.30
290 - 299	2	24	.08	8.70	11.98	20.68
300 - 309	1	25	.04	9.03	4.60	13.63
340 - 349	2	14	.14	10.20	39.00	49.20
420 - 429	1	25	.04	12.72	31.56	44.28
430 - 439	2	14	.14	13.05	24.63	37.68
450 - 459	3	10	.30	13.50	14.25	27.75
470 - 479	4	24	.17	14.22	9.67	23.89
480 - 489	1	24	.04	14.40	49.60	64.00
510 - 519	9	24	.37	15.42	3.22	18.64

Table 14. Continued

(1) Distance interval miles	(2) Total no. trips	(3) Sample boat pop.	(4) Average no. trips/ capita/ time period	(5) Average travel cost/trip	(6) Average on-site cost/trip	(7) Average travel & on-site cost/trip
				dollars	dollars	dollars
530 - 539	2	25	.08	16.02	8.36	24.38
570 - 579	1	24	.04	17.34	28.77	46.11
580 - 589	3	24	.13	17.52	29.48	47.00
600 - 609	3	39	.08	18.03	7.34	25.37
610 - 619	9	44	.20	18.38	22.77	41.15
620 - 629	2	4	.50	18.72	6.13	24.85
660 - 669	3	24	.12	19.86	31.01	49.97
1060 - 1069	1	25	.04	31.80	222.40	254.20

Where:

$\hat{Y}$ = calculated number of trips per capita,

X = average travel and on-site costs per trip.

Using this estimating equation, $\hat{Y}$'s were computed for the values of X at the various distance intervals. These calculated $\hat{Y}$'s were reconverted to real numbers and plotted through the scatter generated by the relationships between the average observed number of trips per capita (Y) and the average trip costs per trip (X) (Figure 5). The resulting curve is the statistical demand estimate.[5]

The regression coefficient (b) of the demand equation, 1.205785, had a standard error of 1.627 and was significant at the 1 percent level. The "b" is also a statement of elasticity indicating that the demand for boating in this instance was relatively elastic.

The correlation coefficient (r) was -.78 and was also significant at the 1 percent level. The coefficient of determination, (r^2), was .608, indicating that 60.8 percent of the variation in Y was explained by variation in X. If this is compared with an r^2 of .195 which resulted when the function was computed as linear without the use of logarithms, it becomes apparent that a better fit was accomplished by using the logarithmic function.

It is of interest at this point to note that travel cost alone explained almost as much of the variability in number of trips as did travel and on-site costs together. A similar regression using only travel costs per trip as the independent variable yielded an r^2 of .595.

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[5]A straight line demand curve results when the same information is plotted on log log paper, Appendix D, Figure 6.

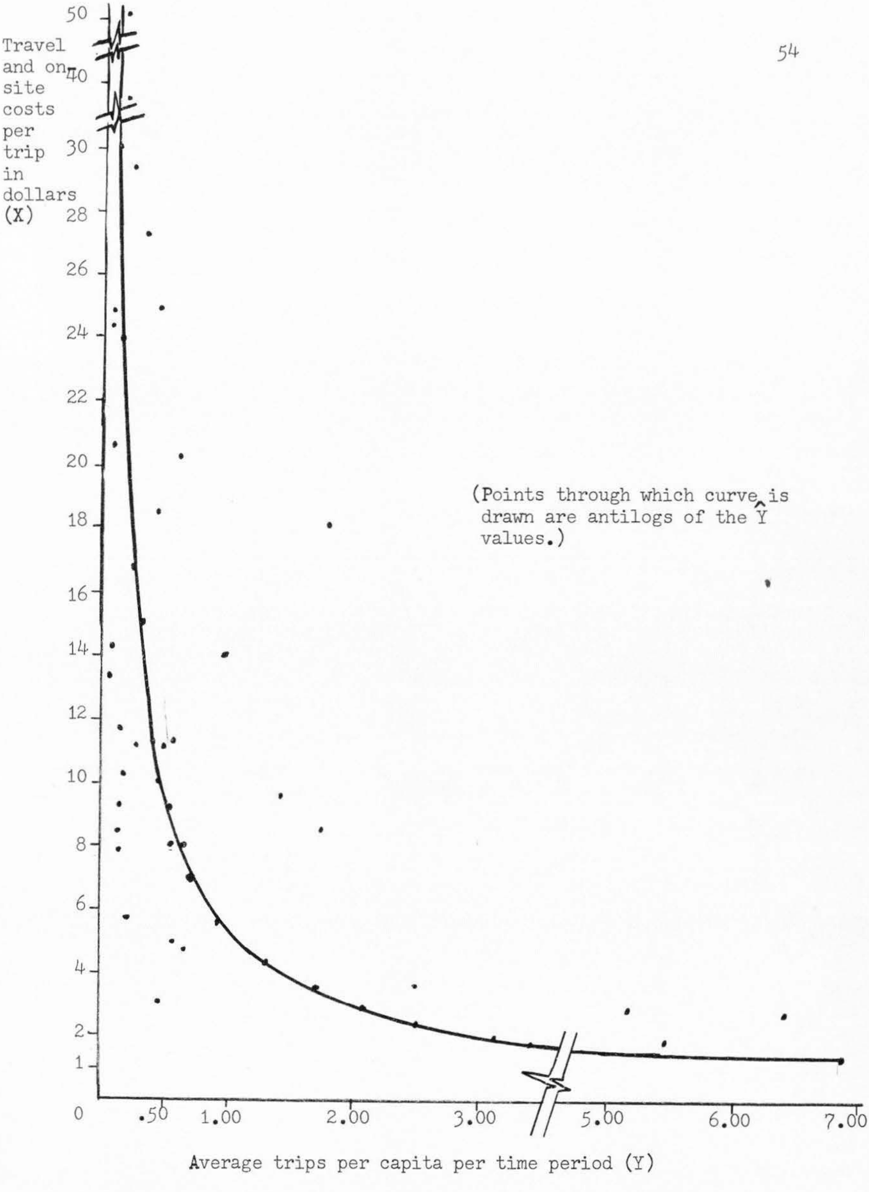

Figure 5. Cache and Box Elder Counties origin demand.

The same procedures were applied to each of the two counties separately. A statistical summary of the results shows that the demand for boating in Box Elder County is very similar to that in the two county area while the Cache County demand is different in that the elasticity is less than one and the r^2 is somewhat smaller; but both the regression and correlation coefficients are significant at the 1 percent level (Table 15).

Table 15. Statistical summary of the demand (for boating) functions of Cache and Box Elder Counties as one area and for each of the two counties separately

Area	Estimating Equation	r	r^2	b	S_b	Significant at
Cache and Box Elder	$\text{Log}_e \hat{Y} = 1.969 - 1.206 \log_e X$	-.78	.608	-1.206	.163	1%
Box Elder	$\text{Log}_e \hat{Y} = 2.244 - 1.203 \log_e X$	-.78	.616	-1.203	.200	1%
Cache	$\text{Log}_e \hat{Y} = .764 - .859 \log_e X$	-.64	.405	-0.764	.210	1%

Value of the Resource

Consumer surplus was estimated statistically for the two county area under study and for the two constituent counties separately.

In each case the following formulas were used to estimate the value:

$$CS_i = B - C \qquad (1)$$

$$CS_z = NCS_i \qquad (2)$$

$$CS = \sum CS_z \qquad (3)$$

Where:

CS_i = <u>individual</u> consumer surplus for a particular distance interval,

CS_z = zone consumer surplus (total CS for a particular distance interval or zone),

CS = consumer surplus summed for all distance intervals or zones,

N = number of boaters traveling to a particular distance interval,

B = total benefit per boater or total area under the average individual demand curve at the average number of trips for the interval,

C = average trip costs per individual boater for the interval or travel zone.

The area under the demand curve was determined by integration of the demand function. By the equation, for each X there is a particular $\hat{Y}$; but the consumer surplus values needed were for various values of $\hat{Y}$. It was therefore necessary to express the demand equation as X in terms of Y. Thus the equation becomes:

$$\log_e X = 1.633 - .829 \log_e \hat{Y}$$

This equation, expressed in exponential form describes the demand curve as shown in Figure 5, i.e. using antilogs of the $\hat{Y}$'s calculated by use of the logarithmic equation to plot the curve. Stated in exponential terms the equation

$$X = e^{1.633}\, \hat{Y}^{-.829} \qquad (4)$$

expresses the curvilinear function.

Let t_0 equal the $\hat{Y}$ for travel and on-site cost (X) to the highest cost interval. And let t_1 equal the $\hat{Y}$ for any one of the various distance intervals for which the area (B in equation 1) is being calculated (see

Figure 4).

The area under the demand curve from t_0 to t_1 (call this area B_1) is the integral of equation 4 or,

$$B_1 = \int_{t_0}^{t_1} e^{1.633}\, t^{-.829}\, dt. \text{ or}$$

$$= e^{1.633} \int_{t_0}^{t_1} t^{-.829}\, dt. \text{ or}$$

$$= e^{1.633} \left[\frac{t^{-.829 + 1}}{-.829 + 1} \right]_{t_0}^{t_1}$$

$$= \frac{e^{1.633}}{.171} \left[t^{.171} \right]_{t_0}^{t_1} \quad \text{or}$$

$$= \frac{e^{1.633}}{.171} \left[(t_1^{\ .171} + \emptyset) - (t_0^{\ .171} + \emptyset) \right]$$

$$= \frac{e^{1.633}}{.171} (t_1^{\ .171} - t_0^{\ .171})$$

The base of the natural log, e = 2.718 . . . The equation then becomes:

$$B_1 = \frac{2.718^{1.633}}{.171} (t_1^{\ .171} - t_0^{\ .171})$$

For the two-county area the greatest distance interval was 1060 - 1069 miles round trip. The average trip cost for this distance was $254.20. For this cost (X) the calculated number of trips (t_0) is .009 (Table 16). By substituting this value in the formula for the two-county area, the only variable remaining is t_1, then:

$$B_1 = \frac{2.718^{1.633}}{.171} (t_1^{\ .171} - .009^{.171}) \qquad (5)$$

The value of B_1 for the various t_1's were calculated using this formula. Note that for the highest cost interval $t_1 = t_0$ and $B_1 = 0$.

Table 16. Consumer surplus: Cache and Box Elder Counties

Round trip distance	X^a Average T + OS costs/trip	t_1 Average trips/ capita	B Total benefit/ boater	C T + OS costs $X.t_1$	CS Surplus per boater	N Boat popu- lation	CS_z Zone consumer surplus
	dollars		dollars	dollars	dollars		dollars
0 - 9	1.83	3.372	25.30	6.14	19.13	85	1,626.05
10 - 19	3.21	1.713	21.35	5.50	15.85	584	9,256.40
20 - 29	3.14	1.759	21.49	5.52	15.97	59	942.23
30 - 39	4.10	1.275	19.76	5.23	14.53	302	4,388.06
40 - 49	3.49	1.548	20.80	5.40	15.40	388	5,975.20
50 - 59	4.93	1.021	18.62	5.03	13.59	420	5,707.80
60 - 69	5.07	.987	18.46	5.00	13.46	494	6,649.24
70 - 79	5.85	.831	17.60	4.86	12.74	44	560.56
80 - 89	7.57	.609	16.13	4.61	11.52	309	3,559.68
90 - 99	9.94	.438	14.66	4.35	10.31	185	1,907.35
100 - 109	8.85	.504	15.28	4.46	10.82	370	4,003.40
110 - 119	7.94	.575	15.87	4.57	11.30	297	3,356.10
120 - 129	8.79	.508	15.32	4.47	10.85	146	1,584.10
130 - 139	18.99	.201	11.48	3.81	7.67	272	2,086.24
140 - 149	7.14	.653	16.46	4.66	11.80	143	1,687.40
150 - 159	10.08	.431	14.59	4.34	10.25	42	430.50
160 - 169	10.06	.432	14.60	4.35	10.25	4	41.00
190 - 199	10.53	.409	14.36	4.31	10.05	297	2,984.85
200 - 209	16.54	.237	12.12	3.92	8.20	44	360.80
240 - 249	14.49	.278	12.76	4.03	8.73	272	2,374.56
280 - 289	13.30	.309	13.18	4.11	9.07	30	272.10
290 - 299	20.68	.181	11.09	3.74	7.35	297	2,182.95
300 - 309	13.63	.300	13.06	4.09	8.97	297	2,664.09
340 - 349	49.20	.063	7.50	3.10	4.40	272	1,196.80
420 - 429	44.28	.072	7.91	3.19	4.72	297	1,401.84
430 - 439	37.68	.087	8.54	3.28	4.26	73	310.98
450 - 459	27.75	.127	9.80	3.52	6.28	44	276.32
470 - 479	23.98	.152	10.43	3.64	6.79	272	1,846.88
480 - 489	64.00	.046	6.54	2.94	3.60	272	979.20
510 - 519	18.62	.205	11.57	3.82	7.75	272	2,108.00

Table 16. Continued

Round trip distance	X^a Average T + OS costs/trip	t_1 Average trips/ capita	B Total benefit/ boater	C T + OS costs $X.t_1$	CS Surplus per boater	N Boat population	CS_z Zone consumer surplus
	dollars		dollars	dollars	dollars		dollars
530 - 539	24.38	.149	10.35	3.63	6.72	397	2,667.84
570 - 579	46.11	.069	7.75	3.18	4.57	272	1,243.04
580 - 589	47.00	.067	7.68	3.14	4.54	272	1,234.88
600 - 609	25.37	.142	10.19	3.60	6.59	370	2,438.30
610 - 619	41.15	.079	8.19	3.25	4.94	426	2,104.44
620 - 629	24.85	.145	10.27	3.60	6.67	29	193.43
660 - 669	50.87	.061	7.38	3.10	4.28	272	1,164.16
1060 - 1069	254.20	.0088	2.24	2.24	0.00	297	0.00
Total							CS = 83,184.77

[a]Column headings correspond to symbols used in the evaluation formulas.

For all other intervals t_1 was greater than t_0 giving B_1 a positive value.

The area under the curve from $\hat{Y} = 0$ to $\hat{Y} = t_0$ is the cost of the highest cost trip times the corresponding number of such trips per capita taken. Call this area B_0; then $B_0 + B_1 = B$, the total area under the average individual demand curve measured at t_1.

Total individual trip costs (C) is determined by multiplying average costs per trip (X) by the number of trips per average individual. Subtracting trip costs (C) from total benefit (B) gives the consumer surplus per average individual boater (CS_i), (equation 1).

Zone consumer surplus (CS_z), for all boaters traveling a given distance (10 miles) interval, is the average individual surplus (CS_i) times the number of boaters (N), (equation 2). Summing the total surplus over the 38 distance intervals ($\sum CS_z$) gives the area consumer surplus (CS) which is an estimate of the value of the resource to the boaters in the area.

Calculations were performed on the 1620 computer and the results are shown in Table 16. Using this method the annual value of the boating resources used by Cache and Box Elder County boaters is estimated at $83,184.77.

The same procedure was used to estimate the value of the boating resource used by boaters of the two counties separately. Results are tabulated for Cache County in Table 17 and for Box Elder County in Table 18. The 1963 consumer surplus for Cache County was estimated at $54,119.29 and that for Box Elder was $30,241.41.

It may be of interest to note the difference between these estimates of resource value and those determined by using total expenditures as a

Table 17. Consumer surplus: Cache County

Round trip distance	X^a Average T + OS costs/trip	t_1 Average trips/capita	B Total benefit/boater	C T + OS costs $X.t_1$	CS Surplus per boater	N Boat population	CS_z Zone consumer surplus
	dollars		dollars	dollars	dollars		dollars
0 - 9	1.93	1.220	18.88	2.35	16.53	52	859.56
10 - 19	3.40	.750	17.68	2.55	15.13	312	4,720.56
20 - 29	3.55	.723	17.59	2.57	15.02	46	690.92
30 - 39	.90	2.350	20.34	2.11	18.23	6	109.38
40 - 49	3.21	.788	17.81	2.53	18.28	359	5,485.52
50 - 59	3.36	.758	17.72	2.54	15.18	48	728.64
60 - 69	8.36	.346	15.58	2.89	12.69	341	4,327.29
70 - 79	5.85	.471	16.45	2.76	13.69	44	602.36
80 - 89	8.43	.344	15.56	2.90	12.66	309	3,911.94
90 - 99	10.28	.290	15.06	2.98	12.08	85	1,026.80
100 - 109	8.93	.327	15.42	2.92	12.50	370	4,625.00
110 - 119	7.94	.362	15.71	2.87	12.84	297	3,813.48
120 - 129	9.10	.322	15.37	2.93	12.44	40	497.60
130 - 139	7.03	.402	16.01	2.83	13.18	3	39.54
150 - 159	11.06	.272	14.87	3.01	11.86	29	343.94
190 - 199	10.53	.284	15.00	2.99	12.01	297	3,566.97
200 - 209	16.54	.193	13.80	3.19	10.61	44	466.84
290 - 299	20.68	.159	13.18	3.29	9.89	297	2,937.33
300 - 309	13.63	.227	14.33	3.09	11.24	297	3,338.28
420 - 429	44.28	.083	10.91	3.68	7.23	297	2,147.31
430 - 439	37.67	.094	11.41	3.54	7.87	73	574.51
450 - 459	27.75	.123	12.33	3.41	8.92	44	392.48
530 - 539	20.42	.161	13.22	3.29	9.93	297	2,949.21
600 - 609	25.37	.133	12.60	3.37	9.23	370	3,415.10
610 - 619	47.49	.078	10.69	3.70	6.99	326	2,278.74
620 - 629	24.85	.135	12.66	3.35	9.31	29	269.99
1060	254.20	1.841	4.68	4.68	0.00	297	0.00
Total						CS =	54,119.29

[a]Column headings correspond to symbols used in the evaluation formulas.

Table 18. Consumer surplus: Box Elder County

Round trip distance	X^a Average T + OS costs/trip	t_1 Average trips/ capita	B Total benefit/ boater	C T + OS costs $X.t_1$	CS Surplus per boater	N Boat popu- lation	CS_z Zone consumer surplus
	dollars		dollars	dollars	dollars		dollars
0 - 9	1.65	5.163	30.50	8.52	21.98	4	87.92
10 - 19	2.87	2.652	25.14	7.61	17.53	272	4,768.16
20 - 29	2.46	3.193	26.57	7.85	18.72	13	243.13
30 - 39	4.17	1.692	21.84	7.06	14.78	302	4,463.56
40 - 49	3.88	1.845	22.46	7.16	15.30	29	443.70
50 - 59	5.05	1.344	20.25	6.79	13.46	372	5,007.12
60 - 69	4.17	1.692	21.84	7.06	14.78	153	2,261.34
80 - 89	7.26	.868	17.39	6.30	11.09	6	66.54
90 - 99	5.02	1.353	20.30	6.79	13.51	100	1,351.00
120 - 129	9.78	.607	15.20	5.94	9.26	106	981.56
130 - 139	19.41	.266	10.63	5.16	5.47	272	1,487.84
140 - 149	6.23	.107	18.57	.67	17.90	143	2,559.70
150 - 159	9.10	.662	15.72	6.02	9.70	13	126.10
160 - 169	10.06	.586	15.00	5.90	9.10	4	36.40
240 - 249	14.49	.378	12.50	5.48	7.02	272	1,909.44
280 - 289	15.30	.354	12.15	5.42	6.73	30	201.90
340 - 349	49.20	.086	5.37	4.23	1.14	272	310.08
470 - 479	23.89	.207	9.37	4.95	4.42	272	1,202.24
480 - 489	47.60	.090	5.54	4.28	1.26	272	342.72
510 - 519	28.34	.169	8.37	4.78	3.59	272	976.48
530 - 539	46.11	.094	5.70	4.33	1.37	100	137.00
570 - 579	47.00	.092	5.60	4.32	1.28	272	348.16
580 - 589	31.65	.148	7.74	4.68	3.06	272	832.32
610 - 619	50.87	.083	5.19	4.22	.97	100	97.00
660 - 669	64.00	.063	4.05	4.05	0.00	272	0.00
Total							CS = 30,241.41

[a]Column headings correspond to symbols used in the evaluation formulas.

measure of value. Using the latter method the 1963 value of the boating resource would be as follows for the same areas:

Cache and Box Elder Counties	$36,625.76
Box Elder County	21,818.54
Cache County	15,622.45

SUMMARY

1. It was intended that this study demonstrate the use of basic economic principles in estimating the demand for boating and the value of a boating resource. It was an attempt to make empirical application of the logic and rationale presented by E. B. Wennergren. (1964).
2. The theoretical model describes the average individual demand for boating as the relationship between marginal trip costs and the value of the marginal utility derived. This relationship determines the number of trips a boater will take to various sites at alternative "prices." Ex post comparison of the one observable point on the demand curves of boaters from all origins for a particular site generates average individual boater demand for the site. Origin demand is derived similarly except that in this case the relationship is for boaters from one origin visiting various sites.
3. The 1963 economic value of the boating resource to the boaters of the area was estimated by the consumer surplus associated with the boating experience.
4. Empirical data for testing the model came from the 1963 boating population of Cache and Box Elder Counties in Northern Utah. A sample of 100 boaters, 50 from each county, represented a boating population of 1,190 boaters. Information was gathered by personal interview supplemented by trip questionnaires mailed in by respondents throughout the 1963 boating season. Accurate reporting of all trips was encouraged by regular personal follow up.
5. Using the data collected, a statistical demand curve for boating in

in Cache and Box Elder Counties was derived and used to estimate the value of the resource (water for boating) to the boating population of the area.

6. The demand function was derived using logarithmic transformation of the two variables, average number of trips per capita per time period and travel and on-site costs per trip.

   (a) The dependent (quantity) variable, average number of trips per capita per time period, was used without regard to the number of days or hours involved; the assumption being that decisions pertaining to the trip are usually made prior to departure.

   (b) The independent (price) variable was travel and on-site costs as these are marginal to the boating experience. Investments in equipment and annual costs such as taxes and insurance have become fixed at the point in time when decisions to go boating are made.

   (c) Logarithmic transformations were used because it was apparent, both from a scatter diagram of the relationship between the variables and by statistical comparison, that a curvilinear function would fit the data better than would a straight line. Also, the curvilinear function is linear in logs and the regression coefficient expresses the elasticity of demand.

   (d) Mathematical computations involved in deriving the demand curve and in estimating resource value were performed on a 1620 computer.

7. Regression of the number of trips per capita on travel and on-site costs per trip produced the demand equation for 1963:

$$\log_e Y = 1.969 - 1.206 \log_e X$$

The coefficient of determination (r^2) of .608 indicated a reasonably good fit of the curve to the data. The regression coefficient (-1.205) indicates that the demand was elastic. Both of these statistics were significant at the 1 percent level.

8. The 1963 consumer surplus per average individual boater at various distance intervals was calculated by subtracting trip costs from the integral of the demand equation. This individual surplus was multiplied by the number of individuals in each interval and the intervals summed to arrive at total 1963 consumer surplus. This total consumer surplus is the value of boater experience imputed to the resource itself, or in other words, the value of the resource for boating. The estimated annual value of the boating resources (water) used by Cache and Box Elder County boaters was $83,184.77. The estimate for Cache County was $54,119.29 and for Box Elder County, $30,241.41.

CONCLUSIONS

The model used (Wennergren, 1964) as basis for this study is, in the opinion of the author, a step forward in demand analysis and resource evaluation in problems concerning outdoor recreation. Though hedged by several assumptions which may appear somewhat strained, these are in reality much the same as those necessary for analysis of the more conventional "market priced" commodities, but which are accepted without undue concern in many cases. The application of the theory expressed in these models should be of significant value in considerations involving resource allocation.

Particular attention is focused, in this study, on one specific application of this model--that of estimating origin demand and the value of the resource to a specific area. Though developed more particularly for site demand and site evaluation, the model can be adapted to origin analysis also. In this case, however, the necessary assumption of homogeneity among sites is more unrealistic. It may be argued that the product purchased, boating, at one particular site is not the same product as boating at another site which offers very different supplementary accomodations.

Basically the demand analysis for boating as presented here does not differ greatly from that of other "marketed" products. Most, if not all, demand analyses, whether cross sectional or time series, involve assumptions of homogeneity among commodities and/or consumers over location or time. The general statistical models, however, can be applied to other similar studies, given the pertinent information.

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APPENDIX A

Table 19. Sample for boating study: Cache and Box Elder Counties, 1963 (Based on sample size of 100)

County	Town	Miles from Hyrum Dam	Miles from Mantua Res.	No. of boat regis.	Percent of total sample	No. boaters in sample
Cache	Hyrum	1.0		19	10	5
	Wellsville	4.8		3		
	Millville	6.0		5	60	30
	Providence	8.7		11		
	River Heights	8.9		3		
	Logan	9.2		247		
	Mendon	10.5		2		
	North Logan	12.3		2	20	10
	Hyde Park	14.8		5		
	Smithfield	17.5		37		
	Cache Junction	19.5		2		
	Newton	21.8		4	10	5
	Richmond	23.5		6		
	Clarkston	26.5		1		
	Trenton	26.3		1		
	Lewiston	31.7		6		
Box Elder	Mantua		0	3	50	25
	Brigham City		5	214		
	Corinne		12	22	20	25
	Willard		13	11		
	Honeyville		14	6		
	Bear River		17	5		
	Deweyville		20	9		
	Elwood		22	2	30	15
	Collinston		24	2		
	Tremonton		25	58		
	Garland		28	5		
	Fielding		30	9		

APPENDIX B

Department of Agricultural Economics
Utah State University

Form 1 BOATING QUESTIONNAIRE CONFIDENTIAL

Name____

Street Address______________________ City__________________

Telephone No.__________ Occupation of Head of Household__________

Initial Costs of Boating Equipment

Type of Equipment	Description, Size, H.P., Number, etc.	Purchase Cost (dollars)	Year Purchased	Expected Life (years)	Obsolescent Depreciation (annual)
Boat					
Motor					
Trailer					
Safety Equipment: Fire Ext.					
Horn or Whistle					
Life Jackets					
Flares					
Anchor					
Bail Bucket or Pump					
First Aid Kit					
Water Skis					
Tow Rope					

Annual Costs of Boating

Item	Description, Size, H.P., Number, etc.	Expected Life (years)	Total Cost (dollars)	Annual Cost (dollars)
Boat License				
Trailer License				
Taxes				
Interest on Boat Equipment Loan				
Insurance				
Repairs: Painting				
Motor				
Trailer				
Use Depreciation				
Tire Replacement				
Harbor Storage				

Other Information

Year	Cost	Expected Life	Estimate of Total Miles Driven Each Year	Estimate of Miles Driven For Boating

Car used to pull boat ____________________

Income of Family $________________________

Length of work week for head of household ______________________ hrs.

Department of Agricultural Economics
Utah State University

Form 2 BOATING QUESTIONNAIRE CONFIDENTIAL

Please complete the following questions for each boating trip taken during the season.

Trip Costs of Boating Trip

	Date	Day of Week	Time
Departed Home			
Arrived Boating Site			
Departed Boating Site			
Arrived Home			

Approximate time spent boating __________ hrs.

Location of boating site ______________________________

Why did you choose this boating site instead of some other alternative site? ______________________________

____

____

____

Please list other recreational activities enjoyed going to and from the boating site and the time spent in these activities. (Such activities as picnicing in the canyon enroute, side trips to sight see, etc.)

To: ______________________________

____

____

____

From: ______________________________

____

____

____

Check number of family making trip:

________Father _______Mother _______Sons ________Daughters _____Others

Number of other persons outside immediate family who went boating ________

Trip Costs Paid by Boat Operator

Item	Description, Number, Type, Gallons, etc. (where applicable)	Total Amount Spent (dollars)
Auto gas to and from site		
Auto oil to and from site		
Food		
Lodging		
Boat gas		
Boat oil		
Launching fees		

APPENDIX C

Calculations

Trips per capita to 10 mile (round trip) distance intervals from all origins in Cache and Box Elder Counties

10 mile interval	No. trips	Boat pop.	Trips per capita
(1) 0-9			
Hyrum	40	4	
Mantua	38	2	
Newton	3	1	
Smithfield	12	10	
	93	17	5.47
(2) 10-19			
Brigham	98	24	
Logan	139	25	
Providence	36	4	
Trenton	6	1	
	279	54	5.15
(3) 20-29			
Mendon	12	1	
Smithfield	56	10	
Willard	31	4	
	99	15	6.60
(4) 30-39			
Brigham	59	24	
Corinne	1	2	
	60	26	2.31
(5) 40-49			
Deweyville	10	1	
Fielding	1	1	
Lewiston	2	2	
Logan	9	25	
Providence	1	4	
Smithfield	2	10	
Willard	3	4	
	28	47	0.60
(6) 50-59			
Brigham	1	24	
Cove	3	1	
Smithfield	1	10	
Tremonton	28	15	
Trenton	1	1	
	34	51	0.67
(7) 60-69			
Willard	10	4	
Tremonton	10	15	
Corinne	5	2	
Deweyville	2	1	
Logan	4	25	
Smithfield	4	10	
	35	57	0.61
(8) 70-79			
Smithfield	3	10	0.30
(9) 80-89			
Logan	52	25	
Providence	1	4	
	53	29	1.82
(10) 90-99			
Hyrum	2	4	
Providence	1	4	
Smithfield	12	10	
Tremonton	1	15	
	16	33	0.48
(11) 100-109			
Hyrum	1	4	
Logan	1	25	
Smithfield	5	10	
	7	39	0.17
(12) 110-119			
Logan	4	25	0.16
(13) 120-129			
Fielding	3	1	
Hyrum	1	4	
Newton	1	1	
Tremonton	27	15	
Trenton	1	1	
	33	22	1.50
(14) 130-139			
Brigham	38	24	1.58

Trips per capita to 10 mile (round trip) distance intervals from all origins in Cache and Box Elder Counties

	10 mile interval	No. trips	Boat pop.	Trips per capita
	(15) 140-149			
Corinne		1	2	
Tremonton		9	15	
Willard		2	4	
		12	21	0.57
	(16) 150-159			
Hyrum		1	4	
Willard		1	4	
		2	8	0.25
	(17) 160-169			
Mantua		3	25	0.50
	(20) 190-199			
Logan		3	25	0.12
	(21) 200-209			
Smithfield		2	10	0.20
	(25) 240-249			
Brigham		2	24	0.08
	(29) 280-289			
Corinne		2	2	1.00
	(30) 290-299			
Logan		2	25	0.08
	(31) 300-309			
Logan		1	24	0.04
	(35) 340-349			
Brigham		1	24	0.04
	(43) 420-429			
Logan		1	25	0.04
	(44) 430-439			
Hyrum		1	4	
Smithfield		1	10	
		2	14	0.14

	10 mile interval	No. trips	Boat pop.	Trips per capita
	(46) 450-459			
Smithfield		3	10	0.30
	(48) 470-479			
Brigham		4	24	0.17
	(49) 480-489			
Brigham		1	24	0.04
	(52) 510-519			
Brigham		9	24	0.37
	(54) 530-539			
Logan		1	25	
Tremonton		1	15	
		2	40	0.08
	(58) 570-579			
Brigham		1	24	0.04
	(59) 580-589			
Brigham		3	24	0.13
	(61) 600-609			
Hyrum		1	4	
Smithfield		1	10	
Logan		1	25	
		3	39	0.08
	(62) 610-619			
Hyrum		2	4	
Logan		3	25	
Tremonton		4	15	
		9	44	0.20
	(63) 620-629			
Hyrum		2	4	0.50
	(67) 660-669			
Brigham		3	24	0.12
	(100) 1060			
Logan		1	25	0.04

Methods Used to Calculated Depreciation on Various Items for the 1963 Boating Study

Boats and trailers

Factory built and purchased new

First year -- 25 percent depreciation

Second year -- 15 percent

Third year -- 12 percent

Fourth and subsequent years -- straight line for the remaining life of the boat.

Used boats and trailers

Age, if not known, was approximated from price paid for it.

Depreciation was figured as for new boats and trailers.

Home-made boats and trailers

Straight line depreciation

Other boating equipment

Straight line depreciation

Average boat life (furnished by local marine dealer)

Fiber glass -- 20 years

Aluminum -- 17-20 years

Wood -- 10 years

Average life of boating equipment used to determine annual cost (furnished by local marine dealer)

Trailers	-- 20 years
Fire extinguishers	-- 10 years (plus $1.00 per year for recharge)
Horn or whistle	-- 10 years
Life jackets	-- 3 years

Bail buckets	--	2 years
Paddles	--	10 years
Light	--	4 years
Ladder	--	10 years
Skis	--	5 years
Tow ropes	--	1 year (ropes costing less than $4)
	--	2 years (ropes costing $4 or more)
Boat covers	--	6 years
First aid kit	--	2 years
Bail pumps	--	10 years

Cost of car charged to boating

Car depreciation for 1963 was determined by comparing average retail prices for the beginning and end of the year as published in the NADA used car guide. Where prices of new cars were not shown, it was assumed that the first year depreciation of the previous year's model was a close approximation.

A mileage ratio $\left[\frac{\text{boat mileage}}{\text{total mileage}}\right]$ was calculated to determine the percentage of total car mileage for the year which was used for boating trips.

Car depreciation charged to boating was determined by multiplying the amount of the 1963 car depreciation by the mileage ratio.

APPENDIX D

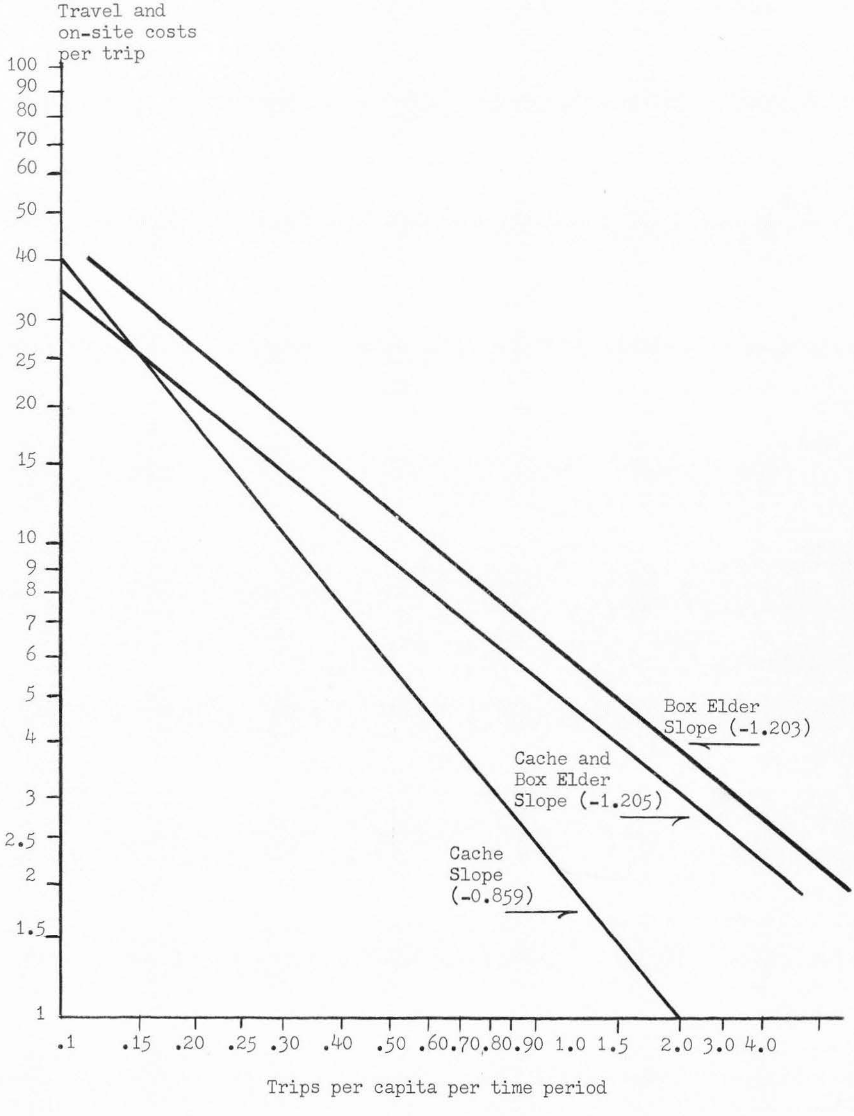

Figure 6. Origin demand for boating in Cache and Box Elder Counties separately and as a two county area (log-log graph).

Table 20. Marginal or trip costs and number of hours spent at the boating site

(1) Distance interval (miles round trip)	(2) No. trips	(3) Average number hrs/trip at site	(4) Average on-site cost/trip at site	(5) Average on-site cost/trip	(6) Percent of total	(7) Average travel & on-site costs/hr. at site	(8) Average travel & on-site cost/trip
			dollars	dollars		dollars	
0 - 9	93	2.85	.62	1.78	98	.64	1.83
10 - 19	279	4.20	.66	2.78	87	.76	3.21
20 - 29	99	3.93	.60	2.86	75	.80	3.14
30 - 39	60	4.54	.67	3.03	74	.90	4.10
40 - 49	28	4.61	.47	2.17	62	.76	3.49
50 - 59	34	9.16	.37	3.36	68	.54	4.93
60 - 69	35	6.34	.50	3.20	63	.80	5.07
70 - 79	3	3.50	1.02	3.57	61	1.67	5.85
80 - 89	53	8.43	.60	5.05	67	.68	7.57
90 - 99	16	9.00	.79	7.07	71	1.10	9.94
100 - 109	7	15.47	.37	5.78	65	.57	8.85
110 - 119	4	7.33	.35	4.58	58	1.08	7.94
120 - 129	33	10.20	.50	5.13	58	.86	8.79
130 - 139	38	22.57	.66	15.00	79	.84	18.99
140 - 149	12	18.33	.16	2.90	41	.39	7.14
150 - 159	2	19.00	.29	5.55	55	.53	10.08
160 - 169	3	3.00	1.73	5.20	52	3.35	10.06
190 - 199	3	22.00	.21	4.67	44	.48	10.53
200 - 209	2	22.50	.46	10.30	62	.74	16.54
240 - 249	2	15.50	.46	7.08	49	.93	14.49
280 - 289	2	40.00	.12	4.78	36	.33	13.30
290 - 299	2	57.50	.21	11.98	58	.36	20.68
300 - 309	1	60.00	.08	4.60	34	.23	13.63
340 - 349	1	50.00	.78	39.00	79	.98	49.20
420 - 429	1	51.00	.62	31.56	71	.87	44.28
430 - 439	2	41.00	.60	24.63	65	.92	37.68
450 - 459	3	48.00	.30	14.25	51	.58	27.75
470 - 479	4	83.00	.11	9.76	41	.29	23.98
480 - 489	1	90.00	.55	49.60	78	.71	64.00
510 - 519	9	57.75	.06	3.22	17	.32	18.62

Table 20. Continued

(1) Distance interval (miles round trip)	(2) No. trips	(3) Average number hrs/trip at site	(4) Average on-site cost/trip at site	(5) Average on-site cost/trip	(6) Percent of total	(7) Average travel & on-site costs/hr. at site	(8) Average travel & on-site cost/trip
			dollars	dollars		dollars	
530 - 539	2	38.00	.22	8.36	34	.64	24.38
570 - 579	1	69.00	.42	28.77	62	.67	46.11
580 - 589	3	64.00	.46	29.48	61	.73	47.00
600 - 609	3	25.50	.29	7.34	29	.99	25.37
610 - 619	9	59.10	.39	22.77	25	.70	41.15
620 - 629	2	79.00	.08	7.13	25	.31	24.85
660 - 669	3	51.33	.60	31.01	61	.99	50.87
1060 - 1069	1	99.00	2.25	222.40	87	2.57	254.20