M.S. THESIS
USDA FS Project No. 44-297
Dr. E. L. Michalson, Project Leader

A STATISTICAL ESTIMATE OF THE DEMAND FOR AND VALUE OF OUTDOOR RECREATION IN THE SAWTOOTH VALLEY AND MOUNTAIN AREA, IDAHO

A Thesis for the Degree
of Master of Science in
Agricultural Economics

By

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Submitted to

U. S. Forest Service
Region 4
Ogden, Utah

This project was supported primarily with funds provided by the U. S. Forest Service, Region 4, Ogden, Utah.

Water Resources Research Institute
University of Idaho
Moscow, Idaho

C. C. Warnick, Director

May, 1973

TABLE OF CONTENTS

Table of Contents (continued)

LIST OF TABLES

List of Tables (continued)

LIST OF DIAGRAMS

ABSTRACT

Outdoor recreation continues to increase as a major use of the natural resource base in the Sawtooth Valley and Mountain Area of southcentral Idaho. Rational resource allocation decisions require knowledge of the value resources have in alternative uses. A study was conducted during the summer recreational season to obtain the necessary information to statistically estimate the demand for and net economic value of recreation in the Sawtooth area.

An ordinary least squares regression estimating procedure was employed to obtain the statistical demand estimate. The consumer's surplus approach was utilized to impute the net economic value of recreation. An aggregate consumer's surplus value of $2,627,813 was derived as an average value of $3.73 per visitor day.

Despite the inherent limitations associated with recreational values imputed from recreational demand curves, the values derived therefrom potentially afford a valuable decision-making tool. Comparing all proposed recreational developments on a standardized basis provides a framework for more objective economic assessments of future recreational resource allocations of the natural resource base.

ACKNOWLEDGEMENTS

Members of the author's graduate committee deserve special recognition for their time, patience and constructive suggestions made throughout the study period. Committee members were:

Dr. E. L. Michalson, Major Professor and Associate Professor, Professor of Agricultural Economics

Dr. E. B. Godfrey, Assistant Professor of Agricultural Economics

Dr. Dale Everson, Professor of Statistics

Gratitude is extended to Dr. Joel Hamilton who contributed significantly to the statistical interpretation of the study.

John Herbst deserves recognition for his companionship and wonderful sense of humor which made field and office work a pleasurable experience.

My parents, Dr. and Mrs. C. M. Gilmour, are singled-out for innumerable contributions made throughout the author's life.

My loving wife, Margret, deserves special recognition for her encouragement and support throughout the study period.

This study was made possible through U. S. Forest Service funding. Forest Service personnel in the Stanley and Sawtooth Valley Ranger Districts are acknowledged for their cooperation and assistance.

CHAPTER I

THE SAWTOOTH SUMMER RECREATIONAL RESOURCE

Introduction

Participation in outdoor recreational activities continues to increase annually. Visits to outdoor recreation attractions have risen at an average yearly rate of approximately ten percent for several decades. Higher per capita incomes, more leisure time, improved transportation facilities and general population growth all contribute to this trend.

The historic rate of increase cannot be expected to continue indefinitely. However, mid-range projections place visits to national forests at nearly double the present level by 1980 (Clawson, 1971). Expressed on a per capita basis, every man, women, and child in the United States would make approximately one and two-fifths visits annually to the national forest system.

The seasonal nature of numerous recreational pursuits accentuates an already heavy burden on the capacity of many recreational areas. A strong impetus is thus created to expand the existing recreational utilization of land and water resources. As competition between alternative uses of scarce natural resources intensifies, sound decision-making will be required to ensure against misallocating resources.

Objective decisions concerning resource allocation can only be reached with an adequate body of information. This includes, but is not limited to, knowledge of the economic values of natural resources for alternative uses. Failure to consider all facets in resource allocation decisions may increase the probability of resource misallocations.

Outdoor recreation continues to increase as a major use of natural resources in the Sawtooth Valley and Mountain Area of south-central Idaho. On August 14, 1972, legislation was passed which established the 754,000 acre Sawtooth National Recreation Area. Under this enactment, the area will be managed "in order to assure the preservation and protection of the natural, scenic, historic, pastoral, and fish and wildlife values associated therewith," (Congressional Record, H7067, 1972). The principal management objective is for the above mentioned places to provide a high quality recreational experience. In addition, alternative resource uses in the area will be constrained by the effects they may have on recreation.

A comprehensive evaluation of all management considerations affecting recreation in the Sawtooth area would be required to assure the principal purposes of the Sawtooth National Recreation Area enactment. These include analysis of potential environmental effects of proposed actions, consideration of the possible effects management decisions would have on the population of recreationists, and the economic ramifications of recreation as a use of the area's natural resource base.

Such factors are not mutually exclusive but tend to interact. For example, a campground development with its attendant environmental impact may affect an overall recreational setting in a manner that degrades (enhances) recreational experiences, weakens (strengthens) demand and thus reduces (increases) recreational benefits derived from the resource.

All of the previously mentioned factors are important inputs to the planning process affecting recreational utilization of the Sawtooth Valley's natural resources. The ensuing study has a narrower focus and will concentrate on deriving economic demand and value estimates for summer recreation in the Sawtooth area. Imputed resource values estimated from demand schedules for recreation will estimate the net benefits accruing to users of the resource. Net user benefits impute the resources' value in recreation that society would forego if the recreational opportunity were to disappear. Statistical demand estimates can also be employed to project future use levels. Coupled with expected recreational supply capacities, future demands on the recreational resource and their resultant implications can be anticipated. Information of this nature should provide valuable inputs for decisions affecting resource allocation in the Sawtooth Valley.

Objectives

A survey was conducted in 1971 to assess summer recreational activity in the Sawtooth Valley and Mountain Area. Forest Service records have documented increases in recreational visits to this area for successive years commencing in 1965. To date, an estimation of the economic value of recreational activity in the area has not been made. Since this area also supports other uses, quantification of the economic value accruing to recreation potentially affords valuable information for decisions affecting resource allocations. Furthermore, knowledge of the recreational participant's socio-economic characteristics, origin, and activities undertaken while visiting gives resource managers additional inputs for management planning. Thus, the following objectives were formulated.

1. To characterize visitors by socio-economic composition, origin and activity participation.
2. To statistically quantify and evaluate the demand for summer recreation in the Sawtooth area.
3. To estimate the net economic value of summer recreation in the Sawtooth area.

The net economic value estimate will measure public benefits foregone if the opportunity to recreate in the Sawtooths were to disappear. These benefits reflect visitors' net willingness to pay for the experience rather than go without it. In addition, the willingness to pay concept is net in the sense that it refers to expenditures above those directly incurred. A later section will discuss this concept in more detail.

The Study Area

The Sawtooth Valley and Mountain Area affords thousands of recreationists a diversified recreational experience every year. Located approximately one hundred and thirty miles northeast of Boise, Idaho, the Sawtooth area encompasses portions of Sawtooth, Boise and Challis National Forests. The study was designed to cover major areas of recreational use in the region. These included Alturus Lake, Redfish Lake, Stanley Lake and the Salmon River from Lower Stanley to Sunbeam and portions of the Sawtooth Primitive Area in the Sawtooth Valley and Stanley Ranger Districts.

Variety characterizes the area's natural endowments. Jagged mountain peaks, large morraines and numerous alpine lakes reveal the extensive glaciation that occurred over ten thousand years ago. Fishermen and hunters are provided ample opportunities to test their skills. Hundreds of creeks feed the Salmon River which bisects the entire Sawtooth Valley. Several species of trout including rainbow and cutthroat inhabit these waters. Chinook and sockeye salmon migrate to the Salmon's headwaters each summer. The fishing resource is complimented with deer, elk, mountain goat and mountain sheep populations sought by photographers, hunters and sightseers alike.

Recreation is not the only use of the Sawtooth's natural resource base. Rangelands on the valley floor and alpine meadows provide excellent forage for herds of cattle and sheep during the summer months. Ghost towns and numerous abandoned cabins complement the area's postoral setting and are reminescient of a past era of prospecting and mining activity.

Review of the Literature

The literature in the economics of outdoor recreation covers extensive territory and would fill shelves of bookspace. This review will not attempt to cover in detail all the literature available. Instead, what ensues will be of narrower scope and addresses only the major pieces of literature with direct relevance to outdoor recreation demand and value estimation. However, before doing so, brief coverage of past research in recreation economics and comments on several faulty methods used in the past to estimate the economic value of outdoor recreation will be made.

Interest in the economics of outdoor recreation is not a recent occurrence. Studies concerned with economic aspects of the recreational use of land and water resources were undertaken as early as 1927 (Barkley, 1968). Some of the studies were farsighted and dealt with aspects of recreational land use that receive considerable attention today (Wehrwein, 1927). Others paid attention to land assessment and taxation techniques, economic impact of recreation, recreational demand and externalities associated with recreation. Most of these studies lack the depth and sophistication of later research efforts, but nonetheless remain important in historical perspective.

During the 1950's a number of studies were aimed at measuring the economic importance of specific recreational activities such as sport fishing and/or big game hunting (Ballaine and Fiekowsky, 1953; Pelgen, 1955; and Wallace, 1956). These efforts clearly show a refinement over previous subject matter in recreational economics as economic theory and statistical methods make their first appearance.

Several suggestions were made in the fifties and sixties proposing method to evaluate the benefits derived from recreational activitie. Clawson (1959), Brown, et. al. (1964) and Lerner (1962) have discussed these schemes in detail and point out major weaknesses of each. Since these methods were important components in the development of procedures to be discussed later, they will now receive summary treatment.

One proposal has come to be known as the gross expenditures method. This method assumes that the recreationists value recreation in an amount at least as high as the expense incurred to participate. While this may be true, such a value overstates the value of the recreation if the recreational opportunity no longer existed; i.e., the recreationist would transfer a portion of this expenditure to a substitute choice. Thus, when these estimates are used for justifying expenditures for the provision of recreation, money would tend to be misallocated.

Furthermore, this method would impair making a meaningful comparison between recreational benefits and benefits derived from alternative uses of the same resource.

From 1950 to 1957 the National Park Service employed a "cost" approach for evaluating recreational benefits. The main contention was that ". . . A reasonable estimate of the benefits arising from a reservoir may be normally considered as an amount equal to the specific costs of developing, operating and maintaining the recommended facilities." (National Park Service, p. 1, 1950). This criterion creates a basis by which the provision of recreational facilities can always be economically justified - benefits are equal to costs. The method neglects the rationale of economics and involves circular reasoning.

The last faulty approach to be discussed has been called the gross national product method which contends that the value of a day in recreation is equal to the gross national product per day per capita. Lerner notes that the basic assumptions of this approach is ". . . that all time except time spent in 'maintenance activity' contributes equally to gross national product in the long-run." (Lerner, p. 59, 1962). In other words, without leisure time activities such as outdoor recreation gross national product would eventually decline due to decreases in labor force productivity. Undoubtedly leisure time pursuits enhance individual productivity, but this is not the relevant question. The concern is how is recreation valued. The gross national product scheme gives equal worth to all recreation and other leisure activities on a unit of consumption basis. It follows that a day spent playing tennis and golf would have identical value to spending a day either floating the rapids of a wild river or manufacturing a car. Marginal comparisons between the value of alternative activities would be identical. Again, sound economic reasoning is displaced. As pointed out by Brown, et al, when this procedure is followed the problem of measuring recreational benefits is negated by assumption (Brown, et al, 1964).

The preceding discussion on various untenable recreational benefit estimation procedures implies that the actual benefit should measure the net value or contribution the recreational activity makes to social welfare. In other words, what benefits would society lose (gain) if the recreational resource disappeared (existed). Furthermore, this "net" benefit should be comparable with the benefits derived from alternative uses of the same resource; i.e., the opportunity cost of various alternative resource uses could be evaluated. Ideally, to facilitate decisions affecting resource allocation, the net benefits attributable to recreation in one area would also be comparable to recreational benefits in other areas. However, quantification of recreational benefits is complicated by the "extra-market" nature of the outdoor recreation commodity.* For this class of goods, a market-determined price is non-existent. Thus, the price-quantity relationship required for net benefits estimation cannot be readily

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*An "Extra-market" good is a commodity for which a market does not exist, but for which a market could conceivably exist. (Guedry, 1971).

determined. What follows will be a review of the more significant attempts to derive economic value estimates for outdoor recreational uses of various natural resources.

Professor Hotelling made an interesting suggestion for measuring the benefits of recreational participation at National Parks. In a letter to the Director of the National Park Service he suggested the following procedure: *

> Let concentric zones be defined around each park so that the cost of travel to the park from all points in one of these zones is approximately constant. The persons entering the park in a year, or a suitably chosen sample of them, are to be listed according to the zone from which they come. The fact that they come means that the service of the park is at least worth the cost, and this cost can probably be estimated with fair accuracy. If we assume that the benefits are the same no matter what the distance, we have, for those living near the park, a consumers' surplus consisting of the differences in transportation costs. The comparison of the cost of coming from a zone with the number of people who do come from it, together with a count of the population of the zone, enables us to plot one point for each zone on a demand curve for the service of the park. By a judicious process of fitting, it should be possible to get a good enough approximation to this demand curve to provide, through integration, a measure of the consumers' surplus resulting from the availability of the park. It is this consumers' surplus (calculated by the above process with deduction for the cost of operating the park) which measures the benefits to the public in the particular year. This, of course, might be capitalized to give a capital value for the park, or the annual measure of benefit might be compared directly with the estimated annual benefits on the hypothesis that the park area was used for some alternate purpose.
>
> The problem of relations between different parks can be treated along the same lines, though in a slightly more complicated manner, provided people entering the park will be asked which other national parks they have visited that year. In place of a demand curve, we have a result of such an inquiry,

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*The contents of this letter were taken from Brown, Singh and Castle's "An Economic Evaluation of the Oregon Salmon and Steelhead Sport Fishery," Technical Bulletin 78 (Agricultural Experiment Station, Oregon State University, Corvallis, September, 1964), pp. 6-7.

> a set of demand functions. The consumer surplus still has a definite meaning, as I have shown in various published articles, and may be used to evaluate the benefit from the park system.
>
> This approach through travel costs is one of several possible modes of attack on this problem. There are also others, which should be examined, though I think the method outlined above looks the most promising.

Implicit to Hotelling's suggestion is that a visitor's cost of transportation would serve as a surrogate for price. In addition, recreation is not a "free" commodity but competes for the limited time and money avilable to potential consumers. Lastly, Hotellings' consumer surplus is the monetary expression of the value gained by participants over the costs of their participation (Wennergren, 1967).

The influence of Hotelling's suggestion is evident in the work of several investigators whos publications appeared in 1958 and 1959. Trice and Wood (1958) advanced an adaptation of the Hotelling suggestion. Using information provided by a sample of visitors to three areas in California, a travel cost per visitor day - visitor day relationship was described for use at each area. Cost per visitor day for travel at the 90th percentile was chosen as the bulk-line market value.* The difference between this amount and median travel cost for the group was taken to represent the "free" benefit received by the average recreationist.

Several writers have pointed out major weaknesses associated with the Trice and Wood procedure (Brown, et al, 1964; Hines, 1958;

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*Bulk-line as used in the Trice-Wood study is the highest cost that the largest or major portion of visitors would be willing to incur to participate.

Lerner, 1962; and Lessinger, 1958). Referral to these sources should be made for a complete description of these drawbacks. Their comments basically refer to the following limitations: (1) The arbitrariness of selecting the 90th percentile as a bulk-line market value, (2) the implicit assumption of identicial individual preference scales, and (3) the price-quantity relationship described. It is apparent that the Trice and Wood analysis, despite its drawbacks, received the rigorous attention of other professional economists.

Another application of a modified Hotelling framework was published in 1959 by Marion Clawson. Clawson's effort seems to have had a significant effect on subsequent research in outdoor recreation. Using data on visits to several national parks, Clawson developed a relationship describing the average cost per visit - number of visits per 100,000 population residing in a concentric distance zone at a specified distance range from the park. This he called the demand for the whole recreation experience. Differences in average costs per zone were due to zone cost of travel differentials. By charging various hypothetical increases in park entrance fees, Clawson used the preceding price-quantity relationship to plot what he termed the demand for recreation per se. Two major assumptions were required for this derivation; first, that visitors would view increased costs through entrance fees rationally (as any other increase in visiting cost) and secondly, that the experience of users from one distance zone would provide a measure of the reaction of visitors from other distance zones if the costs in time and money were the same (identicial preference scales).

The second assumption implies that each distance zone is homogeneous with respect to ther demand determinants such as income and opportunities to recreate at the other areas. Furthermore, the marginal utility of money is held constant by the second assumption. In other words, the amount of expense incurred on a given recreational visit is a small proportion of total income and, therefore, income differentials among visitors will not affect the quantity of recreation consumed at the margin. Lastly, the visit to a given park was considered the main purpose of the trip. These assumptions are obviously unrealistic. However, Clawson felt that on the average perhaps they might not be too unreasonable. Thus, Clawson proceeded to estimate the number of visitors that would visit a park at successively higher entrance fee charges. It follows that the maximum net revenue accruing to the parks' "owner" could be computed. This measure of economic value was purported to be a basis for comparing recreational value and the value associated with other possible uses of the area's resources (Clawson, 1959).

Another form of economc value or benefit is derivable from Clawson's demand curve - consumers' surplus. Consumers' surplus corresponds to the total area under the Clawson demand curve. In the case of recreation, it measures the amount visitors would be willing to pay rather than go without the services of the recreation area (maximum surplus). Actually the amount of the surplus would vary under different fee levels and be greatest when fees are at the zero level.

Brown, Singh and Castle point out several deficiencies of the Clawson analysis* (Brown et al, 1964). Perhaps the most significant limitation of his original formulation was the lack of explanatory variables other than money cost per trip. Other demand determinants would logically be socio-economic variables such as family income, occupation, education and paid vacation time. In addition, items such as travel time, site qualities, and substitute areas should probably be included; otherwise, the probability of specification error in the statistical demand estimation is greatly increased.** Clawson states that travel time may shift the demand curve to the right or left depending on the visitor's evaluation of travel time. Knetsch pursued this aspect and posited that failure to account for travel time consistently biases derived demand curves to the left of the actual demand curve (Knetsch, 1963). Recreationists residing at closer distances would tend to visit more than indicated by monetary considerations alone, i.e., their participation rate would decline due to increased costs but not to the rate exhibited by the more distant visitors (Cesario and Knetsch, 1970).

Brown, et al, empirically substantiate Knetsch's hypothesis in their economic evaluation of Oregon's salmon and steelhead sport fishery.

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*Clawson notes these limitations on pages 20 and 21 of his 1959 Reprint No. 10; no elaboration was made.

**Specification error, in a broad sense, occurs when the formulation of the regression equation or one of its underlying assumptions is incorrect (Kmenta, 1971).

The Oregon study employed the Clawson demand framework and included average family income and average travel distance per fishing trip as additional demand determinants. Information on trip travel time was not available so travel distance was used instead. Since travel distance and travel time are interrelated, this was not an unreasaonble substitution (although statistical ramifications result). Knowledge of family incomes allowed their sample to be stratified into income-population subzones. A comparison was made between the net economic value computed by the standard Clawson distance zone procedure and the Clawson method, with sub-distance zone income and distance traveled as independent variables.* The latter demand estimation technique produced a net economic value estimate 41 percent higher than calculated by the standard Clawson procedure; Knetsch's hypothesis was given empirical substantiation.

Wennegren (1967) derived an average "individual demand" function to obtain estimates of demand and value for resident deer hunting in Utah. A total surplus value per zone of origin was determined by taking the integral of the statistical demand estimate, minus the total variable trip cost per origin, times the number of hunters at each origin. The total surplus value for Utah was computed by summing the values calculated for each point of origin. This value corresponds to the maximum

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*Net economic value as used in the Oregon sport fishery study equals the maximum total revenue which a non-discriminating monopolist (single price charged) could appropriate.

consumers' surplus derivable from Clawson's demand curve per se. Wennegren's formulation required the retention of Clawson's assumptions. Since he dealt with the residents of one state with a common recreational pursuit, perhaps his estimate has greater foundation.

Pearse (1968) expressed discontent over the "restrictive assumptions of established methods" of evaluating non-priced recreational resources. He proposed a method whereby individual recreationists (hunters in this case) would be classified by income class. Assuming identifical preferences within each class, the hunter with the highest fixed cost in a given class was considered the marginal consumer (with zero consumers' surplus). The fixed cost for each hunter was then subtracted from the cost to the marginal hunter in each class to obtain an individual's estimated consumer's surplus. A weighted average surplus was then calculated for the entire sample and multiplied by the total population of hunters to yield an aggregate consumers' surplus value.

Nawis uncovered a crucial error of commission of Pearse's behalf. Implicit to Pearse's formulation is that "each participant in an income group would be willing to pay as much as the highest spender without reducing quantity taken," (Nawis, 1972). Traditionally, the economic measure of surplus value for normal goods has accounted for a reduction in quantity consumed as commodity price is raised (Marshall, 1956). It is interesting to note that Pearse's consumer surplus may either underestimate or inflate surplus value depending on the slope of the demand curve. (Nawis, 1972).

Pearse's approach may have had limitations but by focusing on the individual recreationist it made a significant contribution to outdoor recreation economics. Previous methods utilized Clawson-type approaches and were directed at the population of recreationists in various zones. Pearse's innovation seems to have prompted other researchers to test the effectiveness of utilizing the information provided by all individual observations.

Brown and Nawis (1971) reported that substantial gains in the efficiency of estimation and specification of statistical outdoor recreation demand functions can result when individual observations are utilized. A comparison was made between the variances of the least squares estimators as computed from the "zone average" and individual observations procedures. The latter method yielded dramatic reductions in variances associated with the estimates (Brown and Nawis, 1971). These reductions can be interpreted as producing large increases in the efficiency of parameter estimates (in some cases over several hundred percent).

A principal reason for such efficiency gains lies in the nature of the explanatory variables typically used in outdoor recreation demand functions. As Knetsch and others have discussed, the assumption that the disutility of overcoming distance is a function of money cost alone is not correct (Cesario and Knetsch, 1970). Actually the time involved in undertaking a trip is likely to affect demand. However, when travel time (or its corollary, travel distance) has been incorporated into the traditional demand models, it tended to be highly intercorrelated with the price variable. Thus, the effects of travel time and money cost of distance have been difficult to statistically separate (Brown et al, 1964).

When each observation is utilized, however, the problem of multicollinearity between money cost and travel time can be reduced (Nawis, 1972). It follows that a reduction in the correlation between the two variables also increases the precision of estimate for the coefficient of each variable. Furthermore, one may have more confidence in the estimated demand equation as more variables will have statistically significant coefficients.

All of the demand and resource valuation procedures discussed have come to be called "indirect" methods. This methodological description fits these procedures well. Recreationists' willingness to pay was indirectly derived from observed cross-sectional trip expenditure patterns. Only one study has attempted a "direct" approach to estimate recreational demand.

Davis (1963) utilized a personal interview approach to ascertain the maximum amount recreationists would be willing to pay in order to avoid exclusion from their recreational use of the Maine Woods. The interviews used a bidding procedure whereby recreationists reacted to hypothetical increases in the cost of recreating. Prices were systematically raised and lowered until the recreationist's reaction changed from inclusion to exclusion or vice versa (Knetsch and Davis, 1972). Assuming each respondent was rational in the sense that utility maximization guided his reaction to the bids, an effective demand schedule was derived from this procedure.

Several kinds of biases may exist that would tend to weaken the direct approach. One bias may result from what Knetsch and Davis call the "gaming strategy" of the consumer of public good. That is, the consumer may believe that by understating his preferences he may be able to obtain "free" benefits for the amount of recreation he now consumes. In other words, he will escape being charged as much as he is willing to pay. Conversely, a consumer may also overstate his preferences, hoping that by doing so a better case exists for preserving an area in its present use.

The success of this procedure would seem to depend heavily on the soundness of the interview and the honesty of the respondent. Given these conditions the likelihood of meaningful estimates is greatly enhanced.

The aforesaid has attempted to provide a broad scope and perseptive to the evolvement of outdoor recreation demand and value estimation research. The following chapter will present the study methods employed.

CHAPTER II

METHODS OF OBTAINING OUTDOOR RECREATION DATA

Survey Methods

A primary objective of statistical inference is to provide information about parameters being investigated. Without a body of statistical theory directed at providing results of a given accuracy from only a sample of the population, many studies could not be initiated because of prohibitive costs in time and money.* In addition, statistical sampling procedures provide a solid framework from which data collection can proceed. Data collection was organized with these points in mind. Furthermore, several additional factors should receive explicit attention prior to survey commencement (Cochran, 1963). These include defining the population about which information is desired, specification of the data to be collected, determining the degree of precision desired, selecting the unit to be sampled, and lastly, an awareness of available methods.

Questionnaire Design

The basic data regarding Sawtooth recreationists was provided by a questionnaire designed to assess motivations for visiting the Sawtooths, opinions about the experience, socio-economic characteristics

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*Cochran (p. 6) defines a population as the aggregate from which the sample is chosen.

and trip expenditures. Previous questionnaires with similar objectives were used as sources for the questionnaire construction. It was felt that this procedure would allow for potential comparison of the results of each study. A reproduction of the questionnaire is contained in the Appendix D section.

Sampling Procedure

The population of interest consisted of summer recreationists visiting the Sawtooth Valley and Mountain Area of Idaho. Members of this group were expected to be predominantly composed of vaction and weekend visitors. The data in the following table summarizes visitors sampled:

Table 1. Summary of Visitor Response by Category of Visit.

	Entire Sample	Idaho Residents	Non-Residents
		(Percent)	
Annual Vacation	47.1	33.0	60.1
One of two or more Annual Vacations	20.8	24.3	17.6
Weekend Trip	16.0	29.9	3.7
Combined Business-Vacation	3.6	2.8	4.4
Other	11.5	10.0	12.8
No Answer	1.0	0.0	1.4
TOTAL	100.0	100.0	100.0

As expected, the majority of visitors were either vacationing or making weekend visits to the Sawtooths.

In order to obtain a representative sample of visitors, a sampling unit was specified.* The criterion for selection of the sampling unit was predicated on trip expenditures. Each unit was delineated by the number of people for which trip expenditures covered. The size of the sampling unit varied since expenditures covered different numbers of people. A principal objective of the study was to estimate the demand for and economic value of summer recreation in the Sawtooths. Questionnaires administered to an individual in a sampling unit provided the information required for the statistical demand and value estimation. This procedure reduced the chance of overcounting essential group information.

After defining the population and sampling unit, a decision needed to be made as to what constituted an adequate sample size and what method to employ as a sampling technique. The size of a sample would usually be determined by the resources available to the investigator and the degree of precision desired. To derive a sample size that optimally allocates resources at a predetermined degree of precision requires the investigator to have certain a priori knowledge of the population being investigated. Specifically, he should be aware of the population size and the variance expected in his results. Because

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*Cochran (p. 7, 1963). defines a sampling unit as a division of the population into non-overlapping units such that every element in the population belongs to one and only one unit.

of the lack of information available on the Sawtooth recreational population, other means were used to arrive at the sample size.

The criteria developed utilized Forest Service RIM data on visitor day use levels at area campgrounds, motels, cabins, resorts, and the Sawtooth Primitive Area. It was reasoned that visitors could be most easily contacted at these areas. Furthermore, the locations would logically serve as a basis for segregating the total population of recreationists into non-overlapping groups, called strata, and thus allow employment of a stratified random sampling procedure. Given the time, money and informational constraints of the study, stratified random sampling provided an acceptable means of obtaining a sample composition representative of the population.

The total population, N, measured in visitor days, was obtained by summing use levels, n_i at each subpopulation location (stratum). Knowledge of N and n_i allowed the proportion of use, Pu, to be calculated for each stratum, i.e., $Pu = \frac{n_i}{N}$. Previous studies indicated ten to fifteen questionnaires could be obtained per day. Field work commenced on July 16, 1971, and was planned to continue through August 31, 1971. Given this time frame, approximately five hundred and eighty questionnaires would have been the maximum obtainable. Since several population parameters necessary for computation of the sample size required to give the results, a predetermined degree of precision could not be adequately estimated; a choice was made to administer five hundred and eighty questionnaires. Several days of adverse weather conditions coupled with unanticipated campground occupancy deficiencies resulted in the collection of five hundred and twenty-five questionnaires.

Interviews

Questionnaires were administered via a modified personal interview format. This approach differed from standard personal interviews in that the surveyor did not ask questions and record responses. Instead, the surveyor explained the major purpose of the study and asked the respondent to complete the questionnaire. It was emphasized that any question the respondent might have would be answered when the questionnaire was collected. Furthermore, some selected sampling units were not present during questionnaire distribution. For these units a brief explanatory note on the questionnaire allowed the surveyor to leave the survey at the site without personal contact. Closer adherence to random sampling was thus obtained. This procedure worked well enough to collect approximately ninety percent of the distributed questionnaires. Nearly one hundred percent of those units personally contacted returned questionnaires. Only one unit refused to cooperate. The major factor contributing to non-response was that some recreationists left the vacation site before the questionnaire was gathered.

Data Compilation

Information contained on each questionnaire was transferred to coding forms which were duplicated on data processing cards. These cards were verified to ensure the accuracy of the final results. A computer program designed to summarize information contained on the data cards was utilized. The program was checked for errors by running sample test data on each item tabulated. This procedure was employed in order to obtain the greatest precision at the least cost. Presentation and discussion of the final results will follow in the next chapter.

CHAPTER III

SUMMARY OF VISITORS' RESPONSES TO THE SAWTOOTH QUESTIONNAIRE

Summary of Responses

Visitor Origin By State and Residential Location

The largest percentage of sampled visitors were Idaho residents (Table 2). Non-residents predominately originated from states to the south and southwest of Idaho. Four of these southern states: California, Utah, Arizona and Nevada, comprised seventy percent of the total out-of-state visitation.

A possible explanation of the marked southern orientation of visitor's residency may be provided in Table 3. Over forty-three percent (43.6%) of the Idaho residents and sixty-two percent (62.3%) of out-of-state visitors reside in cities with populations exceeding twenty-five thousand. Urban centers of this size are in close proximity to the Sawtooths in states south of Idaho. In addition, alternative recreational areas that offer outdoor experiences similar to the Sawtooth region are generally more numerous and accessible from population centers in the mountain and pacific coast states to the north, west and east of the Sawtooths. This may have contributed to fewer visits from these areas.

How Visitors First Learned About Sawtooths

The majority of Idaho residents (67.5%) and non-residents (52.6%) indicated having first learned about the Sawtooths from friends and relatives (Table 4). This evidence gives credence to the belief

Table 2. Origin of Visitors to the Sawtooth Valley and Mountain Area by State Residency

State	Number	Percentage
Idaho	252	48.3
California	123	23.6
Utah	40	7.7
Arizona	17	3.3
Illinois	10	1.9
Oregon	10	1.9
Nevada	9	1.7
All Others	61	11.6
TOTAL	522	100.0

Table 3. Respondents by Present Place of Residence

Location of Percent Residence	Entire Sample	Idaho Resident	Non-Resident
		(Percent)	
Farm	5.4	8.4	2.6
Rural, Non-Farm	7.5	9.2	5.9
City (5000 or less)	10.2	15.1	5.5
City (5000 - 25000)	19.7	21.1	18.4
City (25000 - 100,000)	33.1	43.6	25.8
City (100,000 - 1,000,000)	13.6	0.0	24.7
City (over 1,000,000)	6.5	0.0	11.8
No Answer	4.0	2.6	5.3
TOTAL	100.0	100.0	100.0

that recollection is an important phase of a recreational experience. As one might expect, relatively more non-residents (33.5%) than Idaho residents (13.1%) learned about the Sawtooths from reading magazines and books. Advertisements appear to be the poorest source of information about the Sawtooths. This fact has also been discovered in other recreational surveys. Federal agencies managing public and water resources have not made it a policy to advertise in the conventional sense.

Table 4. How Respondents First Learned About the Sawtooth Area.

Source	Entire Sample	Residents	Non-Residents
		(Percent)[a]	
Friends	46.8	52.1	38.9
Relatives	31.2	23.4	25.7
Reading	22.1	13.1	33.5
Advertisement	2.7	2.0	3.3
Previous Visit	13.4	18.7	10.5

[a]Columns will not add to one hundred since respondents could select more than one response.

The informational source entitled previous visits in Table 3 may appear illogical since it connotes a prior means of learning about the area; however, this may not be the case. Many recreationists "happen across" previously unvisited locations while on excursions with other destinations in mind and, thus, discover new areas to visit on future trips.

General Information About Respondents' Sawtooth Trip

Large differences were noted between resident and non-resident responses to questions asking whether the 1971 Sawtooth visit was the first ever taken and whether visiting the Sawtooths was the trip's only purpose (Table 5). Most Idahoans (88.1%) had made previous trips to the Sawtooths. The Sawtooths' close proximity to Idaho's three largest cities undoubtedly contributed to this high percentage. Over one-half (55.3%) of the out-of-state visitors were visiting for the first time.

Table 5. Percentage of Respondents Making First Trip to Sawtooths, Whose Visit Was the Trip's Only Purpose, and Who Indicated They Would Visit Again.

	First Trip	Only Purpose	Visit Again
		(Percentage)	
Entire Sample	34.5	66.7	90.2
Resident	11.9	81.3	96.4
Non-Resident	55.3	53.1	84.5

Two-thirds of all sampled visitors indicated the Sawtooth visit was their trip's only purpose. Considerably more non-residents (46.9%) than Idahoans (18.7%) had trip purposes in addition to visiting the Sawtooths. Other trip purposes generally involved visiting other recreational areas.

A large percentage of both residents (96.4%) and non-residents (84.5%) planned to visit the Sawtooth area again (Table 5). This is a good indication that visitors were satisfied with the recreational experience the Sawtooth area provided.

Age

Age in this study refers to the age of the respondent answering the questionnaire. Table 6 summarizes the age distribution by age class. The breakdown between residents and non-residents is similar for all age classes with the exception of the (30-39) and (60 or older) brackets. No prior reasons can be given for these differences.

Table 6. Distribution of Sample by Age Class

	Age Class					
	1-19	20-29	30-39	40-49	50-59	60 & over
	-Percent-					
Entire Sample	3.2	13.4	27.1	25.8	14.3	16.2
Resident	3.8	14.1	33.7	25.7	12.5	10.2
Non-Resident	3.0	11.1	21.4	26.2	16.2	22.1

Average Group Size and Age Structure

The average group visiting the Sawtooths had an equal composition of three males and three females (Table 7). On the average, adults (18 and older) of both sexes outnumbered children by one per group. Residents outnumbered non-residents for every category of sex and age.

Table 7. Average Group Size By Age and Sex.

	Category				
	Male 18 & Over	Male Under 18	Female 18 & Over	Female Under 18	TOTAL
	-Average Number-				
Entire Sample	1.76	1.23	1.73	1.22	5.94
Resident	1.90	1.48	1.83	1.67	6.88
Non-Resident	1.64	1.00	1.63	0.80	5.07

Category of Visiting Group

The dominant group visiting the Sawtooths was comprised of family members only (39.2%, Table 8). Overall, nearly 9 out of every 10 groups (87.8%) in the sample included family members. Less than 5% of sampled visitors were individuals.

Income

Respondents were asked to give their 1970 pre-tax incomes (Table 9). Farmers indicated their net income, self-supporting individuals - individuals income, and families - family income.

Table 8. Category of Groups Visiting the Sawtooths

Group Category	Percent
Family	39.2
Family and Friends	19.3
Family and Relatives	15.7
Husband or Wife	13.6
Friends	7.8
Individual	4.4
TOTAL	100.0

Table 9. 1970 Incomes of Groups Visiting the Sawtooths

Income Range	United States[a]	Entire Sample	Resident	Non-Resident
	-Percentage-			
0-2,999	8.9	2.1	1.7	2.0
3,000-4,999	10.4	4.3	3.9	4.8
5,000-6,999	11.8	8.7	10.7	6.8
7,000-9,999	19.9	15.7	19.7	11.9
10,000-14,999	26.8	37.2	42.5	32.7
15,000-19,999		15.7	13.3	17.9
20,000-24,999	22.3[b]	9.7 (32.0)	6.0 (21.4)	13.1 (41.8)
Over-25,000		6.6	2.1	10.8

[a]U.S. Bureau of the Census, Statistical Abstract of the United States: 1972 (93rd Edition), Washington, D.C. 1972

[b]Percentage of families with incomes over $15,000.

The 1970 income range distribution for all families in the United States has been included in the table. Inclusion of farm and individual incomes in the sample results should not seriously bias comparisons with the national family income breakdown since less than 5% of the sample contained farmers and individual visitors.

The income range mode for groups visiting the Sawtooths was held in common with all United State famlies at the $10,000 - 14,999 range. Non-residents had noticeably more respondents (41.8%) falling in the $15,000 or more range than did either Idahoans (21.4%) or United State families (22.3%). Resident visitors with yearly earnings between $7,000 and $14,999 outnumbered non-residents by 17.6%. The median income level for all groups visiting the Sawtooths was $14,400, nearly 45% greater than the median income level of $9,867 for all United States families in 1970. These figures support the widely believed notion that natural resource based recreation is dominated by higher income groups.

Education

The majority of respondents sampled had or were attending school beyond high school (Table 10). Over one-third of all respondents held college or postgraduate degrees. The proportion of Sawtooth respondents with more than high school educations outweighed the proportion for United States adults, 25 years or older, by 3:1 (71.7% to 22.1%).

Table 10. Respondent's Educational Attainment

	Grade 0-8	Grade 9-12	Some college or add. schooling	College Grad.	Postgraduate Degree
	-Percentage-[a]				
Entire Sample	3.8	21.3	32.6	22.2	16.9
Resident	2.8	22.3	37.5	18.3	15.5
Non-Resident	4.8	20.3	28.0	25.8	18.8

[a]Rows will not add to 100% as 3.2% of the respondents did not answer the question.

Occupation

Over one-half (54.8%) of the sampled respondents were employed in white-collar positions (Table 11). Retired respondents nearly equalled the number of blue-collar workers in the sample.

Recreational Activity Participation

Visitors were asked to rank the five recreational activities they participated in most. Tables 12 and 13 summarize these rankings for residents and non-residents respectively. Camping, sightseeing and fishing were the principal recreational activities pursued by all respondents. Major secondary activities included hiking, photography and swimming. All other activities were pursued on a less frequent basis.

Table 11. Occupations of Respondents.

Occupation	Percent
Professional, Technical	36.2
Managers, Officials, Proprietors	9.4
Clerical - Sales	9.2
TOTAL White Collar	54.8
Craftsmen, Firemen	10.0
Operators	3.0
Houshold, Service, Farm and Manual	2.1
TOTAL Blue Collar	15.1
Farmers	2.5
Students and Housewives	10.0
Retired	14.0
Occupation Not Reported	4.6
TOTAL	100.0

Table 12. Resident Participation in Recreational Activities Ranked by Time Spent (1 = Most Frequent).

Activity	Rank 1	2	3	4	5	TOTAL
			(Percent)			
Camping	58.2	13.6	6.8	2.8	1.0	82.4
Fishing	18.3	29.5	13.2	9.6	2.8	73.4
Sightseeing	17.9	17.9	12.4	11.2	5.2	64.6
Swimming	8.8	7.6	12.4	10.4	10.4	49.6
Hiking	6.4	8.8	11.2	9.2	6.4	42.0
Photographing	7.2	6.8	5.6	8.0	7.6	35.2
Back Packing	4.8	2.8	4.0	2.8	2.8	17.2
Motorbike Riding	4.8	4.4	3.2	2.8	1.2	16.4
Power Boating	2.8	2.4	5.2	2.4	3.6	16.4
Canoeing or Rafting	2.8	3.2	2.0	2.8	3.2	14.0
Water Skiing	2.4	1.6	3.6	2.4	1.0	11.0
Horse Riding	4.4	2.0	2.4	1.0	1.0	10.8

Table 13. Non-Resident Participation in Recreational Activities Ranked by Time Spent (1 = Most Frequent).

Activity	Rank 1	2	3	4	5	TOTAL
			(Percent)			
Camping	46.2	20.2	8.8	1.8	0.0	77.0
Sightseeing	20.2	16.1	18.0	10.6	6.6	71.5
Fishing	22.2	26.0	11.4	4.4	1.5	67.1
Hiking	5.1	11.0	13.2	11.8	5.5	46.6
Photographing	5.1	7.7	8.8	14.3	10.6	46.5
Swimming	4.8	6.6	8.0	9.5	6.2	35.1
Back Backing	2.9	2.6	2.9	2.9	2.6	13.9
Canoeing or Rafting	1.5	2.2	4.0	2.6	2.2	12.9
Motorbike Riding	2.6	2.6	1.5	1.1	1.8	9.6
Power Boating	2.2	1.0	1.5	1.8	1.0	7.5
Horse Riding	1.1	1.1	1.5	1.1	1.5	6.3
Water Skiing	1.1	1.1	0.0	1.0	1.5	4.7

The principal recreational activities pursued in the Sawtooth area appear to be basically of a non-conflicting nature; i.e. one activity does not seriously impinge upon others. However, public recreational demand for the Sawtooth's natural resources continues to grow. As a consequence, increased competition for the available resource base is inevitable. Greater interpersonal friction caused by more persons pursuing similar and dissimilar activities may well erode recreational and environmental quality. Resource managers have the important task of planning to ensure the integrity of the Sawtooth's resource base and recreational quality.

Trip Expenditures

The summary of expenditures for residents and non-residents pertains to expenses incurred for the entire trip (Tables 14 and 15). Since 45% of the respondents visited recreational areas in addition to the Sawtooths, the total amount of trip costs incurred cannot be solely attributed to recreation consumed in the Sawtooth area. No attempt will be made to apportion trip expenditures between all areas visited. It should be pointed out, however, that for most groups, time spent in the Sawtooth area exceeded the length-of-stay in other areas visited. Moreover, as a portion of time spent in Idaho, the Sawtooth visit was dominant. On this basis, most expenditures made in Idaho could justifiably be attributed to the provision of recreation in the Sawtooths. Rather than delve further into trip expenditure attribution, what follows

Table 14. Average Trip Expenditures for Idaho Residents.

Expenditure Category	Average for Trip	Average in Idaho	Average in Sawtooths
	-Dollars-		
TOTAL Expenditures	89.93	87.65	38.48
Personal Vehicle	25.02	23.76	
Fares	0.00	0.00	
Other[a]	0.90	0.90	
Lodging	6.93	6.70	
Food and Beverages	42.78	42.16	
Recreational Supplies	6.56	6.46	
Boat Rental	1.67	1.65	
Gear Rental	0.18	0.15	
Miscellaneous	5.89	5.87	

[a]Other refers to services rendered on personal vehicles in addition to gas and oil expenses.

Table 15. Average Trip Expenditures For Non-Residents.

Expenditure Category	Average For Trip	Average In Idaho	Average In Sawtooths
	-Dollars-		
TOTAL Expenditures	396.76	180.93	145.17
Personal Vehicle	141.49	51.52	
Fares	6.88	1.64	
Other[a]	9.65	5.34	
Lodging	53.79	25.45	
Food and Beverages	143.38	70.34	
Recreational Supplies	17.14	13.47	
Boat Rental	7.40	4.41	
Gear Rental	0.75	0.41	
Miscellaneous	16.28	8.35	

[a]Other refers to services rendered on personal vehicles in addition to gas and oil expenses.

will discuss the probable economic significance of Sawtooth recreation on the area's local economy.

Considerable portions of resident (42.8%) and non-resident (36.6%) expenditures were made in the Sawtooth area proper. These expenditures were made exclusively in the trade and services sector of the economy*. Respondents were asked to estimate only their total expenditure in the area so economic impacts on business classes within the trade and services sector cannot be determined. Principal recipients of these expenditures include businesses in Stanley, Sunbeam, Obsidian, Redfish Lake and the Beaver Creek area.

Assuming the sample of respondents in this study is representative of the population of recreationists during the 1971 recreational season, an approximation of aggregate spending stemming from recreation can be made. The weighted average expenditure made in the Sawtooths for the entire sample was $96.09. Multiplying this amount by sample size (425), and the reciprocal of the sampling rate (28.75), gives an aggregate expenditure level of $1,173,936.

To estimate the overall impact of recreational expenditures of the magnitude on the entire local economy would require information about the interrelationship between all business sectors in the study area. The best source of this information is supplied from an input-output

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*In the study area the trade sector included retail outlets and eating and drinking establishments; services included automobile service stations, motels, cabins and other lodging places.

analysis. Multipliers developed from such an analysis allow estimates to be made of the total economic impact stemming from a $1.00 change in the business activity (revenues) of any sector. Although an income output study has not been done in the study area, several studies have been completed for Idaho (Peterson, 1968 and Rafsnider and Kunin, 1971). Based on the Idaho results which produced low multiplier values for the trade and services sector (1.1 - 1.3), the overall economic impact of recreational expenditures on other sectors in the Sawtooths' local economy should be small. Moreover, since firms in the Sawtooths are heavily dependent upon supplies from wholesale outlets outside the study area, a substantial portion of the recreational expenditures flow out of the local economy as payments to sectors outside the Sawtooth region itself. Thus, providing the principal recipients of these payments are Idaho based firms, recreational expenditures in the Sawtooth area would tend to benefit Idaho's total economy moreso than the local area where the expenditures actually occur.

Recreational Facilities and Services

Respondents were asked to indicate their opinion as to the quantity of selected facilities and services provided in the Sawtooth area. The summary in Table 16 pertains to campers in developed campgrounds only.

Table 16. Respondents' Opinion Concerning Existing Facilities in the Sawtooth Area.

Category	Percentage of Entire Sample			
	More	Less	No Change	No Opinion
Campgrounds	44.1	4.7	36.3	14.9
Firewood	52.1	1.0	25.9	21.0
Water Supply	22.1	1.2	49.2	27.5
Toilets	30.3	1.0	46.0	22.7
Garbage Disposal	20.0	0.0	54.8	25.2
Hiking Trails	27.3	4.2	32.8	35.7
Motorbike Trails	17.2	38.6	13.9	30.3

On the whole, the majority of campers appeared to be satisfied with existing facilities and services. However, with the exception of motorbike trails, it is noticeable that few campers felt there should be less provision of facilities than already existed. Over half (52.1%) the campers felt there should be more firewood. At the time the survey was taken, it was Forest Service policy not to provide firewood in the campgrounds.

The largest percentage (44.1%) of campers felt that more campgrounds should be developed in the area. This response was most common from campers in the Alturus, Redfish and Stanley Lake areas.

Enjoyment Opportunities

Scenic beauty, family unity, escape from society and the history of the area received the highest ratings as enjoyment opportunities in the Sawtooth area. Wildlife, although abundant in the area, did not receive as high ratings as other categories. Nearly 45% of those sampled felt that opportunities to enjoy wildlife were fair or poor. This may indicate that many campers stay relatively close to developed sites which tend to be avoided by wildlife populations.

Table 17. Respondents' Opinions Concerning Enjoyment Opportunities In The Sawtooth Area.

	-Rating-				
Opportunity	Excellent	Good	Fair	Poor	No Opinion
		-Percentage-			
Scenic Beauty	92.8	6.4	0.0	0.0	1.0
Wildlife	20.7	26.3	29.4	14.7	8.8
Family Unity	55.8	30.7	2.0	1.6	9.9
History of Area	23.9	31.5	19.5	8.0	17.1
Escape From Society	29.5	29.1	18.7	13.9	8.8

Status of the Sawtooths

When the survey was conducted, Congress was in the process of acting on legislation to establish the Sawtooths (and additional area) as a National Recreation Area. In previous years, several National Park and National Recreation Area proposals for the region had been rejected. As indicated earlier, the Sawtooths area has now been designated a National Recreation Area. Respondents were asked their preference as to the recreational status of the Sawtooth area (Table 18). The majority of both residents (57.0%) and non-residents (56.4%) preferred the area to be left "as it is." Unfortunately, this response was probably biased since most respondents indicated they were unfamiliar with National Park, National Recreation Area or a combination National Park - NRA proposals. Thus, some respondents may have been influenced by the available choices to choose the frame of reference that was most familiar - the area "as it is".

Table 18. Status of the Sawtooth Valley & Mountain Area

	National Park	Nat'l Recreation Area	Combin-ation	"As Is"	No Opinion
		-Percentage-			
Entire Sample	8.6	18.1	8.6	56.7	8.0
Residents	5.6	18.3	13.2	57.0	5.9
Non-Residents	11.4	18.0	4.8	56.4	9.4

CHAPTER 4

ANALYTICAL CONSIDERATIONS AND THE STATISTICAL DEMAND ESTIMATION AND EVALUATION FOR SAWTOOTH RECREATION

Introduction

Knowledge provided by statistical estimations can be no better than the underlying data. Despite the most stringent measures to secure the best possible data, complications can arise. This is expecially true when one is gathering information on human populations. The population of Sawtooth recreationists during the 1971 summer season was comprised of a number of visitors who had trip purposes other than recreating in the Sawtooths and/or who had visited areas in addition to the Sawtooths. A complication regarding allocation of trip expenses for the Sawtooth experience was therefore presented. A trip cost allocation framework was formulated in an effort to overcome this problem. A description of the methodology developed can be found in the Appendix.

The first section of this chapter will be devoted to a discussion of the estimating procedure and the statistical model employed. Explicit awareness of the analytical framework is a prerequisite to understanding the soundness of the results.

This chapter will conclude with the statistical demand estimate and their evaluation.

Least Squares Regression and the General Linear Model

Ordinary least squares was the regression procedure used to estimate the parameters in the hypothesized demand models that follow. The principal objective of this procedure is to obtain a least squares estimator, b_i, for each explanatory variable in the demand equation. These estimators are least squares since they minimize the sum of squared deviations, ε_i^2, from the regression line. In other words, the computed regression coefficients minimize unexplained variance in the hypothesized regression model. A stepwise multiple regression computer program was employed to obtain the estimated coefficients.

Several basic assumptions must be made in order to complete the specification of the multiple linear regression equation. These assumptions fulfill the general linear regression model. They are:

i. ε_i is normally distributed

ii. $E(\varepsilon_i) = 0$, errors have zero mean

iii. $E(\varepsilon_i^2) = \sigma^2$, homoscedosticity · ferror terms

iv. $E(\varepsilon_i \varepsilon_j) = 0$ $(i \neq j)$, errors are independent

v. the explanatory variables are a set of fixed numbers

vi. the number of observations exceeds the number of coefficients to be estimated.

vii. no exact linear relation exists between any of the explanatory variables.

The first four assumptions are concerned with the residual or disturbance term while the last three pertain to explanatory variables. If all the assumptions hold, then attainment of best linear unbiased estimates (BLUE) of the regression coefficients can be estimated. BLUE refers to estimators that are: 1) Linear combinations of the sample observations; 2) $E(b_i) = \beta_i$, the expected value of b_i is equal to the parameter, β_i, 3) among all estimates of the parameters β_i, b_i has the least variance. Although best linear unbiased estimators can be obtained when some of the general linear model's assumptions are not completely satisfied, caution should be taken when violations do occur. The seriousness of a violation will depend on which assumption is violated and to what extent.

Of particular importance in regression models that involve economic relationships are violations of homoscedasticity of the error terms and the presence of intercorrection between explanatory variables; the normality assumption is fundamental to all regression models - economic or otherwise.

Homoscedasticity assumes that the variance of the residual is constant for each observation. Heteroscedastic conditions arise when the variance of the error term varies from observation to observation. Heteroscedasticity does not prevent least square estimators from being unbiased but does prevent the estimator from having the smallest variance in a class of unbiased estimators. Thus, BLUE conditions cannot be obtained when heteroscedosticity exists. A graphical test can be performed to test for heteroscedasticity. A plot of the residuals against the computed y_i, $\hat{y}_i$ should appear as a horizontal band if heteroscedasticity does not exist to a large degree. This test is not completely precise but serves as a device by which the investigator can compare alternative regression models for relative degrees of heteroscedasticity. An additional adverse effect of heteroscedasticity is that estimators will appear as having greater precision than is justified by the level of significance chosen. Basically this result stems from the failure of tests of significance to hold when homoscedasticity is violated Thus, inferences made about parameters from invalid statistical tests will be in error.

When an exact linear relationship exists between an explanatory variable and any other explanatory variable or with any linear combination of other explanatory variables, perfect multicollinearity exists. Perfect multicollinearity results in the impossibility of solving for the regression coefficients since the X matrix is singular and cannot be inverted. Of more concern here is the presence of lesser degrees of multicollinearity. Less than perfect intercorrelation can result in parameter estimates that are highly unreliable due to their high variances. Furthermore, the separate influences of intercorrelated variables on Y are difficult to distinguish.

What constitutes a high degree of multicollinearity has not been adequately resolved (Kmenta, 1971). Although relatively large simple correlation coefficients (say > 0.8) indicate that two variables are correlated to a high degree, their correlation may not be "harmful". In this sense, "harmful" would mean an intercorrelation that prevented the separate influences of the explanatory variables on Y from being disentangled (Kmenta, 1971). Past studies in outdoor recreation demand analysis have concluded that serious multicollinearity problems can arise between the price variable and travel time or its counterpart, travel distance. With this prior knowledge the present study utilized individual observations instead of distance zone averages to estimate the partial regression coefficients in the regression model.

As mentioned previously, Nawis (1972) demonstrated that this procedure greatly increased the precision of coefficient estimation. This was due to substantial reductions in the degree of intercorrelation between the price and time variable. To the extent that smaller correlations between variables imply that the degree of multicollinearity is less severe, (given that multicollinearity is present), utilizing individual observations should have produced estimates exhibiting greater precision and smaller intercorrelations compared with alternative estimating procedures.

The final assumption of the general linear model receiving scrutiny is that the error terms follow a normal distribution. Careful consideration of this assumption is of paramount importance since its violation means that significance tests on the regression equation no longer apply. Fortunately, an "overall plot" of the residuals and their frequency of occurrence allows one to evaluate the normally requirement. The plot should resemble the sample's size from a normal distribution with a zero mean. Abnormality indicates that the form of the regression equation is inadequate for explaining the variance in Y_i. New forms relating Y_i to the explanatory variables must then be hypothesized.

Statistical Demand Estimate

The Linear Demand Equation

Fitting the data by ordinary least squares resulted in the following equation:

$$\hat{y} = 40.5505 + \underset{(0.00022)}{0.00056X_{1i}^{**}} + \underset{(0.0272)}{0.0499X_{2i}^{*}} - \underset{(0.9409)}{13.1362X_{3i}^{***}} + \underset{(1.3763)}{19.4988X_{4i}^{***}}$$

where:

i represents the i^{th} individual group. A group was defined as the number of people trip expenditures were responsible for covering.

Y_i represents the dependent variable and is equal to the number of visitor days taken by the i^{th} group visiting the Sawtooths.

X_{1i} represents the total income in 1970 of the individual responsible for covering the i^{th} group's trip expenses.

X_{2i} represents total annual paid vacation time for non-retired respondents or annual vacation time for retired respondents. The respondent is the individual responsible for covering the i^{th} group's expenses. The unit of measure is visitor days.

X_{3i} represents the transfer cost per visitor day of the i^{th} group. Transfer cost serves as a surrogate for price and equals the sum of the costs of travel, lodging, rentals, recreational supplies and miscellaneous expenditures. Food costs were not included. It was reasoned that, on the average, food expenditures would be similar to at home food expenses.

X_{4i} represents the time of travel to and from the Sawtooths for the i^{th} group (measured in visitor days).

See Appendix C for a summary of the average values for each independent variable. The numbers in the parentheses below the partial regression coefficients are standard errors. They are informative of the degree of precision associated with each estimate. Dividing the partial regression coefficient by its standard errors produces a "t" statistic. This statistic is commonly used to test the null hypothesis that the partial regression coefficient is equal to zero. If the hypothesis is refuted, then one can be confident within a stated degree of probability (significance level) that the coefficient is significantly different from zero. Normally, variables with insignificant coefficients are removed from the regression equation.

Asterisks in equation (4-1) reflect the significance level of the partial regression coefficients; ***, **, and * represent significance levels of 0.001, 0.02, and 0.1 respectively. Since all the variables in the regression had coefficients that were significant at levels equal to or greater than 0.1, no variables were removed.

Examination of the signs attached to each partial regression coefficient shows that they conform to what was expected with the exception of variable X_4, travel time. Knetsch (1963) had hypothesized that failure to include travel time as an explanatory variable would bias derived demand curves to the left of the actual curve. It was implicitly assumed that travel time is a disutility to overcome and, thus, exerts a negative influence on the quantity of recreation demanded (although Knetsch allowed that the contrary may be witnessed depending upon the travel route and destination). In other words, the slope of the demand curve decreases with distance traveled.

In conjunction with the present study, several factors can be identified that tend to support a positive travel time coefficient. These include:

1. the nature of the recreational commodity
2. the quantity variable specified in the demand model.
3. nature of the trip, e.g., annual vacation, weekend visit, etc.

For many recreational pursuits per se such as boating, hunting and fishing, a number of alternative areas are available for one to choose from, and as distance increases, the number of alternative choices broadens. If qualitative differences between areas are not too great, travel time would be traded for more participation at closer areas. When seeking a particular kind of experience that few alternative areas can offer, longer distances may be traveled since few alternatives are open. However, the uniqueness aspect is not sufficient to ensure a positive association between travel time and quantity consumed.

Knetsch (1963) has noted that "the effect of time is particularly likely to be a limiting factor in the case of day use areas and for weekend trips. It may be less so for longer vacation trips where travel time can be traded-off for length of stay at the area." Sixty-eight percent of the sampled respondents in the Sawtooth area were on their vacation (see Table 1 page 21); 16% were taking a weekend trip. Thus, the sample's composition was probably responsible for the positive travel time coefficient.

This last statement must be qualified, however. Whether or not the sign would be plus or minus also depends on the quantity variable itself. In this study it was specified as visitor days per group for the particular trip. If trips per season had been the quantity variable, it is likely that the travel time coefficient would have had a negative sign. This largely stems from the probability that visitors residing in close proximity to the Sawtooths made subsequent trips. It is unlikely, however, that visitors from farther (say two days travel time) locations would have made additional visits. Unfortunately, study data did not allow this hypothesis to be tested.

The square of the multiple correlation coefficient, called R^2 or the coefficient of determination, equalled 0.418 for equation 41. R^2 measures the degree to which total variation in the regression equation is explained by the explanatory variables. Since the maximum R^2 attainable is one, the 0.418 value may appear quite low. Draper and Smith (1966) point-out R^2 must be interpreted with caution since it can be made to approach unity by either increasing the number of explanatory variables in the equation or reducing the number of observations. Past studies utilizing the Clawson distance zone approach in some cases had higher R^2 values but less precision associated with their estimates. This is explained by the relatively few degrees of freedom (independent pieces of information) associated with estimates based on distance zones and large standard error of estimate.

The F-ratio (Regression Mean Square/Residual Mean Square) for equation 4-1 indicates that a statistically significant regression was obtained. In other words, the amount of variation observed in the data which was explained by the equation was greater than would be expected by chance at the 0.001 level of significance. Actually, this high level of significance for the regression does not necessarily mean the equation is useful for predictive purposes (Wetz, 1964). However, others have shown that in order for an equation to be viewed as a satisfactory predictor, the observed ratio should exceed the selected percentage point of the

F-distribution by at least four times (Wetz, 1964). The tabled value of $F(4,420, 0.99)$ equals 3.22 and the calculated value was 75.467. Thus, the observed F-ratio exceeds the tabled value by a factor slightly greater than 20. Based on the "four-times" criterion, equation 4-1 should be a reasonable prediction of visitor days demanded per group.

Another factor to be examined is the presence of a high degree of intercorrelation (multicollinearity) between variables in the equation. Simple correlation coefficients measure the degree of association between variables and are used as indicator of multicollinearity. Table 19 records the simple correlation coefficients between variables in equation 4-1.

Table 19. Matrix of Simple Correlation Coefficients For Linear Demand Estimates.

	X_1	X_2	X_3	X_4	X_5
X_1	1	-0.148	0.181	0.164	0.081
X_2		1	0.063	0.164	0.116
X_3			1	0.415	-0.308
X_4				1	0.380
Y					1

The largest r value exists between variables X_3 and X_4, transfer cost per visitor day and travel time respectively. This correlation, however, is relatively small and suggests that a harmful level of intercorrelation is not present. Furthermore, in view of the small standard errors and high levels of statistical significance for X_3 and X_4, it seems reasonable to conclude that multicollinearity is not seriously present in the equation.

A necessary condition underlying the statistical results presented thus far is that the variance of the residual is constant for each observation. Violation of this assumption casts considerable doubt on the validity of statistical tests applied to the results. As mentioned previously (p 49), Draper and Smith (1966) suggest the presence of heteroscedasticity can be observed in a plot of residuals, $(Y_i - \hat{Y}_i)$, against $\hat{Y}_i$, the computed dependent variable. If the plot approximates a horizontal band, then heteroscedasticity is not likely. Diagram 1 on the following page shows the general form of the plot obtained for the linear demand equation, 4-1. Such a fanned-out distribution indicates that the error variance is not constant and that a weighted least squares or a transformation on the observations, Y_i, should be made before performing the regression analysis. In addition, the linear estimate appears to overestimate Y_i considerably. This is evident from the frequency distribution of the residuals, called an "overall plot" (Diagram 2) on page 59. A pronounced rightward skewness is apparent - the majority of residuals falling to the left of mean 0. This frequency distribution also indicates that the linear model is incorrect.

A weighted least squares analysis was the first alternative to the linear function attempted. The weight applied to each variable was the square root of the group size for each observation. Thus, it

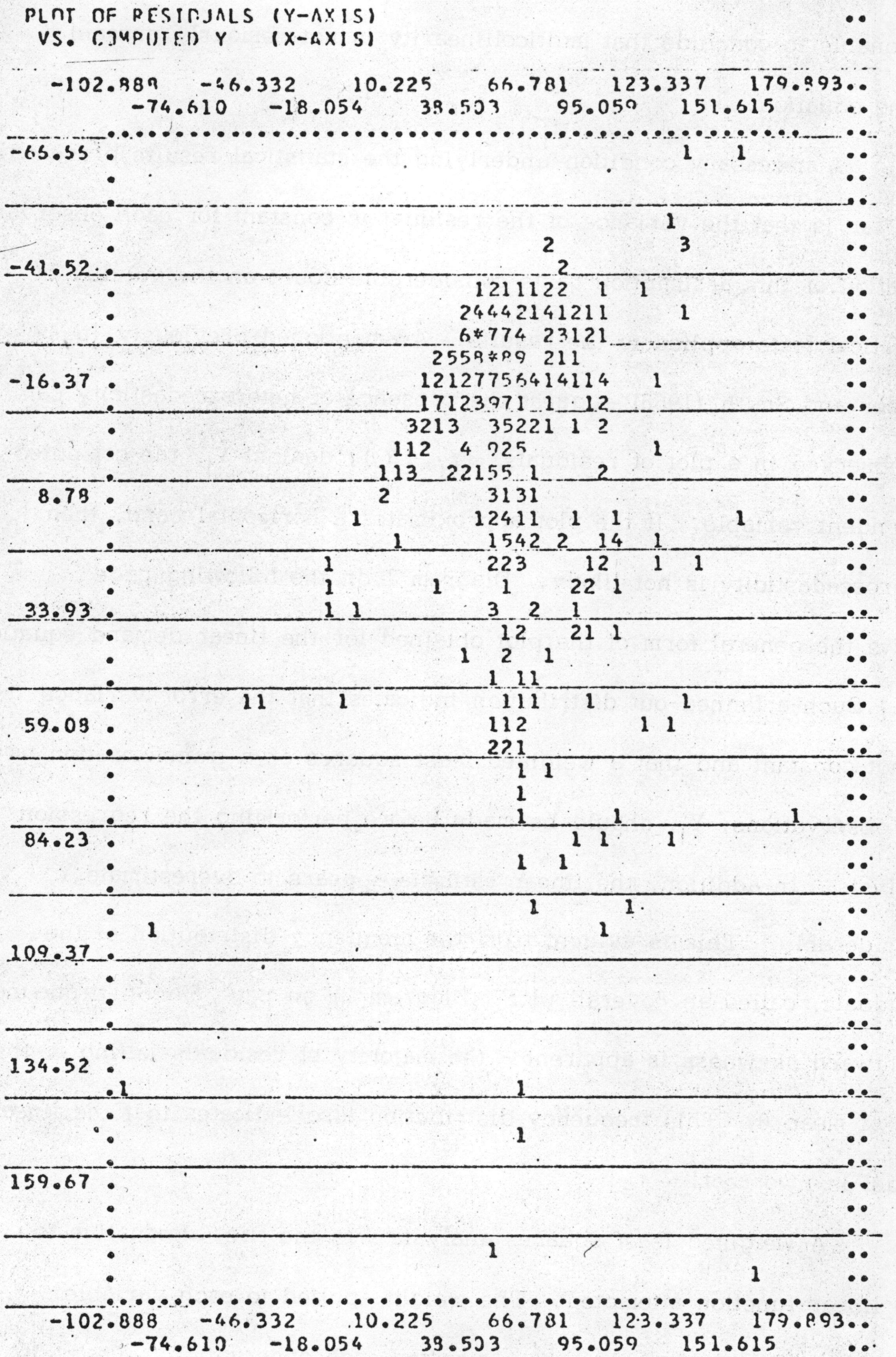

Diagram 1. Residual Plot : Linear Function.

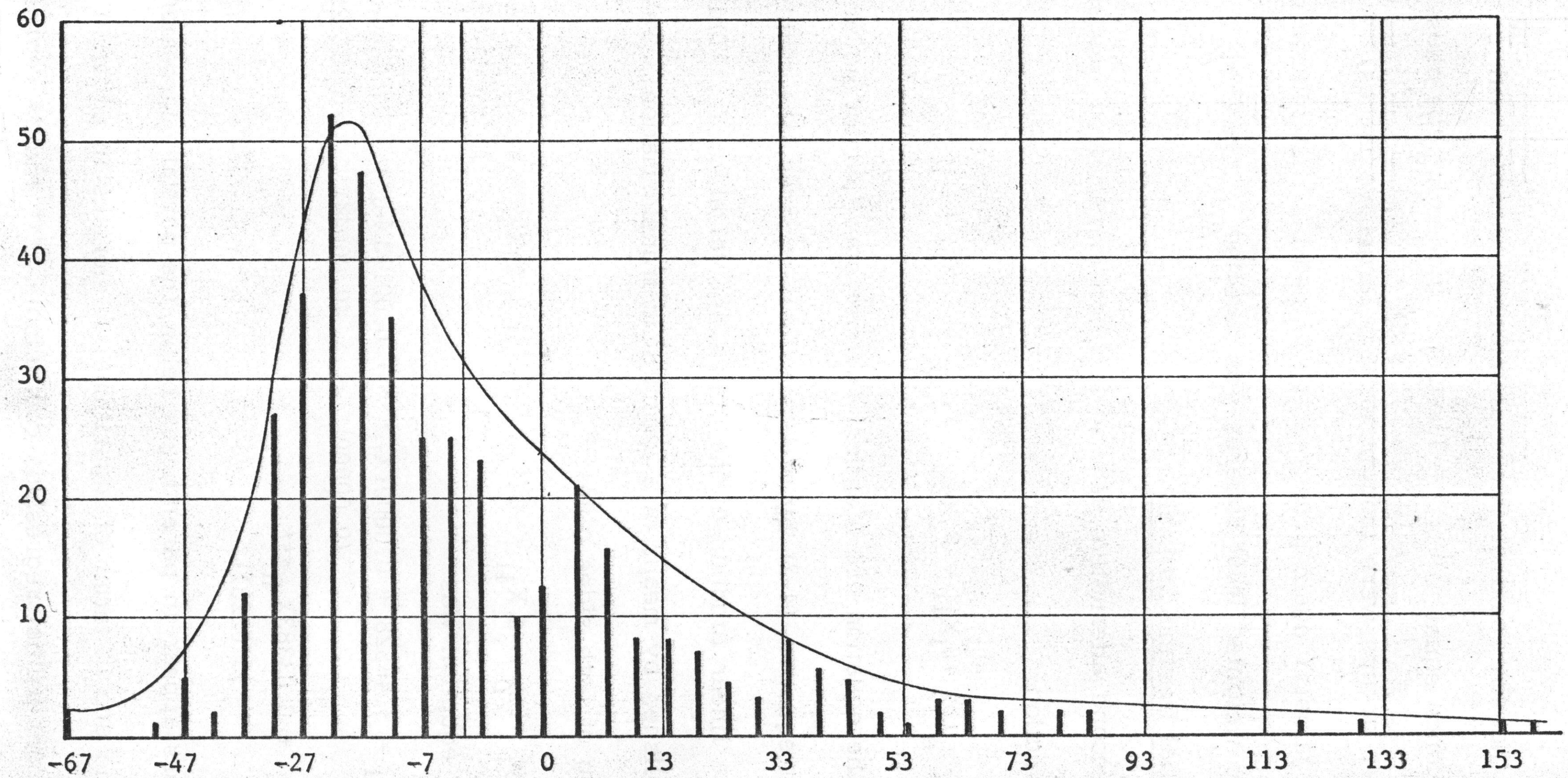

Diagram 2. Overall Plot: Linear Function
Frequency Distribution of $Y - \hat{Y}$

was assumed that the residuals were distributed normally with a zero mean and variance equal to $\frac{\sigma^2}{n}$. The logic underlying the chosen weight was that larger groups were thought to have larger variances. A plot of residuals against Y again produced the fanned-out distribution of Diagram 1 and weighted least squares was rejected.

The Exponential Demand Estimate

The second alternative demand function investigated was an exponential function:

$$(4\text{-}2) \qquad y_i = e^{(\beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \beta_4 X_{4i} + \varepsilon_i)}$$

Variables in the equation are identical to those specified for equation (4-1). In order to fit equation (4-2) by ordinary least squares, the right-hand side must be a linear function of the dependent variable, Y_i. This is easily accomplished by means of a logarithmic transformation. Taking the natural log of both sides gives:

$$(4\text{-}3) \qquad \ln y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \beta_4 X_{4i} + \varepsilon_i$$

The estimated equation was:

$$(4\text{-}4) \qquad \ln \hat{y}_i = 3.46528 + \underset{(0.00000)}{0.00001 X_{1i}^{***}} + \underset{(0.00044)}{0.00113 X_{2i}^{**}} - \underset{(0.01525)}{0.26756 X_{3i}^{***}}$$

$$+ \underset{(0.02231)}{0.03383 X_{4i}^{***}} \qquad R^2 = 0.4978$$

Standard errors appear in parentheses below the partial regression coefficients and are in terms of logarithms. Asterisks in equation (4-4) reflect significant partial regression coefficients; *** and ** represent significant "t" tests at the 0.001 and 0.02 levels, respectively. Taking the antilog of ln $\hat{Y}_i$ transforms equation (4-4) back into its exponential form:

$$(4\text{-}5) \quad \hat{Y}_i = e^{(3.46528 + 0.00001X_{1i} + 0.00113X_{2i} - 0.26756X_{3i} + 0.3383X_{4i})}$$

A plot of residuals against computed Y_i for the log-linear function (equation 4-4) appear in Diagram 3, page 62. The approximately random nature of the distribution indicates that the heteroscedasticity problem encountered in the linear function has been greatly modified. Further evidence of this is attested to in the "overall" plot that appears in Diagram 4, page 63. Its resemblance to a normal distribution is indicative of a correct model (Draper and Smith, 1966). By "correct" it is meant that the assumptions concerning the constancy and normality assumption of the error term in the demand model is satisfactorily met.

Since the partial regression coefficients in the exponential model (equation 4-5) were estimated by first transforming the dependent variable into a natural logairthm (equation 4-4), the statistical evaluation is restricted to log-linear (equation 4-4). As a result, statistics derived from the natural log form will not apply to equation (4-5).

Table 20 summarizes the values of partial regression coefficients, standard errors, t-tests and simple correlation coefficients as estimated by (equation 4-4).

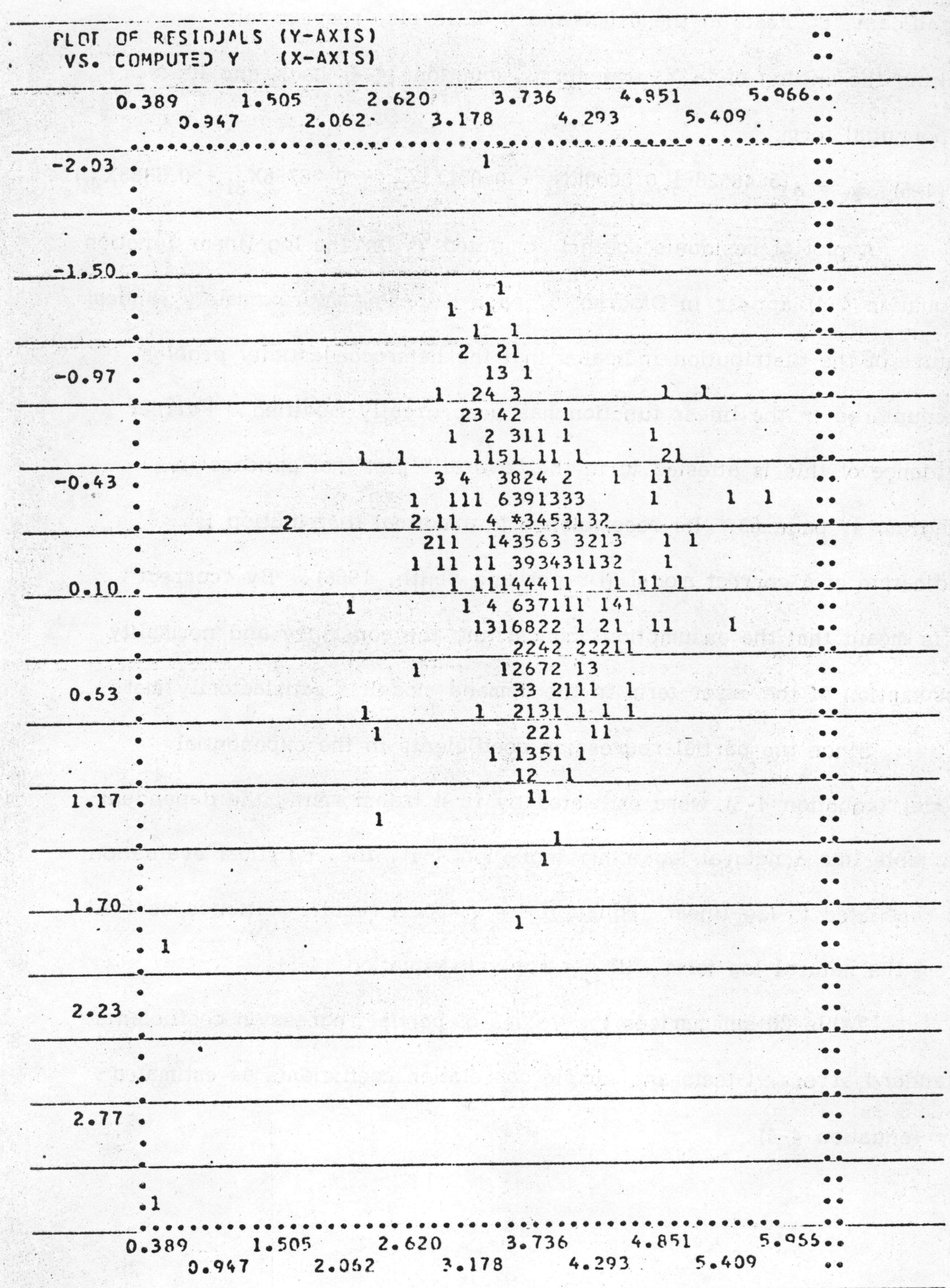

Diagram 3 Residual Plot: Exponential Function

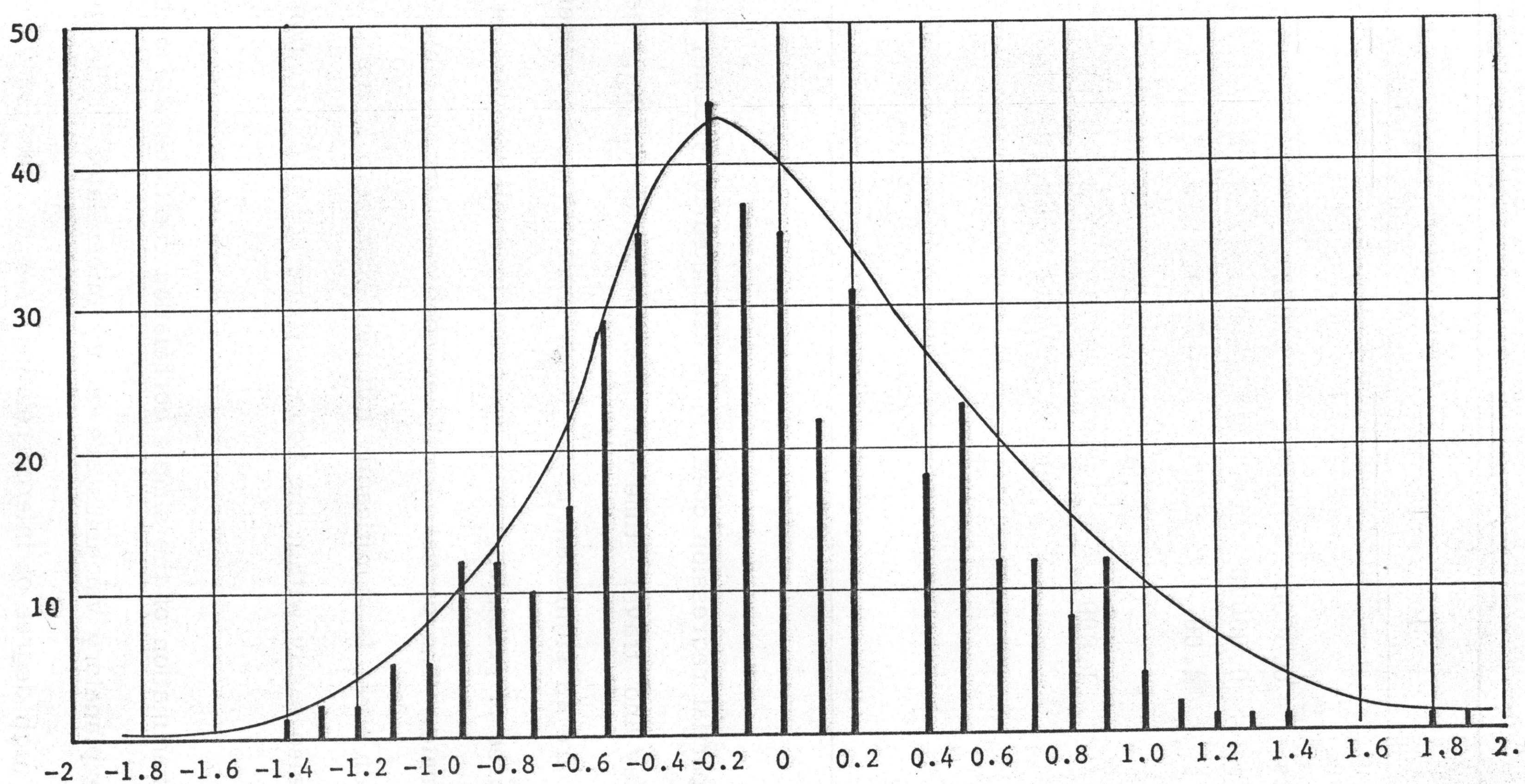

Diagram 4. Overall Plot: Linear Function

Frequency Distribution of $Y - \hat{Y}$

Table 20. Summary of Statistics for Variables in Equation 4-4 (Transformed exponential function).

	X_1	X_2	X_3	X_4	X_5
			-Values-		
Estimated Coefficients	0.00001	0.0043	-0.062	0.34	
Standard Errors	0.00000	0.00044	0.013	0.02	0.56
T Values	4.06	2.57	-17.54	15.17	
		Simple Correlation Coefficients			
X_1	1.000	-0.148	0.181	0.164	0.107
X_2		1,000	0.043	0.164	0.124
X_3			1.000	0.415	-0.396
X_4				1.000	0.348
lnY					1.000

The partial regression coefficients estimated for income, transfer cost/visitor day and travel time variables (variables X_1, X_3, and X_4, respectively) are all significant at the 0.001 level. This is indicative of a high degree of precision and is reflected in small standard errors for each estimate. The partial regression coefficient for variable X_2, annual vacation time, is significantly different than zero at the 0.02 level and is also easily within the bounds of the acceptable region (≤ 0.1).

An examination of the simple correlation coefficients shows that none of the explanatory variables are highly interrelated. The apparent absence of a high degree of intercorrelation does not necessarily ensure that multicollinearity is not present; however, in conjunction with the small standard errors, it would appear that multicollinearity, if present, is not of a serious degree (Kmenta, 1971).

The simple correlation coefficient for variables X_1 and X_2 (income and annual vacation time) appears to have an incorrect sign. Normally one would postulate that income and annual vacation time are positively correlated. This would be more likely if the annual vacation time variable corresponded to paid vacation time only. In equation (4-4), the variable included the annual vacation time of retired visitors. Since retired persons' likely "vacation" is less in proportion to their incomes than members of the labor force, their inclusion may have contributed to the negative correlation. However, a number of self-employed, professionals and farmers indicated having zero vacation time and this undoubtedly contributed to the negative association. Furthermore, income was entered into regression as the midpoint between a selected range in contrast to the actual quantity for vacation time. The imprecision associated with the income variable may, therefore, tend to obsure the actual relationship.

Notwithstanding that the sign of the simple correlation coefficient between income and annual vacation time appeared inconsistent, both variables in the regression equation had the sign hypothesized by economic logic and were estimated with a high degree of precision. The only other logical inconsistency concerning the hypothesized function was the positive partial regression coefficient for variable X_4, travel time. Since this matter has already been discussed in conjunction with the linear demand equation, further treatment is not necessary.

The square of the multiple correlation coefficient, R^2, for equation (4-4) equalled 0.498. In other words, 49.8% of the variation in visitor days, Y_i, between observations was accounted for by explanatory variables in the demand equation. This figure is almost 8% higher than the R^2 computed for the linear demand function, equation (4-1) however, this apparent increase in the explanatory power of equation (4-4) is misleading. As mentioned above, the dependent variable, $\hat{Y}_i$, in equation (4-4) is in terms of a natural logarithm. Edwards (1962) has pointed out that ". . . the mean of the logs of any pair of numbers lies below the log of the mean of the numbers." Consequently, a logarithmic function transformed into its original form may have substantially different predictive properties than those indicated by the logarithmic function. Cognizance of such an occurrence is especially important in this study since the logarithmic function was transformed back to its original exponential form for estimation purposes.

An indication of whether or not a serious bias is introduced when the logarithmic function is transformed into its original (exponential) form can be given by re-computing R^2 for the exponential function. This is accomplished by generating a new set of residuals, $(Y - \hat{Y})$ for the exponential function. R^2 is then calculated in the

standard way by summing the square of all residuals, $\sum_{i=1}^{\hat{}} (y_i - \hat{y}_i)^2$.
Thus, $\sum_{i=1}^{\hat{}} (y_i - \hat{y}_i)^2 \Big/ \sum_{i=1}^{n} (y - \bar{y})^2$ for equation 4-5 was 0.412.
Before a conclusion can be reached as to whether the lower R^2 is "serious", additional factors should be considered.

Guedry (1971) notes that the R^2 calculated for the exponential cannot be given its usual interpretation because the residuals "arise from a model other than the model to which the least squares analysis was actually applied." It should be added that the adjusted R^2 obtained by transforming the logarithmic function into its exponential form will always be smaller than that calculated for the former. Despite this, the amount of divergence between R^2 for the exponential and log functions can indicate if the residuals have been seriously affected by the transformation (Guedry, 1971).

At first thought, the 7.81% reduction in explained variation may appear to dangerously bias results. Several factors tend to support contrary conclusions. First and foremost, the approximately random nature of the plot of residuals against computed Y_i in Diagram 5 demonstrates that the exponential function conforms reasonably well to the constant variance assumption of the general linear model. Secondly, 52% of the unexplained variation was due to twenty-five "outliers" - predicted values accompanied by large residuals (an absolute value $\geq$ 73). Interestingly, all but one of these outliers represented a gross underprediction. Furthermore, most underpredictions were made on visitors who stayed

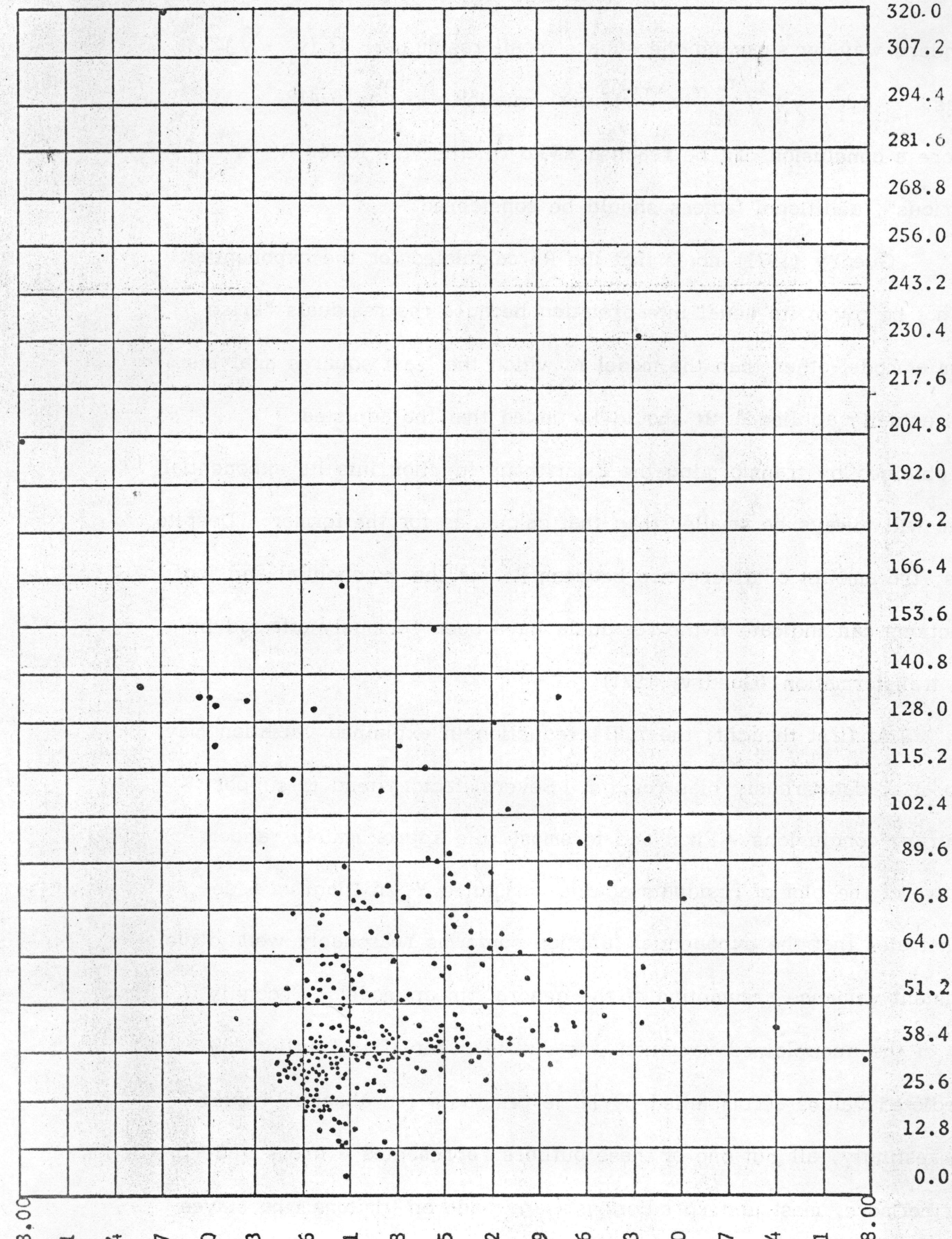

Diagram 5. Residual Plot for Exponential Function.

in the Sawtooths much longer than the average group while traveling a relatively short distance to do so. Thus, they were atypical of the sample as a whole; however, their inclusion in the sample was deemed necessary as justifiable reasons for excluding them were not apparent (Draper and Smith, 1966).

The last factor to be examined is the ability of the exponential function to predict total visitor days for the entire sample. Summing computed length-of-stay for each observation yields 19,787 predicted visitor days. Since the actual sample total is 24,459, the exponential function underestimates total visitor days by 19%. Twenty-four observations (5.65% of the sample) with residuals greater than 73 accounted for nearly 45% of this difference. In addition, all of these observations had lengths-of-stay greater than twice the sample average.

An examination of these outliers exposed that 71% (17) had travel times substantially less than the sample average. Furthermore, travel time was positively correlated with length-of-stay in the sample. Thus, long visitations and short travel times coupled with the positive association between the two variables underlies most of the lack-of-fit in the outliers.

Another factor that may have explained the dissimilarity of the outliers with the rest of the sample was the group size of sampled units, i.e. observations with large group sizes (≥ 8) were poorly fitted. Although 5 of the 24 largest outliers were above average in group size; an examination of other sampled units with large group sizes failed to produce a discernable trend.

The inability of the exponential function as specified in equation (4-4) to explain more of the variation in Y probably stems from the absence of qualitative variables in the equation. By "qualitative" it is meant features of the recreational experience that do not easily lend themselves to quantification. Personal tastes and preferences would fall in the qualitative category; e.g., the intensity of likes or dislikes towards the physical features of a recreational area.

Despite the lack of qualitative variables in equation (4-4) and its tendency to underpredict visitor days, it is still useful for projection and estimation purposes. Several factors support this contention; namely, 1) the structural parameters in the equation are highly significant and exhibit correct signs, 2) lack of intercorrelation between explanatory variables, and 3) the equation is a good predictor based on the F-ratio for the regression = 73.5 which is greater than the tabulated $F(4,420\ 0.99) = 3.95$. Thus, the exponential function will be employed to obtain an estimate of net economic value and a projection of future visitor day levels for recreation in the Sawtooths.

CHAPTER 5

NET ECONOMIC VALUE ESTIMATE AND FUTURE USE PROJECTION FOR RECREATION IN THE SAWTOOTHS

An estimate of the net economic value accruing to users of the Sawtooth recreational resource can be obtained directly from the recreational demand estimate specified in equation (4-5). The economic value estimate will be net in the sense that it purports to measure the economic value or benefits derived by users in excess of actual expenditures made on the Sawtooth trip. As discussed in an earlier section, trip expenditures *per se* are not a proper measure of recreational value. A discussion of the theoretical construction employed will lead to a better understanding of the economic rationale underlying the net economic approach to recreational resource valuation.

Alfred Marshall proposed that consumers are willing to pay more for the consumption of goods and services than the price they actually do pay (Marshall, 1956). Thus, consumers receive a "surplus" satisfaction whenever the price paid for goods and services is less than the value derived therefrom. Marshall called the surplus satisfaction "consumer's surplus." He defined it as "the excess in the price which the consumer would be willing to pay rather than go without the thing over that which he actually does pay" (Marshall, 1956). The following diagram should help to clarify the consumer's surplus concept as applied to recreational resource valuation.

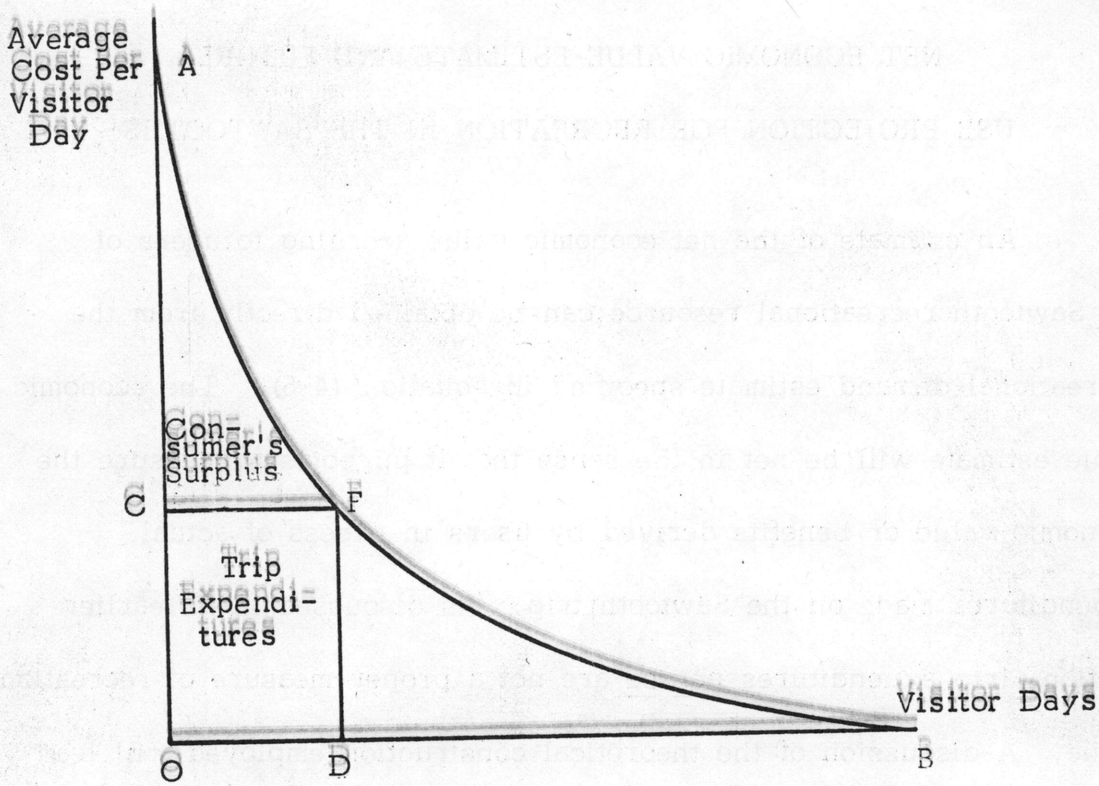

Diagram 6: Hypothetical Group Demand Curve for Recreation in the Sawtooths

The group demand curve in Diagram 6, although hypothetical, depicts the approximate shape of group demand curves derivable from equation (4-5). Its negative slope agrees with the established law of demand; i.e., consumers will demand more (less) of something at a lower (higher) price. The consumer's surplus region, CAF, corresponds to the net economic value measure discussed previously. Total recreational value to the hypothetical group equals area OAFD. Gross or total value is not included in the recreational resource value estimate since recreational benefits in a nationwide sense would be overstated. This largely stems from the reasoning that trip expenditures would normally reappear as expenditures on other recreational opportunities in the absence of a particular recreational opportunity; they do not reflect a net economic loss of value sustained by the group of recreationists.

With reference to Diagram 6, it can be seen that the hypothetical group paid an average transfer cost (price) of OC to experience OD visitor days of recreation. However, the demand curve, AB, as the group's expressed willingness to pay, shows that group would have been willing to spend an amount represented by CAF in addition to what they actually paid (area OCFD) to consume OD visitor days of recreation. It appears that the group has received a "free" benefit from their recreational pursuit. However, the "free" benefit or consumer's surplus region can be given a different interpretation. If the group were charged for each increment of recreation consumed to position F, they would receive zero free or surplus satisfaction but the same aggregate satisfaction as received at an average price of only OC.

A critical assumption necessary for the imputation of recreational value vis-a-vis the consumer's surplus approach is that the demand curve equates the group's marginal cost of obtaining an additional unit of recreation with the marginal value or satisfaction derived from the addition consumption of recreation. This assumption, of course, applies to demand curves for any commodity. To be more theoretically sound, the demand derivation should hold a group's real income constant; i.e., if a group is to maintain a given level of satisfaction while subjected to higher or lower prices of consumption, they must be compensated for losses or gains of income respectively. (For a detailed treatment of this matter see J. R. Hicks, "A Revision of Demand Theory," Chapter 8). As Hicks points out, for most commodities the "compensated" and "uncompensated" demand curves will be practically similar. Group demand curves in this study were uncompensated in that group income levels were held constant in the curve's derivation. In practice, deriving the Hicksian compensated demand curve for recreation would be extremely difficult.

Before proceeding to estimate recreational values accruing to groups visiting the Sawtooths during the 1971 summer season, an explicit account should be made of an important misunderstanding commonly made in reference to recreational valuation. Specifically, the misunderstanding pertains to the belief that use of publicly provided outdoor recreation cannot be valued because of its non-market nature. Actually, outdoor recreation differs only in kind, but not in principle, from the consumption of marketed goods and services (Knetsch and Davis, 1966). The absence of a market mechanism in the provision of outdoor recreation does necessitate the imputation of recreational value. The imputed value to be derived will measure the aggregation of consumer's surpluses for all groups sampled during the 1971 summer recreational season. This aggregation will be "expanded" using the inverse of the sampling rate to obtain the net economic value estimate of recreation accruing to all summer recreationists visiting the Sawtooths in 1971. The "expansion" factor used in this study was based on a sampling rate of 3.5% of total visitor day use levels (excluding summer home use and organization sites) in the Stanley and Sawtooth Valley Ranger Districts. Total visitor day use levels in the study area and sample were 703,100 and 24,468 respectively. Dividing the sample's visitor day level by total visitor days in the study area resulted in the rate of 3.5%.

The statistical demand equation described in equation (4-5) represents the average recreational group in the sample. To obtain the group consumer's surplus (net economic value), the statistical demand curve for the group is integrated between observed average transfer cost per visitor day (position C in Diagram 6) and infinity. An infinite average transfer cost is the upward limit but the consumer's surplus area approaches its maximum value at a price much lower than infinity (see Appendix B). Summing the integral for each group's demand schedule results in the sample consumers' surplus:

$$\left[\sum_{i=1}^{425} \frac{\hat{Y}_i}{b_3} \right] = \$74.150$$

Multiplying this amount by the expansion factor (28.75) gives the estimate of net economic value accruing to summer recreationists in the Sawtooth area and imputes the resource value of Sawtooth recreation:

($74,150) (28.75) = $2,131,813.

This value should be regarded as an underestimate since the demand equation used in its computation generally tended to underestimate predicated visitor days per group. In addition, the estimate excludes values accruing to summer home residents and organization camps since they were not sampled in the study.

Although the estimate is probably low, the value per visitor day conforms quite closely to values proposed in the Water Resources Council's Proposed Principles and Standards for Planning Water and Related Land Resources" (in the Federal Register dated December 21, 1971). Their proposed values for a recreational day in areas characterized by generally limited opportunities, low intensity of use and relatively large personal expenses ranged from 3 to 9 dollars per visitor day. The net economic value estimate for summer recreation in the Sawtooths produces an <u>average</u> per visitor day value of $3.03. This was obtained by dividing the total consumers' surplus value by the 1971 visitor day use levels in the study area (excluding use levels at summer home sites and organization sites).

A statistical adjustment can be made on the estimated demand equation (4-5) that may result in a more accurate computation of the net economic value. The adjustment is accomplished by adjusting the equation's constant term so that the sum of predicted visitor days for the sample equals the actual sum. In effect, the adjustment shifts the aggregate demand schedule to the right until it intersects the point corresponding to actual visitor days in the sample. The adjusted equation becomes:

$$\text{(4-6)} \quad \hat{Y}_i = e^{3.8154 + 0.00001X_{1i} + 0.00113X_{2i} - 0.268X_{3i} + 0.338X_{4i}}$$

Computing the net economic value estimate from equation (4-6) gives $2,627,816, a 23% increase in recreational value over that derived from equation (4-5) and the average value per visitor day becomes $3.73.

A net economic value estimate was also obtained from the linear demand function, equation (4-2), to provide additional perspective on the values imputed by the exponential form. The linear estimation resulted in a net economic value estimate of $3,061,213. Since the linear function tended to overestimate visitor days per group, this value should be considered high. In addition, previous statistical tests conducted on the linear function cast serious doubt on the acceptability of the linear model itself.

With the limitations underlying each estimating equation in mind, it appears that the net economic value estimate imputed by the adjusted exponential function should be adopted as the most acceptable measure of recreational resource value for the Sawtooth experience.

At the Federal level, standards in existence (Senate Document 97) and proposed (Federal Register, December 21, 1971) have placed values on a visitor day of recreation ranging from $0.50 to $9.00. From the demand equation estimated for the Sawtooth area, it has been estimated that the per visitor day value of recreation is $3.73. The principal purpose in establishing these values is to place a value or benefit measure on projects that provide recreational opportunities. In conjunction with estimated project costs and appropriate discounting procedures, a framework is thereby provided within which project costs and benefits can be compared.

Several major limitations to evaluating publicly provided recreational opportunities in the above manner should be pointed out. Benefits attributable to a public recreational project are estimated in the absence of an effective market. The non-market nature of the recreational commodity has necessitated the imputation of recreational benefits on the basis of simulated willingness to pay schedules; i.e., recreational demand curves. Recreational resource values derived from these schedules and put forth by the Federal government are not comparable to the value of market alternative uses of the same resource base; i.e., market values would normally be established on the basis of competitively determined prices that would maximize market returns. Thus, a dichotomy is created which precludes an accurate assessment of the opportunity costs associated with alternative uses of the same resource base.

Another dichotomy arises in the comparison of project benefits to project costs. Project costs are determined from expenditure outlays made for resources used in the construction and maintenance of a given facility. The value of these resource inputs to the project (costs of the project) is largely determined in the private economy and therefore is not strictly comparable to benefits established on the value per unit of recreation basis.

At this time the question should be asked "Just what usefulness do imputed measures of recreation values have?" Albeit imperfect, the value per visitor day measurement does provide a decision-making tool over that recorded in 1971. One problem with the trend analysis is the cumulative effect caused by the compound growth factor. Long periods of analysis to which the compounded growth rate is applied may introduce upward biases in the estimates. In order to compromise the ramifications of too low or too high a growth rate, perhaps the mid-range factor of 2.75% should receive the most scrutiny from resource managers.

Recreational resource value estimates associated with each projection were estimated by multiplying the imputed value per visitor day ($3.73) by the predicted use level. This necessarily assumes that the quality of the recreational experience afforded visitors in 1971, relative costs per trip, and characteristics remain essentially unaltered through 2000. Obviously the validity of this assumption is questionable. Future demand studies in the Sawtooth area should probably be conducted to make necessary adjustments.

Planning to provide a high quality recreational experience for a rising population of recreationists without loss of environmental quality or the creation of harmful externalities will require forsighted planning. Statistics published in Forest Service RIM data sheets report that campground use levels at Redfish and Alturus Lake are averaging over 50% of theoretical seasonal capacity. However, this statistic is somewhat misleading. Theoretical seasonal capacity is based on an occupancy of five persons at one time (PAOT) at all sites in a given campground throughout the summer management season (93-120 days).

The "peak" period between July and September realizes nearly 100% of theoretical seasonal capacity at campgrounds in juxtaposition to major lakes in the area. In addition, the weekly distribution of use falls most heavily between Friday and Monday. A consequence of these concentrated period of use is a supply shortage of developed campsites. Visitors unable to find developed campsites are forced to accommodate themselves at ledd desirable and often undeveloped locations. Anxiety created from long delays and the uncertainty of finding unoccupied campsites may seriously detract from the recreational experience of those affected. Furthermore, environmental degradation caused by visitors setting up camp in undeveloped areas is potentially a serious concern.

It is important to note that the campgrounds adjacent to the Salmon River or at locations not in the proximity of surface water receive much lower use rates. Many recreationists apparently have an affinity for lake-oriented recreation. Visitor's desires for lake campground facilities should receive future study.

CHAPTER VI

SUMMARY AND CONCLUSIONS

Summary

A questionnaire was administered to a sample of recreationists in the Sawtooth Valley and Mountain Area during the 1971 summer recreational season. The principal objective of the questionnaire was to assess visitors' socio-economic characteristics, recreational activity participation and collect cost of trip information for the purpose of estimating recreational demand and resource value.

Groups visiting the Sawtooths predominantly came from urban locations in southern Idaho and states to the south of Idaho (California, Utah, Nevada and Arizona). Recreational groups tended to have high income earnings, averaging $14,400 per year. The majority of groups were composed of family members. Principal recreational activities included camping, sightseeing, fishing, hiking, photography and swimming.

Trip expenditures averaged $89.93 for Idaho residents and $396.76 for out-of-state visitors. However, these amounts cannot be attributed solely to the Sawtooth trip since approximately one-half of the sampled visitors had trip purposes in addition to visiting the Sawtooth area. It was estimated that recreationists spent approximately $1,174,000 in the Sawtooth region. Although these expenditures may have had a significant first-round economic impact on the local trade and service sectors, secondary economic imports on other business sectors in the regional economy of the Sawtooth area was probably small. Recreational expenditures may tend to benefit Idaho's economy in general more so than the local area where the expenditures were made.

Linear and exponential statistical demand equations were hypothesized to obtain an estimate of net economic value accruing to Sawtooth recreationists. The linear form was rejected because it violated the assumption of a constant variance of error terms in the general linear model employed. The exponential function, although having the tendency to underestimate visitor days demanded, was adopted for the net economic value estimate since it conformed to the assumptions of the general linear model. An adjusted exponential equation was formulated to compensate for the underestimation tendency of the unadjusted form.

The consumers' surplus approach to estimating the net economic value accruing to Sawtooth recreationists resulted in an estimate of $2,131,813 (unadjusted). A net economic value of $2,627,816 was derived from the adjusted exponential equation. Since the original expontional demand equation underestimated use levels, a decision was made to adopt the net economic value estimate computed from the adjusted exponential equation as the most acceptable measure. The adjusted model yielded an average recreational value per visitor day of $3.73.

Future use projections for the Sawtooth study area were based upon two methods. One, utilizing the adjusted exponential demand equation with income and United States population as demand shifters, produced the smallest projected increase - 980,000 visitor days by 2000. The other method employed growth rates derived by a trend analysis of previous visitor day use levels in the study area. On this basis, use levels were projected to reach 1,082,800, 1,544,100, and 2,192,700 by 2000. The successive increases stem from assumed annual rates of growth of 1.5%, 2.75% and 4.0% respectively.

Conclusions

The consumers' surplus approach to imputing the net economic value accruing to users of a recreational resource is not without limitations. The non-market nature of publicly provided recreation has necessitated the imputation of recreational benefits on the basis of simulated willingness to pay schedules; i.e. recreation demand curves. Recreational values derived from these schedules are not comparable to the value of market alternative uses of the same resource base.

Despite this inherent weakness of the valuation approach, the value per visitor day measurement does provide a decision-making tool from which "returns" to public expenditures on recreational projects can be evaluated. Moreover, comparing all proposed recreational developments on a standardized basis potentially affords a framework for more objective economic assessments of future recreational utilization of our nation's natural resource base.

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APPENDICES

APPENDIX A

METHOD OF ALLOCATING TRANSFER COSTS FOR VISITORS WHO VISITED AREAS IN ADDITION TO THE SAWTOOTHS

Approximately 45% of the sampled visitors indicated that areas in addition to the Sawtooths were visited on their trip. Trip cost information provided by the questionnaire pertained to the entire trip and thus included expenditures attributable to all areas visited. Allocating this entire amount to the Sawtooth visit would necessarily have overstated visitors' willingness to pay for the Sawtooth experience. Such an over-valuation reflected in the transfer cost variable of the demand equation would have biased the demand estimated.

Ideally, knowledge of expenditures incurred at each site visited would have allowed expenses to be apportioned to each area in a straightforward fashion. Since this information was lacking, an alternative method was developed to allocate trip expenses to the Sawtooths for the segment of the sample that visited other areas.

There were two classes of visitors in the category of having visited other areas; namely:

I. visitors who indicated that the Sawtooth visit was the trip's main purpose (Class I).

II. visitors who had other main purposes for the trip (Class II).

It was reasoned that each class should receive separate treatment. In addition, respondents listing overnight rest stops as visits to other area were not included in the above classification. These visitors were directly enroute to the Sawtooths and required the stops due to the travel distance involved.

Class I

Since class I visitors indicated that the Sawtooth visit was the trip's main intent, it was assumed that these visitors would have visited the Sawtooths even if the other areas had not been visited. If one accepts the supposition that the utility class I visitors derived from other areas was small relative to utility gained from the Sawtooth experience, then the previously mentioned assumption appears to be plausible. In other words, the sacrifice of satisfaction gained from visits incidental to the trip's primary purpose would not alter one's decision to visit the Sawtooth area.

Provided that the above statements are true, it follows that a class I visitor would be willing to incurr at least the time and travel expense of the shortest route to the area. This minimum distance would establish the least possible cost in terms of travel time and travel expense. Thus, a class I visitor traveling 1,000 miles to and from the Sawtooths but who could have traveled 800 miles without the diversions would be assigned 800 miles for the Sawtooth trip. The shortest-route criterion generally resulted in a substantial portion of trip travel cost and travel time being allocated to the Sawtooths. Since for class I visitors the Sawtooth destination was their trip's main intent, this result appeared reasonable.

Another method was employed to allocate variable transfer costs. Variable transfer costs consisted of items such as lodging, recreational supplies, rentals and miscellaneous items. These expenses were prorated on the basis of time spent at each area visited. Thus, if the total time spent at all areas was fourteen days and seven days were spent in the Sawtooths, 7/14 or 50% of variable transfer costs for the entire trip would estimate the amount attributable to the Sawtooth trip.

This procedure results in a constant variable transfer cost per day for all areas visited. Since for a large percentage of trip transfer costs are generally incurred prior to the trip itself, a constant per day cost may not differ greatly from the actual amount spent at each area.

<u>Class II</u>

This class of visitor created a perplexing problem for transfer cost allocation. Characteristically, class II visitors spent more of their total trip time at outdoor recreational areas other than the Sawtooths, i.e., many were on extended trips that involved visits to several areas. All of these visitors had trip purposes other than recreating solely in the Sawtooths. It was, therefore, assumed that the Sawtooth visit would not have been made if the other areas had not been visited. The shortest travel route criterion used in conjunction with class I visitors is thus precluded as a means of allocating travel distance for Class II visitors

Several alternative allocation means were evaluated and subsequently rejected. A decision was finally made to allocate all travel costs, variable costs and travel time on the basis of the Sawtooths pro-rata share of total visitation time in all areas visited. This was the same criterion applied to variable transfer costs incurred by class I visitors.

APPENDIX B

MATHEMATICAL DERIVATION OF GROUP CONSUMER'S SURPLUS

The statistical demand equation for recreational groups visiting the Sawtooths is:

(1) $\hat{Y}_i = e^{3.47 + 0.0001X_{1i} + 0.00113X_{2i} - 0.268X_{3i} + 0.3383X_{4i}}$

Substituting the observed values for variables X_{1i}, X_{2i}, and X_4 results in (1) expressed as:

(2) $\hat{y}_i = e^{a - 0.268X_{3i}}$,

where $a = 3.47 + .00001X_{1i} + 0.00113X_{2i} + 0.3383X_{4i}$.

The indefinite integral of (2) = $\int e^{a - 0.268X_{3i}} \, d X_{3i} = e^a(-e \frac{-0.268X_{3i}}{0.268}) =$

$$\frac{-e^{a - 0.268X_{3i}}}{0.268} \quad . \quad (3)$$

Integrating (2) between zero added cost (X_{3i}) and infinity, ∞ :

$$\int_0^\infty e^{a - 0.268X_{3i}} = \Big|_0^\infty = 0 - \left[\frac{-e^{a - 0.268(0)}}{0.268}\right] = \frac{e^a}{0.268} \quad . \quad (4)$$

Since zero added cost equals the observed group transfer cost, X_{3i}, expression (4) is identical to $\frac{e^{a-0.268X_{3i}}}{0.268}$, (5). From expression (2), (5) is identical to $\frac{\hat{y}_i}{0.268}$ = group i's consumer's surplus.

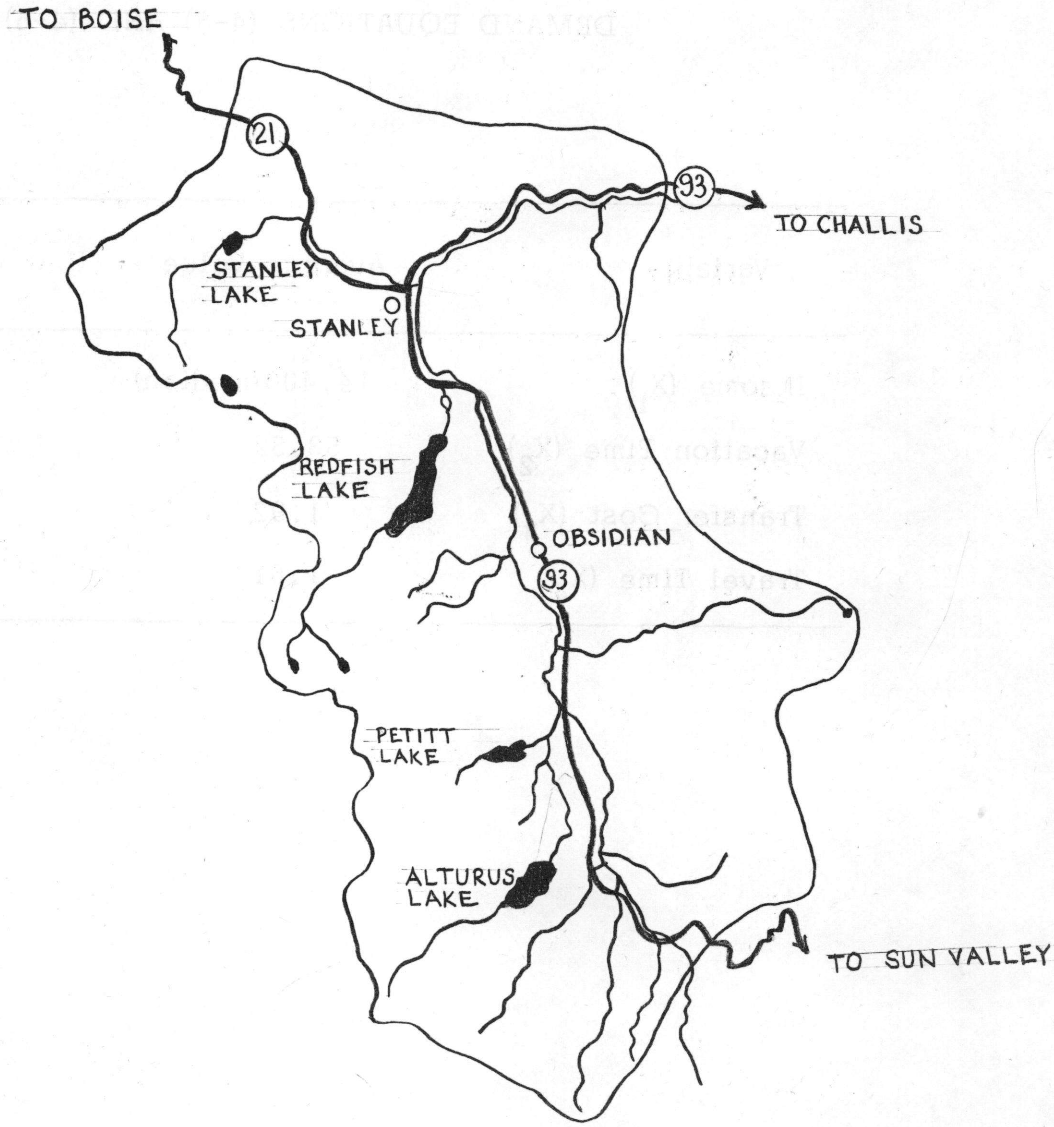
APPENDIX C

AVERAGE VALUES FOR VARIABLES IN DEMAND EQUATIONS (4-5) AND (4-6)

Variable	Average Value	Unit of Measure
Income (X_1)	14,400(median)	Dollars
Vacation Time (X_2)	53.52	Visitor Days
Transfer Cost (X_3)	1.92	Dollars
Travel Time (X_4)	1.61	Visitor Days

APPENDIX D: QUESTIONNAIRE

RECREATIONAL SURVEY--SAWTOOTH VALLEY AND MOUNTAIN AREA



INTRODUCTION

The Forest Service and the University of Idaho are conducting a study to gain more knowledge about recreational use and related impacts in the Sawtooth Valley and Mountain Area.

As a user of the area, you are being surveyed to provide basic information that is essential to the study. Future management and development plans will be affected by information provided in this questionnaire.

Please be of assistance by answering the questions as carefully as you can. Your answers will be strictly confidential.

1. Is this your first trip to the Sawtooth Area? Yes_____ No_____

If not, how many trips have you made: this year___in previous years_______

2. How did you find out about the Sawtooth Area?

_______Friends
_______Relatives
_______General Reading (magazines, books)
_______Advertisement
_______Previous visit
_______Other (explain)____________________

____

Comments:____________________

____

____

3a. Do you consider this visit to the Sawtooth Area the only purpose of your trip? Yes___ No____

If not, then what is the purpose? ____________________

____

3b. What type of visit are you making?

______Annual vacation
______One of two or more annual vacations
______Weekend trip
______Combined business-vacation
______Other (explain)____________________

4a. Did you stop to visit any other places on your trip here? Yes___ No_____

If so, please indicate:

	Where	Length of Visit	Type of Visit
1.			
2.			
3.			
4.			
5.			

4b. Will you visit any places on your trip home? Yes___ No____

	Where	Length of Visit	Type of Visit
1.			
2.			
3.			
4.			
5.			

5a. Based on your experience in this part of the Sawtooth Area, would you like to see:

	More	Less	No Change	No Opinion
Campsites	____	____	________	________
Campgrounds	____	____	________	________
Firewood	____	____	________	________
Well water	____	____	________	________
Toilets	____	____	________	________
Litter Disposal	____	____	________	________
Hiking Trails	____	____	________	________
Motor Bike Trails	____	____	________	________
Access Trails	____	____	________	________
Recreational subdivisions	____	____	________	________
Other (explain)				
________________	____	____	________	________

Comments:____

____

____

5b. Would you suggest any changes (not covered in question 5a) that would make your stay more enjoyable? Yes___ No___

If so, please describe:__________________________________

____

____

5c. Have there been any negative aspects to your visit here? Yes__ No__

If so, please describe: __________________________________

____

____

5d. How would you describe the Sawtooth area in relation to the number of people?

______Used beyond capacity
______About right
______Used under capacity
______No opinion

6. Your opinion is needed to help determine whether the Sawtooth Valley and Mountain Area should become either a National Recreational Area, a National Park, some combination of both, or be left as it is. Please indicate your preference below.

______National Park
______National Recreation Area
______Combination
______Left as it is
______No opinion

Comments:____

7. The Sawtooth Area appeals to people for many different reasons.

	Which activities are you participating in?	Please rank, by number, the activities you participate in most (1=most participation)
Fishing	____	____
Camping	____	____
Canoeing or Rafting	____	____
Power Boating	____	____
Water Skiing	____	____
Hiking	____	____
Back Packing	____	____
Horse Riding	____	____
Motor Bike Riding	____	____
General enjoyment and sightseeing	____	____
Swimming	____	____
Photography	____	____
Other (specify): ____________		

____

8. Do you feel that for this part of the Sawtooth Area, opportunities to enjoy the items listed below are:

	Excellent	Good	Fair	Poor	No Opinion
Scenic Beauty	____	____	____	____	____
Wildlife	____	____	____	____	____
Family Unity	____	____	____	____	____
History of Area	____	____	____	____	____
Escape from Society	____	____	____	____	____
Other (Specify): ____________					

____

9. What category best describes the group you are visiting with?

___ As an individual
___ Family
___ Family and Relatives
___ Husband or wife
___ Family and Friends
___ Friends
___ Other (specify): ____________________

9a. How many are in this group?

___ Males 18 and over
___ Males under 18

___ Females 18 and over
___ Females under 18

10a. Where do you live? City____________________ State____________

or Province____________________

If you live outside the U.S. and Canada: Country:______________

10b. What is your:

Age__ Sex__ Occupation____________________________________

Years in this occupation________ Relation to head of family__________

10c. How many weeks of paid vacation do you have each year? ________ wks
Total annual vacation time (not including holidays) ________ wks.

10d. If you are retired, how many weeks do you vacation each year?________ wks.

10e. How long will you stay in the Sawtooth Area this trip?_____ days.

10F. Do you plan to come back in the future? Yes__ No__ WHY____________

____

____

11. Which category best describes the location you:

Presently live	Years in that Location	Lived prior to age 18	Years in each Location
___Farm	___	___Farm	___
___Rural Non-Farm	___	___Rural Non-Farm	___
___Town (5,000 or less)	___	___Town (5,000 or less)	___
___City (5,000-25,000)	___	___City (5,000-25,000)	___
___City (25,000-100,000)	___	___City (25,000-100,000)	___
___City (100,000-1,000,000)	___	___City (100,000-1,000,000)	___
___City over 1,000,000)	___	___City (over 1,000,000)	___

12. What was the approximate total yearly income of your family in 1970?

_____Less than 2,999
_____3,000-4,999
_____5,000-6,999
_____7,000-9,999
_____10,000-14,999
_____15,000-19,999
_____20,000-24,999
_____over 25,000

13. What is the highest level of education you have completed?

_____Grade 0-8
_____Grade 9-12
_____Some college or additional schooling
_____College graduate
_____Postgraduate degree

14. About how many miles did you travel coming here? ________________miles
    About how many miles will you travel going back? ________________miles

    How many hours or days:

    1. Did you spend traveling here? ______hrs. _____days
    2. Will you spend traveling home? _____hrs. _____days

15a. What will be the approximate total cost of your entire trip? ______

    How much of this will be spent in Idaho? _______

15b. How much do you expect to spend on the entire trip for:

	TOTAL	IN IDAHO
A. Transportation		
Personal Vehicle (gas, repairs, etc.)	_____	________
Fares (bus, plane, train, etc.)	_____	________
Other (explain): _________________	_____	________
Lodging (motels, campground, fees, etc.)	_____	_________
Food and beverage	_____	__________
Guide or outfitter services	_______	___________
Recreational supplies (lures, licenses)	_______	___________
Rental of:		
Boat, motor, and equipment	______	_________
Tackle and gear	______	_________
Other (magazines, film, etc.)	______	_________

15a. How many people do the above expenditures cover?______________. Approximately what percentage of your total trip cost was spent in the Sawtooth Valley and Mountain Area? ___________%

Interviewer____

Weather____Temperature__________

Place____

Date___________________________________Time_____________________________

Accommodations: _____Tent ____Trailer
_____Camper _____Other