AN ABSTRACT OF THE THESIS OF

FARID HASSAN NAWAS for the Doctor of Philosophy
(Name of student) (Degree)

in Agricultural Economics presented on March 7, 1972
(Major) (Date)

Title: THE OREGON BIG GAME RESOURCE: AN ECONOMIC EVALUATION

Abstract approved: Signature redacted for privacy.
W. G. Brown

Despite the obvious importance of the Oregon big game resource to Oregon citizens, economic data regarding the actual magnitude of net and gross values have been lacking. Thus an attempt has been made in this thesis to supply the missing information by estimating the gross economic value and by formulating a demand model from which the net economic value of the Oregon big game resource can be derived.

The gross economic value of the Oregon big game resource, including both the investment in hunting and related equipment and hunting trip expenses, was obtained from two questionnaires mailed to a random sample of Oregon big hunters during the summer and fall of 1968. It was estimated that hunter families averaged about $239 per year for hunting and associated equipment. A total

investment by all Oregon hunters of $44.6 million in 1968 was estimated. It was also estimated that hunter families averaged about $118.70 on big game hunting trips during 1968. Total big game hunting trip expenses for all Oregon hunters were estimated to be $18.6 million. Thus, combining investment in hunting and associated equipment with total trip expenses gave a total estimated expenditure of $63.2 million by Oregon big game hunters in 1968.

Net economic value (which is defined in this study as the potential value of the resource if the opportunity to hunt big game animals were a marketable commodity) was sensitive to the specification of the demand model employed. In this study, the two most important explanatory variables were average trip expenses and distance to the hunting region. As compared to traditional distance zone estimation procedures, estimation based upon individual observations was much more efficient, and better separated the monetary versus the nonmonetary costs of distance.

Several algebraic forms of the demand equation were fitted for each of the five hunting regions of Oregon. However, best overall results were obtained from the exponential demand function, fitted by logarithmic transformation, but corrected for bias in terms of the real numbers. One measure of net economic value (net revenue to a nondiscriminating monopolist) gave an estimated value of the Oregon big game resource of about $4 million. However, consumer surplus, which is more generally accepted by economists, gave an estimated net economic value of about $11 million for the Oregon big game resource in 1968. The $11 million net economic value is considered to be a conservative estimate since expenditures for hunting and related equipment were not included.

It is thought that the estimation of net economic values for each of the five hunting regions makes the study more useful from the viewpoint of big game management and resource allocation in Oregon.

The Oregon Big Game Resource: An Economic Evaluation

by

Farid Hassan Nawas

A THESIS

submitted to

Oregon State University

in partial fulfillment of
the requirements for the
degree of

Doctor of Philosophy

June 1972

APPROVED:

Signature redacted for privacy.

Professor of Agricultural Economics
in charge of major

Signature redacted for privacy.

Head of Department of Agricultural Economics

Signature redacted for privacy.

Dean of Graduate School

Date thesis is presented March 7, 1962

Typed by Velda D. Mullins for Farid Hassan Nawas

ACKNOWLEDGMENT

The author wishes to express his sincere appreciation to many individuals for their advice and contributions to this effort. In particular, debts of gratitude are due to:

Dr. William G. Brown, major professor, who has generously contributed his talent and time at all stages of this study. Special recognition is extended to him for his guidance and assistance throughout the preparation of the thesis.

Dr. Joe B. Stevens, for serving as acting major professor while Dr. Brown was in Argentina and for his counsel and guidance in conducting this research.

Dr. Emery N. Castle, for his help in initiating this study.

Dr. Richard S. Johnston, for providing many helpful comments.

Dr. Robert G. Mason and Mr. Robert C. Lewis, for their help in designing the questionnaire.

Dr. John H. Rayner, Messrs. Homer J. Campbell and Robert H. Stein of the Oregon State Game Commission for their valuable suggestions and comments during the course of the study.

Dr. Scott W. Overton for his contribution to survey design and related statistical analysis.

The Oregon State Game Commission and the Bureau of Land Management, whose financial grant made this research possible.

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CHAPTER I

INTRODUCTION

Statement of the Problem

Demand for outdoor recreation has increased substantially in recent years, as indicated by expenditures of time and money (Clawson, 1959). Various socio-economic and technological changes in American life, such as increases in leisure time, income, population, and mobility, have contributed to this upsurge in outdoor recreational activity. The fact that much outdoor recreation occurs on publicly owned land and water resources creates an economic problem, specifically that of quantifying the benefits of a recreational resource which does not have a conventional market price. Without a price mechanism to guide or direct the allocation of resources, it is more difficult to obtain optimal decisions in the allocation of these publicly owned natural resources in alternative uses, including outdoor recreation.

Big game is an essential part of the natural resources of the State of Oregon and has many important economic values which relate to recreational use such as hunting, photography, and viewing by the public. Because of these values, it is hypothesized that big game is an important source of income to many Oregon industries and local economies.

Despite the obvious importance of the Oregon big game resource to Oregon citizens, economic data regarding the actual magnitude of net and gross values have been lacking. Thus, an attempt will be made in this thesis to supply this missing information by estimating the gross economic value and by formulating a demand model from which the net economic value of the Oregon big game resource can be derived. Once the estimates of economic value for big game are established, it should be easier for public agencies to justify expenditures for the protection and management of Oregon's wildlife resources.

Objectives

The main objective of this study was to develop numerical estimates of the gross and net economic values of the Oregon big game resource, based upon the year 1968. For this study, "net economic value" is defined as the value of the resource if the opportunity to hunt big game animals were a marketable commodity. The "gross economic value" will include the amount spent on durable equipment items used in big game hunting, and on current expenses incurred by big game hunters. These economic value estimates will not include nonconsumptive uses of the big game resource, such as photography and viewing by the public, even though these uses are important to the citizens of Oregon. However, the evaluation of these nonconsumptive uses was not included in the original objectives of this study and, therefore, data pertaining to these uses were not collected.

Although "net" or "gross" economic values have relevance to the management of publicly owned resources, this investigation should not be viewed as a management study. A complete analysis of the management problem perhaps could best be approached by means of a large simulation model (Anderson and Halter, 1971). In this type of computer model information about expected numbers of big game animals under various forage conditions and game management regulations could be considered, along with economic values, in order to increase social and economic benefits from the big game resource. However, the objective of this study, as originally planned, was to focus only on the economic values associated with the Oregon big game resource.

Economic values are only part of the total consideration involved in the management of public owned resources. Nevertheless, without some measure of these economic values, it is very difficult for society to make rational decisions on resource use, especially where big game animals may be competitive with commercial timber production, domestic livestock, farming, or other industry. For example, economic returns from cattle grazing and other commerical uses can at least be approximated (Nielsen, et al., 1966), but no comparable figures have been available for Oregon big game. Thus, this study was designed to help supply needed information about the economic value of Oregon big game, an important component of Oregon's natural resources.

CHAPTER II

REVIEW AND EVALUATION OF METHODS FOR ESTIMATING OUTDOOR RECREATION BENEFITS

Dramatic growth in outdoor recreation demand in recent years, stemming from increases in population, leisure time, income, and mobility, calls for continuous adjustments in resource allocation. The fact that much outdoor recreation is provided by public agencies creates an economic problem, specificially that of measuring the value of a recreational resource which does not have a conventional market price. Due to the absence of a market for outdoor recreation, a number of economists have responded to this challenge by developing methods to quantify the economic benefits accruing to outdoor recreation. These methods, which have proceeded in two directions, are concerned with the estimation of the money that recreationists would be willing to pay for the use of a particular recreational facility. Review and evaluation of these two methods, called "direct" and "indirect", respectively, will be the topic of this chapter.

The Direct Approach for Estimating Outdoor Recreation Benefits

The "direct" approach of estimating recreational benefits attempts to establish a demand curve by inquiring of the recreationists the most they would be willing to pay for the use of the recreational facility rather than to be excluded (Knetsch and Davis, 1965). The demand estimates obtained in this fasion are defensible on theoretical grounds, but the practical difficulty with this approach lies in obtaining unbiased and reliable information from recreationists by simply confronting them with "direct", but hypothetical, questions about recreational resources which have traditionally been regarded as "free". The respondents' answers would be subject to many kinds of bias, due to the emotionalism involved, particularly when the questions asked deal with matters of opinion. One such bias is that a recreationist may, unconsciously or deliberately, under-state his preference for a recreational facility, hoping that he will thereby avoid being charged as much as he would actually be willing to pay, and thus be able to enjoy the activity at its present cost and level of use. Knetsch and Davis argue that this type of bias can be expected, since recreationists observe uniformed officials at most national parks and thus visualize the possibility of being excluded.

An alternative to this hypothesis (that a recreationist might under-state his willingness to pay) is the other possibility that he would over-state his willingness to pay in order to make a case for improving and preserving a recreational resource.

In addition to estimating effective demand by present users, the "direct" method could also be employed to estimate option demands. That is, the "direct" approach allows the possibility of obtaining demand schedules for those persons not presently enjoying the outdoor recreation but who may later decide to participate. However, as mentioned earlier, recreational benefits estimated by this method may not be reliable, due to the hypothetical nature of the questions posed and, consequently, policy recommendations based on such results might be dubious.

The second main development of techniques for estimating recreational benefits is based upon "indirect" evidence. This evidence usually pertains to the travel and related costs incurred by the recreationist.

The Indirect Approach for Estimating Outdoor Recreation Benefits

The "indirect" approach attempts to measure the recreationist's willingness to pay for the use of a particular recreational facility by observing the reaction of recreationists to changes in costs of travel to the recreational site. This procedure does not subject recreationists to hypothetical questions, as is the case for the direct procedure. Nevertheless, it does involve a number of restrictive assumptions that can limit the scope of its applicability, as will be shown next.

The several "indirect" methods which have been employed to estimate recreation benefits appear to have descended from an ingenious suggestion by Hotelling (1949). In a letter to the U.S. National Park Service[1/], 1949, Hotelling advanced the idea of defining concentric zones around the recreational site, so that the cost of travel to the site from all points in one of these zones would be approximately constant. According to this approach, travel cost existing within each zone would be used as a proxy for the price variable, which could be related to the number of visitors from each zone to derive a demand function for recreation.

Hotelling's ideas have stimulated many economists to enter the field of recreation research and, certainly, some progress has occurred over the past several years. However, there have also been some dubious methods used to estimate recreation benefits.

One fallacious approach for estimating benefits was the "cost" method employed by the National Park Service (1950). It was contended as follows: ". . . A reasonable estimate of the benefits

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1/ The Hotelling letter to the National Park Service was also reproduced in Brown, et al., (1964).

arising from a reservoir itself may be normally considered as an amount equal to the specific costs of developing, operating, and maintaining the recommended facilities . . ." The use of costs as a basis for estimating benefits is not valid, since it is almost a perfect example of circular reasoning.

Gross National Product (GNP) concept has also been applied to measure recreational benefits. This approach, which was suggested by Ripley (1958) of the California Department of Fish and Game, attempts to evaluate the contribution of recreation to the gross national product by assuming recreation is a factor of production or something which stimulates production.[2/] He contends that the value of a day spent in recreation can be assumed, on the average, as equal to GNP divided by the product of total population times number of days in the year. As he points out, this method does not permit economic comparison of alternative uses of the same resource. Nevertheless, the relative contribution of different recreation activities (providing varying number of recreation days) to GNP could be compared on this crude basis. This approach can be criticized because it treats recreation as a factor of production,

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[2/] For a detailed appraisal of this method, see Lerner (1962).

whereas recreation more logically should be classed as a consumer's good (even though it might incidentally increase productivity).

The gross expenditures method is another unreliable approach that has been commonly employed to measure recreation benefits. This method has been used by Pelgen (1955), who conducted a study for the California State Department of Fish and Game to establish "economic values of striped bass, salmon, and steelhead sport fishing in California". On occasion, the Corps of Engineers and the Bureau of Reclamation have also used total expenditures as a measure of benefits. The justification underlying this method is that individuals or groups incurring such expenditures must have received values corresponding to the expenditures, or they would not have made them. That is, where people have been free to spend their money on recreational activities, they should have valued it at least as highly as the other things that could have been purchased with the same money. Nevertheless, it is also true that if this recreation were abolished, most of the money would simply be directed toward other goods and services. Economists have contended that loss from this shift, where the recreationists would be forced to some second choice, would not be total expenditures, but some other amount which total expenditures by themselves do not measure. Thus, if gross expenditures were to be used, it would be difficult to compare these gross recreational benefits with the net economic benefits that would be estimated for alternative uses of natural resources. These shortcomings of the gross expenditure method limit its usefulness for measuring recreation benefits.

There have been many other fallacious methods advanced, e.g., Trice and Wood (1958), which are not worth a detailed discussion here since most of these methods have died a natural (and merciful) death. However, Clawson, in 1959, did advance a basically sound approach to the problem of quantifying recreational benefits.

The Clawson Method

Clawson (1959) probably made the most important empirical study of recreational value. By utilizing Hotelling's concentric zone concept, Clawson was able to quantify participation-travel cost relationships for several national parks. He could thus project participation rates for each concentric distance zone for various assumed fee increases by assuming that the park visitors would react to an increase in entrance fees in the same way as to an increase in travel costs. Then, by multiplying projected number of visits times various assumed entrance fees, he was able to estimate the monetary recreational value for each park. Thus, these values could then be compared with other possible uses for these resources.

Hundreds of publications and many research projects in the 1960's traced their origin to the Clawson formulation. However, his approach was not without limitations. One serious deficiency of Clawson's analysis was that he did not consider the non-monetary effects of distance, income, and other important variables. As will be shown later, omission of one or more important variables can lead to a serious bias in the estimate of recreational resource value.

Nevertheless, many empirical studies of recreational benefits have utilized the Clawson approach. The Oregon salmon-steelhead study (Brown, et al., 1964) expanded upon the Clawson method to include incomes and physical distance as explanatory variables. In addition, they used the concept of transfer costs, which was the sum of all variable expenses incurred, including travel costs, food, lodging, bait, lures, etc.

Some economists suggested that the Clawson model would have only limited usefulness until it came to grips with the "quality" of recreation experience. Stevens (1966) approached this problem by further extending the Clawson model to include the quality of the recreational experience, using angling success per unit of angling effort as an explanatory variable.

The Pearse Approach

A different indirect approach for evaluating nonpriced recreational resources was presented by Pearse (1968). He expressed discontent with what he called "the restrictive assumptions" necessary for the estimation of the demand schedule, as proposed by Clawson, and confined his analysis to the recreationists themselves, thus eliminating the assumption concerning the homogeneity of the base population from which recreationists are drawn. Pearse's method entails dividing the sampled recreationists into several income groups and estimating a "consumers' surplus" they receive by finding the difference between each visitor's "fixed" cost[3/] to the recreational site and the fixed cost of the marginal visitor who has the highest fixed cost within that income group.

One limitation of the Pearse approach is the way in which the sample of recreationists was stratified into various income groups, along with the very stringent assumption that all hunters in the

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3/ Pearse defines fixed cost as the declared cash cost of travel to and from the area, an allowance for the value of time spent in travel, and other expenses such as hunting licenses, game tags, etc., which were reported to have been incurred specifically for East Kootenay hunting.

East Kootenay area, who had similar incomes, also had identical preference functions. In economic terms, Pearse is assuming that each participant in an income group would be willing to pay as much as the highest spender in the group and without reducing the quantity taken.

Pearse (p. 96, 1968) denoted the quantity calculated by his procedure as ". . . an aggregate value in the form of consumer surplus. . . ." Strangely, no one seems to have challenged Pearse's method of computing consumer surplus. However, a couple of simple numerical examples are sufficient to show that Pearse's computations have no particular relationship whatever to actual consumer surplus, as traditionally defined in economic theory.

Suppose that we have a group of recreationists with similar incomes and other characteristics such that the quantity taken by each recreationist is a function solely of his costs that must be incurred to participate in the recreational activity. Then consider two cases, the first where the individual's recreational demand function is given by $q = 1 - 0.01C$. That is, suppose we obtained the following hypothetical sample of eight hunters, which might represent 1 percent of the total hunters of the area:

Cost	Quantity (Units of time)
30	0.7
40	0.6
50	0.5
60	0.4
70	0.3
80	0.2
90	0.1
100	0.0

Following the Pearse method, we would obtain an average "Pearse surplus" of 1/8 (0 + 10 + 20 + 30 + 40 + 50 + 60 + 70) = 1/8 (280) = 35. Multiplying the average "Pearse surplus" by 800, a total "Pearse surplus" of 800 (35) = $28, 000 is obtained.

How does the "Pearse surplus" for this case compare with the usual consumer surplus, as conventionally defined? We can readily compute the traditional consumer surplus for each of the eight observations. Given our linear demand function $q = 1 - 0.01C$, the consumer surplus for the lowest cost hunter would be equal to 1/2 [70(0.7)] = 1/2 [49] = 24.5. Summing the individual surpluses for each of the seven hunters, we would obtain a total consumer surplus for our sample equal to 1/2 [1 + 4 + 9 + 16 + 25 + 36 +49] = 1/2 [140] = 70. Blowing up the sampled hunter's consumer surplus by 100, we obtain a total consumer surplus of $7, 000. Thus, in this case, "Pearse surplus" of $28, 000 overestimates the actual consumer surplus by a factor of four!

Will the Pearse method always overestimate the consumer surplus? Unfortunately, the Pearse method may also underestimate the consumer surplus, as for the following hypothetical sample of eight recreationists.

Cost	Quantity (Units of time)
1	7
2	6
3	5
4	4
5	3
6	2
7	1
8	0

Using the Pearse approach an average "Pearse surplus" of $1/8\ (1 + 2 + 3 + 4 + 5 + 6 + 7) = 3.5$ is obtained, and total sample "Pearse surplus" is 28. However, since the above hypothetical observations fall on the demand function, $q = 8 - C$, the sum of the individual consumer surpluses is equal to $1/2\,[1 + 4 + 9 + 16 + 25 + 36 + 49] = \$70$. In this case, the Pearse approach gives a value of only 4/10 of the actual consumer surplus!

From the preceding two examples, one is inclined to doubt the validity of the Pearse approach, since biased estimates of consumer surplus and the resulting recreational values could easily be obtained by following the Pearse procedure. The magnitude and direction of bias resulting from Pearse's method depend upon the numerical coefficients of the true demand function for the recreational experience. However, if one knows or can estimate the underlying demand function, then one could estimate the consumer surplus directly from the estimated demand function, and would not need to employ the Pearse method. Furthermore, our research 4/ indicates that effects of nonmonetary cost of distance are very important and need to be incorporated into the demand function in order to properly estimate recreational values. It would appear to be very difficult to estimate such nonmonetary effects of distance, using the Pearse approach, and it is, therefore, recommended that an adequately specified statistical demand function be estimated by procedures outlined in the aforementioned paper. 5/

Although it is recommended against use of the Pearse method for estimating consumer surplus and economic value of recreational resources, it is evident that he made a contribution with his proposition that inferences from the sampled recreationists should refer to the population of recreationists only, not to the general population of all people. Before his article, all studies (with which I am

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4/ See Brown, W. G. and F. H. Nawas (1971).

5/ Ibid.

familiar) tried to make inferences back to the general population, as did Clawson (1959) in his original study. However, due to Pearse's research, more recent formulations of recreational demand have more properly confined the analysis to the population of participants, as advanced by Edwards and co-workers (1971).

The Edwards, Gibbs, Guedry, and Stoevener Formulation

To avoid some of the restrictive assumptions underlying the indirect approach presented in this section, Edwards *et al.* (1968) developed a new procedure that does not utilize "distance zone averages" or other aggregations of the data, but focuses, instead, on the individual recreationist. Their work also indicates that a more realistic explanation of the consumer's behavior may be possible by dividing the transfer costs into two components: (1) the cost of reaching the recreational site, and (2) the costs expended at the site. The price variable in their theoretical demand model for the individual recreationist is the on-site costs such as lodging, camping fees, equipment rentals, meals, and other miscellaneous expenses incurred at the site. The quantity variable in their demand model is the number of days a recreationist spends at a particular site. Thus, the average individual's demand curve was defined and the economic value per visit was computed, using the concept of the consumer surplus. To determine the total value of a site, they multiplied the per-visit values by the total number of visits.

The limitations of their approach were noted by Gibbs (1969). The most crucial problems concerned the "critical" travel cost (the maximum amount that a consumer is willing to pay for travel costs) and the "critical" price of recreation (the recreationist's maximum willingness to pay the variable on-site costs). The critical values were assumed to be equal to that of the highest spender of the income group, similar in this respect to the procedure used by Pearse. Some difficulty was also encountered in determining the proper blow-up factor to use for multiplying economic value per visit in order to arrive at the total value for the site. However, despite these minor problems, their study was the first to properly utilize individual observations to estimate the statistical demand function for the recreational resource. Thus, their study marked a major advance over previous studies which had relied upon distance zones or other aggregations of the data. Also, their specification of the demand equation was more consistent than earlier models with the economic theory of consumer behavior.

Before discussing the statistical and economic models used in this study, a description of the questionnaires and procedures used in the survey of Oregon big game hunters should first be presented.

CHAPTER III

EXPENDITURES BY OREGON BIG GAME HUNTERS

Sampling Procedures

The Oregon State Game Commission supplied the names and mailing addresses of about 17,000 Oregon licensed hunters, which were grouped into six blocks according to the last two digits of hunting licenses sold in 1966. These six blocks constituted the sample for their survey, "Annual Hunting Inventory", which had been conducted since 1950 to secure a gross measure of all types of hunting. They had selected randomly six two-digit numbers between 1 and 100, namely 10, 34, 38, 66, 78, and 94. All hunting licenses sold in 1966 and ending with 10 formed Block #1, those ending with 34 formed Block #2, etc.

Blocks #1 and #2 were selected randomly to form our sample for the Oregon Big Game Study. The sample was about 3,000, or roughly 1 percent of the licensed big game hunters in the state.

Two questionnaires were mailed to hunters in 1968. The first concerned the investment by the hunter and his family in hunting and associated equipment. This questionnaire was mailed early in August 1968. The second questionnaire was a big game hunting trip record, in which the hunter was asked to record his hunting trip expenses for all his 1968 big game hunting trips. This record was dispatched in the fall hunting season to all hunters who indicated on the first questionnaire that they were planning to hunt big game in 1968. Both questionnaires are reproduced in the Appendix.

Identical "follow-up" procedures were used in both questionnaires. First and second reminders were mailed if the earlier questionnaires were not returned. Furthermore, a decision was made to contact by telephone a randomly selected sample from the nonrespondents who failed to return the original or either of the two reminder questionnaires. An attempt was made to telephone 100 nonrespondents to the first questionnaire and an equivalent number of nonrespondents to the second questionnaire. A professional research firm was retained for this purpose in order to minimize possible bias.

Design of Questionnaires and Hunter Response

The investment questionnaire consisted of two parts. On the first part hunters were asked to list any expenditures made during the past 12 months for equipment used by their families in big game hunting. Since some of the investment items purchased were not used exclusively for big game hunting, hunters were asked to circle the appropriate percentage of the cost which should be allocated to the big game hunting activity.

On the second part, of the investment questionnaire, hunters were asked to list and allocate major expenditures for hunting equipment which were made more than 12 months before receipt of the questionnaire. Additional information was also obtained on family income, occupation, and number of years hunted by the head of the household.

Hunters were asked to record their 1968 big game hunting trip expenses on a later questionnaire. Expenses included the amount spent on food, transportation, lodging, ammunition, and all other expenses incurred on each hunting trip. Other information included the number of days spent on the hunting trip, number of family members who went and hunted on the trip, number of big game animals bagged, the area hunted, and miles traveled.

On the back of the trip record, hunters were asked to list all 1968 Oregon big game tags or licenses purchased by members of their families residing at home.

As can be seen in Table 1, the response to the two questionnaires was good. Overall return rates were 71 and 72 percent, respectively, for the investment questionnaire and the hunting trip record. Responses of this magnitude to fairly complex questionnaires indicate that big game hunters take a real interest

Table 1. Summary of Responses to Questionnaires.

	Investment questionnaire		Hunting trip record	
	Number	% of total	Number	% of total
Initial return	1, 110	36.8	344	23.2
First reminder	749	24.8	469	31.7
Second reminder	281	9.3	259	17.5
Total response	2, 140	71.0	1, 072	72.0
Nonresponse	877	29.0	408	28.0
Total questionnaires mailed	3, 017	100.0	1, 480	100.0

in management of these resources.

Expenditures for Hunting and Related Equipment

The overall response of 71 percent to the investment questionnaire was quite good; nevertheless, some method or assumption had to be adopted to deal with the 29 percent nonresponse in order to estimate total equipment expenditures. We attempted to deal with this problem by conducting a telephone survey of the nonrespondents. Unfortunately, it was possible to complete only 31 investment questionnaires out of 100 hunters called. Many hunters had either moved or did not have listed telephones. Consequently, we did not think that the telephone survey provided sufficient information and, therefore, assumed that the nonrespondents had spent the same as those families who answered the second reminder, \$148.47, as shown in Table 2.

Although the above procedure for estimating expenditures by the nonrespondents can be criticized, there is no approved statistical procedure for handling this situation, other than by a thorough follow-up survey of a sample of the nonrespondents. Although the \$148.47 assumed for nonrespondents could be either too high or too low, it was fairly close to the mean estimated from the small telephone survey.

Probably the reason that the respondents to the second reminder spent less was because the slower respondents tend to be of lower socio-economic status. In this study, lower income families averaged lower investment in hunting and related equipment.

The 95 percent confidence interval about the mean was estimated to be \$238.91 ± 25.60. 6/ Therefore, the average investment per hunter-family is expected to lie between \$213 and \$265.

Oregon Game Commission data indicate that there were 363,000 licensed hunters in Oregon in 1968. However, the sample indicates that 4.4 percent of the licensed hunters were non-big game hunters; thus, estimated numbers of big game hunters in Oregon in 1968 were:

$$363,000 \times 95.6\% = 347,000.$$

6/ See Appendix for the variance computation.

Table 2. Summary of Responses to Investment Questionnaire, and Average Expenditure Per Family for Hunting and Related Equipment in 1968.

	Questionnaires returned a/	Usable questionnaires	Average investment made per family ($\bar{X}_i$) in 1968
Initial questionnaire	1, 057	589	$288. 69
First reminder	686	351	300. 50
Second reminder	260	115	148. 47
Nonrespondents b/ (789)	--	--	148. 47
Total	2, 003	1, 055	$238. 91 c/

a/ The number of responses was adjusted, using sample data, to exclude upland bird hunters. These nonbig game hunters amounted to 7. 46% of the total number of responses.

b/ Usable data were obtained for only 31 of the 100 nonrespondents sampled by phone. Therefore, the nonrespondents were assumed to have spent the same as those who responded to the second reminder.

c/ The weighted mean value was computed as follows:

$$\bar{X} = \Sigma_i \frac{(n_i)}{\Sigma n_i} (\bar{X}_i)$$

$$= \frac{1057}{2792} (288.69) + \frac{686}{2792} (300.50) + \frac{1049}{2792} (148.47) = \$238.91.$$

Furthermore, the data indicate an average of 1.86 hunters per family, which would make the number of hunting families in Oregon equal to 186,000.

Thus, the sample data indicate a total investment in hunting and associated equipment by Oregon big game hunters of approximately $44.6 million in 1968. Confidence limits on this revised estimate have also been computed. The 95 percent confidence interval about the total would be:

$$\$44,600,000 \pm \$4,800,000.$$

Therefore, total investment made by licensed Oregon big game hunters in 1968 is thought to lie between $39.8 and $49.4 million.

The preceding estimate is thought to be conservative, in some respects at least. For example, the people in sample who were eliminated because they did not purchase hunting licenses in 1968 averaged about $101.70 per family on hunting and associated equipment. Their expenditures should also be attributed to big game; but there is no sufficient information about the total number of these people who spent money for big game equipment but who, for one reason or another, did not buy a license and hunt during 1968.

The sample data were also used to divide total investment among the major types of equipment listed on the questionnaire (Table 3). An interesting aspect of these data is the relatively high proportion of investment expenditures that were incurred for

Table 3. Allocation of Total Investment in 1968, by Type of Equipment.

Classification	Item	% of total	Investment
Hunting equipment	Rifles, including scopes and sights	14.63	$ 6,524,000
	Bows, arrows, etc.	.95	423,000
	Other hunting equipment, knives, etc.	5.23	2,332,000
Special clothing	Boots, coats, hats, etc.	5.81	2,591,000
Camping equipment	Tents, tarps, sleeping bags	2.99	1,333,000
	House trailers	13.78	6,145,000
	Campers	12.92	5,762,000
	pickups, jeeps	36.96	16,484,000
	Other camping equipment	6.74	3,006,000
Total		100.00	$44,600,000

pickups and jeeps, house trailers, and campers. These three items together accounted for nearly two-thirds of the total investment. It is also interesting to note the distribution of the percentage allocations for various investment items (Table 4). Substantial allocations on specialized equipment such as rifles were expected, but the frequency of high allocations on campers, trailers, and pickups was somewhat surprising.

In Table 5, average expenditures during 1968 for hunting and associated equipment have been related to the number of years hunted before 1968 by the head of the household. In general, there appears to be a positive correlation between hunting

Table 4. Frequency Distributions of Cost Allocations for Major Categories of Investment. a/

Classification	Item	Percentage of big game hunders purchasing durable items who allocated the following percentages to big game hunting activity				
		10% + 20%	30% + 40%	50% + 60%	70% + 80%	90% + 100%
Hunting equipment	Rifles, scopes, knives	5.76	3.13	6.23	8.89	76.00
	Bows, arrows	10.46	--	5.31	18.51	65.86
	Other hunting equipment	6.59	3.65	9.14	14.64	65.92
Special clothes	Boots, hats, coats	13.63	7.56	16.97	24.24	37.57
Camping equipment	Tents, tarps, sleeping bags	12.81	13.51	25.67	22.94	24.96
	House trailers	19.54	10.90	34.70	17.42	17.42
	Campers	26.92	14.28	23.81	17.39	17.39
	Pickups, jeeps	29.48	16.58	22.83	12.44	18.69
	Other camping equipment	16.38	12.50	30.60	16.80	23.68

a/ Respondents were asked to indicate that percentage of total cost of an item which they felt reflected their allocation of the total cost to big game hunting.

Table 5. Average Expenditure for Hunting and Associated Equipment in 1968, Related to Number of Years that Head of Household had Hunted Big Game.

Number of years before 1968 head of household hunted big game	Number of observations	Average investment during 1968 for hunting and associated equipment
0	33	$179.79
1	15	86.49
2	28	99.03
3	25	149.60
4	20	490.20
5	24	221.45
6	16	46.76
7	18	116.69
8	27	192.96
9	8	321.07
10	71	172.74
11-15	148	330.53
16-20	202	336.87
21-25	117	365.51
26-30	121	291.56
31 and over	183	250.41

experience and expenditures for equipment, with the more experienced hunters spending considerably more. For example, where the head of the household had 16 to 20, or 21 to 25 years of hunting experience, these families made equipment expenditures which were 40 percent above the average.

As might have been expected, the families headed by hunters with less experience spent a larger proportion of their money on hunting equipment, such as rifles, scopes, etc., whereas the families headed by more experienced hunters spent a larger proportion on camping equipment and special clothing. These relationships can be observed from the average expenditures presented in Table 6, listed by number of years hunted by head of household.

Oregon big game hunters were also tabulated according to their incomes, in Table 7. The most common income class for the hunting families was the $7, 001 to $10,000 bracket, which included about one-third of all the families. Correspondingly, this income group made about one-third of the total expenditures for hunting and associated equipment in 1968. Next most numerous were the $5, 001 to $7, 000 and the $10, 001 to $15, 000 groups, each with about 22 percent of the hunting families. The three income groups ranging from $5, 001 to $15, 000 comprised over 77 percent of the families in the sample, and their expenditures accounted for almost 81 percent of the total amount spent for hunting and associated equipment.

As one might expect, average expenditure and income were positively correlated. The highest income groups, "$15, 001 to $20, 000" and "Over $20, 000" (each with about 3 percent of the hunting families), incurred average expenditures of nearly $450 and $600, respectively. Although the average expenditures of the two highest income groups are substantially greater than that of other income groups, their total expenditure was slightly less than 12 percent of the total amount spent for hunting and associated

Table 6. Allocation of Expenditures for Hunting and Associated Equipment, According to Years of Hunting Experience.

Number of years before 1968 head of household hunted big game	Number of observations	Average investment during 1968 for hunting and associated equipment		
		Hunting equipment[a/]	Special clothing[b/]	Camping equipment[c/]
0	23	$80.66	$ 11.10	$166.22
1 - 5	112	52.10	11.30	141.37
6 - 10	140	51.87	10.40	101.27
11 - 15	148	62.59	17.25	250.69
16 - 20	202	57.51	17.81	261.55
21 - 25	117	52.63	19.08	293.80
26 - 30	121	68.96	18.90	203.70
31 and over	183	57.71	18.33	174.37

a/ Includes rifles, scopes, hunting knives, bows, arrows, etc.
b/ Boots, hats, coats, and other clothing for hunting.
c/ Campers, pickups, jeeps, house trailers, tents, tarps, sleeping bags, and other camping equipment.

Table 7. Oregon Big Game Hunters' Expenditures for Hunting and Associated Equipment in 1968, by Income Groups.

Group No.	Income level	Percent of big game hunters	Average expenditure per family	Estimated total expenditure by income groups	Percent of total expenditure
1	Under $3,000	6.34	$ 72.65	$ 740,360	1.66
2	$ 3,001 - $ 5,000	8.88	176.48	2,519,900	5.65
3	$ 5,001 - $ 7,000	20.49	234.62	7,733,640	17.34
4	$ 7,001 - $10,000	34.24	257.16	14,169.420	31.77
5	$10,001 - $15,000	23.61	373.29	14,182,800	31.80
6	$15,001 - $20,000	3.41	446.28	2,453,000	5.50
7	Over $20,000	3.03	575.06	2,800,880	6.28
Average over all reported income groups		--	277.16	--	--
Total		100.00	--	$44,600,000	100.00

equipment in 1968. This result occur because the above two highest income groups represent only 6.4 percent of all hunting families.

Average income of the hunting families was about $9,000 per year, which is not far from the Oregon average, being higher than the average personal disposable income per family, but lower than total personal income per family (Statistical Abstract of the U.S. (1969)). 7/

Oregon big game hunters and their expenditures for hunting and associated equipment, by occupation, are given in Table 8. It can be seen that Oregon hunters consisted of substantial numbers from each major occupational grouping. Families of farm laborers made the lowest average expenditure, $81, while Armed Forces personnel made the highest average expenditure, about $360. However, the estimation for these two occupational groups is not precise, being based upon only eight and five observations, respective. The most common occupation for the head of household of hunting

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7/ Average investment given in Table 7 was $277.16, as compared to only $238.91 in Table 2. Average investment in Table 2 was lower because 789 nonresponding families were given assumed investments of only $148.47. Similar differences occur for Tables 8, 9 and 10.

Table 8. Oregon Big Game Hunters' Expenditures for Hunting and Associated Equipment in 1968, by Occupation.

Group No.	Occupation	Percent of big game hunters	Average expenditure per family	Estimated total expenditure by income groups	Percent of total expenditure
1	Professional, technical	12.68	$272.72	$ 5,566,080	12.48
2	Farmer and farm managers	5.48	269.35	2,377,180	5.33
3	Managers, officials and proprietors	11.72	335.26	6,333,200	14.20
4	Clerical	3.17	310.56	1,587,760	3.56
5	Sales workers	4.61	321.89	2,386,100	5.35
6	Craftsmen, foremen	23.15	289.68	10,793,200	24.20
7	Machine operators, and related workers	8.74	265.82	3,746,400	8.40
8	Service workers	4.80	327.79	2,542,200	5.70
9	Farm laborers	0.77	81.00	102,580	0.23
10	Laborers, excluding farm laborers	16.14	277.91	7,225,200	16.20
11	Others: retired, housewives, students	8.07	122.45	1,592,220	3.57
12	Unemployed	0.19	227.25	71,360	0.16
13	Armed Forces	0.48	357.46	276,520	0.62
	Average over all reported occupations		276.85		
Total		100.00	--	$44,600,000	100.00

families was "Craftsmen, Foremen", which included about one-fourth of all families, and their expenditures also accounted for about one-fourth of the total amount spent.

Table 9 tabulates Oregon big game hunters' expenditures for hunting and associated equipment by county of residence. One interesting aspect of these data is the relatively low average expenditures by the more populous counties in Oregon, especially Clackamas, Washington, and Multnomah (the Portland area), as compared to other less populous counties. [8/] These three counties of the Portland area accounted for only about $10 million of the state total of $44.6 million, or only about 22.5 percent. However, the population of these three counties represented 41.5 percent of the total Oregon population in 1968. Thus, the estimated 851,830 residents of the Portland area in 1968 averaged only about $11.80 per person on equipment expenditures, as compared to $28.80 expenditure per person for the rest of the state. Thus, Portland area residents spent only about 41 percent as much for hunting and associated equipment as did the other residents of the state.

Some care should be exercised in interpreting the figures in Table 9, since some purchases could have been made in counties

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8/ Population figures were obtained from the Bureau of Business and Economic Research, Oregon Economic Statistics, 1969, University of Oregon, Eugene.

Table 9. Oregon Big Game Hunters' Expenditures for Hunting and Associated Equipment in 1968, by County of Residence.

County No.	County	Average expenditure per family	Estimated expenditure for hunting and associated equipment	Percent of total expenditure
1	Baker	$115.16	$ 289, 900	0.65
2	Benton	391.76	1, 387, 060	3.11
3	Clackamas	213.98	2, 386, 100	5.35
4	Clatsop	73.99	263, 140	0.59
5	Columbia	376, 15	1, 065, 940	2.39
6	Coos	305.75	1, 784, 000	4.00
7	Crook	110.28	205, 160	0.46
8	Curry	294.10	446, 000	1.00
9	Deschutes	503.51	2, 345, 960	5.26
10	Douglas	260.43	2, 296.900	5.15
11	Gilliam	0.00	0.00	0.00
12	Grant	424.61	637, 780	1.43
13	Harney	99.64	169.480	0.38
14	Hood River	1, 134.93	1, 511, 940	3.39
15	Jackson	325.16	3, 139, 840	7.04
16	Jefferson	135.03	138, 260	0.31
17	Josephine	109.41	276, 520	0.62
18	Klamath	482.52	3, 130, 920	7.02
19	Lake	129.90	156, 100	0.35
20	Lane	203.24	5, 820, 300	13.05
21	Lincoln	195.79	263, 140	0.59
22	Linn	222.18	1, 480, 720	3.32
23	Malheur	132.61	267, 600	0.60
24	Marion	239.84	2, 395, 020	5.37
25	Morrow	392.02	330.040	0.74
26	Multnomah	259.52	6, 779, 200	15.20
27	Polk	183.43	303, 280	0.68
28	Sherman	945.00	17, 840	0.04
29	Tillamook	154.00	312, 200	0.70

Continued

Table 9--Continued.

County No.	County	Average expenditure per family	Estimated expenditure for hunting and associated equipment	Percent of total expenditure
30	Umatilla	$235.96	$ 1,061,480	2.38
31	Union	238.59	677,920	1.52
32	Wallowa	273.77	321,120	0.72
33	Wasco	535.24	1,159,600	2.60
34	Washington	142.99	883,080	1.98
35	Wheeler	549.00	276,520	0.62
36	Yamhill	175.84	619,940	1.39
	Average over all counties a/	274.64	--	--
Total		--	$44,600,000	100.00

a/ This average was from usable questionnaires only and does not include the extrapolated estimate for nonresponse, as for Table 2.

other than that of the hunter's residence. Thus, the figures in Table 9 cannot be used to show the contribution of hunting equipment purchases to the economy of each individual county.

It can be seen from Table 10 that hunting families with 7 to 10 members residing at home made only five percent of the total expenditures, whereas families with 2 to 6 members made about 91 percent of total expenditures for hunting and associated equipment. There appeared to be a slight increase in average expenditure per family as family size increased, up to a family size of six members. This increased expenditure was probably due to larger

Table 10. Oregon Big Game Hunters' Expenditures for Hunting and Associated Equipment in 1968, According to Number of Family Members Residing at Home.

Number of family members residing at home	Average expenditure per family	Estimated expenditure for hunting and associated equipment	Percent of of total expenditure
1	$261.86	$ 1, 766, 160	3. 96
2	234. 73	9, 076, 100	20. 35
3	252. 08	7, 385, 760	16. 56
4	296. 07	10, 039. 460	22. 51
5	296. 43	7, 867, 440	17. 64
6	392. 54	6, 203, 860	13. 91
7	243. 40	1, 569, 920	3. 52
8 to 10	225. 95	691, 300	1. 55
Average over all families a/: 3. 78	277. 92	--	--
Total		$44, 600, 000	100. 00

a/ Average expenditure for equipment from responding hunter families only was $277. 92, with an average number of 3. 78 family members residing at home.

numbers of hunters per family as family size increased. However, as family size reached seven or more, expenditure per family declined. Perhaps the decline for families of seven or more was due to increased competition for necessities, such as food and shelter, for these larger families.

Expenses Incurred on Hunting Trips

Hunters were requested to keep an account of all expenses incurred on their big game hunting trips. A specially designed "hunting trip record" for this purpose was mailed to the hunters before the 1968 hunting season.

A summary of the response to the Hunting Trip Record can be found in Table 11. As for the Investment Questionnaire, those hunters responding early in the survey incurred more variable expenditure per family and per trip than those who responded later. The mean variable expenditure per hunter family for the entire sample was estimated at about $118.70 for the year 1968. The 95 percent confidence interval for the average variable expenditure was:

$$\$118.70 \pm 10.35.$$

This amounts to saying that average variable expenditure per hunter-family probably ranged between $108 and $129. The procedure by which the variance was estimated is given in the Appendix.

Furthermore, the sample data indicate that the average number of trips undertaken by Oregon big game hunters in 1968 was about 3.38. This implies that the average variable expenditure per trip was:

$$\$118.70 \div 3.38 = \$35.10.$$

As mentioned earlier in the report, the number of big game hunter-families in Oregon in 1968 was estimated at 186, 000. Our data, also, indicate that around 84.16 percent of the licensed hunters went hunting for big game in 1968. Thus, the number of families hunting big game would be:

$$186,600 \times .8416 = 157,000.$$

Thus, total variable expenditures incurred by Oregon big game hunters in 1968 were estimated to be \$18.6 million.

The 95 percent confidence interval for total variable expenditures would be:

$$\$18.6 \pm \$1.6 \text{ million.}$$

Therefore, it is concluded that total variable expenditures incurred by Oregon big game hunters in 1968 probably ranged from \$17.0 to \$20.2 million.

The sample data were also used to allocate the estimate of total variable expenditure to the various categories listed on the Hunting Trip Record Questionnaire (Table 12). It is interesting to note that transportation costs accounted for over 30 percent, while transportation costs combined with expenditures on food and beverages accounted for almost 60 percent of the total variable expenditure. Cost of tags was almost 13 percent of the total variable expenditures, representing almost exactly \$1 out of every \$8 spent.

Table 11. Summary of Responses to Hunting Trip Record.

	Questionnaires returned	Usable questionnaires	Average hunting trip expenses per family in 1968	Average number of trips per hunter-family	Average expenses per hunting trip
Initial questionnaire	344	307	143.71	3.61	39.81
First reminder	469	353	114.11	3.03	37.66
Second reminder	259	197	98.96	2.66	37.20
Nonresponse	408	35	115.46 a/	4.29	26.91
Total	1,480	892	118.70 b/	3.38	35.10

a/ Obtained from 35 telephone and personal interviews of a random sample of nonresponse. Average hunting trip expenses per family vary in later tables where the nonresponse is not included and where information was lacking in some questionnaires for certain classifications.

b/ A weighted mean value was computed as follows:

$$X_1 = \Sigma_i \left(\frac{n_i}{\Sigma n_i}\right) \bar{X}_{1i} = \frac{344}{1480}(143.71) + \frac{469}{1480}(114.11) + \frac{259}{1480}(98.96) + \frac{408}{1480}(115.46) = 118.70$$

$$X_2 = \Sigma_i \left(\frac{n_i}{\Sigma n_i}\right) \bar{X}_{2i} = \frac{344}{1480}(39.81) + \frac{469}{1480}(37.66) + \frac{259}{1480}(37.20) + \frac{408}{1480}(26.91) = 35.10.$$

Table 12. Allocation of Total Variable Expenditure in 1968 by Type of Expenditure Items.

	Type of expenditure	Cost in dollars	Percentage
1	Transportation	5,840,000 a/	31.4
2	Motels, hotels, camping or private hunting fees	409,000	2.2
3	Ammunition, arrows, and broadheads	1,358,000	7.3
4	Food, beverages, and liquor on hunting trip	5,245,000	28.2
5	Guide service and rental of horses, airplanes, or other vehicles	75,000	0.4
6	Cutting and wrapping meat, tanning hides	874,000	4.7
7	Other expenses incurred on hunting trip	2,455,000	13.2
8	Cost of tags	2,344,000	12.6
Total		$18,600,000	100.0

a/ Transportation cost was computed at 5 cents per mile traveled.

In a manner similar to that for equipment expenditures, expenses incurred by Oregon hunters on their hunting trips were tabulated by income groups (Table 13). As was the case for equipment expenditures, the $7,001 to $10,000 income group, which included about one-third of all families, incurred over one-third of the total trip expenses in 1968. The next two most numerous groups, $5,001 to $7,000 and $10,001 to $15,000, incurred about 44 percent of the total trip expenses. The three income groups ranging from $5,001 to $15,000 included over

Table 13. Oregon Big Game Hunters' Trip Expenses in 1968, by Income Groups.

Group No.	Income level	Percent of big game hunters a/	Trip expenses per family	Estimated trip expenses by income groups	Percent of total expenditure
1	Under $3,000	6.19	$ 62.15	$ 589,620	3.17
2	$ 3,001 - $ 5,000	8.94	131.50	1,804,200	9.70
3	$ 5,001 - $ 7,000	21.46	106.87	3,519,120	18.92
4	$ 7,001 - $10,000	33.98	126.44	6,589,980	35.43
5	$10,001 - $15,000	23.79	128.70	4,698,360	25.26
6	$15,001 - $20,000	2.89	197.86	876,060	4.71
7	Over 20,000	2.75	123.92	522,660	2.81
	Average over all reported income groups		121.24		
Total		100.0	--	$18,600,000	100.00

a/ These percentages differ from those in Table 7 because some of the people included in Table 7 did not make any hunting trips.

79 percent of the hunters, and incurred almost 81 percent of the total amount spent. Interestingly, the two highest income groups, \$15, 001 to \$20, 000 and over \$20, 000 spent less than 8 percent of the total expended on hunting trips, as compared to the 12 percent they spent on equipment. Fewer hunting trips were made by these two highest income groups, as shown in Table 14. Average number of trips in Table 14 reached a maximum for the \$7, 001 to \$10, 000 income group, and then declined at the higher income levels.

Oregon big game hunters' total trip expenses, by occupation of the head of household are given in Table 15. Examination of the data in the table reveals that Armed Forces personnel had lowest average trip expenses. This is in contrast to their expenditures on equipment, which were the highest, as mentioned earlier. However, the estimate for this group is not precise, being based on only two observations. Again, as for equipment expenditures, the most common occupation for the head of household of hunting families was "Craftsmen, Foremen", which included about one-fourth of all families. Their trip expenses accounted for about one-fourth of the total, just as their expenditures for equipment had represented about one-fourth of the total, as mentioned earlier.

Hunting trip expenses, by county of residence, are reported in Table 16. Figures in the table indicate that average trip

Table 14. Average Number of Hunting Trips by Oregon Big Game Hunters, in Relation to Family Income Level.

Group No.	Family income level	No. of observa-tions	Total hunting trips	Average No. of trips
1	Under $3,000	41	107	2.61
2	$ 3,001 - $ 5,000	62	199	3.21
3	$ 5,001 - $ 7,000	151	494	3.27
4	$ 7,001 - $10,000	240	858	3.58
5	$10,001 - $15,000	163	475	2.91
6	$15,001 - $20,000	21	59	2.81
7	Over $20,000	17	33	1.94
Total		695	2,225	3.20

expenses by residents of the Portland area (Clackamas, Multnomah, and Washington counties) were almost 40 percent above the state average. However, a smaller percent of the Portland area residents hunted. Therefore, these three counties accounted for less than 38 percent of the total trip expenses, whereas the population of these three counties was around 44.5 percent of the Oregon population in 1968.

Consequently, on a per-capita basis, Portland area residents averaged $8.23 per person, whereas residents of the remainder of the state averaged $9.66 per person. Thus, hunting trip expenses per capita for the Portland area were only about 85 percent as high as for the rest of the state.

Table 15. Oregon Big Game Hunters' Trip Expenses in 1968, by Occupation.

Group No.	Occupation	Percent of big game hunters	Trip expenses per family	Estimated trip expenses by occupation	Percent of total expenditure
1	Professional, technical	11.60	$112.71	$ 2,040,420	10.97
2	Farmers and farm managers	5.73	105.01	948,600	5.10
3	Managers, officials, and proprietors	11.46	121.96	2,181,780	11.73
4	Clerical	2.80	120.24	524,520	2.82
5	Sales workers	4.67	163.49	1,190,400	6.40
6	Craftsmen, foremen	22.93	133.26	4,770,900	25.65
7	Machine operators and related workers	9.60	110.76	1,660,980	8.93
8	Service workers	4.67	138.30	1,008,120	5.42
9	Farm laborers	0.53	69.66	55,800	0.30
10	Laborers, excluding farm laborers	17.60	115.34	3,167,580	17.03
11	Others: retired housewives, students	7.87	80.65	991,380	5.33
12	Unemployed	0.27	86.03	35,340	0.19
13	Armed Forces	0.27	58.63	24,180	0.13
	Average over all reported occupations		119.12		
Total		100.00	--	$18,600,000	100.00

Table 16. Oregon Big Game Hunters' Trip Expenses in 1968, by County of Residence.

County No.	County	Trip expenses per family	Estimated trip expenses by county of residence	Percent of total expenditure
1	Baker	$ 70.43	$ 165,540	0.89
2	Benton	105.45	360,840	1.94
3	Clackamas	159.99	1,711,200	9.20
4	Clatsop	108.10	427,800	2.30
5	Columbia	103.24	204,600	1.10
6	Coos	105.34	548,700	2.95
7	Crook	85.70	154,380	0.83
8	Curry	155.16	223,200	1.20
9	Deschutes	88.31	349,680	1.88
10	Douglas	77.32	543,120	2.92
11	Gilliam	23.25	13,020	0.07
12	Grant	53.80	78,120	0.42
13	Harney	95.61	225,060	1.21
14	Hood River	136.41	172,980	0.93
15	Jackson	112.40	1,032,300	5.55
16	Jefferson	128.43	93,000	0.50
17	Josephine	79.40	204,600	1.10
18	Klamath	121.93	747,720	4.02
19	Lake	54.70	50,220	0.27
20	Lane	118.48	2,114,820	11.37
21	Lincoln	135.98	293,880	1.58
22	Linn	78.36	535,680	2.88
23	Malheur	54.14	146,940	0.79
24	Marion	142.25	1,155,060	6.21
25	Morrow	63.33	33,480	0.18
26	Multnomah	171.41	4,263,120	22.92
27	Polk	74.05	133,920	0.72
28	Sherman	0.00	--	0.00
29	Tillamook	70.00	139,500	0.75
30	Umatilla	114.22	556,140	2.99
31	Union	110.00	258,540	1.39

Continued

Table 16--Continued.

County No.	County	Trip expenses per family	Estimated trip expenses by county of residence	Percent of total expenditure
32	Wallowa	113.34	143,220	0.77
33	Wasco	86.56	171,120	0.92
34	Washington	174.22	1,037,880	5.58
35	Wheeler	98.28	70,680	0.38
36	Yamhill	102.65	239,940	1.29
	Average over all counties	121.26		
Total		--	$18,600,000	100.00

Hunting Trip Expenses for the Various Game Management Units

Oregon is divided by the Oregon State Game Commission into 66 hunting areas called Game Management Units. Data in Table 17 shows that about 48 percent of the 1968 Oregon big game hunters limited their hunting to a single Game Management Unit. It can also be seen that most of the hunters (about 93 percent) hunted in three or fewer Game Management Units, and accounted for almost 85 percent of total trip expenses. Increases in average trip expenses were probably due to greater transportation costs and more days hunted as number of Game Management Units hunted increased.

Total hunting trip expenses, by Oregon Game Management Units, are presented in Table 18. The figures in the table show the variation in hunters' trip expenses according to Game Management

Table 17. Oregon Big Game Hunters' Trip Expenses in 1968, by Number of Game Management Units Hunted.

No. of Oregon Game Management Units hunted	Number [a/] of sample observations	Trip expenses per family	Estimated total trip expenditures by number of Game Management Units hunted	Percent of total expenditure
1	269	$ 92.38	$6,126,840	32.94
2	175	145.90	6,296,100	33.85
3	76	177.79	3,331,260	17.91
4	25	281.90	1,737,240	9.34
5 - 10	16	281.45	1,108,560	5.96
Average over all units [b/]		134.49	--	--
Total	561	--	$18,600,000	100.00

a/ Only about one-half of the responding hunters were able to give the name of the Game Management Unit hunted.

b/ This is based upon trip expenses of hunters who reported the Game Management Unit hunted.

Table 18. Oregon Big Game Hunters' Total Trip Expenses in 1968, by Oregon Game Management Units.

No.	Game Management Unit hunted	No. of observations	Trip expenses per family	Estimated total trip expenditures by Game Management Units hunted	Percent of total expenditure
1	Alsea	30	$109.27	$558,000	3.00
2	Applegate	5	78.42	65, 100	0.35
3	Baker	20	123.72	390,600	2.10
4	Beulah	7	210.32	228,780	1.23
5	Catherine Creek	8	126.94	186,000	1.00
6	Chesnimus	14	191.83	427,800	2.30
7	Chetco	3	188.85	93,000	0.50
8	Clatsop	24	141.63	558,000	3.00
9	Columbia	2	119.23	39,060	0.21
10	Deschutes	16	91.17	226,920	1.22
11	Desolation	22	154.10	558,000	3.00
12	Dixon	14	57.22	186,000	1.00
13	Elkton	7	95.10	111,600	0.60
14	Evans Creek	4	82.36	55,800	0.30
15	Fort Rock	26	147.62	597,060	3.21
16	Grizzly	6	181.12	186,000	1.00
17	Hart Mountain	1	58.40	18,600	0.10
18	Heppner	28	158.39	744,000	4.00
19	Hood River	2	85.63	29,760	0.16
20	Imnaha	8	221.04	279,000	1.50
21	Interstate	15	131.93	306,900	1.65

Continued

Table 18--Continued.

No.	Game Management Unit hunted	No. of observations	Trip expenses per family	Estimated total trip expenses by Game Management Units hunted	Percent of total expenditure
22	Juniper	0	--	--	--
23	Keating	7	67.06	74,400	0.40
24	Keno	4	225.31	186,000	1.00
25	Klamath	13	207.12	46,500	0.25
26	Lookout Mountain	5	182.78	186,000	1.00
27	Malheur River	8	134.49	186,000	1.00
28	Maupin	1	106.80	18,600	0.10
29	Maury	5	125.54	186,000	1.00
30	McKenzie	34	107.14	59,520	0.32
31	Melrose	6	37.08	40,920	0.22
32	Metolius	7	178.22	186,000	1.00
33	Minam	11	292.58	558,000	3.00
34	Murderers Creek	18	205.53	576,600	3.10
35	Mestucca Unit	1	101.90	18,600	0.10
36	Northside	23	207.24	744,000	4.00
37	Ochoco	34	157.35	837,000	4.50
38	Owyhee	0	--	--	--
39	Paulina	16	158.22	394,320	2.12
40	Polk	9	127.92	186,000	1.00
41	Powers	5	133.56	186,000	1.00
42	Rogue	17	89.52	241,800	1.30

Continued

Table 18--Continued.

No.	Game Management Unit hunted	No. of observations	Trip expenses per family	Estimated total trip expenses by Game Management Units hunted	Percent of total expenditure
43	Santiam	29	$158.36	$ 744,000	4.00
44	Sherman	2	24.70	18,600	0.10
45	Silver Lake	25	97.47	372,000	2.00
46	Silvies	13	148.31	372,000	2.00
47	Siuslaw	5	117.42	93,000	0.50
48	Sixes	11	118.50	204,600	1.10
49	Sled Springs	15	253.16	591.480	3.18
50	Snake River	13	177.28	272,000	2.00
51	Sprague	15	126.29	297,600	1.60
52	Starkey	17	179.83	483,600	2.60
53	Steens Mountain	3	102.22	55,800	0.30
54	Tioga	19	153.10	451,980	2.43
55	Trask	20	128.71	409,200	2.20
56	Ukiah	29	180.77	818,400	4.40
57	Umatilla	18	174.72	489,180	2.63
58	Wagontire	2	153.50	55,800	0.30
59	Walla Walla	3	164.27	76,260	0.41
60	Warner	3	123.83	57,660	0.31
61	Wasco	9	61.41	93,000	0.50
62	Wenaha	17	215.51	576,600	3.10
63	Wheeler	28	166.95	744,000	4.00

Continued

Table 18--Continued.

No.	Game Management Unit hunted	No. of observations	Trip expenses per family	Estimated total trip expenses by Game Management Units hunted	Percent of total expenditure
64	White Horse	0	166.95	744,000	4.00
65	Willamette	11	119.75	204,600	1.10
66	Wilson	16	101.02	260,400	1.40
	Average over all management units		147.75	--	--
Total		809	--	$18,600,000	100.00

Units hunted. Average trip expenses ranged from a low of $25 (Sherman) to a high of $293 (Minam). Similarly, percentages of total trip expenses varied considerably, ranging from a low of 1 percent to a high of 4.5 percent. This variation in total trip expenses can be caused by variation in average trip expenses, as well as by the number of hunters hunting in the various management units.

Some care should be taken in interpreting the figures of Table 18. For example, trip expenses per family often represent more than one trip.

Relation of Hunting Trip Expenses to Hunting Trips and Days Taken

As shown in Table 19, almost 52 percent of the Oregon big game hunters made only one or two hunting trips during the 1968 season, and accounted for about 42 percent of total expenses. Almost 80 percent of the hunters made four or fewer trips, and accounted for 71 percent of total trip expenses. The remaining 20 percent of the hunters, who made between 5 and 17 trips, incurred 29 percent of the total trip expenses. The fact that hunters with five or more trips spent almost 50 percent more is not surprising, since trip expenses per family are expected to increase as the number of hunting trips rises.

Table 20 presents hunters' trip expenses by days hunted.

Table 19. Oregon Big Game Hunters' Trip Expenses in 1968, by Hunting Trips.

No. of hunting trips	No. of observations	Trip expenses per family	Estimated total trip expenditures by hunting trips	Percent of total expenditure
1	249	$ 85.75	$ 3,850,200	20.70
2	176	124.45	3,950,640	21.24
3	128	132.26	3,054,120	16.42
4	101	130.53	2,378,940	12.79
5	61	161.61	1,778,160	9.56
6	38	155.20	1,063,920	5.72
7	20	231.81	837,000	4.50
8	15	195.66	530,100	2.85
9	11	199.11	394,320	2.12
10	9	161.77	262,260	1.41
11 - 17	15	184.25	500,340	2.69
Average over all trips		125.29		
Total	823	--	$18,600,000	100.00

Table 20. Oregon Big Game Hunters' Trip Expenses in 1968, by Days Hunted.

No. of days hunted (sum for all trips)	No. of families	Hunting expenses per family	Estimated total trip expenses by days hunted	Percent of total expenditure
1	25	$ 19.64	$ 104,160	0.56
2	58	43.49	539,400	2.90
3	61	52.78	688,200	3.70
4	81	73.76	1,276,960	6.86
5	45	102.79	985,800	5.30
6	57	102.82	1,249,920	6.72
7 - 9	116	135.23	3,355,440	18.04
10 - 12	92	172.75	3,398,220	18.27
13 - 15	46	206.84	2,031,120	10.92
16 - 20	54	252.36	2,912,760	15.66
21 - 50	30	321.59	2,059,020	11.07
Average over all days		130.92	--	--
Total	665	--	$18,600,000	100.00

It can be seen, as expected, that hunting expenses per family rise steadily as the number of days hunted increases. Family hunting trip expenses ranged from $20 (only one day of hunting) to about $322 (for 21-50 days of hunting). Approximately 62 percent of total trip expenses were incurred by families who hunted between 1 and 12 days. However, families hunting more than 20 days made only about 11 percent of the total trip expenditures, because these 30 families represented only about 4.5 percent of the total number of hunting families in the sample.

Hunting Trip Expenses by Species and Game Management Units

In Table 21, big game hunters' trip expenses have been tabulated according to species hunted. Mule deer accounted for over one-half of total expenditures on hunting trips, almost 52 percent. Next highest percent of hunting trip expenses was for Rocky Mountain elk, with about 26 percent of the total. Blacktail deer accounted for about 15 percent of total hunting trip expenditures, and Roosevelt elk for around 6 percent. Other species, such as antelope and bear, accounted for less than 1 percent of total hunting trip expenditures; however, it should be cautioned that this last estimate for antelope and bear is based upon only three antelope and two bear hunting families, as shown in Table 21.

Of the major species hunted (deer and elk), highest expenditures per trip were made for Rocky Mountain elk. However, when hunting expenditures are put on a daily basis, average hunting expense per day is about the same for Roosevelt elk, mule deer, and Rocky Mountain elk, as shown in the next-to-last column in Table 21. The higher expenditure per trip for Rocky Mountain elk is partly due to the longer duration of the Rocky Mountain elk hunting trips, about 3.8 days as compared to about 2.6 days for mule deer hunting trips and only 1.8 days for Roosevelt elk, as shown in Table 22.

Blacktail deer hunting trips averaged less than 1.3 days per hunting trip. Doubtlessly, the fact that blacktail deer and Roosevelt elk are located in western Oregon, close to population centers, accounts for the greater number of one-day hunting trips for these species.

In Table 23, hunting trip expenses have been tabulated by Game Management Unit. Average expenditure per season and average expenditure per trip are listed for each unit hunted. The average expenditure per season represents only part of a hunter's trip expense if he also hunted in one or more of the other units. Thus, average expenditure per season for the units tends to be less than average expenditure per hunting family.

Table 21. Oregon Big Game Hunters' Trip Expenses in 1968, by Species of Big Game Animals.

Species	Number of observations (sample)	Total variable expenditure (sample)	Ave. variable expenditure per season	Ave. variable expenditure per trip	Ave. variable expenditure per day	Percent of total variable expenditure
Blacktail deer	216	$ 11,362.63	$ 52.60	$ 17.44	$ 13.83	15.13
Mule deer	387	38,926.18	100.58	51.18	19.35	15.83
Roosevelt elk	72	4,760.35	66.12	36.62	20.34	6.34
Rocky Mountain elk	187	19,646.65	105.06	73.58	19.49	26.16
Antelope	3	349.00	116.33	116.33	19.39	0.47
Bear	2	54.80	27.40	27.40	27.40	0.07
Total	867	$75,099.61	--	--	--	100.00

Table 22. Average Number of Hunting Trips and Number of Hunting Days in 1968, by Species of Big Game Animals.

Species	Number of observations (sample)	Average number hunting trips per season	Average number hunting days per season	Average number of hunting trips
Black tail deer	216	2.99	3.75	1.25
Mule deer	387	1.95	5.17	2.65
Roosevelt elk	72	1.81	3.25	1.85
Rocky Mountain elk	187	1.43	5.39	3.77
Antelope	3	1.00	6.00	6.00
Bear	2	1.00	1.00	1.00

Table 23. Oregon Big Game Hunters' Trip Expenses in 1968, by Species and Game Management Units.

Unit hunted	Species	Number of observations (sample)	Total variable expenditure (sample)	Ave. variable expenditure per season	Ave. variable expenditure per trip	Ave. variable expenditure per day
Alsea	Deer	25	$ 711.90	$28.48	$10.63	$ 9.62
	Elk	3	118.15	39.38	29.54	13.13
Applegate	Deer	4	46.35	11.59	9.27	11.59
	Elk	1	16.50	16.50	16.50	16.50
Baker	Deer	19	1,141.90	60.10	34.60	18.13
	Elk	9	625.40	69.49	29.78	23.16
Beulah	Deer	8	836.85	104.61	83.69	18.60
	Elk	1	57.00	57.00	57.00	14.25
Catherine Cr.	Deer	6	187.65	31.28	14.43	20.85
	Elk	8	599.10	74.89	39.94	15.77
Chesnimus	Deer	8	840.45	105.56	105.56	24.72
	Elk	10	813.95	81.40	81.40	15.65
Chetco	Deer	3	114.25	38.08	8.79	8.79
Clatsop	Deer	12	553.85	46.15	22.15	20.51
	Elk	18	1,369.15	76.06	52.66	28.52

Continued

Table 23--Continued.

Unit hunted	Species	Number of observations (sample)	Total variable expenditure (sample)	Ave. variable expenditure per season	Ave. variable expenditure per trip	Ave. variable expenditure per day
Columbia	Deer	6	$ 335.00	$55.83	$30.45	$23.93
Deschutes	Deer	21	831.20	39.58	21.31	10.26
	Elk	2	133.40	66.70	66.70	19.06
Desolation	Deer	11	1,933.10	175.74	101.74	35.15
	Elk	17	1,730.35	101.79	78.65	20.12
Dixon	Deer	14	566.85	40.49	18.90	15.75
	Elk	1	26.25	26.25	13.12	26.25
Elkton	Deer	7	327.80	46.83	23.41	27.32
	Elk	6	238.45	39.74	39.74	21.68
Evans Cr.	Deer	4	122.00	30.50	30.50	20.33
Fort Rock	Deer	27	2,100.10	77.78	42.86	16.54
	Elk	1	121.15	121.15	60.58	40.38
Grizzly	Deer	6	315.80	52.63	45.11	18.57
	Elk	2	51.83	25.83	17.22	25.83
Hart Mt.	Deer	3	159.10	53.03	53.03	12.24

Continued

Table 23--Continued.

Unit hunted	Species	Number of observations (sample)	Total variable expenditure (sample)	Ave. variable expenditure per season	Ave. variable expenditure per trip	Ave. variable expenditure per day
Heppner	Deer	26	$2,300.40	$ 88.48	$ 58.98	$26.95
	Elk	6	225.00	37.50	22.50	13.24
Hood River	Deer	2	74.35	37.18	24.78	18.59
Imnaha	Deer	4	281.45	70.36	56.29	21.65
	Elk	7	698.05	99.72	87.26	33.24
Interstate	Deer	21	1,492.05	71.05	53.29	19.89
Juniper	--	--	--	--	--	--
Keating	Deer	6	266.30	44.38	33.29	22.19
	Elk	1	35.45	35.45	17.73	17.73
Keno	Deer	5	477.75	95.55	31.85	19.11
	Elk	1	28.75	28.75	28.75	28.75
Klamath	Deer	21	1,227.75	58.46	29.23	15.35
Lookout Mt.	Deer	5	475.85	95.17	79.31	36.60
	Elk	1	151.10	151.10	151.10	37.78

Continued

Table 23--Continued.

Unit hunted	Species	Number of observations (sample)	Total variable expenditure (sample)	Ave. variable expenditure per season	Ave. variable expenditure per trip	Ave variable expenditure per day
Malheur Riv.	Deer	8	$ 681.95	$ 85.24	$ 56.83	$ 15.50
	Elk	1	55.50	55.50	55.50	18.50
Maupin	Deer	1	19.05	19.05	19.05	19.05
Maury	Deer	4	261.70	65.43	43.62	20.13
McKenzie	Deer	34	1,206.00	35.47	16.08	14.36
	Elk	5	291.50	58.30	29.15	58.30
Melrose	Deer	7	234.50	33.50	11.73	18.04
Metolius	Deer	9	371.40	41.27	28.57	20.63
Minam	Deer	7	510.65	72.95	63.83	36.48
	Elk	8	1,154.20	144.28	115.42	20.99
Murderer's Cr.	Deer	18	2,139.50	118.86	97.25	19.10
	Elk	5	654.05	130.81	59.46	19.24
	Antelope	1	101.50	101.50	101.50	33.83
Nestucca	Deer	1	11.50	11.50	11.50	5.75
	Elk	1	44.50	44.50	44.50	8.90

Continued

Table 23--Continued.

Unit hunted	Species	Number of observations (sample)	Total variable expenditure (sample)	Ave. variable expenditure per season	Ave. variable expenditure per trip	Ave. variable expenditure per day
Northside	Deer	31	$3,179.35	$102.56	$67.65	$23.73
	Elk	5	376.80	75.36	75.36	15.07
Ochoco	Deer	32	2,405.60	75.18	54.67	21.48
	Elk	3	158.50	52.83	39.63	17.61
Owyhee	--	--	--	--	--	--
Paulina	Deer	21	1,539.90	73.33	44.00	16.04
	Antelope	1	62.50	62.50	62.50	12.50
Polk	Deer	11	322.25	29.30	14.65	5.56
	Elk	2	41.25	20.63	20.63	13.75
Powers	Deer	7	321.70	45.96	18.92	22.98
	Elk	1	2.50	2.50	2.50	2.50
Rogue	Deer	19	852.90	44.89	18.95	10.03
	Elk	1	50.50	50.50	50.50	5.05

Continued

Table 23--Continued.

Unit hunted	Species	Number of observations (sample)	Total variable expenditure (sample)	Ave. variable expenditure per season	Ave. variable expenditure per trip	Ave. variable expenditure per day
Santiam	Deer	33	$1,919.65	$58.17	$23.13	$19.01
	Bear	1	41.90	41.90	41.90	41.90
Sherman	Deer	4	101.25	25.31	14.46	10.13
Silver Lake	Deer	30	1,976.25	65.88	50.67	17.65
	Elk	1	15.60	15.60	15.60	15.60
Silvies	Deer	16	936.20	58.51	44.58	19.92
	Elk	1	46.50	46.50	23.25	11.63
Siuslaw	Deer	5	162.00	32.40	9.53	8.53
	Elk	2	90.50	45.25	45.25	15.08
Sixes	Deer	11	428.80	39.98	20.42	19.49
	Elk	2	114.25	57.13	38.08	22.85
Sled Springs	Deer	19	1,436.00	75.58	55.23	16.32
	Elk	16	2,996.00	187.25	149.80	25.39
Snake Riv.	Deer	9	1,062.70	118.08	106.27	17.42
	Elk	6	757.20	126.20	126.20	18.93

Continued

Table 23--Continued.

Unit hunted	Species	Number of observations (sample)	Total variable expenditure (sample)	Ave. variable expenditure per season	Ave. variable expenditure per trip	Ave. variable expenditure per day
Sprague	Deer	17	$1,600.20	$ 94.13	$ 72.74	$17.78
Starkey	Deer	3	152.45	50.82	50.82	21.78
	Elk	21	2,431.40	115.78	93.52	16.54
Steens Mt.	Deer	7	503.95	71.99	71.99	24.00
Tioga	Deer	10	234.45	23.45	10.19	9.77
	Elk	13	1,363.70	104.90	30.99	19.48
	Bear	1	12.90	12.90	12.90	12.90
Trask	Deer	21	978.85	46.61	16.59	17.48
	Elk	4	223.00	55.75	55.75	17.15
Ukiah	Deer	14	1,085.70	77.55	49.35	18.40
	Elk	21	2,065.20	98.34	73.76	18.95
Umatilla	Deer	8	412.15	51.52	27.48	15.26
	Elk	17	1,271.75	74.81	50.87	17.66
Wagontire	Deer	4	182.50	45.63	45.63	13.04
Walla Walla	Deer	3	192.90	64.30	32.15	27.56
	Elk	8	642.45	80.31	71.38	17.85

Continued

Table 23--Continued.

Unit hunted	Species	Number of observations (sample)	Total variable expenditure (sample)	Ave. variable expenditure per person	Ave. variable expenditure per trip	Ave. variable expenditure per day
Warner	Deer	3	$ 285.75	$ 95.25	$95.25	$25.98
Wasco	Deer	16	688.60	43.04	20.25	10.93
	Elk	1	35.50	35.50	11.83	11.83
Wenaha	Deer	7	379.95	54.28	52.22	15.57
	Elk	18	1,922.05	106.78	83.57	20.45
Wheeler	Deer	30	2,593.80	86.46	49.88	19.07
	Elk	2	112.40	56.20	37.47	14.05
Whitehorse	Antelope	1	185.00	185.00	185.00	18.50
Willamette	Deer	11	289.00	26.27	13.14	14.45
Wilson	Deer	11	526.95	47.90	17.57	11.21
	Elk	10	451.35	45.14	30.09	14.10
High Cascade e/	Deer	9	380.75	42.31	29.29	15.23
Total		1,060	75,099.61	--	--	--
Average		15.82 a/	--	70.86 b/	41.40 c/	18.34 d/

Continued

Table 23--Continued.

a/ Divided by 67, the number of units.

b/ Total expenditure divided by 1,060. Note that 1,060 is more than the number of hunting families, 867, since some hunters hunted in more than one unit.

c/ Total expenditure divided by 1,801, observed number of hunting trips.

d/ Total expenditure divided by 4,070, observed number of hunting days.

e/ Some hunters indicated that they hunted in the high Cascades, which could not be placed in any single big game management unit.

Highest average expenditures per season and per trip tended to be for those big game management units located in eastern Oregon. Total hunting trip expenditures for deer were highest in the Northside, Wheeler, Heppner, Murderer's Creek, and Ochoco units.

Highest hunting trip expenditures per season were made by elk hunters in the Sled Springs unit. In this unit, 16 elk hunters averaged $187.25 for the season and $149.80 per hunting trip.

The Oregon State Game Commission has divided Oregon into five administration regions; region I (Northwest), region II (Southwest), region III (Central), region IV (Northeast), region V (Southeast) as shown in Figure 1. Of these administrative regions, Region IV had the greatest hunter expenditure, totaling over $40,000, which represented over 53 percent of the state total.

Investment in Hunting and Related Equipment, by Species and Game Management Units

Expenditures for hunting and associated equipment have been allocated among the various big game species in Table 24. Expenditures were allocated to each specie according to the number of days hunted. For example, if a family hunted mule deer for seven days and Roosevelt elk for three days, 70 percent of their investment in hunting and related equipment was allocated to mule deer and

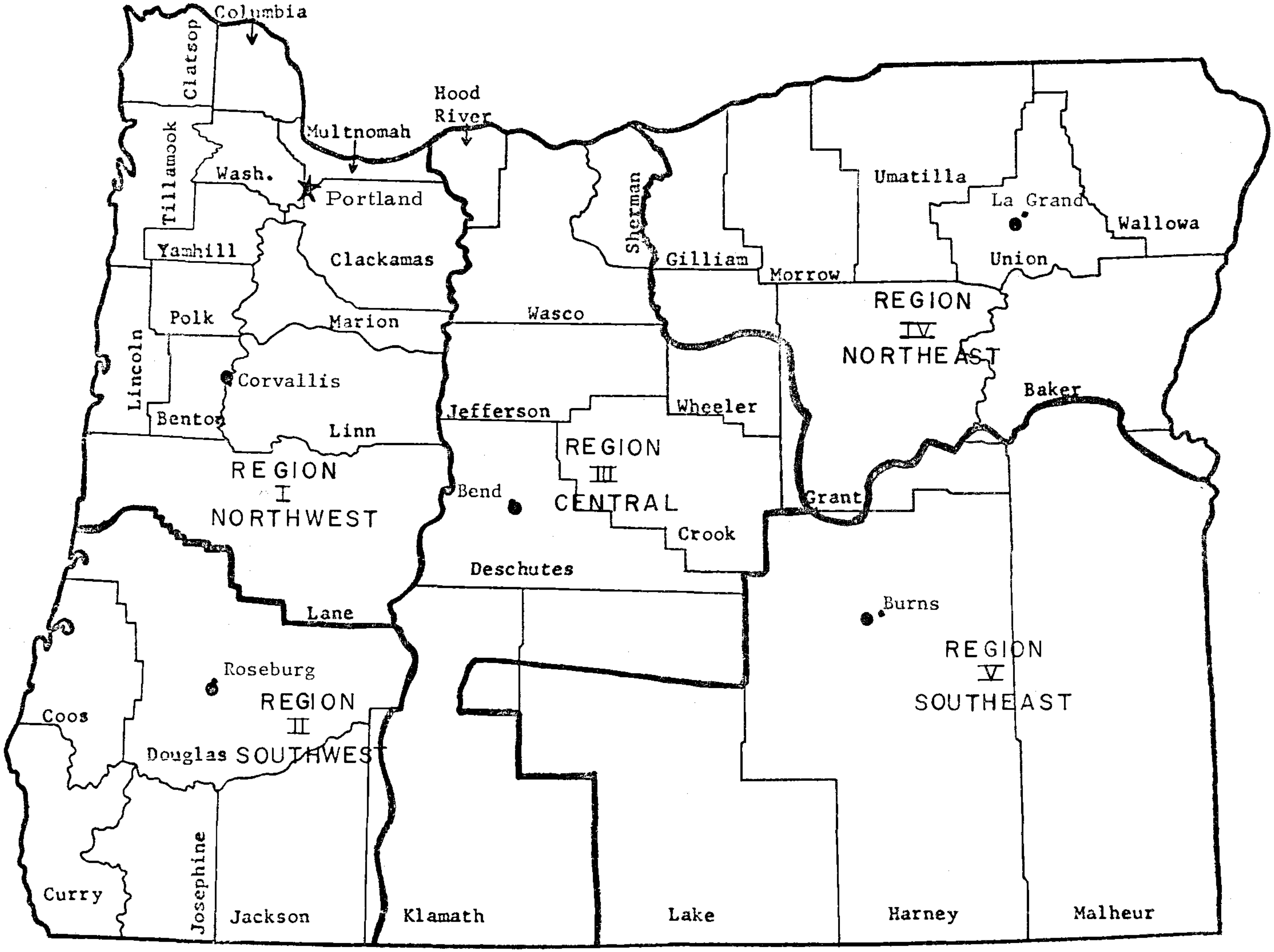

FIGURE I. OREGON GAME COMMISSION ADMINISTRATIVE REGIONS

Table 24. Allocation of Investment in Hunting and Associated Equipment in 1968, by Species a/.

Species	Number of observations (sample)	Total investment (sample)	Average investment per season	Average investment per trip	Average investment per day	Percent of total investment
Blacktail deer	216	$19,319.37	$ 89.44	$ 29.68	$ 23.53	15.80
Mule deer	387	72,647.83	187.75	95.48	36.11	59.41
Roosevelt elk	72	6,817.04	94.68	52.44	29.13	5.57
Rocky Mt. elk	187	21,179.55	113.26	79.32	21.01	17.32
Antelope	3	2,255.24	751.75	751.75	125.29	1.84
Bear	2	68.10	34.05	34.05	34.05	.06
Total	867	$122,297.13	--	--	--	100.00

a/ Allocation was made to each specie according to the number of days hunted. For example, if a hunting family spent $1,000 on equipment, and hunted 6 days for mule deer and 4 days for Rocky Mountain elk, mule would be allocated $600 and Rocky Mountain $400.

30 percent to Roosevelt elk.

As was the case for hunting trip expenses, mule deer were again most important, with over 59 percent of total investment. Rocky Mountain elk were second with over 17 percent, followed closely by blacktail deer with almost 16 percent. Roosevelt elk accounted for less than 6 percent; bear and antelope together were less than 2 percent.

Of course, the preceding method of allocation may not be entirely accurate, since some equipment purchases might be made primarily for hunting some prized specie, such as elk, even though the hunting family in that case might spend more total days hunting for deer. However, we had no information for allocating on any other basis other than using days hunted per specie.

In a similar manner, the 1968 investment in hunting and associated equipment was allocated to both species and big game management units in Table 25. Thus, in Table 25 the hunters' investment in equipment has been credited to the areas hunted.

Greatest total investment in equipment for any area was the Fort Rock game management unit, with over $8,000 invested by deer hunters. However, these investment figures per game management unit should be taken with some caution, since they are much more variable than hunting trip expenditures. For example, the 28 hunting families in our sample who hunted in the Fort Rock unit apparently made a number of large purchases in 1968, whereas the 35 hunting families of the Sled Springs unit invested only $4,600 in 1968. Nevertheless, the Sled Springs hunters may have had as much or more total value of equipment as the Fort Rock hunters, but may have purchased most of it prior to 1968.

At any rate, the high variability of investment, by specie and unit, can be seen from the average investment figures in Table 25. Average investment ranged from 0 to $406 per day hunted.

In Table 26, hunting trip expenses and investment in equipment have been combined and allocated among the various species. Again, mule deer accounted for the largest part of the total expenditures, with over 36 percent; Rocky Mountain elk were second with nearly 21 percent, followed by blacktail deer with over 15 percent. About 6 percent of total expenditures were made by Roosevelt elk hunters, followed by antelope hunters with 1.3 percent of total expenditures.

Total Expenditures by Oregon Big Game Hunters

The preceding cost data were classified as (1) the investment in durable equipment items for big game hunting, and (2) the expenses incurred on hunting trips. Thus, total expenditures by Oregon big game hunters are obtained by adding investment in hunting and related equipment and hunting trip expenses:

Table 25. Allocation of 1968 Investment in Hunting and Associated Equipment, by Species and Game Management Units.

Area hunted	Species	Number of observations (sample)	Total investment (sample)	Average investment per season	Average investment per trip	Average investment per day
Alsea	Dear	25	$1,407.07	$ 56.28	$ 21.00	$ 19.01
	Elk	3	174.80	58.27	43.70	19.42
Applegate	Deer	4	194.98	48.75	39.00	48.75
	Elk	1	0.17	0.17	0.17	0.17
Baker	Deer	19	660.45	34.76	20.01	10.48
	Elk	9	423.36	47.04	20.16	15.68
Beulah	Deer	8	1,257.69	157.21	125.77	27.95
	Elk	1	--	--	--	--
Catherin Creek	Deer	6	645.76	107.63	49.67	71.75
	Elk	8	323.35	40.42	21.56	8.51
Chesnimus	Deer	8	886.32	110.79	110.79	26.07
	Elk	10	685.19	68.52	68.52	13.18
Chetco	Deer	3	283.70	94.57	21.82	21.82
Clatsop	Deer	12	959.90	79.99	38.40	35.55
	Elk	18	354.56	19.70	13.64	7.39

Continued

Table 25--Continued.

Area hunted	Species	Number of observations (sample)	Total investment (sample)	Average investment per season	Average investment per trip	Average investment per day
Columbia	Deer	6	$ 332.46	$ 55.41	$ 30.22	$ 23.75
Deschutes	Deer	21	4,279.18	203.77	109.72	52.83
	Elk	2	--	--	--	--
Desolation	Deer	11	3,624.36	329.49	190.76	65.90
	Elk	17	1,581.55	93.03	71.89	18.39
Dixon	Deer	14	450.00	32.14	15.00	12.50
	Elk	1	406.20	406.20	203.10	406.20
Elkton	Deer	7	769.94	109.99	55.00	64.16
	Elk	6	434.16	72.36	72.36	39.47
Evans Creek	Deer	4	122.54	30.65	30.64	20.42
Fort Rock	Deer	27	8,020.54	297.06	163.68	63.15
	Elk	1	212.10	212.10	106.05	70.70
Grizzly	Deer	6	448.45	74.74	64.06	26.38
	Elk	2	--	--	--	--
Hart Mountain	Deer	3	195.10	65.03	65.03	15.01

Continued

Table 25--Continued.

Area hunted	Species	Number of observations (sample)	Total investment (sample)	Average investment per season	Average investment per trip	Average investment per day
Heppner	Deer	26	$4,599.18	$ 176.89	$ 117.93	$53.48
	Elk	6	1,235.69	205.95	123.57	72.69
Hood River	Deer	2	32.00	16.00	10.67	8.00
Imnaha	Deer	4	481.56	120.39	96.31	37.04
	Elk	7	502.69	71.81	62.84	23.94
Interstate	Deer	21	2,192.71	104.41	78.31	29.24
Juniper	--	--	--	--	--	--
Keating	Deer	6	50.00	8.33	6.25	4.17
	Elk	1	--	--	--	--
Keno	Deer	5	575.82	115.16	38.39	23.03
	Elk	1	406.20	406.20	406.20	406.20
Klamath	Deer	21	3,433.75	163.51	81.76	42.92
Lookout Mountain	Deer	5	55.19	11.04	9.20	4.25
	Elk	1	101.26	101.26	101.26	25.32

Continued

Table 25--Continued.

Area hunted	Species	Number of observations (sample)	Total investment (sample)	Average investment per season	Average investment per trip	Average investment per day
Malheur River	Deer	8	$ 462.90	$ 57.86	$ 38.58	$ 10.52
	Elk	1	18.00	18.00	18.00	6.00
Maupin	Deer	1	--	--	--	--
Maury	Deer	4	2,129.00	532.25	354.83	163.77
McKenzie	Deer	34	2,739.82	80.58	36.53	32.62
	Elk	5	263.78	52.76	26.38	52.76
Melrose	Deer	7	760.86	108.69	38.04	58.53
Metolius	Deer	9	621.03	69.00	47.77	34.50
Minam	Deer	7	228.84	32.69	28.61	16.35
	Elk	8	946.32	118.29	94.63	17.21
Murderer's Cr.	Deer	18	3,040.61	168.92	138.21	27.15
	Elk	5	854.58	170.92	77.69	25.13
	Antelope	1	45.80	45.80	45.80	15.27
Nestucca	Deer	1	7.14	7.14	7.14	3.57
	Elk	1	443.64	443.64	443.64	88.73

Continued

Table 25--Continued.

Area hunted	Species	Number of observations (sample)	Total investment (sample)	Average investment per season	Average investment per trip	Average investment per day
Northside	Deer	31	$ 5,348.54	$ 172.53	$ 113.80	$39.91
	Elk	5	43.17	8.63	8.63	1.73
Ochoco	Deer	32	4,851.68	151.62	110.27	43.32
	Elk	3	274.80	91.60	68.70	30.53
Owyhee	--	--	--	--	--	--
Paulina	Deer	21	734.24	34.96	20.98	7.65
	Antelope	1	1,799.44	1,799.44	1,799.44	359.89
Polk	Deer	11	159.26	14.48	7.24	2.75
	Elk	2	36.62	18.31	18.31	12.21
Powers	Deer	7	429.09	61.30	25.24	30.65
	Elk	1	165.00	165.00	165.00	165.00
Rogue	Deer	19	2,721.78	143.25	60.48	32.02
	Elk	1	294.58	294.58	294.58	29.46
Santiam	Deer	33	1,581.81	47.93	19.06	15.66
	Bear	1	1.43	1.43	1.43	1.43
Sherman	Deer	4	82.00	20.50	11.71	8.20

Continued

Table 25--Continued.

Area hunted	Species	Number of observations (sample)	Total investment (sample)	Average investment per season	Average investment per trip	Average investment per day
Silver Lake	Deer	30	$ 6,789.60	$ 229.32	$ 176.40	$ 61.43
	Elk	1	12.50	12.50	12.50	12.50
Silvies	Deer	16	1,996.54	127.78	95.07	42.48
	Elk	1	122.80	122.80	61.40	30.70
Siuslaw	Deer	5	1,248.41	249.68	73.44	65.71
	Elk	2	353.85	-76.93	176.93	58.98
Sixes	Deer	11	1,089.51	99.05	51.88	49.52
	Elk	2	679.67	339.84	226.56	135.93
Sled Springs	Deer	19	2,087.28	109.86	30.28	23.72
	Elk	16	2,510.60	156.91	125.53	21.28
Snake River	Deer	9	689.34	76.59	68.93	11.30
	Elk	6	332.43	55.41	55.41	8.31
Sprague	Deer	17	1,548.38	91.08	70.38	17.20
Starkey	Deer	3	73.00	24.33	24.33	10.43
	Elk	21	3,302.55	157.26	127.02	22.47
Steens Mountain	Deer	7	714.28	102.04	102.04	34.01

Continued

Table 25--Continued.

Area hunted	Species	Number of observations (sample)	Total investment (sample)	Average investment per season	Average investment per trip	Average investment per day
Tioga	Deer	10	$ 1,173.88	$ 117.39	$ 51.04	$ 48.91
	Elk	13	2,091.45	160.88	47.53	29.88
	Bear	1	66.67	66.67	66.67	66.67
Trask	Deer	21	710.26	33.82	12.04	12.68
	Elk	4	340.50	85.13	85.13	26.19
Ukiah	Deer	14	832.44	59.46	37.84	14.11
	Elk	21	2,914.59	138.79	104.09	26.74
Umatilla	Deer	8	563.12	70.39	37.54	20.86
	Elk	17	2,257.62	132.80	90.30	31.36
Wagontire	Deer	4	584.57	146.14	146.14	41.76
Walla Walla	Deer	3	238.67	79.56	39.78	34.10
	Elk	8	1,155.64	144.46	128.40	32.10
Warner	Deer	3	236.43	78.81	78.81	21.49
Wasco	Deer	16	701.45	43.84	20.63	11.13
	Elk	1	0.38	0.38	0.13	0.13

Continued

Table 25--Continued.

Area hunted	Species	Number of observations (sample)	Total investment (sample)	Average investment per season	Average investment per trip	Average investment per day
Wenaha	Deer	7	$ 508.16	$ 72.59	$ 56.46	$ 18.15
	Elk	18	1,514.61	84.15	65.85	16.11
Wheeler	Deer	30	6,518.47	217.28	125.36	47.93
	Elk	2	66.25	33.13	22.08	8.28
Whitehorse	Antelope	1	410.00	410.00	410.00	41.00
Willamette	Deer	11	291.74	26.52	13.26	14.59
Wilson	Deer	11	382.40	34.76	12.75	8.14
	Elk	10	159.38	15.94	10.63	4.98
High Cascases	Deer	9	1,052.02	116.89	80.92	42.08
Total		1,060	$122,297.13	$ --	$ --	$ --
Average		--	--	$115.37	$ 67.42	$29.86

Table 26. Allocation of Oregon Big Game Hunters' Total Expenditures in 1968, by Species.

Species	Number observations (sample)	Total investment (sample)	Total var. expenditure (sample)	Gross expenditure	Average expenditure per season	Average expenditure per trip	Average expenditure per day	Percent of total expenditures
Blacktail deer	216	$19,319.37	$11,362.00	$ 30,682.00	$142.05	$ 47.13	$ 37.37	15.54
Mule deer	387	72,657.83	38,926.18	111,584.01	288.33	146.63	55.46	56.53
Roosevelt elk	72	6,817.04	4,760.35	11,577.39	160.80	89.06	49.48	5.87
Rocky Mountain elk	187	21,179.55	19,646.65	40,826.20	218.32	152.91	40.50	20.68
Antelope	3	2,255.24	349.00	2,604.24	868.08	868.08	144.68	1.32
Bear	2	68.10	54.80	122.90	61.45	61.45	61.45	.06
Total	867	$122,297.13	$75,099.61	$197,396.74	$ --	$ --	$ --	100.00

Investment in hunting and associated equipment =	$44.6 million
Hunting trip expenses . . . . =	18.6 million
Total	$63.2 million

Thus, total expenditures, or "gross economic value", of the Oregon big game resource in 1968 was estimated to be over $63 million. (This $63 million gross economic value included both resident and nonresident hunters.) Of course, certain assumptions with regard to the nonresponse were necessary to arrive at the above figures, as was discussed earlier. Disregarding the complication of nonresponse, an approximation of the variance of total expenditures was calculated.[9/] Using these estimates, the 95 percent confidence interval for the average annual expenditure per hunting family was computed:

Average annual expenditure per family	$357.61
Standard error	$ 15.15
95 percent confidence interval	$357.61 ± 29.67

Using the above confidence limits, it is estimated that total expenditures by big game hunters in Oregon probably ranged between $58.0 and $68.4 million.

9/ Details of the procedures followed are given in the Appendix.

Impact of Big Game Hunters' Expenditures on the Oregon Economy

Based upon an interindustry analysis in Nevada,[10/] each dollar of hunters' trip expenditure should generate about $2 worth of business and income in Oregon's economy. This multiplier effect of about 2 is also somewhat in agreement with an input-output study which measured the economic impact of expenditures by Oregon anglers in the Yaquina Bay sport fishery.[11/]

Although the economic impact of Oregon hunters' trip expenditures could differ slightly from the impact of expenditures by Nevada hunters, one would not expect very much divergence. Also, the fact that the economic impact of the Oregon angler expenditures was nearly the same as for the Nevada hunters would tend to validate the use of a multiplier effect of about 2.0 for the Oregon big game hunters' trip expenditures.

A recent Colorado study[12/] (pp. 16-17) indicated a total multiplier effect of approximately 2.0 for all expenditures by hunters and anglers in Grand County, Colorado. If the Colorado figures were appropriate for Oregon, then the total expenditures

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10/ Malone and Detering (1969).

11/ Sokoloski (1967).

12/ Rhody and Lovegrove (1970).

of $63.2 million by Oregon big game hunters would generate a total economic activity of over $120 million per year. It should be noted, however, that much of this economic activity would be generated in metropolitan areas such as Portland, Eugene, and Salem, where much of the expenditures for hunting gear and related equipment are made. Also, equipment for camping, such as pickups, campers, or house trailers, would usually be manufactured outside of Oregon and would therefore generate less economic activity than the above figures would indicate.

CHAPTER IV

ANALYTICAL ISSUES IN THE ESTIMATION OF OUTDOOR RECREATION DEMAND FUNCTIONS

In the preceding section, estimated total expenditures provide an indication of the gross economic value or the economic activity generated by the Oregon big game resource. However, estimation of the net economic value requires a more sophisticated theoretical and statistical analysis. A review and evaluation of various proposed methods for estimating net economic benefits of publicly owned recreational resources was presented in Chapter II. In essence, to properly estimate the economic value of these recreational resources, it is necessary to obtain accurate estimates of the underlying demand relationships for the recreational activity.

Once the basic demand relationship has been quantified, then net economic values can be derived. However, in the past there have been two main measures used for defining "net economic value". One definition states that net economic value of the resource should be the amount of revenue that a single owner could obtain by charging a single price. However, others have argued that this definition is too conservative, since some people would be willing to pay more than the single revenue-maximizing price.

Also, in the absence of any substantial charges for the use of publicly owned resources, even people who place lower values on the recreation would still be obtaining a positive benefit which would not be measured by using the single revenue-maximizing price approach.

The preceding objections have encouraged the adoption of another definition of net economic benefits. This second definition states that the net economic value to an individual is equal to the maximum amount that he would be willing to pay for the use of the resource, over and above the actual transfer cost that he must incur in order to participate in the recreational activity. As might be expected, this second definition results in a value two to three times higher than the first.

The first definition is commonly referred to as the "nondiscriminating monopolist" approach, and the second as "consumer surplus". Both measures will be computed with the understanding that the nondiscriminating monopolist approach provides a minimum or conservative estimate of net economic value, whereas the consumer surplus approach provides a full or maximum estimate of net economic value. However, to estimate either measure of net economic value, the underlying demand relationship must be known or approximated. Therefore, the specification and estimation of the basic demand relationship is crucial for the quantification of net economic benefits.

Improving the Estimation and Specification of Outdoor Recreation Demand

Although a demand relationship can sometimes be computed in a simple tabular form, as was the case for Clawson's original study (1959), this tabular approach has certain limitations. For one thing, no estimate of the statistical reliability, or lack thereof, can be obtained by using a tabular approach. Even more importantly, it is difficult or impossible to measure the important effects of other variables which influence the demand, unless one estimates the demand function by statistical techniques.

One very important factor which does not lend itself to a tabular analysis of demand would be the effect of distance or travel time upon the price-quantity relationship for outdoor recreation. Increased travel time, with increased distance, tends to result in an underestimate of value for a particular outdoor attraction if the Clawson tabular approach is used, as noted by Knetsch (1963) and recently reiterated by Cesario and Knetch (1970, p. 703):

> "Perhaps the most serious difficulty of the travel cost method, as it has been applied in the past, is a consistent bias in the derived demand curve. This difficulty results from the basic assumption that the disutility of overcoming distance is a function only of money cost. This assumption is not correct. The effect of distance

is likely to be a function of the time involved in making the trip, as well as the monetary cost . . ."

Along with the increased travel time required as distance increases, Clawson and Knetsch (1966) have noted that alternative recreational opportunities become relatively cheaper in travel and related transfer costs required as distance increases. Thus, one would expect a strong negative bias to result from the complicating factor of increased travel time.

Thus, most empirically estimated recreational demand functions have usually been poorly specified.[13/] It would, therefore, seem highly desirable to eliminate or reduce this bias, if possible, in the model specification and demand estimation procedures.

Given the importance of increased distance on the negative factors of travel time and alternative recreational opportunities, the inclusion of a separate variable, such as travel time per distance zone, would appear to be needed. Thus, visit rate could be expressed as a function of both money and time cost. However, as pointed out by Cesario and Knetsch (1970), the difficulty has

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[13/] Danger of bias resulting from omission of one or more relevant variables in economic research was noted by Theil (1957). A good, more recent statement of this problem is given by Malinvaud (1966, pp. 263-266).

been that travel costs in monetary outlay and time are usually highly correlated, making it very difficult to separate the effect of one from the other.

An attempt to separate monetary from time costs was made by Brown, et al. (1964), where days of fishing was expressed as a function of transfer costs, family income, and average distance traveled per zone. However, the standard error for the coefficient of the distance traveled variable was large, indicating an unreliable estimate of the effect of this variable. Furthermore, including average distance traveled tended to inflate the variance of the transfer cost variable because of the high intercorrelation between the two variables. Therefore, most researchers have simply omitted variables such as hours or miles traveled, perhaps not being properly concerned about the resulting specification bias.

What should the researcher do when confronted by the dilemma of multicollinearity on one hand and specification bias on the other? Cesario and Knetsch (1970) suggested an ingenious method for combining transfer costs and travel time into a single interacting variable. Unfortunately, a disadvantage of their proposal is that the researcher must assume one or more specific trade-offs between monetary cost and time by the participants; however, it is this trade-off that we would, ideally, like to estimate directly from our sample information. Fortunately, it appears that this problem can be solved, in most cases, simply by using a more efficient estimating procedure.

Comparison of Estimating Procedures

It might be instructive to briefly review the "zone average" type of estimating technique traditionally used in analyzing expenditure data, first applied in the pioneering research of Clawson (1959). For illustration, suppose we had a small sample of 18 recreationists, say hunters or anglers, who had originated from three distance zones. Let us further assume that the quantity of recreation days taken by the $i^{\underline{th}}$ individual recreationist, Y_i, has been generated by the following demand function:

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + u_i,$$

where X_{1i} denoted the transfer cost incurred by the $i^{\underline{th}}$ recreationist, X_{2i} denoted the average distance traveled in each zone, and u_i represents deviations from the general function due to individual differences in tastes, income, age, background, and other unmeasured variables. (For simplicity, we will assume u_i has zero mean, constant variance equal to σ^2, and is independently distributed.)

The Traditional "Zone Average" Estimation

Using the traditional procedures for the data in Table 27, we would take zone averages of all the variables, which would yield the following three averaged observations:

X_1	X_2	Z
4	50	Z_1
8	150	Z_2
12	220	Z_3

For the preceding averaged observations, Z_1 denotes the average of the quantities taken by the sampled recreationists from the nearest distance zone, Z_2 denotes the average quantity taken by the second distance zone, etc. Thus, Z_1, Z_2, and Z_3 each represents the average of six individual observations. To simplify the variances in the following analysis, assume that each zone had an equal population.

Denote the estimated parameters from the above averaged observations as β_1^* and β_2^*. Then, from the main elements of the inverse matrix, the magnitude of the variances of β_1^* and β_2^* can be inferred from the following:

$$\text{Var } (\beta_1^*) = \sigma^2/6\ (3.041667) \doteq 0.51\ \sigma^2 \quad \text{and}$$

$$\text{Var } (\beta_2^*) = \sigma^2/6\ (0.00666667) \doteq 0.0011\ \sigma^2.$$

Table 27. Hypothesized Transfer Costs and Average Distances Traveled by 18 Recreationists in Three Distance Zones.

Transfer costs incurred	Average distance travelled in zone	Quantity taken by each recreationist
2	50	Y_1
2	50	Y_2
4	50	Y_3
4	50	Y_4
6	50	Y_5
6	50	Y_6
6	150	Y_7
6	150	Y_8
8	150	Y_9
8	150	Y_{10}
10	150	Y_{11}
10	150	Y_{12}
10	220	Y_{13}
10	220	Y_{14}
12	220	Y_{15}
12	220	Y_{16}
14	220	Y_{17}
14	220	Y_{18}

(The variances of β_1^* and β_2^* are equal to $\sigma^2/6$ times their corresponding main inverse matrix elements, since the variance of an average is σ^2/n.) It will next be shown that the variances of these estimators, based upon averages, are needlessly large compared to the variances of estimators based upon the individual observations.

Estimation Based Upon Individual Observations

Instead of using the average values for each zone, it is recommended that the information given by the individual observations in Table 27 should be used, as by Gillespie and Brewer (1968), and Edwards and co-workers (1971). (I have been unable to find where anyone analyzing expenditure data has compared the efficiency resulting from use of individual observations versus zone averages when statistically estimating per capita demand functions.) By using all 18 observations and the resulting inverse matrix, the variances of the ordinary least squares estimators, $\hat{\beta}_1$ and $\hat{B}_2$ were obtained.

$$\text{Var }(\hat{\beta}_1) \doteq 0.020011\ \sigma^2$$

$$\text{Var }(\hat{\beta}_2) \doteq 0.0000548246\ \sigma^2.$$

Comparison of Efficiency

Therefore, for the preceding illustrative data of Table 27:

$$\frac{\text{Var } (\beta_1^*)}{\text{Var } (\beta_1)} \doteq \frac{.50694}{.02001} \doteq 25.3$$

and

$$\frac{\text{Var } (\beta_2^*)}{\text{Var } (\beta_2)} \doteq \frac{.00111111}{.00005482} \doteq 20.3.$$

Thus, in the simple example considered, using the traditional "zone average" procedure produces an efficiency of estimation of only about 5 percent of that possible by using information from all the individual observations! Another way of interpreting this result is that one would need about 20 times as many sample observations to approach the same precision of estimation possible from using the individual observations.

Reason for Increased Efficiency

Chief reason that the traditional "zone average" regression analysis gives such poor results in the above example is because of the greatly increased correlation between the two explanatory variables, X_1 and X_2. Using individual observations, the correlation is only 0.88982, as compared to 0.99485 for the zone average analysis. Naturally, as the intercorrelation tends toward one, precision of coefficient estimation is drastically reduced because of the inflated main diagonal elements of the inverse matrix. (Also, there is a small loss of variation in the range of X_1, which adds to the inefficiency of the traditional "zone average" analysis.)

Critics may respond at this point that the preceding oversimplified example really proves nothing, since actual empirical cases involve many more observations, zones, and other complications. It is true, of course, that the numerical example of Table 27 was deliberately oversimplified for purposes of exposition. Nevertheless, in the actual estimation of demand for Oregon big game which follows, a similar result was observed.

CHAPTER V

ESTIMATION OF DEMAND FUNCTIONS FOR OREGON BIG GAME

Many possible algebraic forms could be hypothesized for big game demand relationships. The simplest form is the linear demand model, the results of which will be presented first.

The Linear Demand Function

Before presenting the estimated linear demand equations, it should be noted that the data were grouped into five geographical areas, which corresponded to the administrative regions of the Oregon Game Commission. The location of these five administrative regions, and the game management units within each region, are shown in Figure 1.

The grouping by these five regions was appropriate for the demand analysis because each region was reasonably homogeneous, and the regions were large enough to supply sufficient observations for the statistical analysis. Results for the most important hunting region, Northeast Oregon, will be presented first.

Region IV, Northeast Oregon

The Northeast Oregon region, Figure 1, has some of the finest hunting in Oregon and the United States. During the 1968 hunting season, over 45, 000 mule deer were harvested in Region IV, and almost 6, 000 Rocky Mountain elk, according to the 1969 Annual Report of the Oregon State Game Commission.

There were 248 families in the sample who hunted in the Northeast Oregon region. Factors, which were first hypothesized to be important in determining the average number of trips per hunter, included average hunting expenses per trip, family income, hunting success, number of licensed hunters in the family, years of hunting experience, and an index of distance traveled per trip. However, family income and years of hunting experience were usually not statistically significant and did not exert a significant influence on the coefficients of the other independent variables. Regression results are presented first for the traditional "zone average" estimation procedure.

Traditional zone average estimate. The 242 hunting family observations were divided into 31 distance zones, with six to nine observations per zone. Reason for averaging about eight observations per zone was to make the zones small enough to obtain a good geographical disperson of distance zones throughout the state. In contrast to the Southwest and Northwest Oregon hunting areas, most of the families who hunted in the Northeast region came from other parts of the state, since Northeast Oregon has a low population concentration but excellent big game hunting. Of the 31 distance zones, only five zones were located within Northeast Oregon.

As mentioned earlier, nonmonetary costs of distance are hypothesized to be an important shifter of the outdoor recreational demand function (Cesario and Knetsch, 1970). Consequently, one reason for constructing the distance zones was to obtain a measurement of the important distance effect. To reduce multicollinearity between variable cost and distance as much as possible, we computed the average one-way highway distance traveled by the hunting families to the nearest edge of the Northeast Oregon hunting region. This procedure gave somewhat better results than using the average distance traveled by the hunters of each zone.

The five distance zones within the Northeast region were assigned distance values of zero. Measured distances for the other 26 zones ranged from 37 to 269 miles.

For the metropolitan areas, there were enough observations to subdivide these areas into more than one zone. These subdivisions were made by placing the lowest income families in one zone, the second lowest incomes in the second zone, etc. However, one limitation of the distance zone approach is the arbitrary nature of the zone delineation and construction.

Fitting the data by ordinary least squares, the following equation was obtained:

$$(1) \qquad \hat{Y}_j = 2.4141 - \underset{(.006960)}{0.008712}\, X_{1j} - \underset{(.002119)}{0.007943}\, X_{2j}$$

$$R^2 = 0.604$$

$$n = 31$$

Numbers in parentheses below coefficients are standard errors.

In Equation (1), $\hat{Y}_j$ denotes the average number of trips per hunter in distance zone j;

X_{1j} is the average cost incurred per hunting trip for distance zone j (costs included transportation, food, lodging, ammunition, licenses and tags);

X_{2j} is the average measured one-way distance of the hunters in distance zone j to the Northeast Oregon hunting region.

The average cost variable, X_{1j}, is often referred to as transfer cost.

In addition to the preceding two independent variables, four other variables were included but were not statistically significant, and had little effect on the variable cost and distance coefficients. These additional variables were the following:

X_{3j} was an index of hunting success (animals taken, divided by hunter trips for distance zone j);

X_{4j} was average number of licensed hunters per family in distance zone j;

X_{5j} was an index of hunting experience (number of years hunted by head of household);

X_{6j} was average family income in distance zone j.

As was usually the case for the traditional zone average method, the estimate of the important variable cost coefficient in (1) was not precise, partly because of the high correlation between variable cost and distance, r = 0.695. The standard error of the regression coefficient for the cost variable, X_{1j}, is nearly as large as the coefficient. This result is definitely inferior to that obtained from using all observations, as will next be shown.

Estimates based upon individual observations. All variables are defined in the same way as for Equation (1), except that the individual hunting family is the observational unit, rather than the distance zone average. Hence, there are 242 observations fitted in Equation (2), rather than the 31 as for Equation (1). For comparison, Equation (2) was restricted to the same two independent variables used in (1).

$$(2) \qquad \hat{Y}_i = 2.3906 - \underset{(.001997)}{0.009218}\, X_{1i} - \underset{(.001056)}{0.006932}\, X_{2j}$$

$$R^2 = 0.321$$

$$n = 242$$

In the preceding equation, Y_i denotes the predicted number of hunter trips to be taken by the $i^{\underline{th}}$ hunting family in the $j^{\underline{th}}$ distance zone; X_{1i} denotes the variable transfer costs per hunter trip in the $i^{\underline{th}}$ family in the $j^{\underline{th}}$ zone; and X_{2j} denotes the distance in miles of the $j^{\underline{th}}$ distance zone to the Northeast Oregon hunting area. Numbers in brackets below the coefficients are again the standard errors.

In contrast to the unreliable estimate (as indicated by its standard error) of the important variable cost coefficient in Equation (1), the standard error in (2) is only about one-fourth the coefficient value, indicating fairly good precision of estimation. Although the R^2 value in (2) is much smaller than for (1), the R^2 for (1) is a misleading statistic, according to Freund (1971)[14/], and therefore has to be interpreted with caution. In any case, we are much more concerned with the estimate of the structural parameters, the coefficients for X_{1j} and X_{2j}. The importance of these coefficients upon the estimated net economic value of the resource will become apparent in a later chapter.

In addition to the two independent variables used in Equations (1) and (2), the other four variables mentioned previously were also tried. In contrast to the zone average results, two of these other four variables were statistically significant at the 5 percent level. The more complete model was the following:

[14/]For further detail on this remark, see Freund (1971).

$$(3) \qquad \hat{Y}_i = 1.6939 - \underset{(.001952)}{0.006660}\, X_{1i} - \underset{(.001001)}{0.007128}\, X_{2j}$$

$$- \underset{(.1916)}{0.4548}\, X_{3i} + \underset{(.07613)}{0.3783}\, X_{4i}$$

$$R^2 = 0.395$$

$$n = 242$$

The important coefficients for cost and distance, X_{1i} and X_{2j}, remain fairly stable in comparing Equations (2) and (3). Similarly, their standard errors remain relatively unchanged with the addition of X_{3i} and X_{4i}.

At first thought, one might not expect the negative coefficient for X_{3i}, an index of hunting success. However, this coefficient should be negative since the family is much less apt to go hunting a second time if all licensed hunters in the family succeed in obtaining their deer on the first trip. (Game regulations permit only one deer on the general deer tag, but an additional deer can sometimes be taken during controlled deer seasons.)

Number of licensed hunters in the family residing at home, X_{4i}, has the expected positive sign. Years of hunting experience by the head of the household, X_{5i}, did not have a significant effect on the number of hunting trips taken. Furthermore, in contrast to salmon-steelhead fishing (Brown, et al., 1964), family income,

X_{6i}, was not statistically significant, and resulted in a slightly higher standard deviation for the regression. In fact, income had no significant effect in any of the hunting regions, even though several transformations and measures of income were tried in the regression analysis.

Because of the better estimates resulting from the regressions based upon individual observations, I will not present the less reliable results from the zone average method for the remaining regions.

Region III, Central Oregon

The Central Oregon hunting area was similar to Northeast Oregon in that many hunters came to hunt from outside the area, especially from Northwest Oregon. There were 144 families in the sample who hunted in the Central region. From these 144 observations, 19 distance zones were constructed, with an average of about eight observations per zone.

Only 33 of the 144 hunting families resided within the Central Oregon area. Although the regression based upon individual observations gave the best results, distance zones were still used to define the measured distance to the hunting area. (It might have been better to have used the measured distance for each observation, although in most cases the distance would have been the same, or nearly so.)

Hunters harvested 26,640 deer in the Central Oregon region, which placed it third among the five regions of the state. The Central region was surpassed only by the Northeast Oregon area, with 45,000 deer taken, and by the Northwest area, with 36,000, according to the Oregon State Game Commission Annual Report (1969). However, very few elk were taken in the Central area as compared to Northeast or Northwest Oregon.

Presenting only the more reliable results based upon the individual observations, the following regression was obtained:

$$(4) \quad \hat{Y}_i = \underset{}{0.7819} - \underset{(.001850)}{0.004328\, X_{1i}} - \underset{(.001028)}{0.005358\, X_{2j}}$$

$$- \underset{(.1071)}{0.2357\, X_{3i}} + \underset{(.04286)}{0.1012\, X_{4i}}$$

$$R^2 = 0.337$$

$$n = 144$$

In Equation (4), fairly reliable estimates are indicated for the important variables, X_{1i} (variable cost) and X_{2j} (distance). (All variables are defined the same as for the Northeast region.) Again, family income, X_{6i}, failed to exert any significant influence on the dependent variable or on the coefficients of the other independent variables. Hunting success, X_{3i}, exerted its usual negative impact upon additional hunting trips. Also, as for the Northeast region, number of licensed hunters in the family, X_{4i}, exerted a positive influence upon hunting trips taken.

As for the Northeast area, X_{5i}, years of hunting experience by head of household, failed to exert a significant influence. It was therefore deleted, along with X_{6i}, family income.

Contrary to many economic models, the inclusion or omission of variables X_{3i}, X_{4i}, X_{5i}, and X_{6i} did not have a great impact upon the coefficient of the important cost variable, X_{1i}. (The cost coefficient has a crucial effect upon the net economic values which will be presented in a later section.) However, as mentioned earlier, distance, X_{2j}, has a very important impact upon the variable cost coefficient. The effects of the other variables upon the variable cost coefficient can be observed as the variables are added in the stepwise regression:

Step number	Next variable entered		Variable cost coefficient, $\hat{\beta}_1$	Distance coefficient, $\hat{\beta}_2$
1	Variable cost	X_{1i}	-.009361	--
2	Distance	X_{2j}	-.005690	-.005518
3	Licensed hunters in family	X_{4i}	-.005265	-.005442
4	Hunting success	X_{3i}	-.004328	-.005358
5	Hunting experience	X_{5i}	-.005021	-.004912

6	Family income	X_{6i}	-.004904	-.004897

As shown above, no great change is observed in $\hat{\beta}_1$ after the important distance variable has entered. A similar pattern was observed for the previous Northeast region and also for the other hunting regions. Therefore, for my data, no very large specification bias would appear to be introduced by omitting one or more of the variables X_{3i}, X_{4i}, X_{5i}, and X_{6i}.

However, the reader could object, at this point, that the last four variables above might have had greater impact on the variable cost coefficient if distance, X_{2j}, had been excluded in the preceding listing of the variable cost coefficient. To refute this hypothesis, the stepwise regression can be re-run, with X_{2j} excluded. The variable cost coefficient behaved as follows:

Step number	Next variable entered		Variable cost coefficient, $\hat{\beta}_1$
1	Variable cost	X_{1i}	-0.009361
2	Licensed hunters in family	X_{4i}	-0.009955
3	Hunting success	X_{3i}	-0.008964
4	Hunting experience	X_{6i}	-0.008425
5	Family income	X_{5i}	-0.008291

From the above results, it can be seen that $\hat{\beta}_1$ never drops to its value in the more completely specified model. Also, R^2 is 0.257 for the above five independent variables, as compared to $R^2 = 0.337$ for Equation (4). Therefore, it is concluded that distance, X_{2j}, cannot be deleted without causing a serious bias.

Although X_{3i} and X_{4i} did not have much impact on the variable cost coefficient, $\hat{\beta}_1$, X_{3i} and X_{4i} were usually statistically significant and were retained in the model to reduce the variance of the regression. On the other hand, income (X_{6i}) and hunting experience (X_{5i}) usually increased the variance of the regression, and were therefore omitted.

Region I, Northwest Oregon

The Northwest Oregon region has the major population concentration of the state, since it includes the Portland, Salem, and Eugene areas, Figure 1. Due to this heavy population concentration, Region I had the most hunter days for deer of any region in 1968, almost 382,000 according to the 1969 Annual Report of the Oregon State Game Commission. (However, total deer harvested were only about 36,000, as compared to over 45,000 for the Northeast Oregon region.)

Roosevelt elk are also important in Region I, with over 65,000 hunter days according to the 1969 Annual Report of the Oregon State Game Commission. A total of 1,954 elk were harvested by the hunters in Region I in 1968.

There were 139 families in the sample who hunted in the Northwest area. In sharp contrast to the Northeast and Central Oregon areas, there were only 13 families from outside the area who hunted in the Northwest region. Of course, not many hunters would be expected to travel to the Northwest region which already has heavy hunting pressure and less favorable hunting conditions.

The two outside distance zones averaged one-way measured distances to the edge of the Northwest area of 60 and 62 miles. All other zones were located within the region itself, and were assigned a distance index of zero, except for six Portland zones which were assigned an index of 23 miles. It was observed that the Portland area residents averaged 23 miles further in order to reach their hunting sites, as compared to the other hunters within the region.

Basing the regression upon the individual observations,

$$(5) \quad \hat{Y}_i = \underset{}{0.0307} - \underset{(.003534)}{0.007172}\, X_{1i} - \underset{(.003648}{0.009720}\, X_{2j}$$

$$- \underset{(.2053)}{.2898}\, X_{3i} + \underset{(.06305)}{0.4880}\, X_{4i}$$

$$R^2 = 0.387$$

$$n = 139$$

A somewhat less reliable estimate of the variable cost coefficient was obtained in (5), as compared to the earlier estimated coefficients for the Central and Northeast Oregon hunting areas. One reason for the higher standard errors for $\hat{\beta}_1$ and $\hat{\beta}_2$ in (5) was that the hunters in the Northwest zone averaged lower hunting trip expenses and shorter distances traveled. Consequently, with a smaller range of X_{1i} and X_{2i} values, the sums of squares for X_{1i} and X_{2i} would be smaller and would result in higher variances for the coefficients, $\hat{\beta}_1$ and $\hat{\beta}_2$.

Despite the higher standard errors, the coefficients of (5) appear plausible. Again, family income, X_{6i}, failed to have any significant impact upon number of hunter trips taken or upon the coefficients of the other independent variables. All coefficients in (5) had the appropriate signs, as discussed earlier for the other regions.

Region II, Southwest Oregon

Characteristics of the Southwest Oregon administrative region are similar to those of the Northwest, except that hunting pressure is considerably less in Southwest Oregon, due to the lack of major cities in the area. Total deer hunting days for Southwest Oregon were only around 219, 000 in 1968, as compared to 326, 000 for the Northwest area and 315, 000 for the Central region (Annual Report, 1969). Similarly, fewer total deer were taken, 22, 500 as compared to 26, 640 for the Central area and 36, 250 for Northwest Oregon. In addition to deer, 1, 295 Roosevelt elk were taken by hunters in Southwest Oregon.

As was the case for Northwest Oregon, most of the people who hunted in Southwest Oregon resided within that area. Out of 80 observations in the sample, only 15 resided outside of the region.

Best regression results were

$$(6) \quad \hat{Y}_i = 1.0166 - \underset{(007128)}{0.009930}\, X_{1i} - \underset{(.004847)}{0.008197}\, X_{2j}$$

$$- \underset{(.2846)}{0.6404}\, X_{3i} + \underset{(.1894}{0.3126}\, X_{4i}$$

$$R^2 = 0.172$$

$$n = 80$$

According to T-test, the least reliable estimate of the variable cost coefficient was obtained for this region, as indicated by a fairly large standard error in (6). Again, as for the Northwest region, one would expect less precision of estimation because of smaller variation in variable cost per hunting trip and distance to the hunting site. A smaller size sample for this region also contributed to the higher variances of the coefficients in (6).

Despite the higher variances, the magnitude of the variable cost coefficient is in the same range as the variable cost coefficient for the Northwest region. This observed stability tends to increase one's confidence in the estimated coefficient.

Region V, Southeast Oregon

Smallest of the five hunting regions, in terms of number of hunting days and deer taken, is the Southeast Oregon area. In 1968 there were about 186, 000 hunter days for deer and a harvest of nearly 20, 680 deer, which was not far behind the Southwest Oregon area harvest of 22, 500 deer (Annual Report, 1969). Like the Central region relatively few elk were harvested in the Southeast area.

As was the case for the Central and Northeast Oregon areas, most of the hunters resided outside the zone. Out of the 88 families of the sample who hunted in Southeast Oregon, 82 resided outside the Southeast area and 79 of these 82 families were from Western Oregon.

Best linear regression results appeared to result from:

$$(7) \quad \hat{Y}_i = 0.3139 - \underset{(.0006810)}{0.001078}\, X_{1i} - \underset{(.0002762)}{0.0007411}\, X_{2j} - \underset{(.05208)}{.0708}\, X_{3i} + \underset{(.02337)}{0.04067}\, X_{4i}$$

$$R^2 = 0.237$$

$$n = 88$$

Variables X_{5i} and X_{6i} had no appreciable influence on Y_i of β_1 and β_2. The coefficient for variable cost in (7) is considerably smaller than for the other four regions. As a result of this smaller coefficient and smaller constant term in (7), net economic value for the Southeast area is much smaller, as shown in the later economic analysis.

The Exponential Demand Function Fitted by Logarithmic Transformation

The linear demand model of the preceding section can be criticized because it can be argued that the demand curve should not directly intersect the vertical axis with increasing price or cost, but rather should become asymptotic to it.[15/] Although several algebraic forms of the demand function could satisfy this asymptotic property, the exponential function is one of the most convenient to employ. Sometimes the power function has been used (Wennergren, 1967). However, this function yields a constant elasticity of demand, and cannot be used to find the maximum revenue possible to a nondiscriminating single owner (since revenue is maximized only at elasticity equal to one). Therefore the exponential

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[15/] From the sample data, observations at very high prices and nonzero quantities can often be observed. Thus, one would doubt that all consumption would be shut off by the price indicated by the intersection of the linear demand function and the vertical axis. As will be presented, the exponential demand function does fit the data better, as indicated by comparison of R^2 values.

function was fitted.

(8) $$Y = \exp [\beta_0 + \beta_1 X_1 + \beta_2 X_2 + . . . + \beta_k X_k],$$

which has the advantage of variable elasticity of demand.

The exponential function is also convenient to fit by ordinary least squares by means of logarithmic transformation. Defining the variables exactly as for the linear demand function discussed in the preceding section, the exponential function was fitted in the form

(9) $$\ln Y_i = \beta_0 + \beta_1 X_{1i} \beta_2 X_{2j} + \beta_3 X_{3i} + \beta_3 X_{3i} + \beta_4 X_{4i}$$
$$\beta_5 X_{5i} + \beta_6 X_{6i}.$$

Coefficients for resulting regressions for each region are presented in Table 28. (Variables X_{5i} and X_{6i} were usually not significant and were deleted.) The standard errors for the variable cost coefficients in Table 28 tend to be smaller relative to the coefficient than for the linear demand function. This greater precision may be somewhat misleading, however, since the dependent variable is now the natural logarithm of Y_i, rather than Y_i in the real numbers.

This questionable aspect of the results is illustrated by the R^2 values given in the lower part of Table 28. The R^2 value given by the computer printout is in terms of the logarithms. To be comparable to the results of the linear model, one should transform

Table 28. Summary of Results from the Exponential Demand Function for the Five Hunting Regions of Oregon (Fitted by Logarithmic Transformation).

Independent variables	Regression coefficient				
	Region I N.W. Oregon	Region II S.W. Oregon	Region III Central Oregon	Region IV N.E. Oregon	Region V S.E. Oregon
Constant	-0.826343	-0.292463	-0.860059	0.011780	-1.562355
Variable cost per hunting trip, X_{1i}	-0.016248 (0.003397) a/	-0.022425 (0.004938)	-0.008171 (0.002637)	-0.009814 (0.001398)	-0.009797 (0.002877)
Measured one-way distance to region, X_{2j}	-0.029087 (0.003507)	-0.025145 (0.003358)	-0.009381 (0.001465)	-0.005298 (0.000717)	-0.002623 (0.001167)
Animals taken per hunter trip, X_{3i}	-0.665871 (0.197298)	-0.708242 (0.197176)	-0.510787 (0.152665)	-0.320684 (0.137218)	-0.288072 (0.220818)
Number of licensed hunters per family, X_{4i}	0.286751 (0.060607)	0.261346 (0.131191)	0.295937 (0.061078)	0.306250 (0.054523)	0.238014 (0.098300)
R^2 (in terms of logarithms)	0.557	0.640	0.495	0.525	0.349
R^2 (real numbers)	0.453	0.120	0.345	0.407	0.201
Number of observations	139	80	144	242	88

a/ Standard errors are in parentheses below the regression coefficients.

the predicted values back into real numbers. By making this transformation and re-computing the Σe_1^2, we obtain the R^2 values in terms of the real numbers, given in the next-to-bottom line of Table 28. The R^2 values in terms of real numbers are considerably smaller than the R^2 based on logarithms. The real number R^2 values are also less than those obtained from the linear demand functions for two of the regions.

One problem with fitting the exponential by taking $\ln Y_i$ as the dependent variable is that a biased prediction of Y_i in terms of the real numbers is obtained. This bias can be seen by comparing Lines 1 and 2 of Table 29. The predicted sum for Region II is only about 62 percent of the actual sum. This bias could lead to an underestimate of net economic value and, therefore, should be corrected.

Correction for bias is easily accomplished by simply multiplying the predicted values from the exponential function by the ratio of the actual to the predicted sums, given in the third line of Table 29. After correction for bias is made, the exponential demand function gives a higher R^2 value than the linear demand function for each of the five regions.

It should be noted that the correction for bias, which is made here, does not change any of the parameters except for the β_0 coefficient of Equation (9). The β_0 coefficient is merely adjusted

Table 29. Bias for Exponential Demand Function and Comparison of R^2 Values After Correction for Bias.

	Region I N. W. Oregon	Region II S. W. Oregon	Region III Central Oregon	Region IV N. E. Oregon	Region V S. E. Oregon
Actual ΣY_i	85.77	82.96	63.43	227.91	18.02
Predicted ΣY_i	61.75	51.53	49.65	160.52	13.31
Ratio of actual to predicted sum	1.389	1.610	1.298	1.420	1.354
Real number R^2 for uncorrected exponential)	0.453	0.120	0.345	-.407	0.201
Real number R^2 (bias-corrected exponential)	0.551	0.238	0.423	0.519	0.305
R^2 (for linear demand function	0.387	0.172	0.337	0.395	0.237

so that the sum of the predicted values becomes equal to the sum of the actual Y_i values in the real numbers.

Results from the Exponential Function Fitted by Nonlinear Methods

In view of the preceding section where correction of bias for the exponential function was made, it might be thought that it would be better to minimize the sums of squared deviations from regression by nonlinear techniques (Edwards, 1962) In fact, iterative methods were employed to obtain such regressions for each of the five hunting regions.

Such nonlinear techniques to minimize the deviations from regression in terms of the real numbers, the sum of the predicted values of the dependent variable in real numbers tends to be quite close to the actual sum of the dependent variable. Thus, no correction for bias would ordinarily be needed, in contrast to our results in the preceding section.

Another advantage of nonlinear techniques is that smaller deviations from regression and higher R^2 values are almost always obtained. However, despite these advantages, our parameter estimates were not satisfactory, even though higher R^2 values were obtained. The results tended to be quite erratic from one region to the next, insofar as the coefficients of the independent variables were concerned. Since estimation of net economic values depends crucially upon reliable estimates of structural parameters, the results from the nonlinear fitting were judged to be unsatisfactory for the purposes of this study. Perhaps the reason for the erratic nonlinear estimates of the regression coefficients was the high variability in the individual expenditure and hunting trip patterns, cf. Kmenta, p. 466 (1971).

CHAPTER VI

NET ECONOMIC VALUE OF THE OREGON BIG GAME RESOURCE

Once the demand function has been properly specified and estimated, it is relatively simply to compute the net economic value, although as previously mentioned, there have been two commonly employed measures of net economic value: (1) Maximum revenue to a monopolistic owner who charges only one price, and (2) consumer surplus, which would correspond to the maximum revenue possible to a "perfectly discriminating" monopolistic owner. These values will be presented for each region for both the linear and exponential demand functions.

Net Economic Values for Region IV, Northeast Oregon

Since Region IV had the greatest hunting trip expenditures, net economic values will be presented first for this area.

Results From the Linear Demand Function

For the Northeast Oregon area, Equation (3), based upon the individual observations, gave the best statistical results, and is therefore used to generate net economic values.

<u>Revenue to nondiscriminating monopolist.</u> If there were no negative predicted Y_i values from Equation (3), then one could simply substitute the mean values for all the independent variables into (3) to obtain the equation,

$$(10) \qquad \hat{Y} = \bar{Y} - \hat{\beta}_1 P,$$

where $\bar{Y}$ denotes the mean value of the dependent variable Y_i; P denotes increased cost above the actual costs incurred by the hunters. Then, one could multiply the right-hand side of (10) by P to obtain the total revenue function resulting from various imposed hunting fees. The total revenue function could then be differentiated with respect to P and set equal to zero, to give the exact profit-maximizing level of P. This profit-maximizing value of P would then be substituted back into (10) to obtain the number of hunting trips taken at that price. Then, the maximizing price times the preceding quantity would give the maximum possible total revenue.

In practice, however, the procedure is complicated somewhat because some of the predicted Y_i values become negative as the hypothesized fees (cost increases) become larger. Thus, at higher and higher hypothesized fees, one must delete those observations which become negative. The effect of this procedure is to give a profit-maximizing level at higher hypothesized hunting fees, since no negative revenue values are allowed for the lower predicted Y_i values. (Some families have fewer family members who hunt, have to travel greater distances, etc., which results in lower predicted values from Equation (3).)

In order to insure no negative predicted values, the aggregate demand function for the sample observations was constructed as follows: First, suppose that there are no negative predicted values at the zero fee level. Then the aggregate function for the sample observations would be

$$(11) \qquad \sum_{i=1}^{n} \hat{Y}_i = n\bar{Y} - (n\hat{\beta}_1)P.$$

However, as P increases, some $\hat{Y}_i$ value will eventually become negative. At the P value where this first observation is less than zero, a new equation for the aggregate sample demand must be computed. This new equation would be

$$(12) \qquad \sum_{i=1}^{n-1} Y_i = \sum_{i=1}^{n-1} \hat{Y}_i - [(n-1)\,\hat{\beta}_1]\,P.$$

This new function would hold until the second $\hat{Y}_i$ value became zero. Then another function would be computed, etc.

Following the above procedure, the revenue-maximizing price from Equation (3) was about \$133 per hunter trip, and the corresponding number of hunting trips to be taken, at \$133 per trip, was about 94.75 trips. Multiplying \$133 times 94.75 gives about

$12, 602 which could supposedly be obtained from our sample of 242 families who hunted in Northeast Oregon. Since I had 693 complete questionnaires, which represented 693 families or 1, 289 hunters out of 363, 000 for 1968, the blow-up factor was (0. 93) (363, 000) ÷ 1, 289 = 261. 9. (From the questionnaires, it was estimated that about 93 percent of the licensed hunters actually hunted big game in 1968.)

Multiplying the blow-up factor times the revenue obtained from our sampled hunters gave (261. 9) ($12, 602) = $3. 3 million. Thus, estimated net economic value to a nondiscriminating monopolist for the Northeast Oregon hunting area would be $3. 3 million, based upon the linear demand function.

As mentioned earlier, the maximum revenue to a nondiscriminating monopolist has been criticized as being an underestimate of net economic value to the recreationists, since some people would be willing to pay more than the revenue-maximizing price, and other people would also be obtaining benefits at zero fees, even though they would not be willing to pay the revenue-maximizing price. Hence, the consumer surplus has gained much support in recent years (Clawson and Knetsch, 1966; Knetsch and Davis, 1966).

Consumer surplus. Estimation of an individual's consumer surplus is equivalent to computing that area lying beneath his demand curve but above his transfer costs necessary for participation. Making these computations from Equation (3) and values of the independent variables of (3) for observed families, an estimated consumer surplus of about $30, 707 is obtained for the 242 families in our sample who hunted in Northeastern Oregon. Multiplying the sample consumer surplus by the blow-up factor of 261. 9 gives an estimated total consumer surplus of $8. 04 million.

As would be expected, the consumer surplus estimate of net economic value is higher, about 2. 4 times that for the nondiscriminating monopolist. As mentioned earlier, the consumer surplus concept is now usually considered to be a more valid measure of net economic value, although final choice may depend upon the proposed use of the estimate.

The Pearse method was also used to obtain "an aggregate value in the form of consumer surplus" (Pearse, p. 96, 1968). Following Pearse's method, the observed hunters for Northeast Oregon had a "Pearse surplus" of $154, 178. Multiplying by the blow-up factor of 261. 9 gave an estimated total "Pearse surplus" of about $40. 4 million! However, as shown in an earlier section, the "Pearse surplus" has no economic meaning, and should therefore be disregarded.

Estimated Net Economic Values for All Regions from the Linear Demand Function

Maximum revenue to a nondiscriminating monopolist and consumer surplus are presented in Table 30 for each of the five Oregon hunting regions. Since both measures for a given region are based upon the same demand curve, the consumer surplus is from 2.2 to 2.8 times as much as the maximum possible revenue to a nondiscriminating monopolist.

The Northeast Oregon area accounted for almost 60 percent of the estimated net economic value, with over $8 million estimated consumer surplus. Next highest net values were for Northwest Oregon, with almost $2 million consumer surplus, followed by Southwest Oregon with over $1.5 million. Total estimated consumer surplus in Table 30 was nearly $13.5 million. It could be noted at this point that the total consumer surplus amounts to $13.45 ÷ 18.6 equals about 72 percent of the estimated total variable expenditures presented in an earlier section.

Estimated Net Economic Values for All the Exponential Demand Function

As discussed in an earlier section, the exponential demand function had certain logical advantages over the linear demand function. Also, the exponential function gave a better fit (higher

Table 30. Estimates of Net Economic Value for the Five Hunting Regions of Oregon, Based Upon the Linear Demand Function.

Region	Revenue to nondiscriminating monopolist	Consumer surplus
Region I, Northwest Oregon	$ 701, 000	$ 1, 966, 000
Region II, Southwest Oregon	698, 000	1, 543, 000
Region III, Central Oregon	564, 000	1, 342, 000
Region IV, Northeast Oregon	3, 301, 000	8, 042, 000
Region V, Southeast Oregon	249, 000	556, 000
Total	$5, 513, 000	$13, 449, 000

Table 31. Estimates of Net Economic Value for the Five Hunting Regions of Oregon, Based Upon the Exponential Demand Function.

Region	Revenue to nondiscriminating monopolist	Consumer surplus
Region I, Northwest Oregon	$ 511, 000	$ 1, 382, 000
Region II, Southwest Oregon	358, 000	969, 000
Region III, Central Oregon	764, 000	2, 065, 000
Region IV, Northeast Oregon	2, 250, 000	6, 082, 000
Region V, Southeast Oregon	178, 000	482, 000
Total	$4, 061, 000	$ 10, 980, 000

R^2 values) for all regions than the linear demand function, after the exponential function was corrected for bias, Table 29.

Maximum revenues possible to a nondiscriminating monopolist are presented in Table 31.[16/] These values were obtained by multiplying price times the demand equations aggregated over all sample observations to obtain a total sample revenue function for each region. Differentiating the total revenue functions with respect to X_1, and equating to zero, gave the revenue-maximizing prices. Substituting the maximizing prices back into the demand equations yielded the quantities to be taken. Then, multiplying the quantities to be taken times the maximizing prices gave the maximum revenues possible from the sampled hunters. Blowing up the maximum revenues from the sampled hunters by 261.9 yielded the estimates in the middle column of Table 31.

The Northeast Oregon hunting area again yielded the largest revenue, $2.25 million, which was over 55 percent of the total for the state. This importance of the Northeast area is in agreement with the results of the linear demand function presented in Table 30. However, the Central Oregon hunting area ranked second highest in Table 31 for the exponential demand function, whereas it ranked only fourth for the linear function in Table 30.

16/ See Appendix for further details on the computations of net economic values from the exponential demand function.

Estimates of net economic values were slightly lower for the exponential function in Table 31, as compared to the linear function in Table 30. One would be inclined to accept the estimates from the exponential, since it gave a better fit to the observations, Table 29.

Consumer surplus values for all five regions totalled about $11 million. Again, for reasons discussed earlier, the consumer surplus is a better measure of net economic value for most purposes.

Consumer surplus values were obtained for the sampled hunters by integrating for each region,

$$\sum_{i=1}^{n} \hat{Y}_i \int_0^{\infty} e^{\hat{\beta}_1 P} \, dP. \qquad (13)$$

Equation (13 reduced to $\sum_{i=1}^{n} \hat{Y}_1 \div |\hat{\beta}_1|$, since $\hat{\beta}_1$ was always negative. In (13), P represented additional costs or fees incurred above those actually incurred by the sampled hunters. Then, by multiplying the above values by the blow-up factor of 261.9, consumer surplus for each region was easily obtained.

Effect of Omitting Fixed Costs From the Demand Estimates

Actually, the estimated consumer surplus in Tables 30 and 31 represent an underestimate of net economic value in that expenditures for hunting and associated equipment were excluded from the cost variable of the demand equation. To the extent that these durable items were incurred solely for the purpose of hunting, it is not accurate to omit them from estimates of net economic value. At the same time, however, there are certain difficulties in trying to incorporate them into the demand function.

In Clawson's original study (1959), it is quite clear that he was justified in omitting the fixed costs of transportation (cars) for the people visiting national parks, since it is highly unlikely that the people bought their cars just to visit the parks. However, in the case of our Oregon hunters, it is not so simple. For example, in Table 3, hunting equipment expenditures in 1968 were about \$9.279 million. Certainly most of these expenditures were made for the purpose of big game hunting. Similarly, the \$2.591 million for special clothing probably was allocated fairly accurately to big game hunting. However, for the \$32.73 million spent on camping equipment, it is difficult to assess the accuracy of the allocation to big game. For purposes of demand estimation, one would really need an estimate of those items purchased which would <u>not</u> have been purchased if there had been no big game hunting in Oregon.

Furthermore, even if the expenditure of \$32.73 million were the additional amount incurred because of big game hunting, one should translate these fixed investments into an annual amortized equivalent for all hunters, so that it would be comparable to the hunting trip expenses.

If one disregards the preceding difficulties and assumes that the $44.6 million total in Table 3 represents a fair estimate of annual costs to the big game hunters, then the net economic value would be greatly increased. For example, if one assumes a linear demand function, and that the fixed costs were distributed among the individuals in exactly the same proportion as the variable costs, then from simple numerical examples it is easy to see that the slope and vertical intercept would be increased and consumer surplus would be increased exactly by a ratio of the fixed costs to the variable costs. Thus, for the Oregon big game resource, consumer surplus would be increased by the ratio of fixed to variable cost, or $44.6 \div 18.6 \doteq 2.4$, which would increase the consumer surplus in Table 30 to over $32 million per year!

Unfortunately, the above figure has to be interpreted with caution, since different assumptions regarding the relative distribution of the individual hunter's fixed and variable costs would give a different estimate of consumer surplus. For example, if a linear demand function is again assumed, but it is hypothesized that each hunter has exactly the same fixed cost, then the demand function would shift to the right with no change in slope. Thus, the consumer surplus would remain exactly the same, since the increased area under the demand curve would be exactly offset by the increased costs of the individual hunters. Thus, it would be possible to have no increase in net economic value if fixed costs were included in the demand estimating procedure!

Of course, this last possibility of having no increase in consumer surplus seems highly unlikely, since one can observe great variation in investment in equipment by different hunters. However, the reason for considering the case was to illustrate the wide range in outcomes possible from different assumptions regarding the amount of the individual's fixed cost relative to his variable costs. (In fact, by assuming an inverse relationship between the individual's fixed and variable costs, it would even be possible to arrive at a lower estimate of consumer surplus when including fixed costs in the demand estimation. Again, this possibility would be extremely unlikely, since fixed and variable costs were positively correlated in our survey.

In summary, the estimates of consumer surplus in Tables 30 and 31 would underestimate net economic value of the Oregon big game resource, due to exclusion of fixed costs from the demand estimation. However, to properly estimate the effect of fixed costs would require an analysis of the investment of each family's durable items to determine an estimated cost per year. Such an analysis would require more information than was collected in this study.

CHAPTER VII

SUMMARY AND CONCLUSIONS

During the summer and fall of 1968, a mail survey of Oregon big game hunters was conducted. In the first phase of the survey, about 3, 000 questionnaires were mailed to a random sample of licensed hunters before the general deer season. This first questionnaire pertained to the investment by the hunter and his family in hunting and associated equipment.

In the second phase of the survey, about 1, 480 game hunting trip records were mailed to the hunters, in which they were asked to record all their hunting trip expenses. (Both questionnaires are included in the Appendix.)

For both questionnaires, first and second reminders were mailed if earlier questionnaires were not returned. Overall response was 71 percent for the investment questionnaire, and 72 percent for the hunting trip record.

Gross Expenditures by Oregon Big Game Hunters in 1968

From the questionnaire pertaining to investment in hunting and associated equipment, an annual average investment per family of about $239 was estimated. Thus, a total investment by all Oregon hunters of about $44.6 million per year was estimated. Over $9 million per year was spent for hunting equipment, such as rifles, scopes, bows, arrows, etc. Over $35 million was expended for special clothing and camping equipment allocated to hunting.

From estimated variances, the 95 percent confidence interval for total investment was estimated to be $44.6 million ± $4.8 million. Therefore, total investment by licensed Oregon big game hunters in 1968 probably was between $39.8 and $49.4 million.

From the hunting trip record questionnaire, hunter families spent about $118.70 on big game hunting trips during 1968. Total big game hunting trip expenses for all Oregon hunters in 1968 were estimated to be $18.6 million. Estimated 95 percent confidence intervals indicated that hunting trip expenses probably ranged somewhere between $17.0 and $20.2 million.

Combining the investment in hunting and associated equipment with hunting trip expenses gave a total estimated expenditure of $63.2 million by Oregon big game hunters in 1968.

Considering the variances involved, the estimated 95 percent confidence intervals indicated that total expenditures by Oregon hunters in 1968 probably ranged somewhere between $58.0 and $68.4 million.

Net Economic Value of the Oregon Big Game Resource

Estimates of net economic value are sensitive to the specification of the demand model employed. In this study, the two most important explanatory variables were average hunting trip expenses per trip, and distance to the hunting region. Distance was included in order to account for nonmonetary effects of varying amounts of travel required, and had an important influence on the coefficient for average variable cost per hunting trip. As compared to traditional distance zone estimation procedures, estimation based upon individual observations was much more efficient, and better separated the effect of average variable cost per hunting trip versus the nonmonetary costs of travel.

Demand equations were estimated for each of the five hunting regions of Oregon. In addition to average variable cost per hunting trip and distance, hunting success and number of licensed hunters in the hunting family were also usually statistically significant, although these two variables had much less impact on the coefficient of average variable cost and net economic value estimates. In contrast to salmon-steelhead fishing in Oregon in 1962 (Brown, *et al.*, 1962), average family income did not exert a significant influence on amount of hunting taken or the resulting net economic value estimates.

Several algebraic forms of the demand equation were fitted. Best overall results appeared to be obtained from the exponential demand function fitted by logarithmic transformation but corrected for bias in terms of the real numbers. Two measures of net economic value were presented: (1) Net revenue possible to a nondiscriminating monopolist, and (2) consumer surplus. However, consumer surplus is more generally accepted as a full measure of the net economic benefits accruing to the recreationists (Clawson and Knetsch, 1966).

Net economic value estimates for each of the five hunting regions of Oregon are presented in Table 32, along with hunting trip expenses. In total, consumer surplus is about 59 percent of hunting trip expenses. However, this percentage is considerably higher in some regions and lower in others.

Limitations and Recommendations for Further Research

Although net economic value estimates in Table 32 have a stronger basis than those in previous studies, since the important nonmonetary effects of distance have been more accurately estimated, several economic and statistical deficiencies remain. For one thing, this study did not differentiate between species in estimating net economic values. For example, in Northeast

Oregon, elk hunting days in 1968 were almost 84 percent as much as for deer (Annual Report of the Oregon State Game Commission, 1969). Thus, additional research estimating the net economic value for each specie might have been of interest.

Another deficiency of this study was an inadequate treatment of quality of hunting in our demand models. One suggested possibility would be to use a composite variable representing probability of hunting success for hunting within a given game management unit, combined with other factors such as access to hunting areas, hunting conditions, etc. Lack of time and funds prevented exploration of this possibility.

A serious difficulty with the results of this and previous similar studies is that investment in hunting and associated equipment has not been incorporated into the net economic value estimates. Since these investments often represent a substitution for variable hunting trip expenses (e. g., purchase of a camper may be a substitute for motel expenses), the exclusion of investment in durable items results in a serious underestimate of net economic value. Future studies should attempt to measure the substitution of investment in durable equipment for variable trip expenses, thus permitting a more accurate estimate of net economic value. Another possibility would be to obtain the inventory and original cost of the durable recreational equipment owned by the sampled families, and their estimates of its present value, in order to obtain an annual cost equivalent for this investment. Then, the proper percent of this annual cost equivalent for a given family could be added to their variable hunting trip expenses for demand estimation.

Table 32. Hunting Trip Expenses and Net Economic Value Estimates for the Oregon Big Game Resource, Based Upon 1968 Survey.

Region	Hunting trip expenses	Estimated net economic value from exponential function (consumer surplus)
Region I, Northwest	$ 3,091,320	$ 1,382,000
Region II, Southwest	1,636,800	969,000
Region III, Central	3,303,360	2,065,000
Region IV, Northeast	8,914,980	6,082,000
Region V, Southeast	1,653,540	482,000
Total	$18,600,000	$10,980,000

Offsetting the exclusion of investment costs in this study, to a certain extent, was the inclusion of food expenditures. Actually, the hunters should have been asked to list only those expenses for food <u>in excess</u> of what they would have spent if they had not hunted. Since food and beverages accounted for 28.2 percent of all hunting trip expenses, Table 12, inclusion of all such expenditures tends to overestimate actual net expenditures. However, this amount of $5.245 million is small, compared to $44.6 million expended annually for hunting gear and camping equipment allocated to hunting, which was excluded entirely from the net economic value estimates. Therefore, the overall estimate of net economic value in Table 32, even by consumer surplus, is considered to be quite conservative.

It should be mentioned that the computation of net economic value for each of the five regions was made independently of the other regions. In fact, hunting in one region could be considered as a substitute for hunting in the other regions, and a question could be raised about the independence assumed in the net economic value computations. However, it can be pointed out that the overall effect of this complication is to give a conservative estimate of value for each region. For example, hunters residing in Northwest Oregon should be willing to pay even more to hunt in Northeast Oregon if additional hunting charges were imposed on hunting in Northwest Oregon.

Finally, it should be noted that the net economic values in Table 32 do not include so-called nonconsumptive values of big game, since some of the nonhunting public derive pleasure from viewing or photographing wildlife. Similarly, option demand by those who may wish to utilize the resource in the future is not included. These exclusions serve to further emphasize the conservative nature of the net economic value estimates in Table 32.

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APPENDICES

APPENDIX 1

Introductory Letters, Follow-up Letters, Investment Questionnaire, and 1968 Hunting Trip Record.

OSU

CORVALLIS, OREGON 97331

OREGON STATE UNIVERSITY

DEPARTMENT OF AGRICULTURAL ECONOMICS
219 Extension Hall

Budget Bureau No. 42-S67008
Approval Expires July 1969

Dear Oregon Hunter:

Because of its importance to the State of Oregon and its citizens, we are investigating the economic value of big game as a wildlife resource. As part of this effort, we are asking you to complete and return the enclosed questionnaire which lists various big game hunting expenditures. Please read each question carefully and list the expenditures made by you and other members of your family. Please do not skip questions, since all your answers are important to us. If you wish to elaborate on an answer, feel free to write your comments in the space provided, or in the margins. Also, please complete and return this questionnaire as soon as possible.

You can see that your questionnaire is numbered. This is to provide a way by which reminders may be sent, if necessary, without further imposing upon those who have completed and returned the questionnaire. With this, we promise that your answers will be treated confidentially and used only for the purpose of this study.

This list of your expenditures, together with those of others, will provide valuable knowledge of the importance of hunting activities to Oregon's economy. This knowledge can then be used to improve the habitat and management of our Oregon wildlife in the years ahead.

Please fill out both sides of the questionnaire, EVEN IF YOU DO NOT PLAN TO HUNT BIG GAME THIS YEAR, and place in the enclosed stamped envelope and mail as soon as possible. Thanks very much.

Sincerely yours,

Signature redacted for privacy.

William G. Brown
Professor

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DEPARTMENT OF AGRICULTURAL ECONOMICS
219 Extension Hall

CORVALLIS, OREGON 97331

Budget Bureau No. 42-S67008
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FIRST REMINDER

Dear Oregon Hunter:

A few days ago we asked you to help us by completing an itemized list of the cost of your hunting and camping equipment. This information which you mail to us can be used to estimate the importance of big game to Oregon's economy. In turn, this knowledge can be used to improve the habitat and management of our Oregon wildlife in the years ahead.

Since we have not heard from you, we would appreciate it if you would fill out the enclosed questionnaire and mail it in the enclosed envelope at your earliest convenience. The information from the questionnaire is needed, EVEN THOUGH YOU MAY NOT PLAN TO HUNT BIG GAME THIS YEAR.

If you have already mailed the earlier questionnaire, please disregard this one.

Many thanks.

Sincerely yours,

Signature redacted for privacy.

William G. Brown
Professor

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OREGON STATE UNIVERSITY

DEPARTMENT OF AGRICULTURAL ECONOMICS
219 Extension Hall

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SECOND REMINDER

Dear Oregon Hunter:

Some time ago we asked you to help us by supplying information about your expenditures for equipment used on big game hunting trips. Since the information that you can give is very important, we are sending another questionnaire in case the others have been lost or mislaid. EVEN IF YOU DO NOT PLAN TO HUNT BIG GAME DURING 1968, PLEASE COMPLETE THE QUESTIONNAIRE AND RETURN IT AS SOON AS POSSIBLE.

Your list of expenditures, together with those of others, can provide a basis for obtaining better habitat and management of our Oregon wildlife in the years ahead. Of course, all information supplied will be kept confidential and used only for estimating the importance of hunting activities to Oregon's economy.

If you would please fill out the questionnaire and mail it in the enclosed envelope, it would be greatly appreciated. Oregon's future wildlife resources will be improved by your cooperation.

Sincerely yours,

Signature redacted for privacy.

William G. Brown
Professor

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INVESTMENT IN BIG GAME HUNTING

1. How many members of your family, including yourself, are residing at home at the present time? ....

2. How many years altogether has the head of your household hunted big game? ....

3. Do you, or any member of your family, plan to hunt deer, elk, antelope or bear during 1968?

   Yes .... (Go to item #4)

   No .... (Skip to item #6)

4. What is the earliest month that you or any family member plan to start hunting big game this year? .... (month)

5. When do you and other family members plan to be finished with your big game hunting this year? .... (month)

6. Please record below expenditures made *during the past 12 months* for equipment used by your family for Big Game Hunting. Circle the appropriate percentage of the cost which should be allocated to the Big Game Hunting activity.

   EXAMPLE: Suppose that you purchased a small house trailer. If using the house trailer for big game hunting was the main reason for buying it, then you should circle one of the higher percents such as 50,60,70,80,90, or 100. On the other hand, if you purchased the house trailer mainly for activities other than big game hunting, then you should circle a lower percent such as 40,30,20,10, or 0.

Items purchased or acquired during past 12 months	Cost (only if incurred during past 12 months)	Percent allocated to Big Game Hunting
	(Dollars)	
HUNTING EQUIPMENT		
Rifles or other firearms, including scopes and sights..	....	0 10 20 30 40 50 60 70 80 90 100
Bows, Cross-bows, Quivers, Arrows, Broadheads and other archery equipment	....	0 10 20 30 40 50 60 70 80 90 100
Knives and other equipment for handling meat	....	0 10 20 30 40 50 60 70 80 90 100
Rifle cases or carriers	....	0 10 20 30 40 50 60 70 80 90 100
Other hunting gear and maintenance costs	....	0 10 20 30 40 50 60 70 80 90 100
SPECIAL CLOTHING		
Hunting boots, coats, hats, and gloves	....	0 10 20 30 40 50 60 70 80 90 100
Special underwear and rainwear	....	0 10 20 30 40 50 60 70 80 90 100
Ammunition belts or carriers	....	0 10 20 30 40 50 60 70 80 90 100
Other special clothing	....	0 10 20 30 40 50 60 70 80 90 100
CAMPING EQUIPMENT		
Tents and Tarps	....	0 10 20 30 40 50 60 70 80 90 100
Sleeping bags	....	0 10 20 30 40 50 60 70 80 90 100
Stoves, Coolers, & Lanterns	....	0 10 20 30 40 50 60 70 80 90 100
House trailers (including maintenance)	....	0 10 20 30 40 50 60 70 80 90 100
Campers (including maintenance)	....	0 10 20 30 40 50 60 70 80 90 100
Cost and maintenance of Pickups, Jeeps, Motorcycles & Boats	....	0 10 20 30 40 50 60 70 80 90 100
Pack boards & other packing equipment	....	0 10 20 30 40 50 60 70 80 90 100
Horses (including feed and stable costs), Saddles, Bridles, & Horse Trailers	....	0 10 20 30 40 50 60 70 80 90 100
Axes, Shovels, Saws, Ropes, & other camping equipment	....	0 10 20 30 40 50 60 70 80 90 100

(Please Turn Page)

7. Please record below major expenditures that you made ***more than 12 months ago*** for equipment used by your family for Big Game Hunting. *(List only items which you still use.)* Please circle the appropriate percentage of the cost which should be allocated to Big Game Hunting, as you did in the preceding table.

Major items purchased or acquired more than 12 months ago that you are still using	Purchase Cost (only if incurred more than 12 months ago)	Year or Years Purchased or Acquired	Percent allocated to Big Game Hunting
	(Dollars)		
Rifles or other firearms, including scopes, sights, & cases	....	....	0 10 20 30 40 50 60 70 80 90 100
Bows, Cross-bows, Quivers, and other archery equipment	....	....	0 10 20 30 40 50 60 70 80 90 100
Tents, Tarps, and Sleeping Bags	....	....	0 10 20 30 40 50 60 70 80 90 100
House trailers and campers	....		
Pickups, Jeeps, Motorcycles & Boats (in-	......	....	0 10 20 30 40 50 60 70 80 90 100
cluding maintenance)	....	....	0 10 20 30 40 50 60 70 80 90 100
Horses, Saddles, Bridles & Horse Trailers	....	....	0 10 20 30 40 50 60 70 80 90 100
Other major hunting and camping equipment	....	....	0 10 20 30 40 50 60 70 80 90 100

8. What was the approximate total taxable income of your family in 1967? (If more than one member of your family worked, include his or her income in the total):

- .... Under $3,000
- .... $3,000 - $5,000
- .... $5,001 - $7,000
- .... $7,001 - $10,000
- .... $10,001 - $15,000
- .... $15,001 - $20,000
- .... Over $20,000

9. What is the occupation of the head of the household? (NOTE: Please fill in each line)

Type of Industry or Profession ....

Specific Job ....

10. Is there anything else that you would like to tell us?

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CORVALLIS, OREGON 97331

OREGON STATE UNIVERSITY

DEPARTMENT OF AGRICULTURAL ECONOMICS
219 Extension Hall

Budget Bureau No. 42-S67008
Approval Expires July 1969

Dear Oregon Hunter:

Early last fall you supplied us with some valuable information about your hunting and camping equipment used for Big Game hunting. We certainly appreciated your help and cooperation in completing that earlier questionnaire.

We now need your further cooperation to obtain a record of your expenses incurred during the hunting season. The enclosed 1968 Hunting Trip Record is designed to help you keep an up-to-date record of all your expenses on Big Game hunting trips. This record of your trip expenses, together with those of others, will provide valuable knowledge of the importance of Big Game hunting to Oregon's economy. Of course, your record will be treated confidentially and will be used only for the purpose of this study.

Please record your expenses throughout the Big Game hunting season, then fold, seal, and return the enclosed 1968 Hunting Trip Record immediately after your last 1968 Big Game hunting trip in Oregon. The postage is prepaid.

Thanks very much.

Sincerely yours,

Signature redacted for privacy.

William G. Brown
Professor

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FIRST REMINDER

Dear Oregon Hunter:

Early last fall you supplied us with some valuable information about your hunting and camping equipment used for Big Game Hunting. We certainly appreciated your help and cooperation in completing that earlier questionnaire.

Some time later we sent you a second questionnaire, a 1968 Hunting Trip Record pertaining to your actual hunting trip expenditures over this past hunting season. However, to date we have not yet received your completed record. In order to make full use of the information from your first questionnaire, it is essential that we receive your 1968 Hunting Trip Record. Since the information that you can give us is so important, we are enclosing another record in case the first one has been lost or mislaid. IF YOU DID NOT HUNT, AND DO NOT PLAN TO HUNT BIG GAME DURING 1968, please complete Item #2 of the enclosed 1968 Hunting Trip Record and return it to us.

If you are still planning to hunt in one of the later 1968 seasons, please send us your completed record as soon as possible after your last 1968 Big Game hunting trip in Oregon.

Thanks for your cooperation.

Sincerely yours,

Signature redacted for privacy.

William G. Brown
Professor

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SECOND REMINDER

Dear Oregon Hunter:

Some time ago we sent you a 1968 Hunting Trip Record for recording your Big Game hunting trip expenses during 1968. However, we have not yet received your completed record.

Because the information you can give is very important, we are enclosing another 1968 Hunting Trip Record in case the others have been lost or mislaid. EVEN IF YOU DID NOT HUNT BIG GAME DURING 1968, PLEASE COMPLETE ITEM #2 OF THE ENCLOSED 1968 HUNTING TRIP RECORD AND MAIL IT TO US AS SOON AS POSSIBLE.

If you did hunt Big Game during 1968, we need your completed record at your earliest convenience.

We hope to hear from you soon. Thanks very much.

Sincerely yours,

Signature redacted for privacy.

William G. Brown
Professor

In cooperation with the
OREGON STATE GAME COMMISSION

ab
Enclosure

OREGON STATE UNIVERSITY 1868 1968 CENTENNIAL

1968 BIG GAME HUNTING TRIP RECORD

Budget Bureau No. 42—S67008
Approval Expires July 1969

1. This record is designed to help you and other family members, who are presently residing at home, keep track of 1968 Big Game hunting trip expenses. Please record the information under each column heading for each hunting trip, in Oregon, family members take for deer, elk, or other Big Game during any of the 1968 hunting seasons.

   After your LAST Oregon hunting trip of the 1968 season, be sure to complete the back side of the page, then seal the record sheet so that the mailing address is on the outside, and mail it at your earliest convenience.

		1st Trip	2nd Trip	3rd Trip	4th Trip	5th Trip	6th Trip	7th Trip	8th Trip	9th Trip	10th Trip	11th Trip	12th Trip
List number of days spent on hunting trip, including travel time:													
How many family members?	Went on trip												
	Hunted on trip												
On this trip list total hours all members of family, counted together, spent hunting for:	Deer												
	Elk												
	Other (Specify)												
Number of Big Game animals bagged by your family on trip:	Deer												
	Elk												
	Other (Specify)												
Oregon Game Commission unit or area hunted on trip:													
TRANSPORTATION	Miles traveled from home to hunting site & back												
	Hours spent traveling from home to hunting site and back												
	Miles traveled while on hunting site, by vehicle												
	Amount, if any, paid to you by others for transportation $												
	Amount, if any, you paid to others for transportation $												
EXPENDITURES	Motels, hotels, camping or private hunting fees $												
	Ammunition, arrows, & broadheads $												
	Food, beverages & liquor on hunting trip $												
	Guide service & rental of horses, airplanes, or other vehicles $												
	Cutting & wrapping meat, tanning hides $												
	Other expenses incurred on hunting trip $												

(Please continue questionnaire on other side)

2. Please list the number of 1968 Oregon Big Game tags or licenses purchased by members of your family who are presently residing at home:

Hunter's or combination angler's & hunter's licenses.............................. Resident.................... Non-Resident....................

General deer tags .... Resident.................... Non-Resident....................

Controlled season deer tags ....

General elk tags .... Resident.................... Non-Resident....................

General antelope tags ....

Other tags (Please specify) ....

3. Is there anything else that you would like to tell us?

Please Fold and Glue Along This Edge

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219 Extension Hall
Oregon State University
Corvallis
Oregon
97331

1968 HUNTING TRIP RECORD

APPENDIX 2

Procedures Used for Estimating Variances of Investment in Big Game Hunting, Hunting Trip Expenses, and Total Expenditures.

Estimate of Variance and Confidence Limits for Investment in Hunting and Related Equipment

The variance of the average investment in hunting and related equipment was estimated using a formula from Cochran's (1963) Chapter 12 on double sampling. Before presenting the formula, it is advisable to define the notation that was used.

Let

N = Size of population of Oregon big game hunters in 1968.

$\bar{Y}$ = Average expenditure for this population.

h = An index of the four strata of respondents, i.e., respondents to the initial questionnaire, first reminder, second reminder, and nonresponse.

W_h = N_h/N = proportion of population falling into stratum h.

$\bar{Y}_h$ = Average expenditure for stratum h.

n' = Size of the first random sample.

W_h = n'_h/n' = proportion of the first sample falling into stratum h.

n = Size of the second random sample, a subsample of the first (in this case, the subsample of usable responses).

n_h = The size of that part of the second sample drawn from stratum h.

$\bar{y}_h$ = Observed average expenditure for this stratum.

s_h^2 = Sample variance of stratum h.

$\bar{y}$ = $\sum_h w_h \bar{y}_h$ is unbiased estimate of $\bar{Y}_h = \Sigma W_h \bar{Y}_h$ as was shown by Cochran (1963).

An unbiased estimate of the variance of average investment, $V(\bar{y})$, assuming, n_h/N_h and $1/N$ are negligible, is

$$V(\bar{y}) = \frac{n'}{n'-1} \sum_h \left\{ \left[W_h^2 - \frac{N-n'}{N-1} \right] \frac{S_h^2}{n_h} + \frac{N=n'}{N-1} \; W_h \; \frac{(\bar{y}_h - \bar{y})^2}{n'} \right\} \quad (1)$$

In our case, we have

Stratum h	Responses n'_h	$W_h = n'_h/n'$	Usable questionnaires n_h	Ave. expenditure in stratum h	Variance in stratum h S_h^2
1 Initial questionnaire	1,057	0.3786	589	$ 288.69	294941.34
2 First reminder	686	0.2457	351	300.50	401159.85
3 Second reminder	260	0.0931	115	148.47	90979.71
4 Nonresponse	789	0.2826	349	148.47 a/	9097.71
Total	n' 2,792	--	n =1,085	$\bar{y}$ = $238.91	--

a/ It was assumed that nonrespondents had spent the same as those families who answered the second reminder.

By substituting these figures into the variance formula given above, we obtain a value of 170.55 which is the variance of investment in hunting and related equipment. Consequently, the standard error is 13.06 which is not high considering the magnitude of average expenditure.

Based on the above computations and assuming that average investment is normally distributed, the 95 percent confidence interval would be:

$$\bar{y} \pm tS(\bar{y}), \text{ where}$$

$\bar{y}$ = average investment per hunting family

t = 1.96 (from t-table)

$S(\bar{y})$ = standard error

Therefore the 95 percent confidence interval is:

$$238.91 \pm 1.96\ (13.06)$$

$$\text{or} \quad 238.91 \pm 25.60$$

This implies that the estimated investment in hunting and related equipment in 1968 probably ranged between $38.5 and $47.8 million.

Estimate of Variance and Confidence Limits for Hunting Trip Expenses

The variance of hunting trip expenses was calculated in a manner exactly similar to that used in calculating the variance of investment expenditure as was explained earlier. In this case we have

Stratum h	Reponses n'_h	$W_n = n'_h/n'$	Usable questionnaires n_h	Ave. trip expenses in stratum h $\bar{y}_h$	Variance in stratum h S_h^2
1 Initial questionnaire	344	0.2324	307	$143.71	21660
2 First reminder	469	0.3169	353	114.11	11322
3 Second reminder	259	0.1750	197	98.96	6813
4 Nonresponse	408	0.2757	35	115.46 a/	9055
Total	1,480	--	892	$118.70	--

a/ The manner in which this weighted average was calculated is shown in Table 11.

Substituting these figures in formula (1) we obtain a value of 27.90 which is the variance of hunting trip expenses. Consequently, the standard error is 5.28 which is relatively low considering the magnitude of average trip expenses.

Thus, the 95 percent confidence interval for average hunting trip expenses, assuming that this average is normally distributed would be:

$$118.70 \pm 10.35$$

This amounts to saying that average trip expenses per hunter-family probably ranged between $108 and $129.

Variance of Total Expenditure

The following formula was used in calculating the variance of total expenditure:

$$\sigma_{I+V}^2 = \sigma_I^2 + \sigma_V^2 + 2\rho\sigma_I \sigma_V \tag{2}$$

where

I = investment expenditure

V = variable expenses (hunting trip expenses)

σ^2 = variance

σ = standard error

ρ = correlation coefficient

The correlation coefficient between investment expenditure and hunting trip expenses was computed to be 0. 223. Also, the variances for investment expenditure and hunting trip expenses were earlier computed to be 170. 55 and 27. 90, respectively. Substituting these estimates in equation (2) above, we get

$$\sigma_{I+V}^2 = 170.55 + 27.90 + 2(0.223)(13.10)(5.28) = 229.30.$$

Thus, σ_{I+V} = 15. 14 which is the standard error for the total expenditure.

APPENDIX 3

Estimation of Net Economic Values From Exponential Demand Functions

Estimation of Net Economic Value From Exponential Demand Functions

$$q_i = e^{A_0 + A_{1i}X_{1i} + A_{2i}X_{2i} + \ldots A_{ni}X_{in}} \quad , \; i=1,\; 2,\; 3, \; \ldots \; n$$

$$l_n q_i = A_o + A_{1i}X_{1i} + A_{2i}X_{2i} + \; \ldots \; A_{ni}X_{in}$$

Let $(\Sigma q_i \mid \text{added } P = 0) =$ No. of hunter-trip equivalents with zero added cost

If the added cost, $P > 0$, then

$$(\Sigma q_i \mid P > 0) = e^{-A_1 P} \quad (\Sigma \hat{q}_i \mid P = 0)$$

$$\text{Total revenue (TR)} = P \cdot e^{-A_{1i}P} \; (\Sigma \hat{q}_i \mid P = 0) \quad = P \cdot e^{-A_{1i}P} \; (\Sigma_i \hat{q}_i \mid P = 0)$$

$$\frac{\partial TR}{\partial P} = e^{-A_{1i}P} \; (\Sigma \hat{q}_i \mid P = 0) \; + \; P (\Sigma \hat{q}_1 \mid P = 0) \cdot (-A) \; e^{-A_{1i}P} = 0$$

$$\rightarrow e^{-A_{1i}P} \; (\Sigma \hat{q}_1 \mid P = 0) \quad = P \cdot (\Sigma \hat{q}_i \mid P = 0) \cdot A_{1i} \quad (e^{-A_{1i}P})$$

$$\rightarrow A_{1i}P \; (\Sigma \hat{q}_1 \mid P = 0) \; (e^{-A_{1i}P} = e^{-A_{1i}P} \; (\Sigma \hat{q}_i \mid P = 0)$$

$\rightarrow P = 1 / A_{1i}$, which is the price that maximizes revenue for single owner.

$$\text{Thus, } TR = P_{max} (\Sigma \hat{q}_i \mid P_{max}) = P_{max} \cdot \; e^{-A_{1i}(\frac{1}{A_{1i}})} \quad (\Sigma \hat{q}_i \mid P = 0)$$

$$= 1/A_{1i} \cdot e^{-1} \; (\Sigma \hat{q}_i \mid P = 0),$$

and net economic value for any given region is

$$(261.90)\ (TR) = (261.9)\ \left(\frac{1}{A_{1i}}\right)\ (e^{-1})\ (\Sigma q_i \quad P = 0),$$

where

$$261.9 = \frac{\text{Total number of big game hunters in the state}}{\text{Total numbers of hunters in sample}}$$

$$\frac{337590}{1289} = \text{a blow-up factor}$$

A_{1i} = variable cost regression coefficient for a specific region (total number of licensed hunters in Oregon in 1968 was 363,000 but our sample indicates that only 0.93 were big game hunters)

(I) So, net economic value for Region I (Northwest) is

$$(261.9)(TR) = (261.9)(\text{Price})(e^{-1})(\Sigma q_i \quad P = 0)$$

$$= (261.9)(1\ A_{1i})(e^{-1})(\Sigma q_i \quad P = 0)$$

$$= \frac{(261.9)(0.37)\ (85.767)}{0.0162485} =$$

$511,000

(II) Net economic value for Region II (Southwest) is

$$= (261.9)(\text{Price})(e^{-1})(\Sigma q_i \quad P = 0)$$

$$= (261.9)\left(\frac{1}{A_{1i}}\right)(e^{-1})(\Sigma q_i \quad P = 0)$$

$$= \frac{(261.9)(0.37)(82.96)}{0.022425} = \$358,000$$

(III) Net economic value for Region III (Central) is

$$(261.9)(\text{Price})(e^{-1})(\Sigma\hat{q}_i \mid P = 0)$$

$$= (261.9)(\frac{1}{A_{1i}})(e^{-1})(\Sigma\hat{q}_i \mid P = 0)$$

$$= \frac{(261.9\ (.37)\ (64.43)}{0.008171} = \$764,100$$

(IV) Net economic value for Region IV (Northeast) is

$$(261.9)(\text{Price})(e^{-1})(\Sigma\hat{q}_i \mid P = 0)$$

$$= (261.9)(\frac{1}{A_{1i}})(e^{-1})(\Sigma\hat{q}_i \mid P = 0)$$

$$= \frac{(261.9)(.37)(227.91)}{0.0098142} = \$2,250,000$$

(V) Finally, net economic value for region V (Southeast) is

$$(261.9)(\text{Price})(e^{-1})(\Sigma\hat{q}_i \mid P = 0)$$

$$= (261.9)(\frac{1}{A_{1i}})(e^{-1})(\Sigma\hat{q}_i \mid P = 0)$$

$$= \frac{(261.9)(.37)(18.02)}{0.009797} = \$178,000$$

The revenue to a nondiscriminating monopolist which is a measure of the net economic value is:

511,000 + 358,000 + 764,100 + 2,250,000 + 178,000 = $4,061,000.