AN ABSTRACT OF THE THESIS OF

Yuji Imaizumi for the degree of Master of Science in Forest Resources presented on December 12, 1994. Title: Using Contingent Valuation Method to Determine Optimal User Fees for the Recreational Use of McDonald Forest, Oregon.

Abstract approved: ______________________________

Rebecca L. Johnson

Forest recreation is one of the many non-commodity functions of forests that have experienced a rapid growth in demand in the past few decades. Even faster growth in demand for recreation is expected for several decades. However, such growing demand for forest recreation is often not well perceived by owners or managers of forests and thus is not well incorporated into their resource allocation decisions. This can be attributed to two major problems: the difficulty in correctly measuring the economic value of non-marketed goods and the lack of a proper system (institution) under which the economic value can be transferred into actual revenue.

The contingent valuation method (CVM) is one of the techniques to elicit people's willingness to pay for non-marketed goods and services. On the other hand, the recreational user fee system has been proposed as a method to transfer economic value of recreation into actual revenue.

This paper describes a case study in which a CVM survey was administered to recreationists in McDonald Forest, Oregon. The dichotomous-choice format was chosen for the CVM. The survey elicited the economic value of recreation in the forest, and the consequences of charging a lump sum annual fee were examined.

The economic value of (i.e., recreationists' willingness to pay for) recreational opportunities in McDonald Forest was estimated to be around 80,000 to 100,000 dollars per year, slightly exceeding the current level of spending on recreational management in the forest. It was also estimated that charging an annual fee to the recreationists could generate gross revenue of up to 21,000 dollars per year, but it was shown that the fee revenue could not completely cover the current level of spending at any single level of fee price. Further, it was estimated that a fee would have discriminatory impacts on less frequent users and hikers compared with frequent users and those who participate in more specialized activities such as biking, horseback riding, running, and dog walking. However, it was not clear whether a fee would have distinguishable impacts on different income levels, although there was a statistical evidence of difference.

Using Contingent Valuation Method to Determine Optimal User Fees for the Recreational Use of McDonald Forest, Oregon

by

Yuji Imaizumi

A THESIS

submitted to

Oregon State University

in partial fulfillment of
the requirements for the
degree of

Master of Science

Completed December 12, 1994
Commencement June 1995

Master of Science thesis of Yuji Imaizumi presented on December 12, 1994

APPROVED:

Major Professor, representing Forest Resources

Chair of Department of Forest Resources

Dean of Graduate School

I understand that my thesis will become part of the permanent collection of Oregon State University libraries. My signature below authorizes release of my thesis to any reader upon request.

Yuji Imaizumi, Author

ACKNOWLEDGMENT

I would like to express my gratitude to my major professor, Rebecca Johnson, who has warmly guided my graduate study here in Corvallis. Thanks to her instruction, my two years at Oregon State University were so productive that I accomplished far more than what I guessed I could. I would also like to thank other members of my committee, Frank Conklin, Doug Brodie, and Bruce Rettig, for their invaluable advice in my pursuit of the degree.

I am also indebted to Michael Wing, project manager of the McDonald Forest Recreation Survey project, Debbie Deagen, recreation manager of McDonald Forest, and Kreg Lindberg, graduate student in the Department of Forest Resources, Oregon State University. I am sure that this thesis could not have been completed without their help.

I must thank Japan International Cooperation Agency (JICA) and Forestry Agency of Japan for supporting my study at Oregon State University and giving me a priceless opportunity to study in a wonderful environment that would be difficult to find in Japan.

Finally, I really have no words to thank my wife, Mihoko, and my son, Tomohiro, for their warmth and patience during the two years of my study. They always encouraged me with their love to keep pursuing the maximum I could achieve. Without their encouragement, I could never have finished the degree successfully.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

Using Contingent Valuation Method to Determine Optimal User Fees for the Recreational Use of McDonald Forest, Oregon

1. INTRODUCTION

Excessive exploitation of forest resources seen in many countries around the world is one of today's most urgent global problems. Especially in developing countries, it is causing significant physical and economic harms which directly affect the lives of the people living in and near those forests or those living in the nearby areas. In developed countries such as the United States, exploitation of forests seems to be causing less physical harms compared to those in developing countries. Even in those countries, however, growing public interest in wildlife habitat protection, water quality preservation, and outdoor recreation have resulted in calls for ways of forest management that would not only produce commodities such as timber but also enhance various non-commodity functions of forests. The increased demand for non-commodity use of forests should have increased their economic value (i.e., people's willingness to pay) over time.

Nevertheless, the economic value of non-commodity functions of forests is often not perceived or underestimated at best and, even if perceived, not well incorporated into actual forest management decisions in a way that the total value provided by the forest, including both commodity and non-commodity values, would be maximized. This can be attributed mainly to the following basic problems:

(1) Difficulty in correctly measuring the economic value of non-marketed goods. Many of the non-commodity benefits of forests are not exchanged in markets and therefore their economic value can not be measured by observing their market-clearing prices. Without receiving a clear and correct market signal in the form of prices which represent relative values, forest owners and policy makers would not be able to choose an appropriate mix of products and quality of services they would provide from their forests (Bowes and Krutilla, 1989), and a bias toward commodity use would result (Dixon and Sherman, 1990).

(2) Lack of proper system (institution) under which the economic value can be transferred into actual revenue. From the forest owner's point of view, resource uses that do not generate revenue would be less attractive than those that do, even if he/she knows that the former has more overall benefit to society. This is also true for public forests where shortages of funds make policy makers inclined to favor commodity uses which generate revenue (Bowes and Krutilla, 1989; Dixon and Sherman, 1990).

Forest recreation is one of the many non-commodity functions of forests which has experienced a rapid growth in demand in the past few decades, especially in developed countries. For example, in the United States, recreational visitor hours increased by 12% and 27% on Forest Service and National Park lands respectively in the ten years from 1980 to 1990 (U.S.D.C. Bureau of the Census, 1993). In Oregon, State Parks received approximately 40 million day-visits and accommodated 2.3 million camper nights in the fiscal year 1991-92, and experienced a 32% and 38% increase respectively in ten years since 1981-82, although they slightly decreased in 1992-93 (State of Oregon, 1994a). State of Oregon (1991) estimates that the demand for outdoor recreational opportunities in Oregon will further increase in the next several years: for example, in 13 years from 1987 to 2000, demand for nature and wildlife observation is estimated to increase by 70%, dayhiking on trails by 89%, bicycle riding on roads by 91%, horseback riding by 17%, and jogging and running by 74%. The upward trend of demand for outdoor recreational opportunities is expected to hold in the United States for the next several decades (Cordell, Bergstrom, Hartmann, and English, 1990), outgrowing the demand for other major renewable resources such as timber, range forage, and water (U.S.D.A. Forest Service, 1990). Under such circumstances, correctly measuring the economic value of forest recreation would become more and more important in order to achieve a better allocation of forest resources that reflects such growing demand for forest recreation. The contingent valuation method (CVM) is one of the techniques expected to contribute to this goal.

Forest recreation could provide a sustainable and significant source of income and employment for forest-based economies and government bodies, both in developed and developing countries, if the growing demand could be captured and transferred into actual revenue. According to O'Toole (1988), the U.S. Forest Service estimates that amenity (e.g., recreation, fish, and wildlife) values provided by national forests exceed commodity (e.g., timber, grazing, and mineral) values in every region except in Region 6 (Pacific Northwest), suggesting that forest recreation has a potential to provide an equivalent or even greater revenue source than commodities such as timber. Revenues from recreational fees and permits on Bureau of Land Management (BLM) fee sites totaled some 1.6 million dollars in FY1992 (U.S.D.I. Bureau of Land Management, 1993), which was equivalent to about 5% of the total of 31 million dollars appropriated to BLM's recreation programs in FY1989. U.S. Army Corps of Engineers (1990) estimated that charging day use fees on the Corps-managed recreation areas would generate net revenue of 40 to 50 million dollars per year, which is roughly equivalent to a quarter of the Corps' total recreation operation and maintenance budget in 1990. In Oregon State Parks, revenue from user fees currently pays for one-third of the total expenditures by the Oregon Parks and Recreation Department (State of Oregon, 1994b).

Recognizing the importance and urgency of correctly measuring the economic value of forest recreation, and also recognizing the high potential of a recreational user fee system as an additional source of revenue for forest owners and managers, this paper will describe a case study in which "dichotomous-choice" CVM, one of the several variations of CVM, was applied to forest recreation. The objectives of the study were to measure the economic value of forest recreation in a given study site and to estimate the consequences of charging a user fee at the site, using information obtained through implementation of the CVM survey. Specifically, the consequences of interest included revenue and cost for the management, exclusion of a particular group of users, and consumer surplus associated with charging a fee. McDonald Research Forest of the College of Forestry, Oregon State University was selected as the study site.

Because of the limitation on time and other resources that were available for this study, the economic value of the site was estimated only under current resource allocation, e.g., acres allocated for recreational use, miles of trails available, etc. Estimating the economic value of the site under alternative resource allocations would have required more sophisticated survey design and analysis techniques than doing so under a fixed resource allocation.

2. LITERATURE REVIEW

In the previous chapter, the measurement of economic values of forest recreation and the generation of revenue from it were identified as major problems concerning forest resource management both in developed and developing countries. These two problems are indeed among the several high-priority issues for outdoor recreation listed by Cordell et al. (1990). This chapter will introduce some of the major theoretical and empirical works regarding these problems.

2.1 Measuring Economic Value of Forest Recreation

Economic value is defined as "the amount of money, or the other goods that could be purchased with the money, that a person is willing to give up in order to get a thing, or the amount required in compensation for the loss of a thing" (Peterson, Driver, and Brown, 1990). By using the amount of money as the measure, one person's value of a certain thing can be compared with another's of a different thing, and it can be summed up for all the members in society. Because of this nature, it can be used to evaluate how society's well-being would be increased or reduced by a given change in the situation such as policy change or provision of a certain good, by comparing people's value placed on things gained by the change (i.e., benefit) and those placed on things lost by the change (i.e., cost). When the former exceeds the latter, i.e., if people who were made better-off could fully compensate those who were made worse-off and still be better-off, the change in the situation can be considered to make society better-off as a whole (Bishop, 1987). Further, economic value can be used to know which of the proposed situation changes would maximize the net benefit accrued to society (i.e., efficiency) and whether any segment of the society would benefit more or less than others (i.e., equity) (Peterson, Driver, and Brown, 1990).

Economic value of a change in a readily marketed good is measured by its price in the market, as long as the change in quantity is small so that it does not affect the price. This depends on the assumption that people consume any good up to the point where they can no longer gain net benefit from consuming another one unit of the good; in other words, willingness to pay for an additional one unit of the good equals its price. However, for goods not generally exchanged in the market such as forest recreation, prices can not be observed and thus their economic value can not be measured by their prices.

The reason why many non-commodity benefits of forests are not exchanged in the market is generally attributed to their "public good" characteristics; i.e., non-rivalry and non-excludability. A good is non-rival when providing it to one user does not diminish the amount available to others and thus requires no cost for adding one user once the good is provided to someone, meaning that the marginal cost of an additional user equals zero. On the other hand, a good is non-exclusive when people can not be excluded from consuming it (Pindyck and Rubinfeld, 1992). When a good is non-rival, the producer of the good faces a downward sloping average total cost curve and zero (or close to zero) marginal cost, meaning that the economically efficient quantity of supply would not generate profit: a non-rival good can generate revenue only when it is excludable so that the supplier can control the level of supply. Forest recreation can be non-rival up to the point where congestion cost becomes significant and non-exclusive where it is difficult to control the access to the site, and thus can be a public good. Because there is no market-clearing price to observe, the economic value of forest recreation must be measured by an alternative method.

Among the various techniques for valuing non-marketed goods, the travel cost method (TCM) is one of the most widely used and most developed techniques for valuing recreational amenities. This method assumes that recreationists visiting a given recreation site from different distances are paying different "prices" for access to the site in the form of travel costs, and that the quantity of recreational visits responds to increased distance as they would to increased price (e.g., entry fee) for access to the site (Rosenthal, Loomis, and Peterson, 1984a; Randall, 1987; Dixon and Sherman, 1990). In this method, a random sample of visitors is surveyed in order to determine their place of residence and the total expenditure they made in the trip. Then, the relationship between the cost of visiting the site and the proportion of residents in each locality who chose to visit the site is derived. Finally, the derived relationship is transformed into the relationship between the price for accessing the site and the quantity demanded, which is the demand curve for the site, so that the economic value of the site can be estimated (Randall, 1987).

Although being widely applied, the travel cost method has some difficulties and limitations in its use for valuing recreational amenities. For example, assumptions underlying this method would be violated when the trip itself generates utility, when the trip entails more than one destination, and/or when the cost of the trip does not make up a significant portion of the total expenses made during the visit to the site (Randall, 1987). The difficulty of interpreting the time spent for traveling to the site as a cost is also a major problem in this method (Mitchell and Carson, 1989).

Alternatively, the contingent valuation method (CVM) is a method that can directly estimate the value of non-marketed goods without referring to the market value of other goods or services such as those of travel. CVM uses surveys in order to directly elicit either the amount of money people would pay for receiving a given benefit or the amount they would accept for foregoing it, depending on who is assumed to have the right to the benefit initially, i.e., whether the provider of the benefit has the right to require the recipients to pay for it or the recipients have the right to require the provider to compensate for their foregone benefit (Mitchell and Carson, 1989; Dixon and Sherman, 1990).

As with other survey research techniques, the validity of a CVM study can be affected by many sources of bias, such as interviewer bias and nonresponse bias. Even with the greatest care to apply a sound survey methodology, CVM is still subject to many potential sources of bias that are peculiar to the method. Strategic bias is caused by the respondents' attempts to influence the outcome of the survey and hypothetical bias is caused by the inability of the respondents to accurately predict their behavior in a real market if it existed (Bishop and Heberlein, 1990). Nevertheless, a carefully designed and administered contingent valuation study is expected to work well, and most of all, it provides a useful tool that can value various elements of economic values, such as existence value, which may not be valued by any other methods (Arrow, Solow, Portney, Leamer, Radner, and Schuman, 1993). In the report submitted to the National Oceanic and Atmospheric Administration (NOAA) ("blue-ribbon" panel report), Arrow et al. (1993) concluded that CVM studies administered with close adherence to their recommended guidelines would produce reliable results.

Numerous variations of CVM can be categorized into five distinct approaches: bidding games, open-ended questions, payment-card formats, dichotomous-choice questions, and contingent-ranking techniques (Bishop and Heberlein, 1990). Among them, the dichotomous-choice CVM is one of the most popular techniques among CVM researchers. In this approach, respondents are quoted a price for the good to be valued and asked whether they would pay that amount in order to obtain it. By varying the quoted price among respondents, inference about the economic value of the good, i.e., total or mean willingness to pay of the population, can be drawn by estimating the probability of "yes" responses to various price levels.

Bowker and Stoll (1988) and Loomis (1988) listed the advantages and disadvantages of the dichotomous-choice approach. The advantages of this method include: (1) it puts respondents in a situation similar to those usually experienced by them in a real market, i.e., deciding whether or not to buy the good at a given price, not expressing their exact willingness to pay dollar amounts, (2) it is less likely to be influenced by interviewer or strategic bias, and (3) it can be easily performed in a mail survey. The disadvantages include: (1) it requires a statistical inference to estimate the willingness to pay of the respondents and thus requires a specification of the underlying probability function in which the probability of receiving "yes" answers to a given dollar amount is expressed as a function of the dollar amount (2) it elicits less information from each respondent and thus requires a larger sample size, and (3) an appropriate range of quoted dollar amounts (bids) must be predetermined. Arrow et al. (1993), in their report mentioned above, concluded that the dichotomous-choice format CVM produces the most reliable result mainly because of the first two advantages listed above, although they strongly recommended that the method be carried out with personal interviews, not with mail surveys.

The growing body of literature on dichotomous-choice CVM reflects such advantages of the approach and the reliability expected of it. In addition to many empirical studies that applied this approach for estimating various environmental amenity values, many study efforts are also devoted to the development of theoretical bases for the approach. For example, methods for optimal bid design to determine optimal range of dollar amounts to be quoted, number of different bid amounts, and number of respondents to be assigned to each bid were recently proposed by some researchers (e.g., Duffield and Patterson, 1991; Cooper, 1993). Accumulation of such theoretical studies is expected to further enhance the reliability and validity of dichotomous-choice CVM by allowing it to elicit information as efficiently as possible under a given sample size constraint.

Although the theoretical basis of CVM (in general) has been well developed and many studies have suggested its high potential, further research effort is needed to increase its reliability so that forest owners and policy makers can use it with confidence for their critical management decisions, such as when assessing the consequences of a recreational user-fee system. Smith (1993) listed some of the types of research efforts that are undertaken by researchers to evaluate the validity and reliability of the method, including the comparison of CVM estimates and the price and quantity observed in an actual or simulated market, and the comparison of stated intention to purchase and the actual sales of commodities. Accumulation of empirical information through case-by-case research efforts in these areas would contribute to better understanding of how the CVM performs under various circumstances and how its validity and reliability can be further improved.

2.2 Generating Revenue from Recreational Use of Forests

There are several possible methods to generate revenue from non-marketed forest resources and amenities. Dixon and Sherman (1990) listed user fees, concession fees, patents and royalties such as patents for medicinal plants, plant breeding and improvement programs, and international compensation schemes as some of the possible revenue sources in protected forests in developing countries. Although all but the last one would also work in developed countries, only user fees and concession fees would be relevant for forest recreation. Alternative funding methods for forest recreation would include voluntary contribution or donation, sales and services such as equipment rental, interpretive guides, and publication sales, general taxation/subsidies schemes, and special levies such as recreational vehicle fees.

A user-fee is often proposed as one of the most practical ways to transfer users' willingness to pay for forest recreation into actual revenue. For example, O'Toole (1988) estimated that an "average fee of $2 per visitor-day would make recreation highly competitive with timber in a majority of national forests". In fact, many public agencies of national, state, and municipal levels actually charge fees to the recreational users and, according to Harris and Driver (1987), studies show that recreationists are showing favorable reaction to the fees that would help finance recreation programs. The user fee system was also strongly supported by U.S. Army Corps of Engineers (1990) as one of the few options that have high potential of revenue generation (greater than 20 million dollars).

One of the advantages of user fees over other revenue-raising methods is that it could contribute to an economically efficient use of forests by allowing those who value the forest highest to use it while excluding those who have a lower value (Rosenthal, Loomis, and Peterson, 1984b; Binkley and Mendelsohn, 1987; O'Toole, 1988; Walsh, Peterson, and McKean, 1990). On the other hand, the disadvantages of user fees include the possibility of discriminatory impacts on (i.e., exclusion of) a certain group of users such as the low income population.

Empirical analyses show rather inconsistent results on the issue of discriminatory impact on users. Leuschner, Cook, Roggenbuck, and Oderwald (1987) compared the users' socioeconomic characteristics in two comparable recreation areas located adjacent to each other in North Carolina, one operated privately with fees and another being a national forest wilderness area with no fees, and concluded that fees would not exclude any readily identifiable socioeconomic group. On the contrary, Adams, Bergland, Musser, Johnson, and Musser (1989) conducted a dichotomous-choice CVM on the hunters in a state wildlife area in Oregon, dividing them into three income levels, and concluded that a fee would substantially reduce the participation of low income groups unless a discriminatory pricing system is used, that charges higher fees to higher income groups. Walsh et al. (1990), used the travel cost method (TCM) to estimate the demand curves for a wilderness area in Minnesota at three levels of market size, i.e., local, regional including some adjacent cities, and national, and concluded that even a very low level of fee would force more local users out of the site than those from remote areas. Reiling, Cheng, and Trott (1992) conducted an open-ended CVM on the campers in a state park in Maine, asking how many nights they would have camped at higher fee levels, and suggested that lower income groups would reduce more of their nights camped than higher income groups as the fee level was raised. These contradictory results suggest that the discriminatory impact of charging fees would differ by specific characteristics of the site, and therefore it should be assessed on a case-by-case basis. Especially in developing countries where fees might have significantly different effects on foreign visitors and local residents, great care should be taken to assess the discriminatory effect of fees on local residents if the fee were to be charged to them.

As user-fees became popular as a useful policy and/or management tool, pricing of the permits has become one of the major research interests. Rosenthal et al. (1984b), after reviewing several pricing methods including marginal cost pricing, average cost pricing, and two-part pricing, showed theoretically that marginal cost pricing was the most preferable pricing method because it would maximize the net economic benefit of the society, i.e., consumer surplus plus producer surplus. Cory (1980) argued that in many cases society will be better-off by putting heavier weights on the gains and losses of low-income population, and thus proposed a "socially efficient" user fee pricing for publicly provided services, which would lead to a price lower than marginal cost price. On the other hand, several pricing methods are proposed to cover large start-up costs (i.e., fixed costs) which would not be covered by marginal cost pricing. A two-part fee system and average cost pricing are some examples (e.g., Binkley and Mendelsohn, 1987). O'Toole (1988) and Bahls (1990) argued that unfair competition due to "below-cost" marginal pricing on public forests, even though it might be economically efficient, would reduce incentives for private forest owners to provide their resources for recreational uses. Any fee pricing policy, whatever its primary objective might be, would thus require careful examination from various perspectives on its potential effects, in order to avoid socially undesired consequences.

3. STUDY SITE

McDonald Research Forest of the College of Forestry, Oregon State University, was chosen for the study site. This chapter will provide a brief description of the site and explain what motivated the application of CVM to forest recreation specifically in McDonald Forest.

3.1 Study Site Description

McDonald Forest is located north of the city of Corvallis, a small city in Oregon with a population of approximately 45,000 (as of 1990; State of Oregon, 1992). The forest's land, approximately 7,000 acres, is managed together with Paul M. Dunn Forest, approximately 4,000 acres located to the north of McDonald Forest, by the College of Forestry, Oregon State University. The primary purpose of the forest is to support research and education. The forest also receives recreational visits, mainly from hikers, bicyclists, and equestrians. A conservative estimate of recreational visits is 33,000 in 1988 (Finley, 1990). Because of its proximity to Corvallis, and also because of some unique opportunities it is providing, such as non-motorized recreation and relatively undeveloped settings, the forest is a very popular outdoor recreation site for Corvallis residents. Finley (1990) estimated that 85% of McDonald Forest visitors were Corvallis residents and 89% lived within 10 miles or less of the forest. She also estimated that 80% of Corvallis households had visited the forest at least once in the past.

The topography and vegetation of the forest are typical of the Oregon Coast Range, Douglas-Fir (*Pseudotsuga menziesii*) being the dominant species. The forest has over 100 miles of forest roads and multiple-use trails where not only hikers and runners but also bikers and horseback riders are allowed, and over 8 miles of foot-use only trails. The forest is connected with public roads at some major access points; e.g., Peavy

Arboretum, Lewisburg Saddle, Sulphur Springs, Jackson Place, and Oak Creek. These major access points have some car-parking capabilities. The forest's popular recreational destinations include the meadows and hardwood stands in Oak Creek, Peavy Arboretum where about 160 tree and shrub species can be found, viewpoints such as Dimple Hill where the city of Corvallis can be viewed, and old-growth forest stands (Oregon State University, 1993a).

3.2 Motivation for This Study

Historically, the forest has been actively managed by the college foresters and the timber harvest has provided an important source of revenue which supported the management of the forest. Despite the forest's popularity as a recreation site for Corvallis residents, recreation was not formally recognized as an intended use of the forest until recently (Finley, 1990). However, growing public interest in various non-timber amenities, such as the existence of an old-growth forest, scenic views of the forest, and outdoor recreation opportunities, have been forcing the management to take into account not only the forest's timber values but also its non-timber values. This, along with other concerns, led to the establishment of a new comprehensive long-term management plan (McDonald-Dunn Forest Plan: Oregon State University, 1993a) in 1993.

The plan sets an annual harvest volume goal of 4.4 million board feet (MMbf) in the first decade of the plan, compared with approximately 6.3 MMbf per year during the latest 10 years before the plan (figures include the harvest from Paul M. Dunn Forest). Reduction of the timber harvest would significantly reduce the forest's revenue that could be spent on recreation management, and therefore, it is urgently desired to establish alternative funding measures for the management of the forest. In fact, the plan clearly states in its "Forest-Wide Standards and Guidelines" that "Ways of generating income for recreation management other than from timber harvesting should be explored" and suggests a user-fee system as a possible option to be considered (Oregon State University, 1993b).

Despite the importance of the problem, very few studies have been conducted to evaluate non-timber values or the revenue-capture potential of the forest. Finley (1990) used the recreation opportunity spectrum (ROS) framework to identify and classify various recreational opportunities provided by McDonald Forest. She qualitatively examined how people directly related to the forest such as educators, researchers, recreation managers, forest staff, recreationists, and adjacent residents valued those opportunities. Kimura (1992), using the scenic beauty estimation (SBE) method and CVM, measured the effect of different landscapes created by alternative management schemes such as clearcutting and thinning on the neighboring residents of the forest. Balfour (forthcoming) has conducted a survey including CVM questions to elicit the recreational value of McDonald Forest.

As a part of these and other continuing efforts to better guide the management of McDonald Forest, this study was expected to provide the management of the forest some useful information for evaluating its non-timber values and for assessing the feasibility of a recreational user fee system in the forest.

4. CHOICE OF THE CVM FORMAT AND MODEL SPECIFICATION

This study used dichotomous-choice CVM format questions with a logit model as the underlying probability function. This chapter explains the considerations given in choosing this format and the model specification.

4.1 Choice of the Format

As mentioned in chapter 2, the dichotomous-choice CVM has become popular among CVM researchers because of its various advantages. In addition, as mentioned in the previous chapter, one of this study's major motivations was to estimate the consequences of introducing a recreational user fee system. Taking into account those circumstances, this study also chose the dichotomous-choice format. Specifically, the following reasons justified the use of this format:

(1) Because a user fee system was being considered, the most appropriate payment vehicle seemed to be the price of a pass needed to access the study site (i.e., McDonald Forest). Then, a scenario asking the respondents to decide whether or not to purchase the pass seemed to be most consistent with the actual situation they would face if the user fee system was introduced, rather than a scenario asking them how much they would pay for the pass in an open-ended format.

(2) The sample size was expected to be relatively large. The sample size could be roughly estimated before deciding specific format of the survey because it took a two-stage sampling procedure: users were initially sampled at the site and asked to provide their address so that a survey could be mailed later, and after completing this on-site sampling, the survey was mailed to those who provided the address in order to get the final sample. (The details of the sampling procedure will be discussed in the next chapter.)

(3) Because of the resource and time constraints, mailing was the primary method possible for this study.

4.2 Model Specification: Basic Considerations

After deciding on the use of the dichotomous-choice CVM format with the price of a pass as the payment vehicle, the underlying probability function had to be modeled in order to analyze the data and to make inferences on the economic value of forest recreation in McDonald Forest.

One of the most often used models in the dichotomous-choice CVM literature is the logit model, either in a standard [4-1] or logarithmic [4-2] form:

$$\text{logit}(\pi) = ln(\pi/(1-\pi)) = \alpha + \beta \text{ FEE} + \boldsymbol{\gamma} \mathbf{Z} \quad [4\text{-}1]$$

or

$$\text{logit}(\pi) = ln(\pi/(1-\pi)) = \alpha + \beta \, ln(\text{FEE}) + \boldsymbol{\gamma} \mathbf{Z} \quad [4\text{-}2]$$

where π is the probability of receiving a "yes" response, FEE is the level of the payment vehicle (e.g., price of a pass) in dollars, **Z** is a vector of explanatory variables other than FEE (e.g., personal characteristics), $\boldsymbol{\gamma}$ is a vector of coefficients, β is the coefficient on FEE, and α is the intercept term. The above models can be converted to obtain cumulative probability functions as:

$$\pi = exp\,(\alpha + \beta \text{ FEE} + \boldsymbol{\gamma} \mathbf{Z}) \,/\, [\, 1 + exp\,(\alpha + \beta \text{ FEE} + \boldsymbol{\gamma} \mathbf{Z})] \quad [4\text{-}3]$$

or

$$\pi = exp\,(\alpha + \beta \, ln(\text{FEE}) + \boldsymbol{\gamma} \mathbf{Z}) \,/\, [\, 1 + exp\,(\alpha + \beta \, ln(\text{FEE}) + \boldsymbol{\gamma} \mathbf{Z})] \quad [4\text{-}4]$$

where *exp* (.) is the exponential function.

If we stand on the normality assumption, which is the case in many natural phenomena, the probit model which is based on the normal distribution would seem to be a reasonable choice. However, the logit model has an advantage over the probit model in its computational simplicity, and at the same time it accurately approximates the probit model (Cameron, 1988).

Of the above-mentioned two specifications of the logit model, Hanemann (1984) argued that only the former one ([4-1] and [4-3]), but not the latter ([4-2] and [4-4]), was consistent with utility theory, stating that the choice of responses between "yes" and "no" to a given fee level was "unordered"; i.e., users answer "yes" if they gain net utility from purchasing it, and "no" if not, having no inherent preferences on one choice over another. On the other hand, Cameron (1988) suggested that the latter form could also be legitimate, interpreting that users may in some cases inherently prefer choosing "yes" over "no" and would answer "no" only when the fee level exceeded their "threshold" amounts. However, McConnell (1990) finally showed that either model has a legitimate interpretation regardless of the inherent "order" in the choices, and thus concluded that the choice between them would be "a matter of style as well as of known defects or merits". Practically, one of the potential defects in the former model is that the estimated model would not predict 100% "Yes" response at the fee level of $0, although it is generally expected that this does not cause significantly lower willingness to pay estimates (Johnson, Bregenzer and Shelby, 1990).

Considering all the points mentioned above, this study used both standard and logarithmic forms of the logistic model as the underlying probability function, and chose the one which better fit the data for use in the analyses.

In this study, price of an annual pass was used as the payment vehicle, i.e., "FEE" in the models mentioned above. The estimated model, either in standard or logarithmic form, whichever fit the data better, was used to calculate the economic value of forest recreation in McDonald Forest, in the form of users' willingness to pay for an annual pass. Specifically, with a given vector of personal characteristics **Z**, integrating the cumulative probability function ([4-3] or [4-4]) over the range of annual pass price of 0 to ∞ (dollars) would yield the mean annual willingness to pay of users having identical characteristics.

Summing up the mean annual willingness to pay values for the whole population or for any subpopulation of interest would then yield the total annual willingness to pay of the population, or the economic value for the given year. The estimated model also allowed the estimation of the demand curve for recreational opportunities in the forest. By summing up the estimated cumulative probability function ([4-3] or [4-4]) for the population of interest, a demand curve could be derived in the form of relationship between price of annual pass and the number of users who would purchase it at that price. Demand curves were then combined with the supply functions (estimated separately) to estimate the consequences of introducing an annual user fee system.

4.3 Explanatory Variables Other Than the Fee Level

Possible explanatory variables other than the fee level that could enter the above-mentioned models, i.e., variables in the vector **Z**, were identified as: frequency of use, percentage of use on weekends, years since the first visit, primary activity participated in the forest, distance traveled to the forest for each visit, number of family members accompanying them on their typical visit to the forest, age, sex, marital status, level of education completed, income, and whether an Oregon State University student or not. Whether charging a fee would have any discriminatory impact on a particular social group could be tested by hypothesizing that the coefficient on the relevant variable in the model is zero and examining the probability of that hypothesis being true. Even if coefficients on the variable of interest didn't have statistical significance, other variables could also suggest discriminatory impact if those variables had correlation with the variable in question.

The signs on the estimated coefficients of the variables listed above, if at all significant, were expected to be as follows (note that the model describes the probability of receiving "Yes" response):

(1) Frequency of use: Positive, because more frequent users would benefit more from using the forest.

(2) Percentage of use on weekends: No a priori expectation. On the one hand, this variable would have negative correlation with frequency of use, and thus might have negative sign if frequency of use was not present in the model. On the other hand, if the effect of frequency of use was removed, this variable might have positive sign because weekend users might tend to be willing to pay more as a premium for their non-daily experience in the forest.

(3) Years since the first visit: Positive, because the more familiar they are with the forest, the more they would be willing to pay for access to it.

(4) Primary activity participated: No a priori expectation. There was no prior information as to which activity group would be willing to pay more or less than others.

(5) Distance traveled: No a priori expectation. Like percentage of use on weekends, this variable would also have negative correlation with frequency of use because of increasing travel cost, and thus might have negative sign if frequency of use and/or percentage of use on weekends were not present in the model. Also, distant users might have more alternative sites to visit, and thus might have lower willingness to pay for accessing McDonald Forest than adjacent users would have. On the other hand, if the effect of frequency of use was accounted for, this variable might have a positive sign because of the same reason as in the case of percentage of use on weekends.

(6) Characteristics of a group in which the respondent would belong to when visiting the forest: Those who visit the forest typically with their family members were expected to have lower probability of purchasing a pass at a given price than those who visit alone or with others (e.g., friends, neighbors) because the more passes they had to purchase, the less likely it would be that they could afford them at a certain price. Thus, a negative sign was expected on the dummy variable corresponding to those who visit the forest with

family members. The number of family members they typically accompany to the forest was also expected to have a negative sign because of the same reason.

(7) Age, sex, and marital status: No a priori expectation. These variables could have significant correlation with some particular activities, or with income level and family size, and thus might have significance in the model. Nevertheless, there was no prior information about which direction these variables would affect the probability of receiving a "Yes" response.

(8) Level of education completed: No a priori expectation. This variable would have positive correlation with income, and thus might have positive sign. However, after accounting for the effect of income, there would be no reason to believe that more or less educated users would have more or less willingness to pay for accessing the forest.

(9) Income: Positive, because the more income they earn, the more they would be able to, and possibly willing to, pay.

(10) Whether an Oregon State University student or not: No a priori expectation. Like age, sex, and marital status, this variable could have correlation with some particular activities or attitude toward outdoor recreation, since they would generally have different income, time, or social constraints in their daily lives.

5. SURVEY PROCEDURES

The CVM survey questionnaire used in this study was included in the McDonald Forest Recreation Survey which was conducted mainly for another on-going study project that is seeking users' opinions on various aspects of forest recreation in McDonald Forest. Therefore, survey procedures such as sampling, coordination of the survey, and mailing were administered in cooperation with that study project, not solely by this study. This chapter will explain the CVM survey procedures used to collect the data for this study in detail.

5.1 Sampling

The sampling for the CVM survey in this study was carried out during the period of one full year from the summer in 1993 to the next summer in 1994. Actual sampling started on July 22, 1993, and finished on June 19, 1994. As a matter of fact, it initially started for the McDonald Forest Recreation Survey study[1] before this study was planned.

In this study, the primary interest was on how much an average user would be willing to pay for accessing the forest for a period of one year, or alternatively, how many users would purchase an annual pass at any given price. This meant that the population we should investigate was the recreational visitors to McDonald Forest, not the visits, and thus it was suggested that the sampling frame for this study should be based on visitors rather than visits.

Regardless of the sampling frame being used, it is usually recommended that a probability sampling method, where every sampling unit has an equal or calculable probability of being sampled, be used to draw samples in recreation site studies (Tourism

---

[1] Principle investigator is Michael Wing, Graduate Student, Department of Forest Resources, Oregon State University.

and Recreation Research Unit, 1983; Mitchell and Carson, 1989). In fact, probability sampling could not be used in this study nor in the McDonald Forest Recreation Survey study mentioned above since there was little prior information available about the population of McDonald Forest visitors and their visits. Therefore, an alternative method had to be used.

The actual sampling procedure used in this study was designed as follows:

(1) Four major access points to the forest were selected as the points for carrying out the sampling of the users. In fact, some minor access points were also selected initially. However, because of resource constraints and the inefficiency of sample collection at these minor access points, sampling was carried out on these minor access points only in the first summer and fall. This would have led to a conservative estimate of visitation to the forest but not to a total neglect of visitors via minor access points.

(2) The sampling period (a year) was divided into 4 seasons: summer (from June to Aug.), fall (Sept. to Nov.), winter (Dec. to Feb.), and spring (March to May). Days of each season were further divided into weekdays and weekends, and each day was divided into morning (8 AM to 2 PM) and afternoon (2 PM to 8 PM).

(3) For all sampling points, the dates for sampling were chosen randomly from each of the 16 groups of season-date-time combinations (4 [seasons] × 2 [weekdays/weekends] × 2 [morning/afternoon]). It would have been ideal to choose sampling dates so that the number of sampling days for the 16 groups would be proportional to the total number of days in those groups. However, the sampling was in fact carried out more often in summer and fall than in winter or spring and more often on weekends than on weekdays (in terms of proportion to the total number of days) because of the resource constraints, e.g., need of student workers, and the expected efficiency of sampling in summer and fall or on weekends.

(4) When sampling at the site, the time of entrance and exit, the activity participated in, and the group size were observed and recorded for every adult recreational user that

entered and/or exited the forest. The activities participated in were basically classified into 5 categories, i.e., hiking, biking, horseback riding, running, and dog walking, unless it was obvious that a user did not fall into these categories. In addition, the users were stopped when exiting the forest and were asked to answer a simple survey including a question asking them to provide their address so that an additional survey could be mailed later. All adult users (16 years old or older) were asked to do so individually, even if more than one adult were in a same group or a family. Some users could not be sampled either because they left the forest so quickly such as by bicycle that they could not be stopped, or because they refused to answer the survey.

(5) Of those who provided their address, out-of-Oregon residents were omitted from the mailing list. This was done partly because they would not have been familiar enough with the forest to appropriately respond to the survey, and partly because encountering an out-of-state visitor seemed to be a relatively rare and random event compared to encountering local users, so that it seemed reasonable to believe that they would not represent any population such as an "out-of-state users" population, at least not in the same manner that a local-user sample would represent the local-user population. Because many of the users in the sample were in fact sampled more than once on different sampling dates and/or at different sampling points, names and addresses in the sample were checked to make sure that the same person would not be mailed more than one survey.

After completing all the procedures described above, there were 1,152 names on the mailing list. These people represented the initial sample of this study. Some of the summary statistics about the users sighted during the sampling and the initial sample are summarized in Table-1 and Table-2, respectively.

The sampling in this study actually used the days within a given period of interest (i.e., a year) as the primary sampling frame, as explained above. Because this method did not allow equal probability of being sampled to every visitor, the sample was considered

Table-1. Summary of the Users Sighted During Sampling

	Number of Groups	Number of Users	Ave.Minutes Stayed[1]	Num.of Users Surveyed
All Users Sighted	2,127	3,547	64.8	1,668
(Hikers)	636	1,203	64.8	650
(Bikers)	814	1,305	71.3	487
(Horseback Riders)	76	109	84.8	46
(Joggers/Runners)	245	339	48.1	160
(Dog Walkers)	356	591	63.7	325

	Number of Users Sighted by Season[2]			
	Summer	Fall	Winter	Spring
All Users Sighted	1,230	1,112	120	1,085
(Hikers)	441	361	21	380
(Bikers)	441	391	26	447
(Horseback Riders)	43	30	15	21
(Joggers/Runners)	143	125	16	55
(Dog Walkers)	162	205	42	182
Total Number of Days[3] Sampled	29	26.5	7.5	19

Notes

1. Average minutes stayed in the forest were calculated only for those who entered and exited the forest at the sampling point within the sampling time. Therefore, time spent in the forest by those who entered earlier or exited later than the sampling time, and by those who entered or exited at other access points are not included in the calculation.
2. Summer, Fall, Winter, and Spring correspond to June to August, September to November, December to February, and March to May, respectively.
3. One day of sampling is equivalent to one full-day (12 hours) of sampling at one access point.

Table-2. Summary of the Initial Sample

Sample Size $n = 1,152$

Major Place of Mailing Address

Corvallis*	913	(79.3%)
Albany*	85	(7.4%)
Philomath*	35	(3.0%)
Monmouth**	15	(1.3%)
Lebanon**	8	(0.7%)
Salem***	26	(2.3%)
Eugene***	13	(1.1%)
Portland****	11	(1.0%)
Other	46	(4.0%)

Note: Asterisks (*) show typical distance from each town to the forest as follows.

*	up to 10 miles
**	15 to 20 miles
***	35 to 40 miles
****	80 to 90 miles

to have either over- or under-represented some subpopulations, such as low frequency users. The probability of each user being sampled was estimated using the information about each user's frequency of use in each season and percentage of use on weekends obtained through the mail survey, in order to estimate the true proportion of any given subpopulation. However, in theory, over- or under-representation of a particular subpopulation should not cause a bias in the model estimation itself because parameters estimated in terms of the odds ratio of the responses of interest will not be affected by the sampling probability of each subpopulation (Ramsey and Schafer, 1992).

5.2 Pretest

Before mailing the survey, a pretest was conducted in order to determine the appropriate range of dollar amounts to be offered as the price for an annual pass. Specifically, on the last two times of the on-site sampling, users were asked how much they would pay at most for an annual pass[2], in addition to being asked to answer the simple survey questions mentioned in the previous section.

37 users responded to the question, within which 35 people provided valid annual dollar amounts. 2 people answered that they would not pay because the forest should be funded by general funding such as through taxation, and were excluded from the sample as they were considered to be protest or strategic responses. The annual willingness to pay distribution of the population was estimated from the pretest data, assuming that those 35 respondents represented the population.

The annual willingness to pay showed a distribution close to a log-normal distribution but with fat tails in the higher end, and thus it was suggested that the log-logistic function would best describe the distribution of willingness to pay values. The annual willingness to pay data were converted into a dichotomous-choice format by assuming that each respondent would have answered "yes" to dollar amounts equal to or lower than his/her stated amount and "no" to the amounts higher than the stated one. Then, the logistic model was fit to the converted data to estimate the willingness to pay distribution function in a log-logistic form. The estimated distribution function and some of the summary statistics of the pretest data are shown in Table-3.

---

[2] In fact, willingness to pay amount for a daily pass was also asked because of the initial design of this study and the survey (see Appendix A. for the survey design). The survey question asked not only for the choice of purchasing an annual pass or not, but also for the choice among purchasing an annual pass, purchasing a daily pass, and purchasing neither. However, because of time constraints, results of the analyses only for the former question were available at the time of this writing, and therefore this paper reports only the results from annual fee analyses.

Table-3. Summary Statistics of the Pretest Data

Natural Logarithm of the Willingness-to-Pay **per Year** (in dollars)

$n = 35$
mean = 3.160 (corresponds to 23.6 dollars)
SD = 0.673
Minimum = 1.792 (corresponds to 6 dollars)
Maximum = 4.605 (corresponds to 100 dollars)
Skewness = 0.51
Kurtosis = 0.20

Estimated Model: $\text{Logit}(\pi) = ln(\pi/(1-\pi)) = 8.7274 - 2.6660\, ln(\text{FEE})$

(π is the probability of a person willing to pay more than FEE dollars.)

5.3 Questionnaire Design

When designing the questionnaire, the necessary data to be collected were identified and the actual wording and the order by which they would be asked were determined. Data to be collected included those corresponding to the explanatory variables discussed in the previous chapter and some supplemental data. Some of the key considerations given in designing the questionnaire included the following:

(1) At the beginning of the CVM question which was in the last part of the entire survey, a scenario explaining why recreational users had to be charged was given, including what the revenue from fees would be spent on. This intended to put respondents in as realistic a situation as possible, where they would feel that they had no other options than to pay if they wanted to continue using the forest. Also, when describing the payment vehicle which was either an annual or a daily pass, an existing similar recreational user fee

system, namely, Oregon Sno-Park permit system, was referred to in order to enhance the reality of the scenario as well as to make the scenario more understandable. Reality of the scenario is particularly important in motivating the respondents to reveal their true willingness to pay.

(2) The respondents were first asked whether they would buy an annual pass at a given price, a daily pass at a given price, or neither, and those who answered they would purchase a daily pass were further asked whether they would purchase an annual pass if a daily pass were not available. It was assumed that either choosing "buy annual pass" in the first question or choosing "Yes" in the second question was equivalent to answering "Yes" to a dichotomous-choice question which would have directly asked whether they would buy an annual pass or not.

(3) To those who answered "neither" in the first question, the reason was asked in order to distinguish valid "neither" responses, meaning that the respondent is really not willing to pay the specified dollar amounts, and protest "neither", meaning that the respondent could be willing to pay in fact, but is refusing to reveal his/her true willingness to pay. A list of some possible reasons was provided to the respondents, including "other reason" with a space provided for specifying it, and they were asked to choose any of them. In the final list of reasons provided in the survey question (see Appendix A), "Using the forest isn't worth that much to you", "You can't afford it", and "You would go to another place" were considered to be valid reasons, whereas "You don't think you should pay" was considered to be a protest reason. When designing this question, two basic considerations were given: whether or not to include "You don't think you should pay" in the list of reasons, and whether to ask respondents to choose only one of the reasons listed or any of them. For the former point, including "You don't think you should pay" in the list might have induced some additional respondents, who would have answered honestly without seeing that reason in the list, to provide a protest response, on the one hand. On the other hand, however, if that reason were not included in the list, some "protest"

respondents, finding it too time consuming to specify their reasons in the "other reason" category, might have chosen one of the "valid" reasons such as "You can't afford it" as a second-best choice. In order to obtain a reliable result, it seemed far more important to be able to identify protest responses even at the cost of inducing some additional protest responses, rather than overlooking some protest responses and judging them as "valid". Similarly, it seemed better to allow more than one choice because some "protest" responses could be identified as "valid" by doing so. For example, if a respondent chose both "You don't think you should pay" which is a protest reason and "You can't afford it" which is a valid reason at the same time, it could be interpreted as a valid response because he/she would not be willing to pay the specified amount anyway, regardless of whether he/she is protesting or not.

The final survey questions are shown in Appendix A. Some of the data such as demographic data were shared by this study and the McDonald Forest Recreation Survey study mentioned earlier.

5.4 Bid Design

Based on the willingness to pay distributions estimated through the pretest, the bid design, i.e., dollar amounts to be offered as the pass prices and the number of sample to be assigned to each amount, were determined.

5.4.1 Optimal Bid Design Models

As a method to achieve an optimal bid design which leads to an efficient use of a given sample size, Cooper (1993) proposed the Bid Distribution With Equal Area Bid Selection (DWEABS) model. In this model, for all possible numbers of different bid amounts, m (= 1, 2, ..., N), the expected willingness to pay distribution which is obtained through a pretest will be divided into m + 1 equal probability increments, and the willingness to pay amount corresponding to each of the m division points will be calculated. For each m, the expected mean squared error of the estimated mean willingness to pay, MSE (WTP), will be calculated under a given total sample size (N); i.e.,

$$\text{MSE}(WTP) = (\mathbf{WTP} - WTP)^2 + \text{var}(WTP) \qquad [5\text{-}1]$$

where

$$WTP = \sum_{i=1}^{m} \Delta b_i \, \pi_i$$

$$\text{var}(WTP) = \sum_{i=1}^{m} \Delta b_i^2 \, [\pi_i (1-\pi_i)] \, / \, n_i$$

$$n_i = \frac{N \, \Delta b_i \, [\pi_i (1-\pi_i)]^{1/2}}{\sum_{j=1}^{m} \Delta b_j \, [\pi_j (1-\pi_j)]^{1/2}}$$

$$\Delta b_i = (b_{i+1} - b_{i-1}) / 2 \qquad (\text{for } i = 2, 3, \ldots, m\text{-}1)$$

$$\Delta b_1 = (b_2 - b_1) / 2 \qquad \text{and} \qquad \Delta b_m = (b_m - b_{m-1}) / 2$$

$$\sum_{i=1}^{m} n_i = N$$

$$i, j = 1, 2, \ldots, m$$

Here, π_i (or π_j) is the probability of receiving a "yes" response for the i th (or j th) bid, b_i. **WTP** (in bold typeface) is the mean willingness to pay amount calculated by integrating the assumed cumulative probability function of willingness to pay through the range of dollar amounts = 0 to b_m, which would represent the "expected" value of true mean willingness to pay of the users that is not observable. By repeating the calculation for all possible m, i.e., 1 to N, the optimal m and n_i (i = 1, 2, ..., m) that minimize MSE (WTP) will be obtained.

In this study, a spreadsheet file which runs the iteration of the DWEABS model was constructed with a personal computer. However, the program did not reproduce the same result reported in Cooper (1993). This seemed to be partly because of different assumptions used due to insufficient data provided in Cooper (1993), and also because of some computational errors (e.g., rounding error) in the program. Nevertheless, the program seemed to provide a rough estimate for the appropriate range of m that would give the value of MSE (*WTP*) close to its minimum value. Therefore, the constructed program was used to determine the bid design in this study.

5.4.2 Bid Design Procedure

The program run for the annual pass price design showed that the MSE (*WTP*) converged to the minimum value as m increased, and slightly increased as m became close to N (=1,152). Also, it showed that the MSE (*WTP*) stayed very close to the minimum value around m = 400 to 700, suggesting that any m in this range would make little difference. Therefore, it was determined that m = 600 would be used for the bid design in this study.

After obtaining a bid design corresponding to N = 1,152 and m = 600 and examining it, it was decided that some major adjustments would be added to the original DWEABS method as follows:

(1) About 200 out of 1,152 total sample size were set aside for assigning to the lower dollar amounts. The DWEABS method was designed so that the bid dollar amounts, b_i, were chosen in equal probability increments, and the number of sample assigned to each dollar amount was determined as a function of the interval of the adjacent two dollar amounts, Δb_i. Since Δb_i would become extremely large at higher dollar amounts when logarithmic distribution was assumed, the DWEABS model assigns a significant portion of the sample to the high-end dollar amounts. In fact, an initial run of the program assigned more than half the sample size to the highest 20th percentile of the distribution, whereas only about one-fourth of the sample was assigned to the lower half of the

distribution. Because the correct estimation of the demand curve was important in this study in order to correctly estimate the consequences of a user fee system, it was felt that the number of bids assigned to lower dollar amounts should be raised from those obtained by the DWEABS method, especially in the region where actual pass price was likely to fall into.

(2) On the other hand, about 50 of the bids were set aside for assigning to the dollar amounts higher than the highest amount generated by the method. Because an open-ended question format was used in the pretest to preliminarily estimate the users' willingness to pay distribution, and since past studies showed that an open-ended format often resulted in low willingness to pay estimations (Bishop and Heberline, 1990), it was feared that the estimated distribution might have been biased to the lower direction. A small sample size (n=35) in the pretest could have exacerbated this because of its inability to capture users with high-end willingness to pay. Because the presence of few people with extremely high willingness to pay would significantly raise the estimated mean willingness to pay, setting the cut-off point of the bids too low could result in a significant underestimation of the economic value of forest recreation in McDonald Forest.

(3) The DWEABS model was applied to the remaining sample (about 900), and the optimal bid design was obtained. The dollar amounts obtained through the DWEABS program were rounded to integer amounts because attaching "cents" to the annual pass price seemed to be unrealistic.

(4) Then, the bids set aside earlier for the lower-end dollar amounts were assigned to dollar amounts below $50. Also, the bids set aside for the highest dollar amounts were assigned to 3 new dollar amounts, $350, $500, and $1,000, which were above the highest amount generated by the program, i.e., $291.

The final bid design included 109 different bid amounts ranging from $3 to $1,000 per year, corresponding to the probabilities of receiving a "yes" response of 99.698% and

0.006%, respectively, based on the cumulative probability function estimated through the pretest[3].

5.5 Mailing

The completed questionnaire was mailed to the sample in mid-September, 1994. The mailing included the questionnaire, a cover letter explaining the importance of responding, and a postage-paid return envelope. About two weeks later, a postcard was mailed to those who had not responded at that time, asking them to respond. Because the overall response rate was still below 50% after about 2 weeks after mailing the postcard, another questionnaire was sent with a new cover letter and a return envelope. In the second mailing, bid dollar amounts were assigned randomly from the bids that had not yet been replied to. Therefore, those who received the second mailing may have been quoted a different bid dollar amount than in the first mailing.

[3] Daily bid amounts ranged from $0.10 to $10.00 a day. The method used to design daily bid amounts will not be reported in this paper because it would not be relevant in this paper.

6. RESULTS

As mentioned in the first chapter, this study had two main objectives: (1) to measure the economic value of forest recreation in McDonald Forest, and (2) to estimate the consequences (e.g., revenue and costs) of charging a user fee in the forest, using the data obtained through procedures described in the previous chapter. This chapter will report the results of data collection and the analyses done on the data to achieve those objectives.

6.1 Summary of the Data

Of the 1,152 surveys mailed to the initial sample, 69 were undeliverable due to incorrect address or in many cases because the person had moved after being sampled at the site. Of 1,083 people who seemed to have received the survey (584 of which also received the second mailing[4]), 694 people returned their responses (529 and 165 people to the first and second mailings, respectively). Among them, 2 respondents turned out to be under 16 years old, and were omitted from the analyses. Also, responses included 11 having no answer to the entire survey and 6 having no answer to the CVM question. After removing 69 undeliverable surveys and 2 responses of under 16 years old from the calculation, the response rate to the CVM question was calculated to be 64.0% with 17 no-answer responses included and 62.4% without them.

Some of the major characteristics of the survey respondents including those who didn't answer the CVM question are summarized in Table-4. The median annual household income of respondents was in the "$40,000 to $49,999" group. Assuming that the respondents' household income concentrated on the midpoint of each income group

---

[4] These people include those who responded to the first mailing but the responses arrived after the second mailing was done.

Table-4. Characteristics of Respondents

Primary Activity	Variables (1)	(2)	(2a)	(2b)	(3)	(3a)	(3b)	(4)	(5)	(6)	(7)	(7a)	(7b)
# of Effective Response	681	677	--	--	671	--	--	665	661	671	632	--	--
Hiking	277	35.5	41.5	18.8	43.8	44.4	18.2	43.0	67.8	79.3	45,285	19.0	36.5
Biking	188	73.7	8.0	56.4	31.4	80.1	1.6	81.6	41.8	69.4	43,866	29.1	36.6
Horseback Riding	19	114.7	5.3	84.2	38.2	52.6	0.0	11.1	56.3	73.7	45,526	21.1	42.1
Running/Jogging	80	81.7	6.3	55.0	35.5	65.0	1.2	63.3	60.8	70.0	53,487	19.7	51.3
Dog Walking	59	60.9	15.3	40.7	37.0	66.7	3.5	24.6	53.6	92.9	44,182	14.5	41.8
Multiple Activities[1]	55	63.3	23.6	40.0	39.6	58.8	9.8	31.4	50.0	69.2	38,333	31.1	31.1
Not Known	3	28.0	0.0	0.0	36.0	66.7	0.0	66.7	0.0	50.0	45,000	50.0	50.0
Total or Average	681	58.3	23.2	39.0	38.3	60.1	9.1	52.9	56.6	75.6	45,301	22.5	38.6

Variables:
(1) Number of respondents
(2) Estimated average frequency of visitation (times / year)[2]
(2a) Percentage of respondents with frequency of visitation of 6 times / year (equivalent to once every other month) or less
(2b) Percentage of respondents with frequency of visitation of 52 times / year (equivalent to once every week) or greater
(3) Average age
(3a) Percentage of respondents under 40 years old
(3b) Percentage of respondents of 60 years old or older
(4) Percentage of male respondents
(5) Percentage of married respondents
(6) Percentage of respondents completed bachelor's or higher education
(7) Estimated average annual household income ($ / year)[2]
(7a) Percentage of respondents with annual household income of less than $20,000
(7b) Percentage of respondents with annual household income of $50,000 or greater

Notes
1. "Multiple activities" refers to those who answered more than one activity as their primary activities.
2. For the assumptions made to estimate average frequency of visitation and average household income, see text sections 6.3 and 6.4.

and assuming $130,000 for the "more than $100,000" group, the mean household income of the respondents was calculated to be approximately $45,300. These median and mean income amounts were significantly higher than the median annual family income in Benton and Linn counties ($35,559 and $29,421, respectively, as of 1989; State of Oregon, 1993) where most of the respondents reside. Respondents typically visit McDonald Forest alone (35%), with family members (39%), and with others (e.g., friends, neighbors, colleagues)(35%)[5].

Among 675 respondents who answered the CVM question asking them to choose from purchasing an annual pass, purchasing a daily pass, or purchasing neither, 202, 177, and 296 chose each respectively. Because "purchase neither" responses included 86 "protest" responses (which will be discussed in the next section), the "valid" number of respondents who were considered to have answered the CVM question was 589, within which 202 (34%), 177 (30%), and 210 (36%) chose the respective three choices mentioned above. Of the 177 respondents who chose purchasing a daily pass, 27 answered that they would purchase an annual pass if a daily pass were not available, whereas 147 answered that they wouldn't, and 3 did not answer. Therefore, the "valid" number of respondents who were considered to have answered the annual pass dichotomous-choice CVM question was 586, within which 229 (39%) answered "yes" and 357 (61%) answered "no".

6.2 Protest Responses

Protest responses are responses made by those who did not accept the scenario posed in the survey, i.e., "having to pay for forest recreation". According to Mitchell and Carson (1989), although CVM survey respondents may be motivated either to understate

---

[5] Percentages do not add up to 100% because some respondents chose more than one of these three choices.

their true willingness to pay or to overpledge them, such a "strategic" behavior is less likely to affect the answers in a dichotomous-choice format question. Nevertheless, some respondents may refuse to "play the game" providing a "no" (or "neither" in this study) response which should be distinguished from true "no" responses and removed from the analysis.

In this study, most of the respondents seemed to have "played the game" with taking the scenario provided in the survey (i.e., "the recreation in McDonald Forest would have to be cut back if another revenue source, possibly a user fee system, were not found") seriously and feeling that their honest responses would count. Even under such a situation, however, some respondents seemed to have refused to accept the scenario answering that they would buy neither an annual nor daily pass. To distinguish protest "neither" from valid "neither" responses, the reasons for choosing "neither" were examined. As explained in the previous chapter, "Using the forest isn't worth that much to you", "You can't afford it", and "You would go to another place" were considered to be valid reasons, whereas "You don't think you should pay" was considered to be a protest reason. Reasons specified in the "other reason" category were examined and judged whether to be a protest reason or a valid "no" on a case-by-case basis. Those specified reasons could be roughly categorized into several groups of similar reasons as shown in Table-5. The judgement made as to whether each of those categories of reasons was protest or valid is also provided in the same table.

6.3 Other Data Management Issues

Besides the problem of protest responses, some data management issues that required manipulation of data before proceeding to the model estimation arose. Major ones were as follows:

Table-5. Criteria for Distinguishing Protest and Valid "No" Responses

Category	Major Stated Reasons	Protest/ Valid	Interpretation
1	- "I would rather volunteer"	P	protest against the fee system in fact willing to contribute something
2	- "I would not use if charged" - "I use because it's free"	V	their use not worth the quoted price
3	- "Why should I pay for something already free?" - "Why should I pay?"	P	free-riding attitude protest against the system
4	- "Community should pay" - "University should pay" - "Should be funded by taxation"	P	free-riding attitude protest against the system
5	- "It's public land" - "The forest isn't for fund-raising" - "OSU need not profit"	P	free-riding attitude protest against the system
6	- "Payment should be voluntary" - "I wouldn't pay if forced to"	P	protest against the system
7	- "Management should be minimized" - "I don't need signs, brochures, and good trails" - "I don't agree with the current management"	P	protest against the system
8	- "I only use lightly"	V	their use not worth the quoted price
9	- "It's not enforceable" - "Others wouldn't pay"	P	free-riding attitude
10	- " I would use without paying"	P	free-riding attitude
11	- "Fee is not fair" - "Low income people should not be excluded"	P	protest against the system
12	- "Price is too high" - "I would pay if price was $ ..."	V	either can't afford or their use not worth the quoted price

P: Protest Response; V: Valid "No" Response

(1) In the survey, frequency of visitation was asked in categorical format, i.e., "More than once a week", "About once a week", "About once every other week", "About once a month", "Less than once a month", "Once a season", and "Don't go", for each season. From the choices made by respondents, frequency of annual visitation was estimated. Specifically, categories other than "More than once a week" could be transformed into exact number of visits per season; for example, "About once a month" could be transformed into 3 times a season. For the "More than once a week" category, it was assumed that a typical frequency of use per week would be 3 times, and therefore the frequency of use per season was estimated to be approximately 39 times (3 times / week × 13 weeks / season). This transformation meant that the maximum frequency of visitation per year was 156 times, although there must have been some respondents who visited more frequently. Nevertheless, the estimated frequency of annual visitation was used in the model estimation because there was no further information to correct the assumption (i.e., 3 times / week), and also because changing the assumption did not seem to significantly affect the model estimation especially when the frequency of annual use was transformed into logarithmic scale.

(2) In the survey, respondents were asked to choose only one primary activity. However, many respondents chose more than one. In Table-4 which summarizes the characteristics of respondents, those respondents are expressed as "Multiple Activities". In model estimation, however, creating a multiple activities category seemed to be inappropriate since it contained various combinations of activities. On the other hand, excluding the responses with multiple choice on the primary activity meant losing about 50 responses from the sample. Therefore, in the model estimation, a response which contained more than one activity was duplicated for the number of activities chosen, assigned each of the activities chosen, and attached weights that summed up to one. Each of the duplicated responses was assigned characteristics (e.g., age, sex, and income) identical to the original response except for the activity.

(3) The distance traveled to the forest was based on stated distance in the survey. Some respondents stated more than one distance, noting that it depends on which access point they use. In such a case, an average of those distances was taken to make a single value. Also, some respondents did not answer this question. In such a case, the distance from its mailing address to the nearest major access point of the forest was estimated on a map. Only in one case it was not possible to estimate the distance because the respondent used a P.O. box.

(4) Some respondents to the CVM question answered "maybe" they would purchase. These cases were interpreted as "not purchase" in order to obtain conservative model estimation.

6.4 Model Estimation

Logit models specified in chapter 4 were fitted to the data. In order to perform logistic regression analyses, the "CATMOD" procedure in SAS software on an IBM compatible personal computer was used. As explained in chapter 4, both standard and logarithmic models were tried. The choice of final model from each of the standard and logarithmic models was based on some of the statistics including significance of individual coefficients, likelihood ratio chi-square statistics and its significance at its degrees of freedom, and percentage of correct predictions. The final choice between standard and logarithmic models was based also on graphical output of cumulative probability curves in order to see the overall fit of cumulative probability curves to the actually observed probabilities.

In addition to the original formats of data collected through the survey and those created by some data manipulation described in the previous section, data were transformed to create additional variables for the analyses as follows:

(1) The "Primary activity" variable was initially in a categorical format with 5 levels: hiking, biking, horseback riding, running, and dog walking. However, in the course of model estimation, only the "hiking" dummy variable showed some significance throughout the analysis, suggesting a lower probability of receiving "Yes" from hikers than from other activity participants. Therefore, the other four activities were combined together to make one category in the analysis.

(2) Among 11 household income levels ranging from "less than $10,000 per year" to "more than $100,000 per year" in $10,000 increments, "$10,000 to $19,999 per year" level consistently showed a significantly lower probability of "Yes" responses compared to the reference level, which was "more than $100,000" level. Surprisingly, the lowest income level, i.e., "less than $10,000 per year", consistently showed insignificant difference compared with the reference level. Some of the levels above $20,000 per year showed significantly lower probability of "Yes" response, whereas some levels showed significantly higher probability. However, the magnitude of estimated coefficients in all of those cases were not as large as that of the "$10,000 to $19,999" level. This inconsistent tendency in above $20,000 levels seemed to be because of making too many income levels causing "overfitting" of the model. Therefore, it was decided that the two lowest income levels and remaining 9 levels be combined together to make only two income levels, and this 2-level variable was used instead of the original income variable. In addition, the midpoint of each income level, such as $15,000 for the "$10,000 to $19,999" level, and $130,000 for the "more than $100,000" level, were used to create a continuous income variable.

(3) The "percentage of use on weekends" variable was also initially in categorical format with 6 levels: "Always (100%)", "Usually (75-99%)", "Often (50-74%)", "Sometimes (25-49%)", "Rarely (1-24%)", and "Never (0%)". A continuous variable was created from this original variable by taking midpoints of the 6 levels, i.e., 100%, 87%, 62%, 37%, 13%, and 0%.

(4) Some continuous variables were transformed into logarithmic forms. Specifically, "frequency of annual visits", "years since first visit", "distance traveled", and "income" variables were transformed into natural logarithms. For the "distance traveled" variable, values less than 0.5 mile, including many zeros collected from neighbors living adjacent to the forest, were modified to 0.5 miles in order to make them transformable.

(5) As for the characteristics of groups in which respondents would belong in a typical visit to the forest, dummy variables were created for those who visit alone, with family members, and with others (e.g., friends). Two variables, the total number of adults in a group and total group size including children, were also used. Group size for those who visit with others was set to 1 because it was intended to show the number of passes that had to be purchased by the same household.

In the course of model estimation, some general demographic variables such as age, sex, marital status, education level, and whether an O.S.U. student or not consistently showed low statistical significance, p-values being greater than 0.15. On the other hand, three variables, i.e., annual pass price, income level, and frequency of annual visitation, consistently showed high significance, p-values being 0.05 or smaller, both in standard or logarithmic forms. Other variables such as years since first visit, primary activity, distance traveled, and the characteristics and size of visitation group had significance when included in the model only with annual pass price, but generally lost significance as income and frequency came into the model, or when used with other variables. On the other hand, percentage of use on weekends did not have significance when used only with annual pass price, but gained significance when included in the model with some other significant variables such as frequency of annual visitation.

Final models for the probability of receiving a "Yes" response to the dichotomous-choice question, i.e., whether to purchase an annual pass or not, were estimated as shown in Table-6. It turned out that both final models, standard and logarithmic ones, contained exactly the same explanatory variables except the price of an annual pass was in different

Table-6. Model Estimation Results

	Standard Model		Logarithmic Model	
Coefficients	Estimate	SE	Estimate	SE
Intercept	-2.312****	0.551	1.448***	0.680
AFEE	-0.0226****	0.0026	-	-
LNAFEE	-	-	-1.404****	0.137
LNFQAV	0.758****	0.112	0.788****	0.117
PWKED	0.0087**	0.0045	0.0087**	0.0046
INCLOW	-0.320***	0.137	-0.340***	0.142
HIKE	-0.179*	0.124	-0.222**	0.128
Likelihood Ratio (LR)	490.86		474.40	
(d.f.)	556		556	
$p(\chi^2 > \text{LR})$	0.995		0.978	
% of Correct Prediction	78.7%		79.3%	
# of Responses Used	540		540	
# of Yes Responses	213		213	

Notes:

1. Variable names denote for followings:

AFEE	Annual pass price (dollars)
LNAFEE	Natural logarithm of annual pass price
LNFQAV	Natural logarithm of frequency of annual visits
PWKED	Percentage of use on weekends
INCLOW	Dummy variable for household income <$20,000
HIKE	Dummy variable for hikers

2. Asterisks (*) on estimated coefficients show the probabilities of chi-square (χ^2) statistics being greater than those in the estimated model as follows:

*	$0.10 < p \leq 0.15$
**	$0.05 < p \leq 0.10$
***	$0.01 < p \leq 0.05$
****	$p \leq 0.01$

3. The reason why degrees of freedom (d.f.) for likelihood ratio exceeds the total number of responses is that "multiple activity" responses were duplicated for the number of activities and attached weights that summed up to one. (See text section 6.3)

forms, although the estimated coefficient for the hikers dummy variable had only suggestive significance, p-value being between 0.05 and 0.15, in both models. Estimated coefficients on variables with prior expectations as to their signs, i.e., annual pass price, frequency of annual use, and income variables, all had signs as expected. None of the other variables showed significance when added to those final models. Although adding other variables slightly improved the percentage of correct prediction in some cases, it did not seem to be worth doing so because it made some variables less significant, possibly because of multicollinearity, and made it difficult to interpret the model.

From the estimated models, the average cumulative probability function, F_R, for the respondents could be derived as:

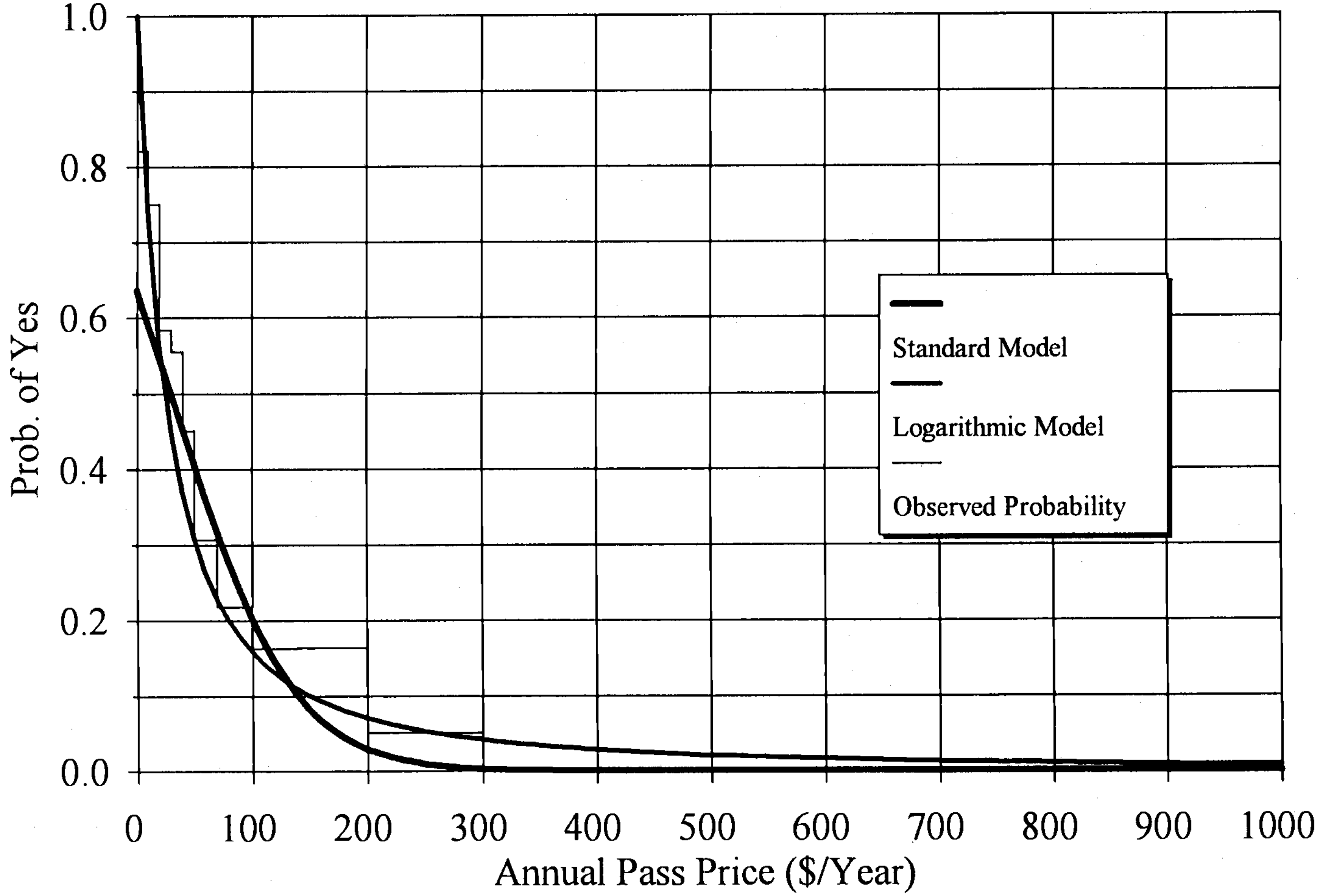
$$F_R = (\sum_{r \in R} F_r) / n \qquad [6\text{-}1]$$

where F_r denotes the individual cumulative probability function (i.e., [4-3] or [4-4]) for respondent r, n denotes the number of respondents, and R labels the collective of respondents (Adams et al., 1989). Average cumulative probability curves derived from the final models are shown in Figure-1, with the observed probability of "Yes" responses also plotted. Graphically comparing the two curves, it was determined that the logarithmic model would be chosen as the final model used for further analyses because of the following reasons:

(1) The standard cumulative probability curve did not converge to 1 at the annual pass price of $0 as a matter of course, and it showed a large departure from the actually observed probability of "Yes" responses around the annual pass price range of $0 to $20. This seemed to cause significant error in estimating the consequences of charging a fee, especially a fee based on marginal cost, because such a price was expected to be close to zero.

(2) Although the logarithmic cumulative probability curve showed a thick tail in the high-end of annual pass prices over $300 despite the fact that no respondents answered "Yes"

Figure-1. Average Cumulative Probability Curves of Respondents



Note: Observed probability shows the proportion of "Yes" responses within corresponding ranges.

to annual pass prices above $225, overestimation of mean willingness to pay caused by it could be partly mitigated by censoring the cumulative probability curve at $291, at and above which no respondents answered "Yes".

6.5 Population Estimation

Public goods typically generate external benefits to a broad population regardless of its individual members' intent of receiving them. This nature of public goods makes it difficult to define the population, i.e., who benefits and who bears the cost, in CVM studies. On the contrary, there was little ambiguity in this study as to what should be defined as the population of interest. Benefits from forest recreation in McDonald Forest would primarily accrue to direct users. Considering the fact that the current provision of forest recreation opportunities in McDonald Forest is basically funded by timber sales and that virtually no tax dollars are spent on it, those direct users would also be the primary cost-bearers once a user fee system was introduced. In this study, the population of interest was defined as the recreational users of McDonald Forest who visited the forest at least once during a period of one year from June 20, 1993 to June 19, 1994. This population seemed to adequately correspond to the current population of direct users of McDonald Forest, although those two populations would not be exactly equal.

As mentioned in the previous chapter, the initial sample in this study, i.e., those who provided their address at the site, did not correctly represent the population, meaning that the mean willingness to pay of the sample could not be assumed to be equal to the mean willingness to pay of the population. This was attributed to the sampling procedure and survey execution which involved several stages of "extracting" users from a broader population in a biased way. For example, a sample of users was extracted at the site from a population of users who actually visited the forest on sampling days. In this instance, the extracted sample might have not correctly represented the population of users who visited on sampling days if some particular group of users tended to be missed more than others.

If the objectives of this study were only to estimate the model described in chapter 4 and to estimate mean willingness to pay for each subpopulation separately, estimation of overall population size and proportion of subpopulations would not have been necessary. However, because the major interest of this study included estimating the overall mean willingness to pay of the population, the number of users who would be excluded from the site due to fees, or the revenue and cost associated with fees, estimation of the population was necessary in this study.

Starting from respondents to the mail survey who provided needed data for the explanatory variables in the final logit model, the population of previous stages of "extraction" were estimated stage by stage to finally obtain the base population[6] estimation. Table-7 shows the hierarchy of such stages of "extraction" that were present in this study. At each stage, each respondent was assigned a weight which corresponded to how well, in relative terms, that respondent represented the broader population. For example, if a respondent was assigned a weight of 1 and another respondent was assigned a 2, then the latter respondent was considered to have represented twice as large a population than the former (greater weight showed more underrepresentation). One thing to be noted here is that the respondents on which weights were assigned were those whose probability of "Yes" response could be calculated by the final model, i.e., those who provided all needed information corresponding to the explanatory variables (no missing values). These respondents could include those who provided protest responses or those who did not answer the CVM question, as long as they gave all data for the

[6] The term "base population" will hereinafter describe the population of recreational users who visited McDonald Forest at least once during the sampling period, which was the population of primary interest in this study. This term was used in order to distinguish it from an "intermediate" population from which a sample was extracted at any given stage.

Table-7. Stages of Sample Extraction and Population Estimation

---

Base Population: Users who visited the forest at least once during the one-year period of June 22, 1993 through June 19, 1994.

↓ ↑ Fourth Stage

Sighted Users: Users who actually visited the forest during the sampling days via the access point where sampling was carried out. They are assumed to have been sighted at the site.

↓ ↑ Third Stage

Initial Sample: Users who responded to the on-site survey and provided an address. (Except out of state users.) (1,152 users)

↓ ↑ Second Stage

Survey Respondents: Those who responded to the mail survey. (692 users)

↓ ↑ First Stage

Respondents who provided all needed data for explanatory variables in the final model. (623 users)

Note: ↓ shows the direction of sample extraction that was present in this study and ↑ shows the direction of population estimation.

---

explanatory variables in the final model. Six hundred twenty three responses fell into this category.

By multiplying the weights attached at all stages, how well, in relative terms, each respondent represented the base population could be known. Also, by summing up the weights assigned to all respondents having common characteristics that are of interest and comparing with the total of weights for all respondents, the proportion of any subpopulation of interest could be known. For example, by summing up the weights assigned to hikers among the respondents and comparing it with the total weights, the "true" proportion of hikers within the base population could be estimated, which might be different from the proportion of hikers among the respondents. Proportion of visitation made by any subpopulation could be estimated in a similar way, by summing up the weighted frequency of visitation for all respondents who would fall into that subpopulation.

On the other hand, from the observation done at the site on sampling days, total visitation made by the base population could be estimated. By multiplying the weights by the ratio of this estimated total visitation to the sum of weighted frequency of visitation, size of the population or of any subpopulation could be finally estimated.

The actual estimation procedure was as explained below.

6.5.1 Weights for First Stage: Respondents Who Provided All Needed Data for Explanatory Variables to All Survey Respondents

Respondents whose responses were used in the final model estimation were those who provided both (1) a valid response to the CVM question and (2) responses for all explanatory variables. Among the total of 692 respondents to the survey, 586 respondents fulfilled the first condition, 623 respondents fulfilled the second, and 540 respondents fulfilled both. Although the number of respondents whose responses were used in the final model estimation was 540, population estimation could be started from 623 respondents who fulfilled the second condition mentioned above but not necessarily the first one, because the value of logits (i.e., left-hand side of [4-2]) could be calculated for those 623 respondents, making it possible to make inferences from those 623 respondents instead of 540. If the underlying population size was fixed, inference made from a larger sample would be more reliable than that made from a smaller sample. However, in order for it to be legitimate, the characteristics of those 623 respondents must have been identical to those 540 respondents.

To see whether there were any differences between those two groups of respondents, they were compared in terms of the four explanatory variables included in the final model. For continuous variables, i.e., LNFQAV (natural logarithm of frequency of annual visitation) and PWKED (percentage of use on weekends), means were compared. For categorical variables, i.e., INCLOW (dummy variable for household income less than $20,000 per year) and HIKE (dummy variable for hikers), Fisher's exact test was performed.

Fisher's exact test examines how the difference in a given two sample proportions differ from what could be expected from a randomized distribution of those proportions (Ramsey and Schafer, 1992). For example, the difference in the proportions of respondents who have INCLOW value of 1 and 2 among 540 respondents mentioned above should be roughly identical to those among 623 respondents, if the 540 respondents were a random sample drawn from the 623 respondents. The smaller the p-value from this test is, the more unlikely that the given sample proportions were the result of "chance," indicating that the sample was not drawn randomly. Although there are several equivalent methods to test such sample proportions, and although there is very little difference between those methods, Fisher's exact test has some advantages over other methods; e.g., it provides exact, not model-based, p-values, and it is appropriate for any sample size (Ramsey and Schafer, 1992). In this analysis, a 2-sided p-value was relevant because the direction in which the sample proportions differed was not the question of interest.

The differences in the means for the two continuous variables, LNFQAV and PWKED, showed p-values of 0.95 and 0.93, respectively. Fisher's exact test for the two categorical variables, INCLOW and HIKE, showed 2-sided p-values of greater than 0.99 and 0.81, respectively. Considering these four p-values, it could be concluded that the 540 respondents and 623 respondents mentioned above were identical in terms of their characteristics, and therefore, starting the population estimation from 623 respondents was concluded to be legitimate.

In order to calculate the weights to be assigned to respondents who fulfilled the second condition mentioned above (i.e., 623 respondents), whether those 623 respondents were identical to the group of all respondents (i.e., 692 respondents) or not was examined with exactly the same methods used above. As a result, the differences in the means for LNFQAV and PWKED showed p-values of 0.70 and 0.74, respectively, and the 2-sided p-values from the Fisher's exact test for INCLOW and HIKE were both greater than 0.99. From this result, it was concluded that 623 respondents and 692 respondents mentioned above were identical in terms of their characteristics. Therefore, each of the 623 respondents was assigned an equal weight at this stage. Although the weight could be any number as long as an equal number was assigned to all respondents, the actual weight assigned was calculated as 1.111, which was the ratio of 692, the total number of respondents, to 623, the number of respondents who provided all needed data for explanatory variables.

6.5.2 Weights for Second Stage: Survey Respondents to Initial Sample

Among the initial sample size of 1,150 (2 respondents of under 16 years old mentioned earlier were subtracted from the original sample size of 1,152), 458 people did not respond to the survey in any way, including those who could not do so because of undelivered mail.

In order to see how respondents and nonrespondents differed, similar tests as described in the previous section were performed between respondents to the first mailing and those to the second one. The rationale for comparing those two groups was that it seemed reasonable to think that the respondents to the second mailings were closer to nonrespondents than those who responded to the first mailings, and therefore, it seemed that the difference between respondents to the first and second mailings could be used as a clue to estimate the difference between respondents and nonrespondents.

As a result of those tests, only LNFQAV and PWKED showed significant difference between the two groups (p = 0.0001 and 0.004, respectively). However, the magnitude of difference in PWKED was very small (i.e., second mail respondents had 7.2% higher percentage of use on weekends). Thus, it was concluded that the weights assigned to respondents at this stage could be based solely on the frequency of use.

To determine the weights to be assigned, respondents were first divided into three groups: those with frequency of annual visitation of 20 times per year or greater, those with 9 to 19 times per year, and those with frequency of 8 times per year or smaller. Although this classification was somewhat arbitrary, it was based on the calculation that, roughly speaking, those who visited 20 times per year or more would in fact have had a probability of being sighted at the site of close to 1, whereas those who visited 8 times or less would have had a probability of being sighted of less than 0.5. (Details of the calculation will be discussed later where the base population of users will be estimated from the users who visited the site on sampling days.)

Then, the proportions of respondents in these three groups were calculated for the first and second mailing respondents. The proportion of respondents with a frequency of visitation of up to 8 times per year, 9 to 19 times, and 20 times or more were 15.0%, 17.5%, and 67.6%, respectively, for the first mailing respondents, and 24.2%, 25.5%, and 50.3% for the second mailing respondents. This clearly showed that the proportion of respondents in the lower two categories increased whereas that of the highest one decreased between the two mailings. From this information, two alternative assumptions were made about the proportion of users in each of these three categories for nonrespondents: one assumption was that the proportions were identical between second mailing respondents and nonrespondents, and another was that the change in proportion between first and second mailing respondents would also hold between second mailing respondents and nonrespondents, i.e., nonrespondents would have proportions of 33%, 34%, and 33%, respectively, although this was quite an arbitrary assumption. It seemed reasonable to expect that the first assumption would overestimate the number of more frequent users compared with less frequent users.

These two assumptions lead to the following weights to be assigned to the respondents: from the first assumption, 2.272, 2.054, and 1.675 for the respective three categories, and from the second assumption, 2.670, 2.374, and 1.477, respectively.

6.5.3 Weights for Third Stage: Initial Sample to Users Sighted During Sampling

As explained in chapter 5, the initial sample of the survey was drawn from the users who were sighted at the site during the sampling. Among the total of 3,547 adult users sighted either their entering or exiting the forest or both, 2,361 users were sighted exiting from the forest and therefore could have been sampled. However, only 1,668 users responded to the on-site survey whereas the remaining 693 users either refused or left the forest so quickly that it was not possible to ask them to respond. Response rates to the on-site survey by hikers, bikers, horseback riders, runners, and dog walkers were 69.3%, 73.4%, 66.9%, 66.7%, and 72.9%, respectively, which seemed to be not significantly different between activities. Those 693 users must have included many users who were in fact sampled at some other site on another sampling date. Therefore, the "effective" on-site sampling rate seemed to be higher than those figures.

It was concluded that all respondents would be assigned equal weight of 1 at this stage, because (1) it could be estimated that the effective sampling rate was very high, (2) there was a small difference in sampling rates between different activity participants, and (3) there was no further information to conclude whether any particular group of users were more likely to have been missed or not.

6.5.4 Weights for Fourth Stage: Sighted Users to Base Population of Users

As a matter of course, users who did not visit the forest during the sampling could not be sighted in any way. This means that respondents with less frequency of visitation represented a larger population than those with a larger frequency of visitation, because less frequency of visitation would mean smaller chance of visiting the forest on a sampling day. The weight to be assigned to each respondent in order to adjust for this distortion would be the inverse of the probability of he/she being sighted, because if n users with a probability of being sighted p were actually sighted, the maximum likely size of population sharing that same probability would equal n / p.

The survey asked respondents to provide their frequency of use for each season, and also asked the percentage of use on weekends. Therefore, the probability of each respondent being sighted at the site could be calculated separately for each season, and also separately for weekdays and weekends. In the actual calculation, probability of **not** sighting a user was first calculated for all of those season-weekend/weekday combinations. Then, the probability of **not** sighting a user during the whole sampling period (i.e., one year) was calculated as the product of all such probabilities. Finally, subtracting the probability of **not** sighting from 1 and taking the inverse yielded the weight to be assigned to each respondent.

Probability of **not** sighting a certain user during any sampling period D would be primarily calculated as:

$$\begin{aligned}\overline{p} &= 1 - p \\ &= {}_{D-f}C_d \;/\; {}_{D}C_d \\ &= \{(D-f)! \,/\, (D-f-d)!\} / \{D! \,/\, (D-d)!\} \\ &= \{(D-f)!\,(D-d)!\} / \{(D-f-d)!\, D!\} \qquad [6\text{-}2]\end{aligned}$$

where d denotes the number of days sampled during the period, and f denotes the user's frequency of visitation during the period. This probability is equivalent to the probability of drawing no red balls when d balls are randomly drawn from the original population of D balls within which f are red balls and D - f are white balls. (In this instance, red balls correspond to the days when a user visited the forest, and white balls correspond to the days he/she didn't.) For extremely frequent users whose frequency of visitation f exceeds D - d, i.e., when $f + d > D$, the probability of sighting such a user would be 1, such as in the case of a user who visited the forest every single day.

Alternatively, when d is relatively small compared with D, [6-2] can be approximated by:

$$\bar{p} = 1 - p$$
$$= \{(D - f)/D\}^{d} \qquad [6\text{-}3]$$

When actually calculating the probability of not sighting each user, [6-3] was used instead of [6-2] because d seemed to be small compared with D, and also because d was not necessarily an integer value in some cases in this study. This occurred because the number of days sampled was not necessarily equal across all access points, and therefore those numbers had to be averaged. For example, when sampling was carried out for 3 days at 3 of the 4 access points and 4 days for another access point, the average days of sampling for all 4 access points was calculated to be 3.25 days (= (3×3+4)÷4). Since [6-2] assumes D, f, and d to be all integer values, such cases required using [6-3].

6.5.5 Result of Population Estimation

In order to conclude the population estimation, total visitation made by the base population of users was estimated from the observation done at the site on sampling days. For each season, separately for weekdays and weekends, sighted number of users were multiplied by the factor calculated by dividing the total number of days by the number of days sampled, i.e., the "true" number of days which would have been necessary if an equivalent sampling were carried out at all access points on same days.

On the other hand, for each respondent, weights calculated at all stages were multiplied together to obtain the overall weight. Figure-2 shows the calculated weights plotted against the frequency of annual visitation. This figure shows that a respondent whose frequency of visitation to the forest was only once in a year has in fact represented more than 30 users in the population, whereas a respondent who visited more than 50 times per year has actually represented only around 1.5 users in the population.

Then, the weighted sum of visitation frequencies of respondents were calculated, i.e.,

$$\text{Weighted Sum of Freq.} = \sum_{r \in R} w_r f_r \qquad [6\text{-}4]$$

where w_r denotes the overall weight assigned to respondent r, i.e., product of weights assigned at all stages, and f_r denotes the frequency of annual visitation of respondent r. Weights calculated in all stages except for the third stage did in fact take into account not only the relative size of subpopulations in the population, but also the absolute size of them. In the third stage of weight calculation, the calculated weight, which was 1 for all respondents, did not reflect the possibility of some users having been missed. However, as explained, it was expected that the effective on-site sampling rate was very high, even close to 1. Therefore, the weighted sum of visitation frequency of respondents ([6-4]) was expected to be roughly equal to the estimated total visitation.

Table-8 shows the estimated visitation by the base population. Because of insufficient sampling information on the visitation via minor access points, this table includes visitations only via 4 major access points. As can be seen in the table, the estimated total visitation of the base population via major access points was approximately 57 thousand. On the other hand, Table-9 shows the weighted sum of

Figure-2. Weights Assigned to Respondents

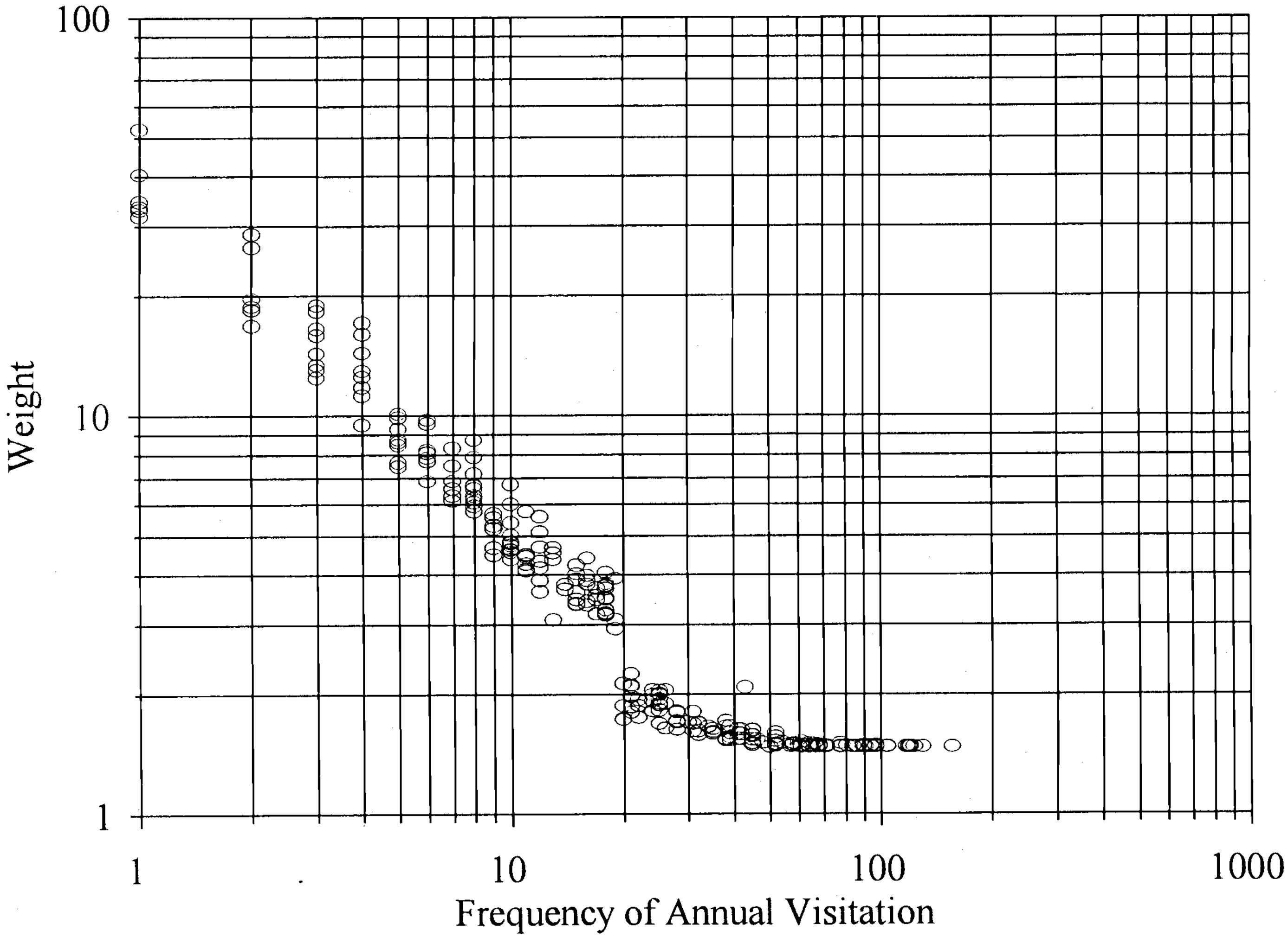


Table-8. Estimated Visitation via 4 Major Access Points

Season	Hikers	Bikers	Horseback Riders	Runners	Dog Walkers	Total	# of Days
Spring	6,840	8,360	380	1,090	3,390	20,060	92
(Weekdays)	3,290	4,250	170	730	1,860	10,300	66
(Weekends)	3,550	4,120	210	360	1,530	9,760	26
Summer	5,790	6,330	610	2,200	2,160	17,090	92
(Weekdays)	2,240	3,750	400	1,430	990	8,810	65
(Weekends)	3,550	2,590	210	770	1,170	8,280	27
Fall	4,840	4,860	350	1,700	2,740	14,500	91
(Weekdays)	2,300	2,170	190	990	1,220	6,860	65
(Weekends)	2,540	2,690	160	720	1,530	7,640	26
Winter	990	1,250	550	820	1,820	5,430	90
(Weekdays)	680	790	100	680	920	3,170	64
(Weekends)	310	450	450	140	900	2,250	26
Total	18,470	20,800	1,890	5,810	10,110	57,070	365
(Weekdays)	8,510	10,960	860	3,830	4,990	29,140	260
(Weekends)	9,950	9,850	1,030	1,980	5,130	27,930	105

Note: Numbers may not add up to total because of roundings. (Numbers are rounded to 10's.)

visitation frequency of respondents under two assumptions made in the second stage of weight calculation. As shown in the table, it was approximately 63 thousand to 69 thousand depending on the assumption. Considering that the estimated visitation of 57 thousand included only those via major access points and that the first assumption made in the second stage of weight calculation was expected to result in an overestimation of visitation, the second assumption seemed to give a fair estimation on the number of visits.

Table-9. Weighted Sum of Visitation Frequency of Respondents

Assumption	Hikers	Bikers	Horseback Riders	Runners	Dog Walkers	Total
1	21,924	22,981	3,774	12,083	8,176	68,938
2	21,291	20,711	3,344	10,781	7,467	63,594

The total number of visits to the forest was thus roughly estimated to be somewhere around 60 to 65 thousand.

These numbers also suggest that the sum of weights assigned to respondents:

$$\text{Sum of Weights} = \sum_{r \in R} w_r \qquad [6\text{-}5]$$

must roughly show the base population size in terms of number of users. Table-10 shows the sum of weights calculated under the two assumptions. Considering that the second

Table-10. Sum of Weights Assigned to Respondents

Assumption	Hikers	Bikers	Horseback Riders	Runners	Dog Walkers	Total
1	1,407	489	38	181	215	2,330
2	1,586	498	35	174	227	2,520

assumption seemed to give a fair estimate on the number of visits, the population of recreational users of McDonald Forest could be roughly estimated to be somewhere around 2,500 to 2,600 people, possibly up to 3,000 people.

These estimation results depend largely on an assumption made in the second stage. To see how these estimations could be affected by different assumptions, a seemingly extreme assumption was made and the result was compared with the estimation obtained above. It was assumed that 70% of nonrespondents had 8 times or less visitation frequency whereas only 10% of them had 20 times or more. This assumption resulted in 55,879 for weighted sum of visitation frequency and 3,147 for sum of weights. Considering that even this extreme assumption resulted in figures roughly equivalent to those obtained from the second assumption mentioned above, it was concluded that the estimated visitation and population were reasonably stable against different assumptions unless an extremely high proportion of less frequent users was assumed in nonrespondents. Therefore, it was decided that, for further analyses, the weighted sum of visitation frequency and sum of weights obtained from the second assumption mentioned above would be used as a proxy for total visitation and population size.

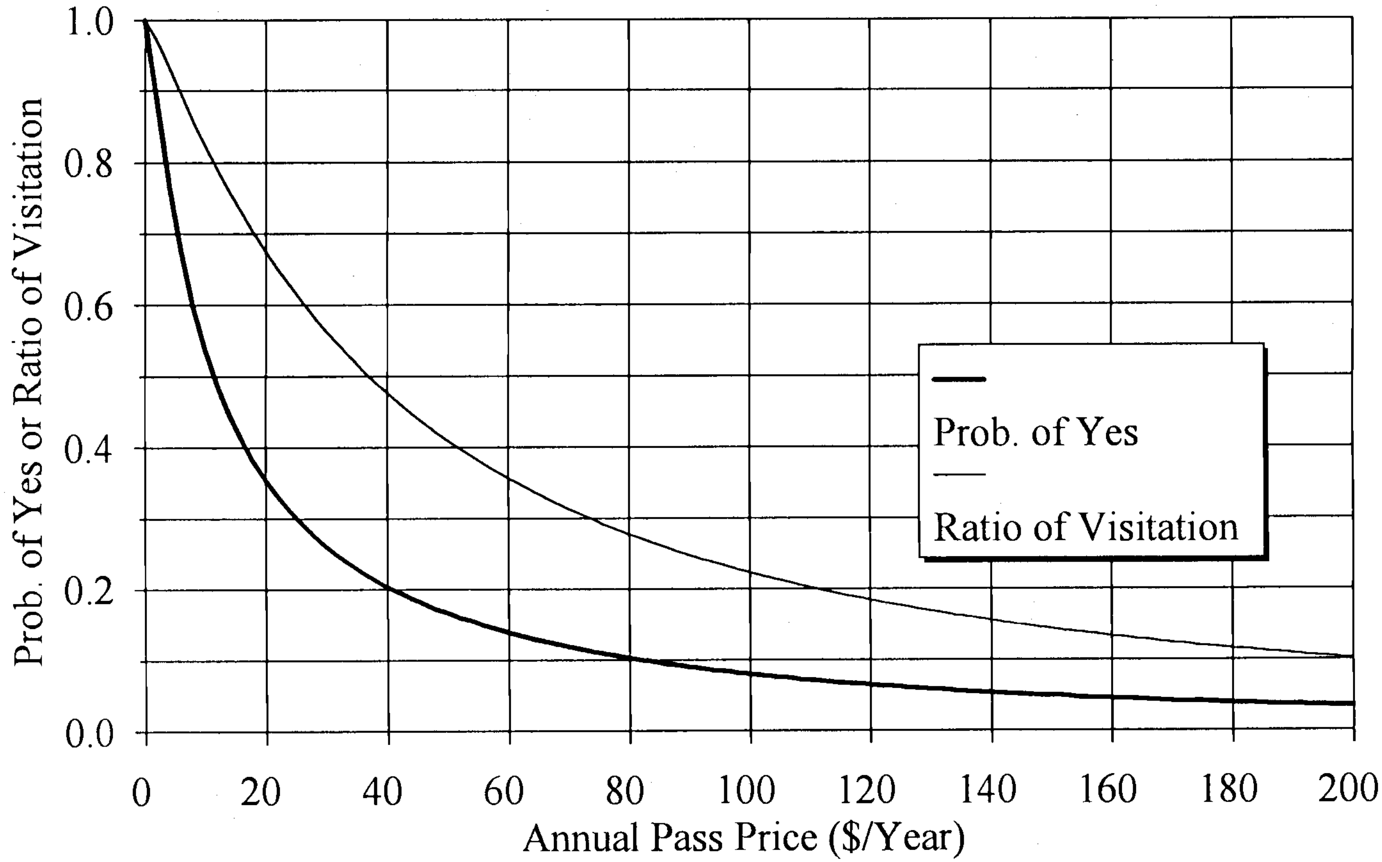
6.6 Economic Value of Forest Recreation in McDonald Forest

Economic value of forest recreation in McDonald Forest was estimated by deriving a population average cumulative probability curve and calculating the area below the curve. To derive an average cumulative probability function, F_P, for the population, [6-1] was modified to:

$$F_P = \left(\sum_{r \in R} w_r F_r\right) / \left(\sum_{r \in R} w_r\right) \qquad [6\text{-}6]$$

where F_P denotes the average cumulative probability function for the population. The derived average cumulative probability curve of the population is shown in Figure-3, with

Figure-3. Average Cumulative Probability Curves of Population



Note: Ratio of visitation shows the ratio of expected amount of visitation at each annual pass price to the current level of visitation.

the amount of total visitation expected at each price level also plotted as a ratio to the current visitation level. The ratio of total estimated visitation, V, to the current visitation level, V_c, was estimated by:

$$V / V_c = (\sum_{r \in R} w_r f_r F_r) / (\sum_{r \in R} w_r f_r) \qquad [6\text{-}7]$$

The mean willingness to pay amounts for the population and for respondents were then estimated by calculating the area below the cumulative probability curves within the annual pass price range of $0 to $1,000. To do so, the whole price range was first split into 3 sections: $0 to $10, $10 to $110, and $110 to $1,000. Then each range was further divided into 100 equal price increments; i.e., $0.10 increment for the $0 to $10 range, $1.00 increment for the next range, and $8.90 increment for the last range. Then, the area below average cumulative probability curves were calculated for each of 3 ranges by:

$$\text{Area} = (P_0 + P_{100})(\Delta\,\text{AFEE} / 2) + \sum_{i=1}^{99} P_i\,\Delta\,\text{AFEE} \qquad [6\text{-}8]$$

where P_i (i = 1, 2, ... 99) denotes the probability of "Yes" at the i th increment point in each range, P_0 and P_{100} denote the cumulative probabilities at lower and upper borders of the range, respectively, and ΔAFEE denotes the price increment in each range, i.e., $0.10, $1.00, and $8.90 for the respective 3 ranges. Overall mean willingness to pay amounts were finally estimated by adding [6-8] for all 3 ranges.

Mean willingness to pay amounts for the population and respondents were estimated to be $38.52 and $67.21 per year, respectively. As mentioned earlier, this could be overestimating the true mean willingness to pay amounts since no respondents answered "Yes" to annual pass price of $291 and above. By censoring the average cumulative probability curves at $291 and calculating the area below those curves, mean willingness to pay amounts were estimated to be $32.25 and $54.10 for the population and respondents, respectively.

On the other hand, for comparison purpose, median willingness to pay amounts for the population and respondents were estimated by examining the dollar amount that gave the probability of "Yes" response of 0.5 in the average cumulative probability functions [6-1] and [6-6]. The median willingness to pay amounts were calculated to be approximately \$11 and \$25 for the population and respondents, respectively.

The mean willingness to pay amount and an approximate median willingness to pay amount for the respondents were also calculated by a method described in Cameron (1988). Specifically, the coefficients in the final logit model except for the LNAFEE (i.e., natural logarithm of the annual pass price) were divided through by the negative of the coefficient of LNAFEE, and each of the divided results was multiplied by the mean of the corresponding variable for respondents. Then, all of those products were summed up, and the exponential of that sum was taken. Because the final model in this study was in logarithmic form, the result was considered to give an approximate median willingness to pay amount. To obtain the mean willingness to pay amount, this median amount was multiplied by a correction factor $\Gamma(1-\kappa)\,\Gamma(1+\kappa)$ (or $\pi\kappa\,[\sin(\pi\kappa)]^{-1}$) where $\kappa = -1/\beta$ (β is the estimated coefficient for LNAFEE; see model [4-2]) and $\Gamma(.)$ denotes the gamma function (Cameron, 1988; Cameron, 1991). This resulted in \$24.66 for the approximate median and \$70.18 for the mean willingness to pay amounts of the respondents. These were essentially equal to the median and mean willingness to pay amounts of respondents obtained earlier, except that the mean amount obtained here was slightly greater than that obtained earlier. This was because the amount obtained earlier was truncated at the annual pass price of \$1,000, which was the highest bid dollar amount, whereas the amount obtained here was not truncated.

The total annual economic value of forest recreation in McDonald Forest was estimated by multiplying the estimated mean willingness to pay amount for the population by the population size which was estimated to be 2,520. The estimated value was approximately $97,000 when the cumulative probability curve was not censored at $291, and approximately $81,000 when the curve was censored.

If the respondents were assumed to have correctly represented the population, no weighting procedure would have been used and the mean willingness to pay amount for respondents would have been assumed to be equal to that of the population. Even in such a case, total economic value would not have been overestimated; in fact, it could have been even smaller than the value estimated with weighting the respondents. This is because, without weighting, population size would have been estimated to be significantly smaller than what was estimated with weighting, although the respondents' mean willingness to pay amount was significantly higher.

6.7 Consequences of a User Fee in McDonald Forest

By vertically multiplying the average cumulative probability curve for any population by the population size, a demand curve for recreational opportunities in McDonald Forest was derived for the relevant population. The derived demand curve, combined with the supply curve and other related curves, was then used as a basis for estimating the consequences of various levels of user fees.

6.7.1 Derivation of Demand Curve and Marginal Revenue Curve

The population average cumulative probability function [6-6] can be interpreted as the expected proportion of the relevant population that would buy an annual pass, expressed as a function of price of the pass and other explanatory variables. Therefore, by multiplying [6-6] by the size of population, which is the sum of weights assigned to all respondents who belong to the relevant population, a demand function:

$$Q = (\sum_{r \in R} w_r) F_P = \sum_{r \in R} w_r F_r \qquad [6\text{-}9]$$

could be obtained, where Q denotes the number of users who would buy an annual pass. Graphically, this was equivalent to vertically multiplying the population average cumulative probability curve by the population size.

From the demand curve derived in [6-9], the marginal revenue curve was also derived. For any chosen range of pass price, which could be any continuous part of the \$0 to \$1,000 range, the range was split into 100 equal price increments. Then, the revenue (Rev_i) expected at the i th increment point could be expressed as:

$$Rev_i = AFEE_i \times Q_i \qquad [6\text{-}10]$$

where $AFEE_i$ and Q_i denote the pass price and the number of users who would purchase a pass at that price, respectively, at the i th increment point. The marginal revenue, MR_i, at i th increment point was calculated by:

$$MR_i = -(Rev_{i+1} - Rev_{i-1}) / (Q_{i+1} - Q_{i-1}) \quad \text{for } i = 1, 2, \ldots 99$$

and

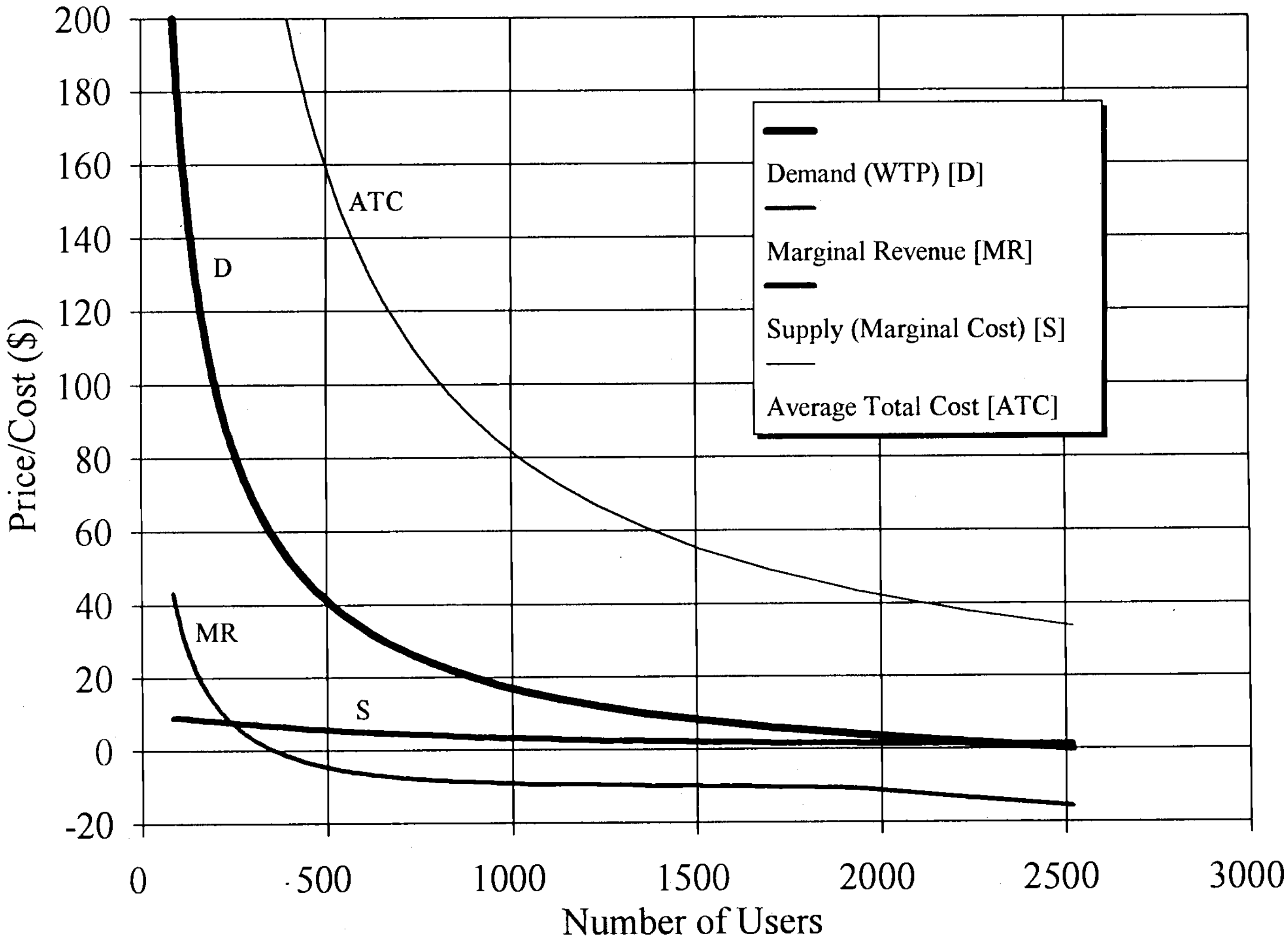
$$MR_0 = -(Rev_1 - Rev_0) / (Q_1 - Q_0) \qquad [6\text{-}11]$$

$$MR_{100} = -(Rev_{100} - Rev_{99}) / (Q_{100} - Q_{99})$$

where $i = 0$ and $i = 100$ correspond to the lower and upper borders of the range, respectively.

Figure-4 shows the demand curve and marginal revenue curve of the population. These curves in the figure were plotted by taking the \$0 to \$200 range, meaning that [6-9] and [6-11] were calculated by \$2.00 increments. The figure also shows the supply curve (or marginal cost curve) and average total cost curve, which will be discussed in the next subsection.

Figure-4. Demand, Marginal Revenue, Supply, and Average Total Cost Curves



6.7.2 Derivation of Supply Curve and Average Total Cost Curve

The supply curve for the provision of recreational opportunities in McDonald Forest was derived basically from 1993-94 Education/Recreation budget of McDonald Forest.

First, within approximately $89,700 budget for education/recreation, an educational budget of $11,000 was identified ($9,000 for a student worker specializing in educational programs and $2,000 for educational materials), and $500 for mailing to hunters was identified as irrelevant in this study. The remaining approximately $78,000 were assumed to be the cost needed to provide the current level of recreational opportunities in McDonald Forest. Although it could still include some costs that should be attributed to the educational function of the forest, it was not possible to separate them from the ordinary recreation management costs.

This $78,000 budget was then divided into fixed costs which would not be affected by the number of users purchasing passes and variable costs which would vary with the number of users who purchase passes. Two alternative assumptions were made as to the proportion of variable costs. The first assumption was that the $7,000 budget for "trail maintenance/repair" and "maps/brochures" were variable costs, whereas the remaining $71,000 were fixed costs. The second assumption added a half of the "information kiosk/signs" budget of $10,000 to the variable costs in the first assumption, resulting in $12,000 for variable costs and $66,000 for fixed costs. The second assumption came from the hypothesis that a significant portion of kiosk/signs costs might be attributed to vandalism of the users, which would be in some way associated with the amount of visitation.

Under each cost assumption, variable costs were then divided by the estimated current total visitation, i.e., approximately 60,000, to obtain unit variable costs of approximately $0.12 per visit under the first assumption and $0.20 per visit under the second assumption. On the other hand, additional fixed costs of \$5,000 were assumed for enforcement costs (1 student worker × \$7/hour × 15 hours/week × 52 weeks = approx. \$5,000/year), i.e., cost for checking the compliance of users at the site, and \$0.50 variable cost per user for printing and handling of passes. Then, total variable cost, TVC_i, at the *i* th increment point in any chosen range of pass prices was calculated as:

$$TVC_i = 0.50 \times Q_i + uvc \times V_i \qquad [6\text{-}12]$$

where V_i denotes the total number of visits at the *i* th increment point and *uvc* denotes the unit variable cost per visit calculated above under each assumption. This derivation of total variable cost assumed that the unit variable cost per visit was constant at any level of visitation, for any activity, and in any season or on any day. The total amount of visitation V was derived as:

$$V = \sum_{r \in R} w_r f_r F_r \qquad [6\text{-}13]$$

By splitting the given range into 100 equal increments, the marginal cost, MC_i, at the *i* th increment point was calculated from the total variable cost [6-12] as:

$$MC_i = (TVC_{i+1} - TVC_{i-1}) / (Q_{i+1} - Q_{i-1}) \quad \text{for i} = 1, 2, \ldots 99$$

and

$$MC_0 = (TVC_1 - TVC_0) / (Q_1 - Q_0) \qquad [6\text{-}14]$$

$$MC_{100} = (TVC_{100} - TVC_{99}) / (Q_{100} - Q_{99})$$

where $i = 0$ and $i = 100$ correspond to the lower and upper borders of the range, respectively.

Average total cost, ATC_i, at the *i* th increment point was also calculated as:

$$ATC_i = (FIX + TVC_i) / Q_i \qquad [6\text{-}15]$$

where FIX denotes the total fixed cost under each assumption.

Figure-4 shows the supply (marginal cost) curve and average total cost curve under the first cost assumption, in addition to the demand curve and marginal revenue curve derived in the previous section. (Because the second cost assumption gave marginal cost and average total cost curves very close to those under the first assumption, only curves under the first assumption are shown in the figure.)

As shown in Figure-4, the marginal cost curve showed a downward slope for the entire range of pass prices, which seemed to be contradictory to ordinary economic theory. This phenomenon would be explained by the different expected frequency of visitation of a marginal user at different pass prices. As the final logit model showed, the probability of receiving a "Yes" response from a user at a certain pass price was strongly correlated with the frequency of visitation of that user. Because more frequent users had higher probability of giving a "Yes" response than less frequent users, those who would be excluded at low pass prices were likely to be less frequent users. Because an equal unit variable cost per visit was assumed, it was likely that the first user to be excluded had a lower cost to the forest than, say, the 1,000 th user to be excluded. This led to a downward sloping marginal cost curve with higher marginal costs for smaller Q, i.e., smaller number of users purchasing a pass, and lower marginal costs for larger Q.

6.7.3 Consequences of Charging a User Fee in McDonald Forest

Using the demand and supply curves as well as other curves and functions derived, consequences of various fee prices were estimated under two cost assumptions. The estimated consequences included gross revenue, total cost, number of users who would purchase a pass, number of visits they would make, and consumer surplus accrued to them.

First, consequences of a fee with marginal cost pricing, average cost pricing, and marginal revenue pricing were examined as a benchmark. These pricing methods are often referred to in the literature as three basic pricing methods for goods facing monopolistic competition which is characterized by large fixed costs and very small marginal costs (e.g., Rosenthal et al., 1984b; Gramlich, 1990). Marginal cost price, depicted as the price at the intersection of demand curve and supply curve, is an economically efficient price which maximizes total benefit accrued to the society but would not cover the large total cost. To obtain the marginal revenue price, the number of users at the intersection of the marginal revenue curve and marginal cost curve must be first obtained. The marginal revenue price would then be the price corresponding to that number of users on the demand curve. Marginal revenue price maximizes net revenue to the forest but may cause significant loss of consumer surplus, i.e., dead weight loss. Average cost price can be depicted as the price at the intersection of the demand curve and average total cost curve. It just covers the total cost and minimizes dead weight loss under a budget constraint.

It turned out that average cost pricing was not possible in the case of McDonald Forest recreation because the demand curve and average total cost curve did not intersect (see Figure-4). This meant that a fee could never completely cover all costs born by the forest at any price of the pass. In fact, the total cost born by the forest could be covered with the fee revenue only if most of the economic value, which is equal to the consumer surplus enjoyed currently, could be captured through discriminatory pricing.

The marginal cost price of a pass was estimated to be approximately $1.30 per year under the first cost assumption and $1.90 under the second assumption. At these prices, gross revenue would be $3,000 and $4,300, respectively. Total cost would be approximately $85,000 under both assumptions, within which fee-related costs would be $6,200 and $6,100, respectively. The number of users would be 93% and 89% of the current level, and the number of visits would be 98% and 97% of the current level. Consumer surplus with those prices would be $94,800 and $93,400, respectively, or 98% and 96% of the current level.

On the other hand, the marginal revenue price was estimated to be approximately $84 per year under the first cost assumption and $101 under the second assumption. At these prices, gross revenue would be slightly over $20,000 under both assumptions, total cost would be respective $78,000 and $74,000, within which fee-related cost would be approximately $5,100 under both assumptions, number of users would be 10% and 8% of the current level, respectively, and the number of visits would be 27% and 22% of the current level. Consumer surplus with those prices would be $58,000 and $54,300, or 60% and 56% of the current level.

Figure-5 shows the relationships between price of a pass and gross revenue, total cost, net cost for the forest, and consumer surplus, under the first cost assumption. (Because the second cost assumption gave curves very close to those under the first assumption, only curves under the first assumption are shown in the figure.) Table-11 summarizes the consequences of a fee at several price levels between marginal cost price and marginal revenue price.

Besides estimating the consequences of a fee on overall population, the discriminatory impact of a fee on different subpopulations was also examined. To do so, the population was stratified into subpopulations by variables that showed significance in the final logit model; i.e., frequency of annual visitation, percentage of use on weekends, household income (less than $20,000 or not), and activity (hiker or not). Then, the population average cumulative probability function [6-6] and population demand function [6-9] were applied to subpopulations in order to derive separate average cumulative probability curves and demand curves for different subpopulations. Figures 6-13 show those curves. Frequency of visitation and activity were shown to have a large effect on probability of purchasing a pass across different subpopulations. On the other hand, household income and percentage of use on weekends did not show as large an effect as suggested by their statistical significance. The primary reason for this seemed to be that the effect of frequency of visitation was so significant, in terms of both statistical

Figure-5. Revenue, Cost, and Consumer Surplus under a User Fee System

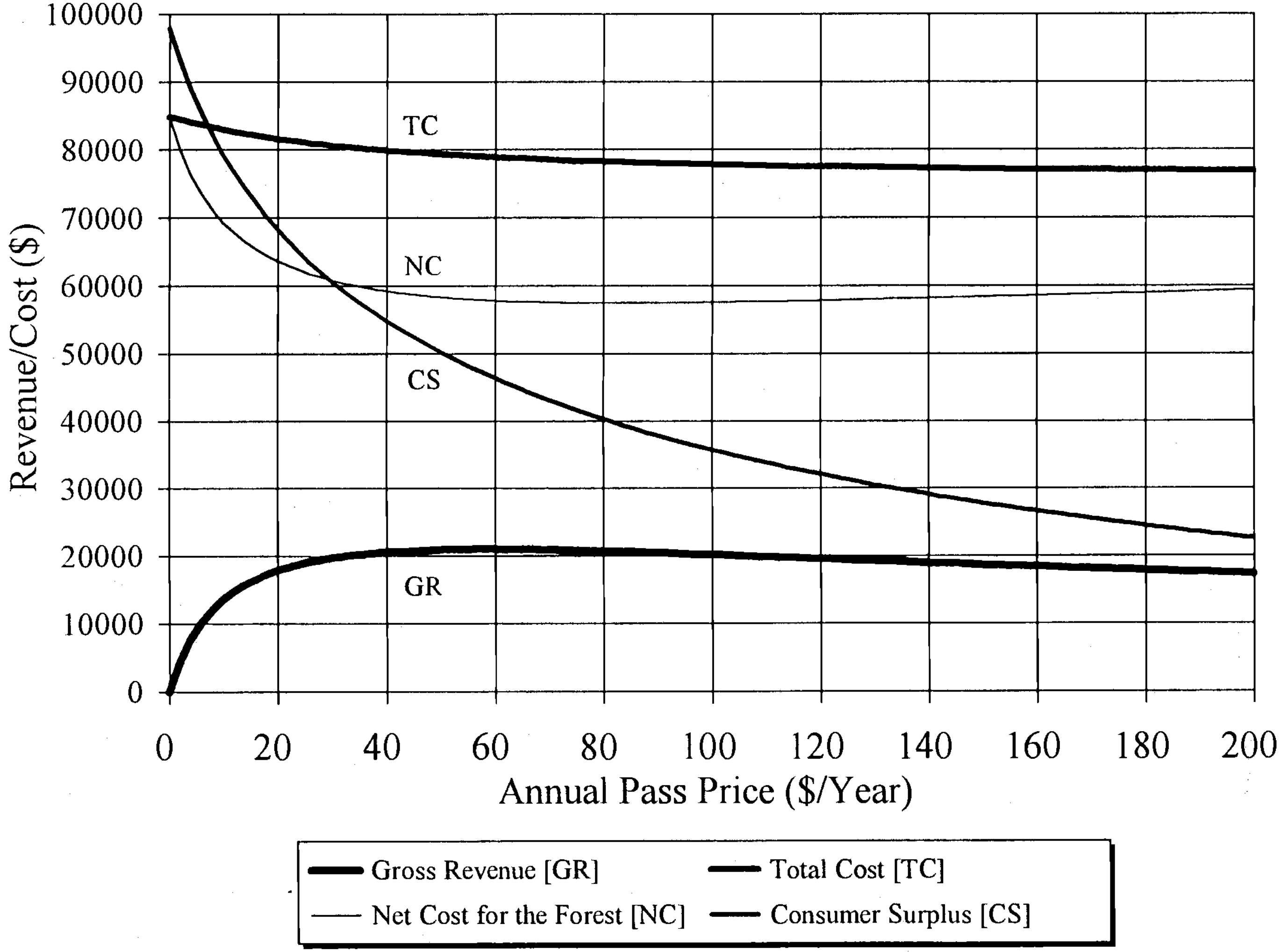


Table-11. Consequences of Charging a User Fee

Annual Pass Price ($)	3	5	7	10	15	20	30	40	50
Gross Revenue ($)	6,200	9,100	11,200	13,600	16,200	17,900	19,800	20,600	21,000
Total Cost ($)									
Cost Assumption 1.	84,300	83,900	83,500	83,000	82,200	81,600	80,600	79,900	79,300
Cost Assumption 2.	84,200	83,500	82,900	82,200	81,000	80,000	78,500	77,300	76,400
(Fee Related Cost ($))	6,000	5,900	5,800	5,700	5,500	5,300	5,300	5,300	5,200
Number of Users	2,080	1,810	1,600	1,360	1,080	900	660	520	420
(% of Current Level)	(83%)	(72%)	(64%)	(54%)	(43%)	(36%)	(26%)	(20%)	(17%)
Number of Visits	60,600	58,200	55,800	52,400	47,300	43,000	35,900	30,400	26,100
(% of Current Level)	(95%)	(91%)	(88%)	(82%)	(90%)	(36%)	(26%)	(20%)	(17%)
Consumer Surplus ($)	91,100	87,200	83,800	79,400	91,900	87,000	79,400	73,600	68,800
(% of Current Level)	(83%)	(72%)	(64%)	(54%)	(43%)	(36%)	(26%)	(20%)	(17%)

Notes:

1. Cost Assumptions are as follows:
   Assumption 1: $76,000 fixed cost + $0.12 (per visit) variable cost + $0.50 (per user) printing & handling cost
   Assumption 2: $71,000 fixed cost + $0.20 (per visit) variable cost + $0.50 (per user) printing & handling cost
   Fixed costs include $5,000 enforcement cost under both assumptions.
2. Numbers are rounded to 100's. Number of users are rounded to 10's.

Figure-6. Subpopulation Average Cumulative Probability Curves by Frequency of Annual Visitation

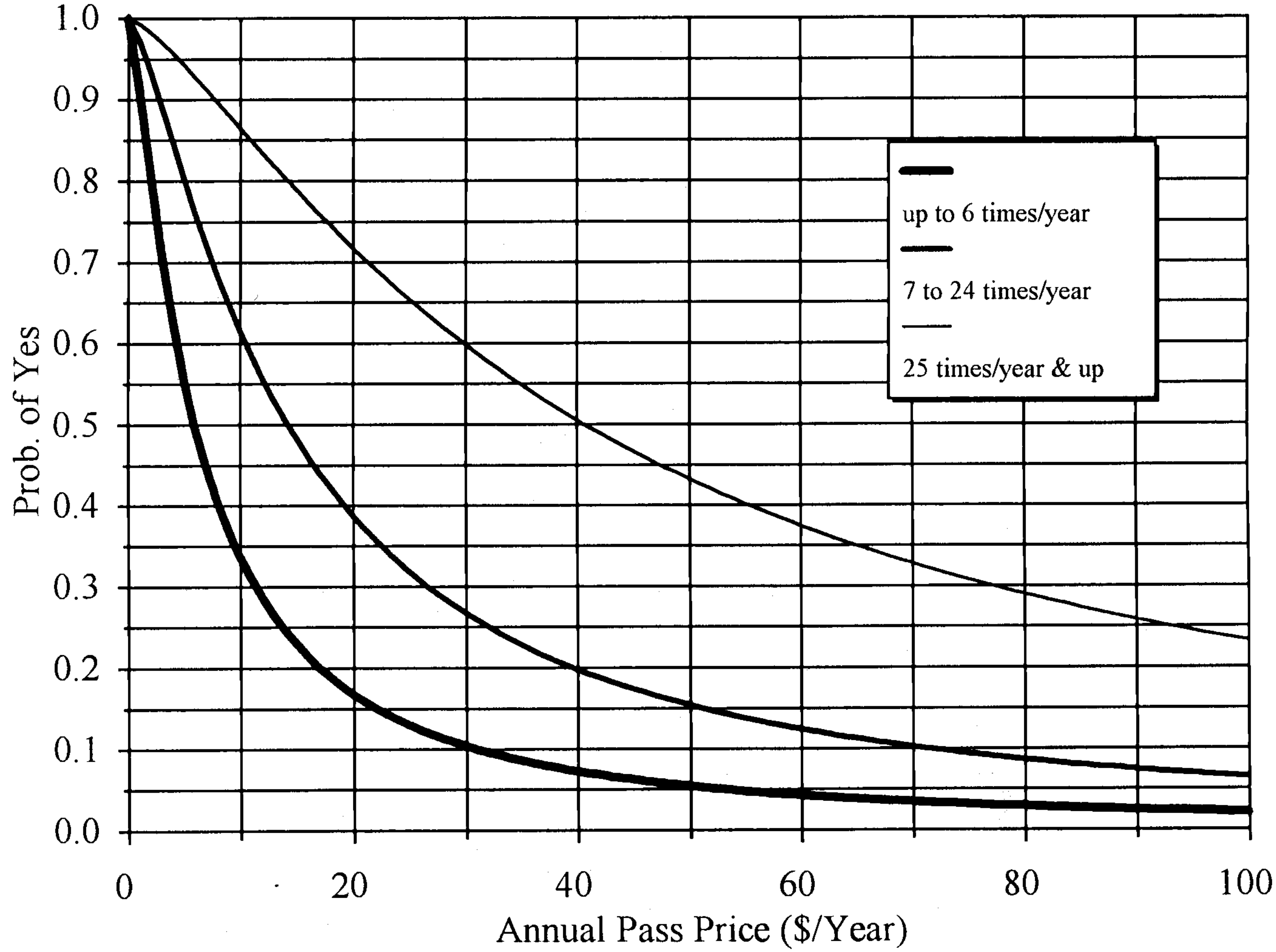


Figure-7. Subpopulation Demand Curves by Frequency of Annual Visitation

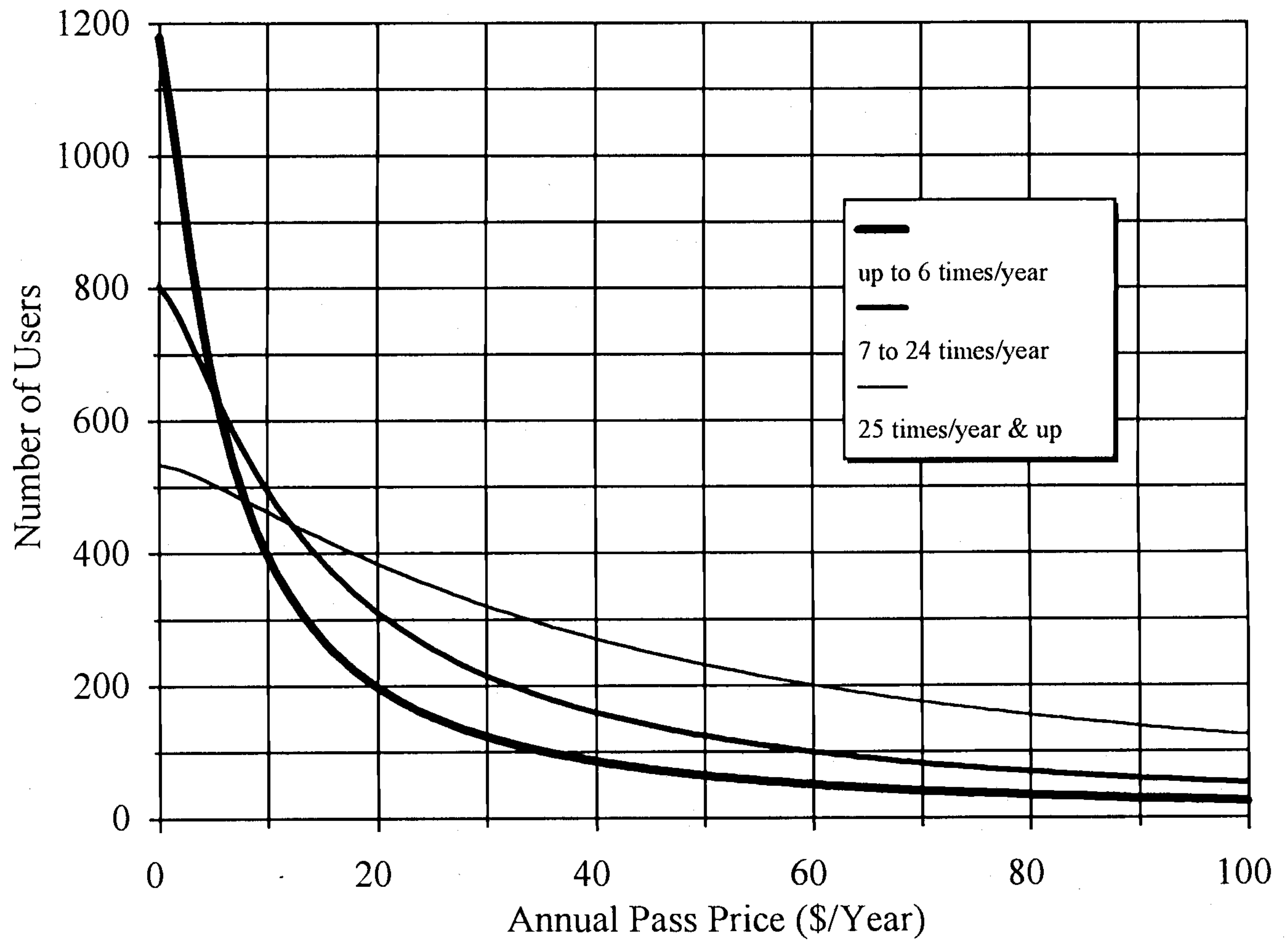


Figure-8. Subpopulation Average Cumulative Probability Curves by Percentage of Use on Weekends

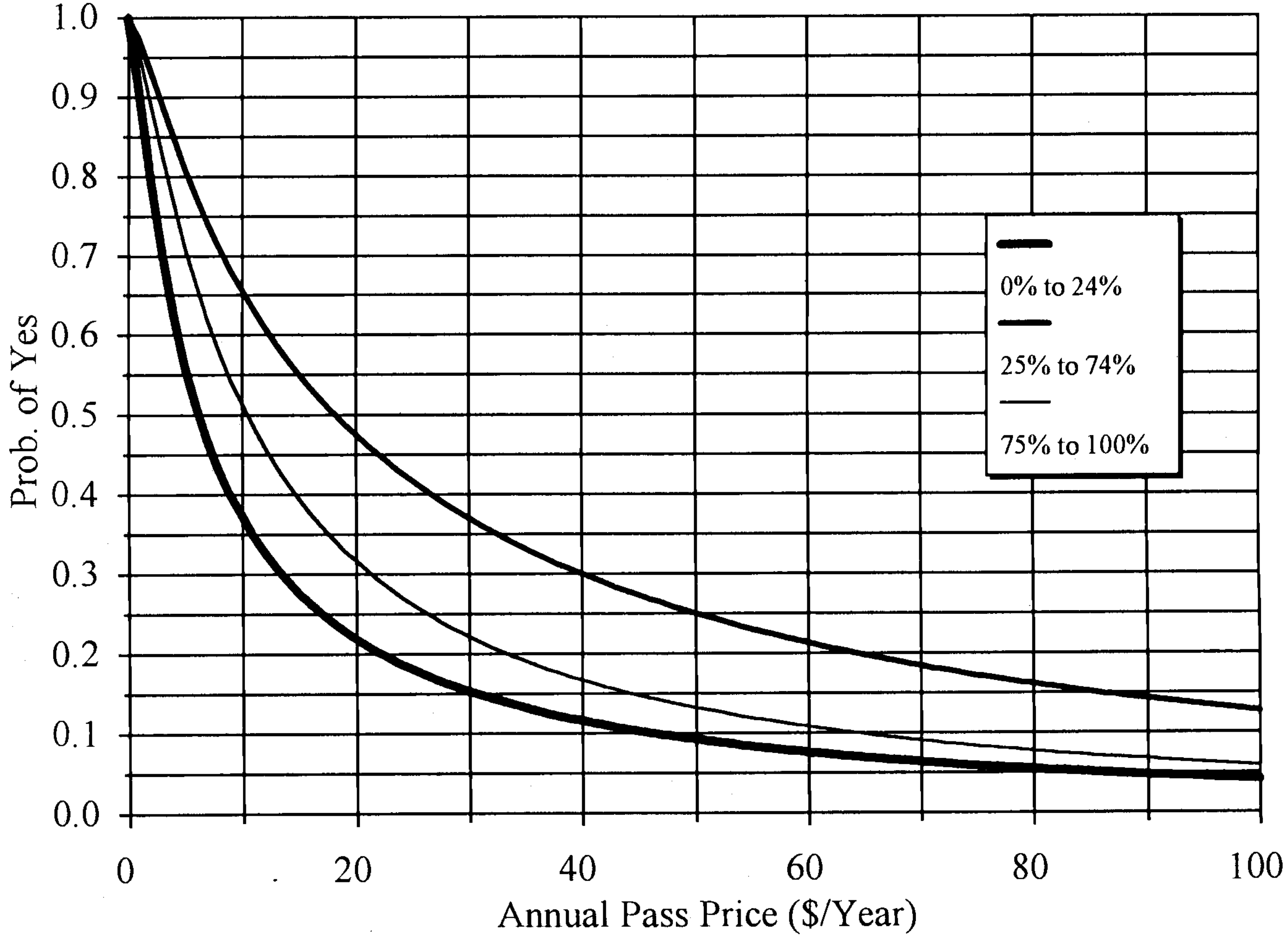


Figure-9. Subpopulation Demand Curves by Percentage of Use on Weekends

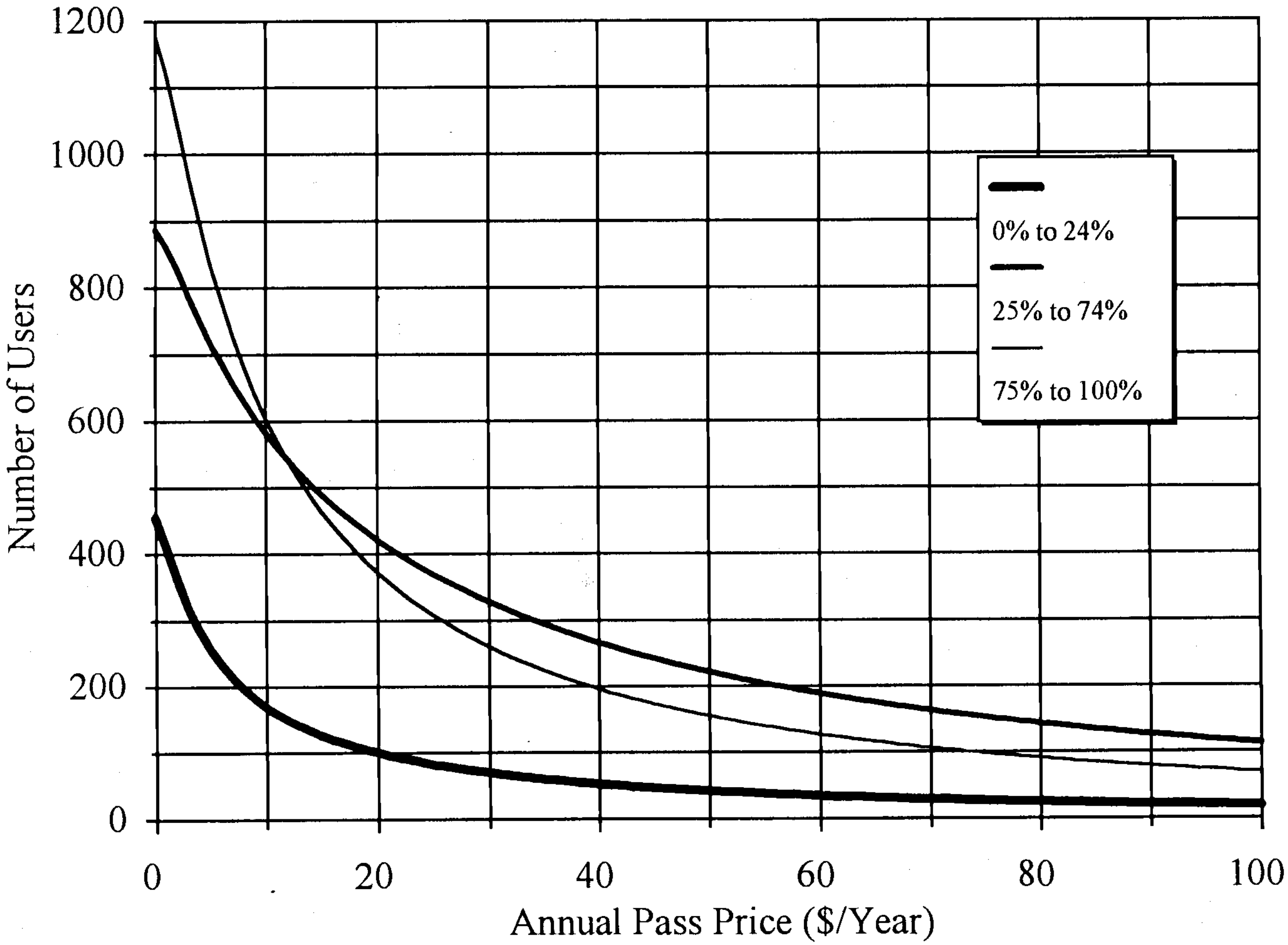


Figure-10. Subpopulation Average Cumulative Probability Curves by Household Income Level

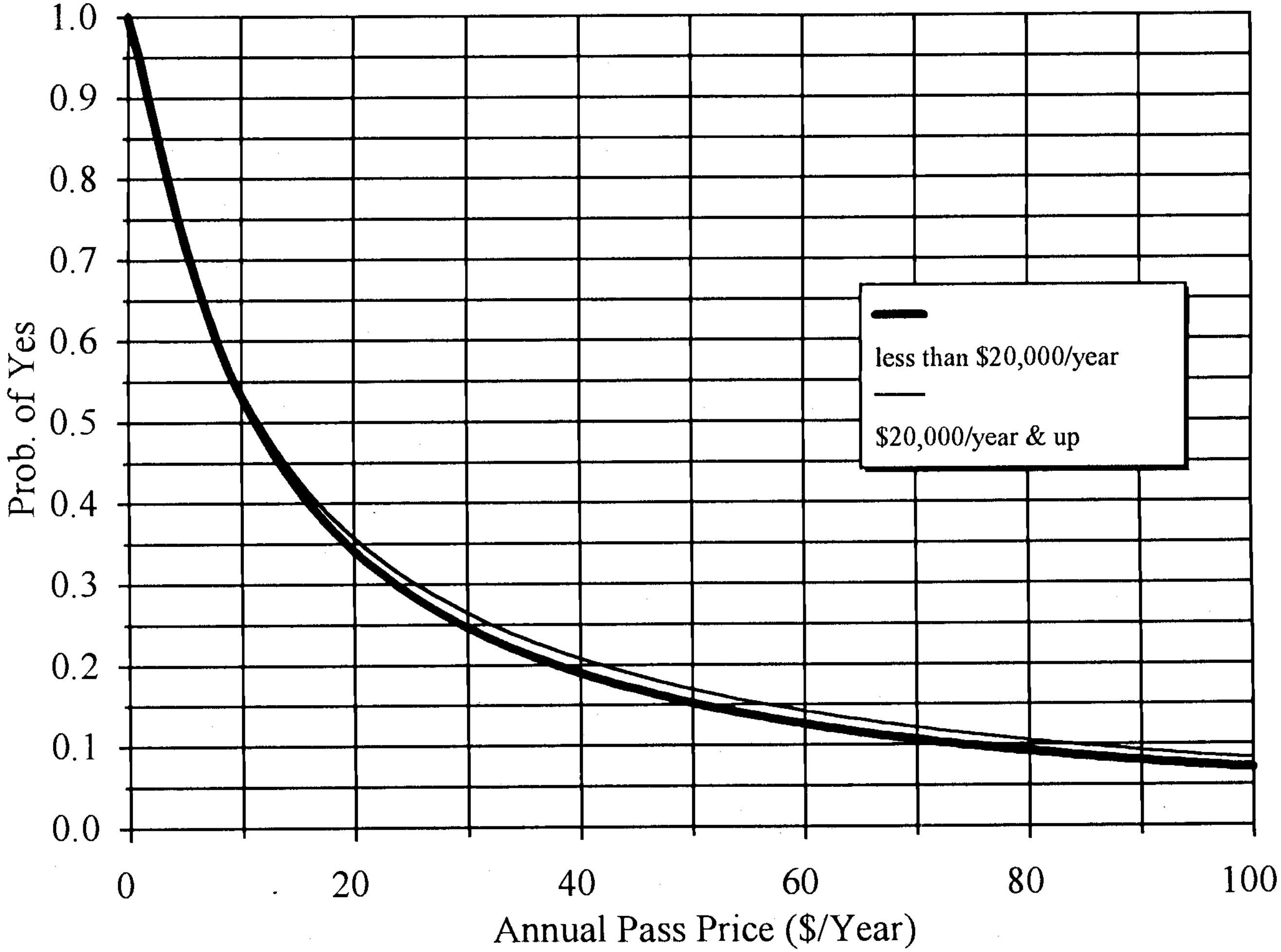


Figure-11. Subpopulation Demand Curves by Household Income Level

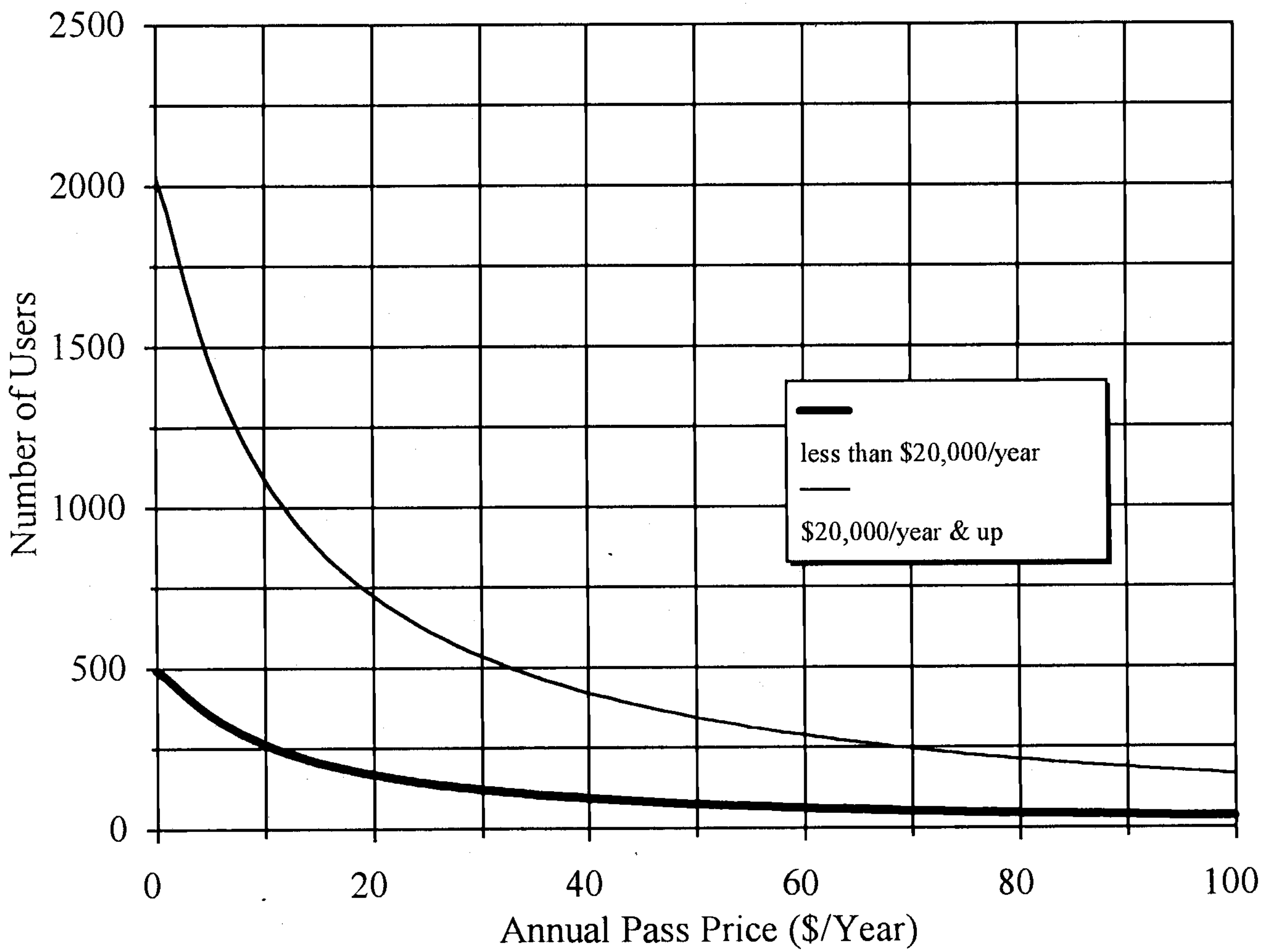


Figure-12. Subpopulation Average Cumulative Probability Curves by Primary Activity

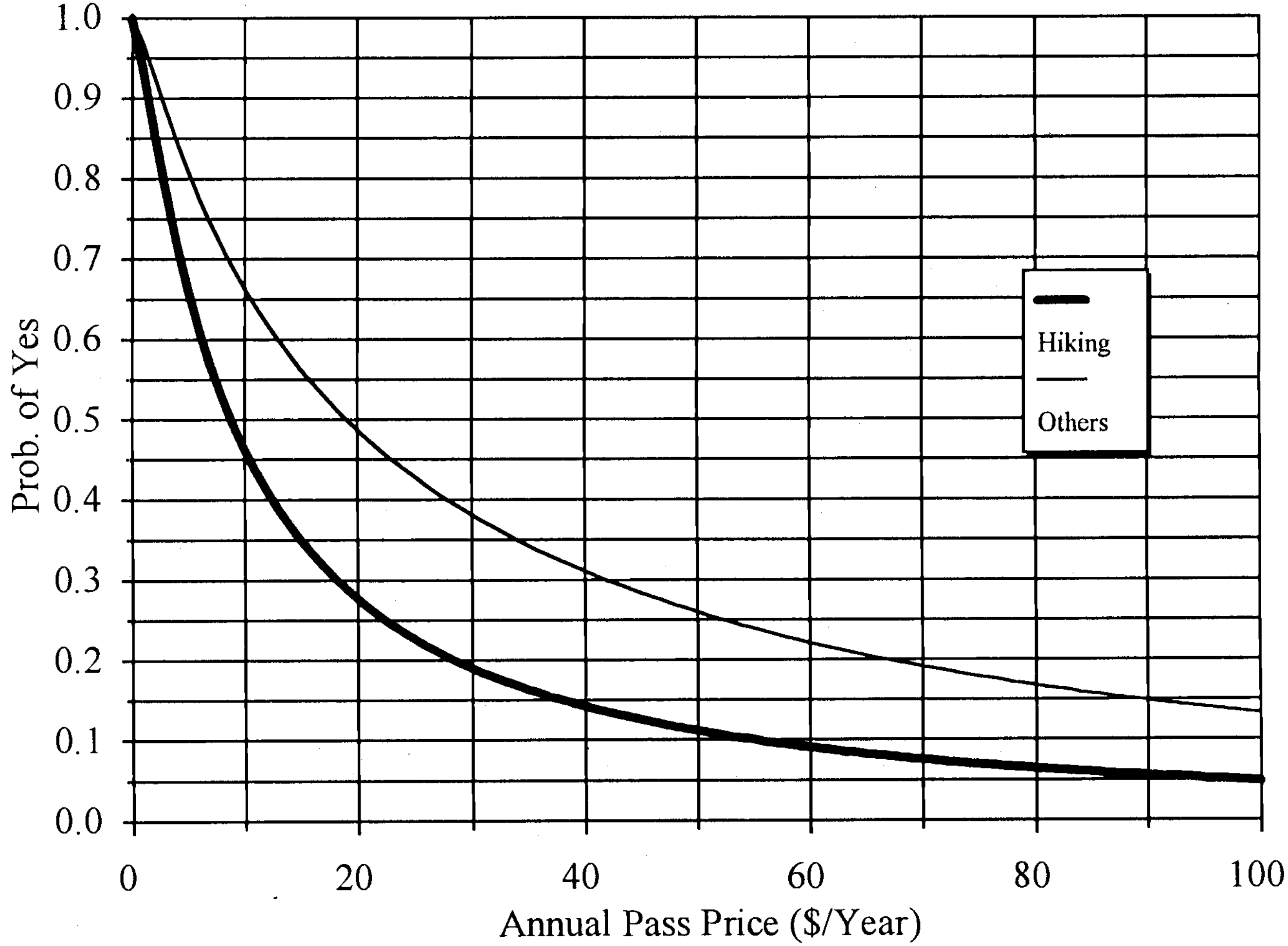
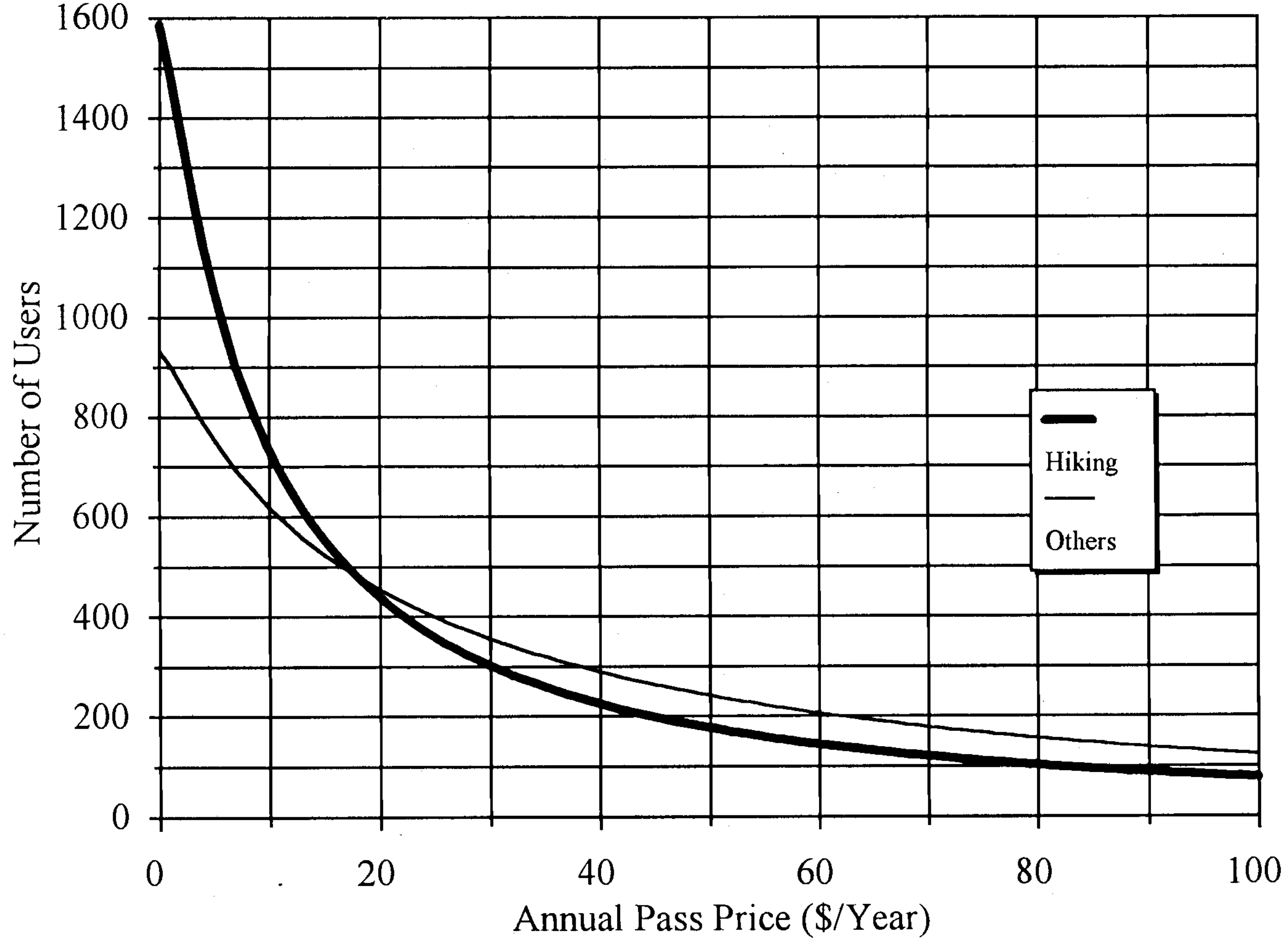


Figure-13. Subpopulation Demand Curves by Primary Activity



significance and magnitude, that the effects of income and percentage of use on weekends were overridden by the effect of frequency of visitation. The fact that the average cumulative probability curves for hikers and other activity users differed largely would thus mean that there was a correlation between frequency of visitation and activity (whether hikers or not). This is indeed shown in the significantly low frequency of visitation of hikers, as reported in Table-4.

7. DISCUSSION

Implications of the findings of this study, as well as some technical or procedural problems noticed in the course of analyses, will be discussed in this chapter.

7.1 Economic Value of Recreation in McDonald Forest

This study estimated that the economic value of recreation in McDonald Forest is about $80,000 to $100,000 for one year. This is roughly equivalent to the annual budget spent on recreational management in McDonald Forest, which was assumed to be $78,000 per year, or larger than it considering that this budget would still include some costs that should be attributed to the educational function of the forest. These figures would justify the current level of spending on recreational management in McDonald Forest in terms of simple benefit-cost comparison.

However, whether the current level of spending is optimal or not is another problem and requires more information. Since the CVM question scenario used in this study described the fee as a price to continue using the forest and assumed that the level of services provided to the users such as trail maintenance, maps and brochures would stay constant at the current level, it did not provide information as to how much they would be willing to pay if the level of services were to be increased or decreased. If spending an additional one dollar would increase the total economic value by more than one dollar, then the optimal spending level should be above the current level. If, on the other hand, reducing the current spending by one dollar would not reduce the value by one dollar, the optimal spending level should be below current level.

The true net benefit accrued to society by providing recreational opportunities in McDonald Forest could be greater than the simple difference between the estimated economic value and the current spending level. This can be examined by comparing the benefit and costs of alternative policies concerning the provision of recreational opportunities in McDonald Forest; i.e., benefit and costs with current policy, that were estimated in this study, and those without such a policy. Any "without" policy option would fall between two extremes, i.e., totally banning recreational access to the forest and just withdrawing the management efforts in the forest. Although a "without" policy option would cut the recreational management costs to zero, there are several reasons to think that it would add other kinds of costs to the management or society. First, to the extent that the policy tries to ban access to the forest, the costs for excluding the users would become significant. On the other hand, to the extent that the policy allows access to the forest without devoting any management efforts, social costs in terms of environmental degradation and congestion could become a significant problem. In addition, even if the forest withdraws provision of recreational opportunities from its management objectives, it could still be responsible for assuring safety for the users. In 1987, Oregon Supreme Court upheld the so-called "foreseeability doctrine", i.e., state agencies have an obligation to take reasonable precautions against foreseeable risks to the users (State of Oregon, 1990). This means that, even if McDonald Forest officially bans access to the forest, it could be still liable for the injuries occurred in the forest, as long as the management could foresee users' entrance to the forest[7].

It was also shown that a relatively small number of people receive the benefit from recreation management in McDonald Forest. Besides the benefit-cost comparison, it might be necessary to examine whether the current level of spending is appropriate or not from an equity perspective.

On the other hand, the McDonald-Dunn Forest Plan (Oregon State University, 1993a) estimated that the timber revenue in McDonald Forest would be approximately

---

[7] This argument does not directly apply to private forests because Oregon Revised Statues (ORS) 105.665 (2) and 105.675 (2) explicitly exempt private landowners from liabilities unless they charge fees to the users.

3.5 million dollars per year if present net value was to be maximized under a non-declining flow of harvest, or 2.2 million dollars even under the proposed plan. This shows that the economic value of recreational use of McDonald Forest is equivalent to 2 to 5% of the value of timber in the forest. This relatively low value of recreation in McDonald Forest, compared with timber value, can be attributed to the following reasons:

(1) Due to active management efforts in the past, McDonald Forest is rich with well maintained high quality timber resources. On the other hand, because of the relatively new history of recreation as an official management objective of the forest, and also because of some recreation opportunities not provided to the public (e.g., camping), recreation resources are not fully developed in McDonald Forest (although whether they should be developed or not is another problem).

(2) Because of relatively low population density around the forest and relatively abundant substitute sites, intensity of recreational use in McDonald Forest is relatively low. In fact, it was estimated that only around 2,500 to 3,000 people (adults) recreate in the forest in a year.

7.2 Charging a User Fee in McDonald Forest

As the relatively low economic value of recreation suggested, it was shown that charging any single level of fee would not completely cover the total cost of recreation management in McDonald Forest; in fact, only about a quarter of the expenditure would be covered at the most. Therefore, the marginal revenue price should be called a "loss minimizing" price rather than a "profit maximizing" price. However, considering that recreation in McDonald Forest currently does not generate revenue at all, and also considering that the spending on recreation management in McDonald Forest can also be attributed to educational functions which would ultimately contribute to better public understanding about forest management and environmental issues or to better public attitudes in outdoor recreation, it might be more appropriate to look at the result as a net savings to the management, rather than a net loss. In this sense, even a moderate price of a permit would save a large amount of money for McDonald Forest, compared with the current level of spending. For example, as Table-11 shows, charging a fee of around $10 per year would result in a net cost to the forest of approximately $69,000, which saves about 11% of the current cost of recreation management.

The analysis showed that a fee would force out less frequent users and hikers, compared with those who visit more frequently and those who participate in activities with more specialized purposes such as biking, horseback riding, running, and dog walking. This finding showed that a fee would make the forest more like a specialized recreational facility than a casual "backyard" for the broader public. Although statistical analysis showed that a fee would have a discriminatory impact on low income users, it turned out that a fee would not have a very large impact on different household income groups.

In this study, it was assumed that adding one visit to the forest would add an equal amount of cost, i.e., constant marginal cost of visitation, regardless of which activity that additional visit would be. However, it may be reasonable to think that some activities have higher impacts on resources, such as horseback riding and biking, so that they would cost more to the forest than others. Therefore, charging a uniform fee might cause an inequitable burden on users with less impact.

Many respondents stated that they would rather donate than being forced to pay, or would volunteer for trail maintenance or any necessary job. Some respondents even stated that they would quit their current donation if a fee system was actually introduced. These opinions expressed by respondents suggest a donation system as an alternative fund raising method for recreational management in McDonald Forest. Assuming that 30% of users would donate 30% of their maximum willingness to pay amount if they were asked to, the total revenue would be approximately $7,000 to $9,000. This would be equivalent to charging a fee of $8 to $10 per year, considering that the donation system would not require enforcement costs, although it might require some additional transaction costs.

Advantages of a donation system over a user fee system would be that it would not exclude any subpopulation of users from the site, it could generate revenue also from nonusers, organizations and firms, and it has a potential to generate much larger revenue than a user fee system. Disadvantages would be that it would require sophisticated solicitation techniques, it might be inequitable in a sense that nonpayers would use the forest in a same way as donors would, it would not reduce congestion in the forest as a fee system would, and the ways of spending the fund may be limited by the specific request of the donors.

The City of Corvallis (1994) reported information about the potential of a donation system. According to the report, "One Dollar Park Donation Program" promoted by the city collected donations of some $30,000 in FY1993/94, including matching grants. In this program, the city asks households to voluntarily add $1.00 to their monthly water bill payments. The amount collected by the city far exceeds the maximum possible revenue expected under a user fee system in McDonald Forest. Although it would not be appropriate to make a direct inference from it, it seems at least worthwhile to consider the donation system as a possible alternative fund raising method.

7.3 Economic Valuation or Fee Consideration?

The dichotomous-choice CVM survey conducted in this study was aimed both at estimating the economic value of forest recreation in McDonald Forest and at estimating possible user fee levels with their consequences. However, as explained in chapter 5, economic valuation required that a large portion of sample being assigned very high bid dollar amounts in the CVM question in order to minimize the error in the estimated mean willingness to pay amount. This seems to have led to some waste of data when we consider the survey as a tool to obtain information on how users would react to probable fees. Considering the pretest result, bid amounts above, say, $150 might not have been necessary if obtaining fee related information was the only objective of this study.

Whether the objective of the study was economic valuation or fee consideration might have some implication also in the design of the CVM question scenario. Because economic valuation was one of the major objectives, the scenario in this study assumed that the users "must" buy a pass in order to continue using the forest, so that their maximum willingness to pay would be elicited. However, if the enforcement fails in a fee system actually implemented, many of those who stated that they would purchase a pass might not do so in fact. On the other hand, some respondents might have stated that they wouldn't buy a pass, reacting to what they thought a fee price "should be" rather than how much they would pay. These users may in fact purchase a pass after looking at how other users behave and correcting their perception as to how much they should pay, or simply by knowing that they were willing to pay more than what they thought they should be. Factors such as advertisement or education would therefore have significant effect on the actual behavior of users toward the fee system. Therefore, an alternative CVM question scenario design which describes factors such as the probable level of enforcement and expected behavior of other members might have been necessary if the objective of the study was solely to elicit "true" behavior of the users.

It is not yet well known how people would react to different situations involving different levels of enforcement and different attitudes of other members of the society. Therefore, it might be worthwhile to choose a sample of respondents in this study and conduct a follow-up survey to elicit their true behavior under various situations.

7.4 Sampling and Population Estimation

In this study, the population of interest was defined as users who visited the forest at least once during a given one year period, and the economic value of recreation valued in this study was, in essence, limited to the use value. Provision of recreational opportunities in McDonald Forest might in fact benefit some potential recreational users who currently do not use the forest by ensuring them their future access to the forest (i.e., option value). Even some people who would never use the forest in the future might benefit from just knowing that other people are given opportunities to recreate in McDonald Forest (i.e., existence value). However, because of the existence of relatively abundant substitute sites, option value or existence value of forest recreation in McDonald Forest didn't seem to be significant compared with its use value. Therefore, it seemed appropriate to limit the population of interest to current users of McDonald Forest. This was also consistent with the argument made by Arrow et al. (1993), stating that "undersampling and even zero sampling of a subgroup of the relevant population may be appropriate if the subgroup has a predictably low valuation of the resource". If, on the contrary, the forest could be considered to have significant option or existence value, limiting the population to the current users might have been inappropriate since it would result in significant underestimation of total economic value.

It was estimated that respondents to the survey significantly underrepresented less frequent users in the base population mainly because of the sampling method used and partly because of nonresponses to the survey. Besides the problem of nonresponses which could not be directly controlled (although a better design and execution of the survey could have improved the response rate), the sampling procedure employed in this study seemed to be the best possible one, despite such a bias. First of all, it was not possible to know the population beforehand. An alternative method that would not cause a significant bias might be to randomly choose a sample from a list of households in Benton and Linn counties. However, this would require a much larger sample size to obtain an effective number of actual users equivalent to those collected in this study, since many of the households would be nonusers or very infrequent users. Considering that most frequent users of McDonald Forest seemed to have been included in the sample and that there was information to correct for the bias, the sampling method used in this study seemed to be the most efficient one among any possible sampling methods.

The estimated number of users mentioned in the previous chapter seemed to contradict with the finding of Finley (1990) that, based on a mail survey to randomly chosen Corvallis households, 80% of Corvallis households had visited the forest at least once in the past, which would mean that roughly 35,000 adult Corvallis residents must have visited the forest at least once in the past. Although many of those people should be infrequent users of less than one visit per year, it still seems to be significantly larger than the population of users estimated in this study, which would correspond to 7% to 8% of the adult population of the city of Corvallis. Possible causes of this large difference lie both in this study and Finley (1990).

Possible causes attributed to this study include the following:

(1) Respondents to the survey in this study might have overstated their frequency of annual visitation. If this is true, the true number of users should be higher than estimated in this study, whereas the true frequency of visitation per user should be lower.

(2) The model used to estimate the probability of a respondent being sighted at the site ([6-3]) might have overestimated the true probability for some reason. If this is true, weights assigned to the respondents must have been greater than they should have been, and therefore the true number of users should have been greater than estimated in this study.

(3) Substantial number of users might be visiting the forest via minor or officially unrecognized access points. Such users would not have been sampled in this study,

whereas they could be sampled in Finley (1990). If this is true, the true number of users and visitation must be both greater than estimated in this study.

On the other hand, possible causes of the difference lying in Finley (1990) include the following:

(1) The U.S.West telephone directory used by Finley (1990) for sample selection might have been biased because many residents do not appear in the directory. Also, a bias might have occurred because some residents do not print their address in the directory. If the directory contained more McDonald Forest users than expected from the true proportion of users among Corvallis residents, her estimate of "80% of Corvallis households" might have been an overestimate.

(2) A substantial number of Corvallis households who have visited the forest in the past might in fact be very infrequent users, such as only once in several years or even once in a lifetime. If many of the respondents in Finley (1990) had visited the forest very few times in quite a long time period, it would mean that her study and this study dealt with quite different populations with different size and visitation frequency.

(3) Many of the visits referred to by the respondents in Finley (1990) might have been visits to the Peavy Arboretum area (e.g., Peavy Lodge), which is located outside the access point where sampling for this study was carried out. This study did not assume such uses to be included, although many respondents might have included such uses in their stated frequency of visitation.

(4) Although 80% of households in Finley (1990) stated that they had visited the forest, it would not mean that all adult members of those households had actually visited the forest.

8. CONCLUSION

Three "key" findings of this study, among other findings, can be summarized as the following:

(1) Economic value of recreational opportunities in McDonald Forest was estimated to be approximately $100,000 for one year in total, or $39 per user. This slightly exceeds the current spending level on the recreational management of the forest. Therefore, current spending can be justified in terms of a benefit-cost comparison.

(2) A user fee could generate revenue of more than $20,000 per year. The net loss for the forest would be minimized at a fee level of $80 to $100 per year. However, at those price levels, the number of users and amount of visitation will be only a fraction of the current level.

(3) Even a moderate fee such as $5 per year would force a significant number of occasional users and hikers out of the site. The higher the fee would be, the more McDonald Forest would become a specialized recreation facility than a casual place to visit.

It was shown that a user fee could cover some portion of the recreational management cost currently spent by the forest, but not all. This study examined only the consequences of an annual fee. However, there would be several other possible pricing methods that could be used. For example, adding a daily fee might generate some additional revenue from those would have been excluded from the site if only an annual fee were available. A two-part tariff system, which charges a one-time access fee plus fees in accordance with use, could have a similar result. If some particular activity costs more to the forest than other activities, different fees could be charged to users participating in different activities. Because users other than hikers had lower price elasticity of demand than hikers, charging higher fees to some activities other than hiking could be justified not only in terms of economic efficiency but also from an equity point of view, if those activities were shown to cost the forest more than hiking does. Further research effort is thus desired to explore the potential of various fee pricing options.

It was estimated that the economic value of recreation in McDonald Forest is relatively low compared with that of timber. Recreation, as well as timber, accounts for only a part of the overall economic value of forests. Many other benefits, such as those accrued from the provision of scenic views, clean air and clean water, fish and wildlife, and education and research sites, also contribute to the overall economic value of forests. Therefore, comparing specific "pieces", such as in the case of "timber versus owl" type of controversy, would be not only meaningless but also misleading. Rather, which management option maximizes the overall benefit accrued to the society should be the real problem. Some options may maximize timber value but may reduce recreational and other amenity values. Some options may enhance both timber and amenity values. Economic valuation has the potential to provide a basis for choosing a resource management option that is most beneficial to society. Further research effort is thus desired to identify and measure various benefits that forests provide to society. The contingent valuation method would be a useful tool for this purpose.

As a final remark, this study did not particularly address problems specifically relevant in developing countries. There are some reasons to think that applying CVM in developing countries would be more difficult than applying it in developed countries. For example, unstable and undeveloped monetary systems would make it difficult to rely on money as a measure of values. Because of relatively large social inequality in developing countries, definition of the population of interest would also be one of the major problems. Lack of census data would exacerbate the difficulty of defining the population of interest. Therefore, before planning a CVM study in developing countries, the researchers must make clear whose value should be counted more than others, who benefits, and who pays for the valued good. Also, they should not overlook the social and cultural backgrounds of the population of interest. In addition, low education levels and literacy rates and/or a complex language system might make it extremely difficult for CVM researchers to describe the CVM scenario and to ask questions in a uniform fashion across respondents, causing biases such as interviewer bias.

Despite these problems particularly relevant in developing countries, CVM is still expected to provide useful information about the economic value of non-marketed goods in developing countries. It can be used also to examine whether they can charge foreign visitors, e.g., tourists, to subsidize local residents. It is thus desirable that CVM techniques specifically designed for application in developing countries be developed.

BIBLIOGRAPHY

Adams, R. M., O. Bergland, W. N. Musser, S. L. Johnson, and L. M. Musser. 1989. User Fees and Equity Issues in Public Hunting Expenditures: The Case of Ring-Necked Pheasant in Oregon. *Land Economics*, 65(4):376-85.

Arrow, Kenneth, Robert Solow, Paul R. Portney, Edward E. Leamer, Roy Radner, and Howard Schuman. 1993. Report of the NOAA Panel on Contingent Valuation. A report of National Oceanic and Atmospheric Administration (NOAA) Contingent Valuation Panel submitted to the Office of General Counsel, U.S.D.C., Washington, D.C. 64p.

Bahls, Jane Easter. 1990. Forest Fun: Fee or Free? *American Forests*, 96(Jan/Feb):28-30&65-67.

Binkley, Clark S. and Robert O. Mendelsohn. 1987. Recreation User Fees: II. An Economic Analysis. *Journal of Forestry*, 85(May):31-35.

Bishop, Richard C. 1987. Economic Values Defined. In: D. Decker and G. Goff (Eds.), Valuing Wildlife: Economic and Social Perspectives (pp.24-33). Westview Press, Boulder, CO.

Bishop, Richard C. and Thomas A. Heberlein. 1990. The Contingent Valuation Method. In: Rebecca L. Johnson and Gary V. Johnson (Eds.), *Economic Valuation of Natural Resources* (pp.81-104). Westview Press, Boulder, CO.

Bowes, Michael D. and John V. Krutilla. 1989. Multiple-Use Management: The Economics of Public Forestlands. Resources for the Future, Washington, D.C. 356p.

Bowker, J. M. and John R. Stoll. 1988. Use of Dichotomous Choice Nonmarket Methods to Value the Whooping Crane Resource. *American Journal of Agricultural Economics*, 70(May):372-81.

Cameron, Trudy Ann. 1988. A New Paradigm for Valuing Non-Market Goods Using Referendum Data: Maximum Likelihood Estimation by Censored Logistic Regression. *Journal of Environmental Economics and Management*, 15:355-79.

Cameron, Trudy Ann. 1991. Interval Estimates of Non-Market Resource Values from Referendum Contingent Valuation Surveys. *Land Economics*, 67(4):413-21.

City of Corvallis. 1994. One Dollar Park Donation Program Bi-Annual Report. A report (letter size, 2 pages) distributed to Corvallis residents. Parks and Recreation Department, Corvallis, OR.

Cooper, Joseph C. 1993. Optimal Bid Selection for Dichotomous Choice Contingent Valuation Surveys. *Journal of Environmental Economics and Management*, 24:25-40.

Cordell, H. Ken, John C. Bergstrom, Lawrence A. Hartmann, and Donald B. K. English. 1990. An Analysis of the Outdoor Recreation and Wilderness Situation in the United States: 1989-2040. A technical Document Supporting the 1989 USDA Forest Service RPA Assessment. General Technical Report RM-189. Rocky Mountain Forest and Range Experiment Station, U.S.D.A. Forest Service, Fort Collins, CO. 113p.

Cory, Dennis C. 1980. Equity-Efficiency Tradeoffs in Natural Resource Management: The Case of Congestion. *Journal of Environmental Systems*, 9(4):325-34.

Dixon, John A. and Paul B. Sherman. 1990. Economics of Protected Areas. Island Press, Washington, D.C. 234p.

Duffield, John W. and David A. Patterson. 1991. Inference and Optimal Design for a Welfare Measure in Dichotomous Choice Contingent Valuation. *Land Economics*, 67(2):225-39.

Finley, Marlene T. 1990. McDonald Forest: A Case Study in the Use of the Recreation Opportunity Spectrum Planning Framework in a Near-Urban Forest. Thesis submitted to Oregon State University for the degree of M.S. 82p.

Gramlich, Edward M. 1990. A Guide to Benefit-Cost Analysis. 2nd ed. Prentice-Hall, Inc., New Jersey. 246p.

Hanemann, W. Michael. 1984. Welfare Evaluations in Contingent Valuation Experiments with Discrete Responses. *American Journal of Agricultural Economics*, 66:332-41.

Harris, Charles C. and B.L. Driver. 1987. Recreation User Fees: I. Pros and Cons. *Journal of Forestry*, 85(May):25-29.

Johnson, Rebecca L., N. Stewart Bregenzer, and Bo Shelby. 1990. Contingent Valuation Question Formats: Dichotomous Choice versus Open-Ended Responses. In: Rebecca L. Johnson and Gary V. Johnson (Eds.), *Economic Valuation of Natural Resources* (pp.193-204). Westview Press, Boulder, CO.

Kimura, Takashi. 1992. The Value of Forested Landscapes for Adjacent Residents of an Urban Forest. Thesis submitted to Oregon State University for the degree of M.S. 82p.

Leuschner, William A., Philip S. Cook, Joseph W. Roggenbuck, and Richard G. Oderwald. 1987. A Comparative Analysis for Wilderness User Fee Policy. *Journal of Leisure Research*, 19(2):101-14.

Loomis, John B. 1988. Contingent Valuation Using Dichotomous Choice Models. *Journal of Leisure Research*, 20(1):46-56.

McConnell, K. E. 1990. Models for Referendum Data: The Structure of Discrete Choice Models for Contingent Valuation. *Journal of Environmental Economics and Management*, 18:19-34.

Mitchell, Robert Cameron and Richard T. Carson. 1989. Using Surveys to Value Public Goods: The Contingent Valuation Method. Resources for the Future, Washington, D.C. 463p.

Oregon State University. 1993a. McDonald-Dunn Forest Plan: Presentation to the Dean. Second draft presented to the dean of the College of Forestry, Oregon State University on Feb.19, 1993, with minor revisions on May 24, 1993. McDonald-Dunn Research Forest Planning Team, College of Forestry. 60p.

Oregon State University. 1993b. Draft OSU College Forest Standards, Guidelines, and Monitoring Plan. Document accompanying McDonald-Dunn Forest Plan. Revision Mar.29, 1993. McDonald-Dunn Research Forest Planning Team, College of Forestry. 75p.

O'Toole, Randal. 1988. Reforming the Forest Service. Island Press, Washington, D.C. 247p.

Peterson, George L., Beverly L. Driver, and Perry J. Brown. 1990. The Benefits and Costs of Recreation: Dollars and Sense. In: Rebecca L. Johnson and Gary V. Johnson (Eds.), *Economic Valuation of Natural Resources* (pp.7-24). Westview Press, Boulder, CO.

Pindyck, Robert S. and Daniel L. Rubinfeld. 1992. Microeconomics. 2nd ed. Macmillan, New York. 719p.

Ramsey, Fred and Dan Schafer. 1992. The Statistical Sleuth: An Intermediate Course in Statistical Methods. A text material used by the Department of Statistics, Oregon State University, for intermediate statistics courses.

Randall, Alan. 1987. Resource Economics: An Economic Approach to Natural Resource and Environmental Policy. John Wiley & Sons, Inc., New York. 434p.

Reiling, Stephen D., Hsiang-Tai Cheng, and Cheryl Trott. 1992. Measuring the Discriminatory Impact Associated with Higher Recreation Fees. *Leisure Science*, 14:121-37.

Rosenthal, Donald H., John B. Loomis, and George L. Peterson. 1984a. The Travel Cost Model: Concepts and Applications. General Technical Report RM-109. Rocky Mountain Forest and Range Experiment Station, U.S.D.A. Forest Service, Fort Collins, CO.

Rosenthal, Donald H., John B. Loomis, and George L. Peterson. 1984b. Pricing for Efficiency and Revenue in Public Recreation Areas. *Journal of Leisure Research*, 16(3):195-208.

Smith, V. Kerry. 1993. Nonmarket Valuation of Environmental Resources: An Interpretive Appraisal. *Land Economics*, 69(1):1-26.

State of Oregon. 1990. Riskey Notes, Vol.4, No.1. Risk Management Division, Department of General Services, Salem, OR.

State of Oregon. 1991. Recreational Needs Bulletin: Oregon State Comprehensive Outdoor Recreation Plan 1991. Parks and Recreation Department, Salem, OR. 116p.

State of Oregon. 1992. Business and Employment Outlook 1992 Volume 1: Economic Structure and Analysis, District 4: Benton County, Linn County. Employment Division, Salem, OR.

State of Oregon. 1993. Regional Economic Profile: Region 4, 1993: Benton, Lincoln and Linn Counties. Employment Department, Salem, OR.

State of Oregon. 1994a. Employee Handbook. Unpublished guidance material provided for Oregon State Park employees. Parks and Recreation Department, Salem, OR.

State of Oregon. 1994b. Park User Fees. A leaflet (legal size, fourfold) for public distribution. Parks and Recreation Department, Salem, OR.

Tourism and Recreation Research Unit. 1983. Recreation Site Survey Manual: Methods and Techniques for Conducting Visitor Surveys. E. & F. N. Spon Ltd., London.

U.S. Army Corps of Engineers. 1990. U.S. Army Corps of Engineers Recreation Study: A Plan Prepared for the Assistant Secretary of the Army (Civil Works); Volume I: Main Report. Washington, D.C. 147p.

U.S.D.A. Forest Service. 1990. The Forest Service Program for Forest and Rangeland Resources: A Long-Term Strategic Plan. Summary Recommended 1990 RPA Program. Washington, D.C. 41p.

U.S.D.C. Bureau of the Census. 1993. Statistical Abstract of the United States 1993. CD-ROM database #CD-ABSTR-93. Data User Services Division, Washington, D.C.

U.S.D.I. Bureau of Land Management. 1993. Public Land Statistics 1992: Volume 177. Washington, D.C. 143p.

Walsh, Richard G., George L. Peterson, and John R. McKean. 1990. Distribution and Efficiency Effects of Alternative Recreation Funding Methods. *Journal of Leisure Research*, 21(4):327-47.

APPENDIX

APPENDIX A. Survey Questions Used in This Study

First, we would like to ask you some questions about the history of your visits to McDonald Forest.

1. About how often do you visit McDonald Forest during a typical year? Please check "frequency of use" for each season.

Frequency of Use	Season Summer	Fall	Winter	Spring
More than once a week	____	____	____	____
About once a week	____	____	____	____
About once every other week	____	____	____	____
About once a month	____	____	____	____
Less than once a month	____	____	____	____
Once a season	____	____	____	____
Don't go	____	____	____	____

2. About what percentage of your total use of McDonald Forest occurs on weekends? (Sat. and Sun.)

____ Always (100%)　　____ Sometimes (25-49%)
____ Usually (75-99%)　　____ Rarely (1-24%)
____ Often (50-74%)　　____ Never (0%)

3. When was your first visit to McDonald Forest?

____ (Year)

4. When visiting McDonald Forest, what is your primary activity? (Check only one.)

____ Hiking　____ Biking　____ Horseback Riding　____ Running
____ Dog Walking　____ Other (Specify): ______________________________

[**5.** to **8.** Omitted (Not used for this study)]

9. How many miles do you have to travel one way from your home to reach McDonald Forest?

____ Miles

[Continued on next page]

McDonald Forest currently spends over $100,000 per year on recreation management, which includes trail building and maintenance, brochures, signs, and planning. In the past, this money has come from McDonald Forest timber harvest revenues. The new forest plan will reduce timber harvests. If new revenue sources aren't found, the recreation budget may have to be cut back on McDonald Forest. One possible revenue source is a recreation user fee system.

1. Many public areas require recreationists to pay fees to cover the costs of management and special services. At McDonald Forest, such a system would work like the Oregon Sno-Park permits, where either an annual or daily pass would be necessary to use the forest. If the passes had the prices listed below, which would you purchase?

Circle One
a. Annual pass at $ _____ per year.
b. Daily pass at $ _____ per day.
c. Neither.

If you said neither, is it because (circle any):
a. Using the forest isn't worth that much to you.
b. You can't afford it.
c. You don't think you should pay.
d. You would go to another place. Please specify the most likely place: ____
e. Other reason, please specify: ____

2. If you said you would buy a daily pass, answer a and b below.

a. How many times per year do you think you would visit McDonald Forest at this price? ____ times.
b. It may not be possible to administer a daily pass system. If only annual passes were available, would you purchase one at the price above (in 1a)?
____ YES ____ NO

3. With whom do you typically visit McDonald Forest? (Circle One.)

a. Alone.
b. Your family member(s). If so, how many people excluding yourself?
____ adults (18 years or older).
____ children (less than 18 years).
c. Others (friends, neighbors, colleagues).

[Continued on next page]

In this section, we would like to ask some questions about your background which will help us compare your answers to those of other people. Please be assured that all of your answers will be kept confidential.

1. What is your age? ____ Years
2. Are you: ____ Male ____ Female
3. Marital Status: ____ Single ____ Married

4. How many years of school have you completed? (Check one.)

____ Some high school
____ High School graduate
____ Some college
____ Bachelor's or equivalent
____ Master's or equivalent
____ Advanced degree (M.D., Ph.D., etc.)

[5. Omitted]

6. Please check the amount closest to your total household income before taxes.

____ Under $10,000
____ $10,000-$19,999
____ $20,000-$29,999
____ $30,000-$39,999
____ $40,000-$49,999
____ $50,000-$59,999
____ $60,000-$69,999
____ $70,000-$79,999
____ $80,000-$89,999
____ $90,000-$99,999
____ More than $100,000

[7. Omitted]

8. If attending OSU, what is your major? ______________ Class standing?________

[9. to 11. Omitted]