2002

An economic analysis of transportation and congestion in Yosemite Valley

Robert B. Ferguson
The University of Montana

An Economic Analysis of Transportation and Congestion in Yosemite Valley

By

Robert B. Ferguson

B.A., The University of California at Davis, 1997

Presented in partial fulfillment of the requirements

For the degree of

Master of Arts

The University of Montana

2002

Approved by

Richard N. Barrett

Chairperson

Dean, Graduate School

3-28-02

Date

Ferguson, Robert B., M.A., January 2002 Economics

An Economic Analysis of Transportation and Congestion in Yosemite Valley (82 pp.)

Director: Richard Barrett RWB

This thesis assessed the economic magnitude of the costs and benefits that may be imposed on visitors through the Yosemite Valley Plan. In order to accomplish this assessment, the contingent valuation method was used. For this study, park visitors were interviewed regarding their willingness to pay to enter the park under differing traffic conditions and by differing transportation modes that were proposed under the hypothetical scenario. The willingness to pay estimates allowed for the calculations of the total benefits and costs of the scenario presented to the respondents.

The estimated mean willingness to pay of the respondents showed very little value placed on reduced congestion by the visitors to Yosemite Valley. Overnight visitors on the average valued a 50% reduction in automobile congestion by $1.53 per visitor group. This study also showed that any visitor benefits that may be created by the plan would be small, approximately $670,000.

While this study assessed the visitor benefits that may be created due to the Yosemite Valley Plan, it did not account for ecological benefits due to the reduction of total automobile use in Yosemite Valley or benefits due to increased road and pedestrian safety.

Table of Contents

List of Tables

Chapter 1: Introduction

Over the last few decades, visitation at national parks has risen steadily, and the problems associated with high visitor rates at national parks have been characterized by the familiar phrase, "loving our parks to death." As a result, national park managers have begun looking at different ways to lessen the human impact on the natural environment of the parks. Automobile use and traffic congestion have been among the problems on which park managers have focused their attention. Zion, Denali, and Grand Canyon National Parks have already implemented public transportation systems and begun to restrict some private automobile use. With the publication of the *Final Yosemite Valley Plan/SEIS*, Yosemite National Park is also looking to automobile restrictions and public transportation as the answers to the problems caused by private automobile use.

1.1. Yosemite National Park

The national park at Yosemite was created in 1890. Since that time Yosemite National Park has emerged as one of the most visited natural attractions in the United States. Automobiles were officially permitted in the park in 1913. In 1954, the number of visitors to Yosemite exceeded one million for the first time, and by the mid 1990's, attendance at Yosemite grew to over four million annually.

Yosemite's large visitor numbers can be attributed to its location in California. It is located in the central-eastern portion of the Golden State and in relatively close proximity to the Bay Area. Yosemite National Park is accessible by three highways from its south, southwest, west, and east entrances (highway 120 passes through Yosemite and is the road leading to the west and east entrances). Automobiles are unrestricted in Yosemite and tour buses, along with a regional transit system, allow for easy access to the park.

Yosemite Valley is the park's most visited tourist attraction. Within the Valley lie El Capitan and Half Dome, two of the most recognizable features in Yosemite. Meadows, waterfalls, river, wildlife, and massive granite walls make Yosemite Valley a strong lure for the millions of visitors each year.

Since the visitor attendance at many national parks has risen dramatically over the last few decades, the National Park Service has begun to evaluate the implications of high automobile use within parks. In many high profile parks automobile use has been viewed as a problem in a number of areas. In response to the identification of the problems caused by automobile use, Yosemite National Park has focused on reducing automobile congestion in order to lessen these problems.

In 2001, Yosemite National Park published the *Final Yosemite Valley Plan/SEIS*. The specific purposes of the plan, as listed under the Executive Summary, are to restore and protect the resources of Yosemite Valley, provide for high-quality visitor experiences, reduce traffic congestion, and provide effective park operations. In dealing with automobile congestion, the *Final Yosemite Valley Plan/SEIS* is intended to move towards the goal of the *General Management Plan* of reducing automobile congestion.

The *Final Yosemite Valley Plan/SEIS* focuses primarily on the impact of those visitors traveling to Yosemite Valley via personal vehicle without overnight accommodations inside the Valley. From this point forward, these visitors will be categorized as "day-use visitors". All other visitors will be referred to as "overnight visitors". This categorization of visitors includes day-use visitors accessing the Valley by public vehicle in the category "overnight visitors". The Valley Plan proposes a prohibition of some day-use personal vehicles and the creation of a free out-of-Valley shuttle bus system. Under this plan, automobile congestion in Yosemite Valley during peak tourist months would be reduced by approximately 50%[1]. This reduction in traffic would confer benefits in the form of reduced congestion but impose costs in the form of the lost convenience of private automobile use.

[1] 44.7% of vehicles in Yosemite Valley are day-use vehicles (Gramann, vii).

With management plans aimed at changing the quality of Yosemite Valley and the way it is accessed, it is important to understand how this change will affect visitors. This is especially true when looking at the environment in which Yosemite National Park finds itself. Because of political and economic concerns, the park managers at Yosemite must not only be concerned with protecting its natural environment; they must also focus on how the management plans will affect the gateway communities and other groups that rely on Yosemite National Park.

1.2. Thesis Objective

The purpose of this study is to assess the economic magnitude of the costs and benefits that may be imposed on visitors through the Yosemite Valley Plan. To accomplish this assessment, the contingent valuation method is used. In the contingent valuation method, individuals are asked their willingness to pay for a good contingent upon a hypothetical scenario described by the researcher. For this study, park visitors are interviewed regarding their willingness to pay to enter the park under differing traffic conditions and by differing transportation modes that are proposed under the hypothetical scenario. The willingness to pay estimate will allow for the calculations of the total benefits and costs of the scenario presented to the respondents.

1.3. Thesis Organization

This thesis is presented in six chapters. The second chapter of this thesis contains the review of literature. This chapter discusses the current literature concerning the valuation of non-market goods and the contingent valuation method, dichotomous choice modeling methods, and national park management plans and studies. The third chapter discusses the different modeling methods used in the study and presents the models used. The model estimation and estimation of benefits derived from the models is also explained. The fourth chapter discusses the survey instrument used and the approval for research. Also, the descriptive data is reported along with analysis of protest responses. The fifth chapter covers the model estimation and calculation of benefits associated with alternative transportation and congestion scenarios. This chapter covers the multivariate and bivariate model results along with the median and truncated mean willingness to pay estimates. To finish this chapter, the total values based on visitor groups and the truncated mean willingness to pay estimates are discussed. The last chapter of this thesis discusses the overall conclusions of the study as well as ideas for future research.

Chapter 2: Review of Literature

2.1. Introduction

Non-market commodities and the measurement of values associated with these commodities have received considerable attention in the economic literature in the last two decades+. This attention has been greatest in the area of resource and environmental economics where public goods and market externalities are the focal point. The following is a review of literature describing the characteristics of non-market commodities and the different methods used in measuring the values of these commodities.

2.2. The Economic Value of Non-Market Commodities

Non-market commodities are valued for a variety of uses and reasons, all of which are important in estimating the total economic value of a resource. *Use* values of a non-market commodity may be either consumptive or non-consumptive (Jakobsson 1996). Fishing in a public lake or stream is a consumptive use of that resource. That same resource, though, may be used in a non-consumptive way. An individual may simply enjoy the scenic beauty or tranquility associated with the lake or stream. Both consumptive and non-consumptive values play important roles when valuing non-market commodities.

Non-use values are divided into three types: existence, option, and bequest. Existence value derives from the pleasure of knowing that a resource exists. Option value is that associated with keeping alternative possibilities open. It derives from the fact that creating future options and keeping the options available at the present time is a benefit. Bequest value comes from the satisfaction of allowing for the well being of future generations (Power 1996).

2.3. Measuring the Value of Non-Market Commodities

Seeing the lack of markets as a missing key component for the efficient provision of public goods, economists first began developing different methods for providing the information needed for efficient policy making as early as the 1940's, when Hotelling first proposed the travel cost method and Ciriacy-Wantrup suggested the use of the "direct interview method" to measure the values associated with natural resources (Mitchell 1989). Since these first explorations into the values associated with non-market goods, three distinct methods for evaluating non-market goods have emerged: the hedonic pricing, travel cost, and contingent valuation methods. These three methods are discussed in the following sections.

2.3.1 The Hedonic Pricing Method

The hedonic pricing method is used for estimating values of both market and non-market characteristics of a marketed good. The method analyzes a marketed good and assumes that the price of the good is a function of its different characteristics. Variations in the price of the good are associated with the non-market characteristics of that good. These variations in price due to variations in the non-market characteristics are taken to be a measure of the characteristic's value. The method is most commonly used in property value studies in which the value of a particular property is determined by all relevant characteristics of that property, including environmental and neighborhood characteristics. For example, the additional amount an individual is willing to pay for a house in location A rather than in location B is taken as a measure of the willingness to pay for the environmental conditions associated with location A but not B (Mitchell 1989).

Because the foundation for valuing a good using the hedonic pricing method rests on correctly specifying the characteristics of the good, the researcher must be able to control for, and obtain data on, all relevant characteristics of the good. (Mitchell 1989). The hedonic pricing method is not suitable for this study since there is no example of a good whose price varies with the level of congestion at Yosemite.

2.3.2. The Travel Cost Method

The travel cost method was first proposed by Hotelling in 1949 and is used to value site-specific recreational benefits (Jakobsson 1996). The travel cost method assumes that the travel costs incurred by a visitor to a recreation site may be interpreted as the price that the visitor is willing to pay for that visit to the site (Neher 1989). A demand curve for the recreational site may be derived by first specifying zones at different distances from the recreation site in question and then surveying individuals in order to estimate the number of visits to the site from each of the different zones. Per capita visitation rates from each zone are associated with travel costs from zone to site, in order to establish the demand curve for the recreation site. The value of the site derived from the travel cost model is an estimate of Marshallian consumer surplus under the demand curve.

Because the travel cost model relies on observed willingness to pay for travel costs, it is difficult to adapt to hypothetical changes in environmental quality. While some progress has been made in dealing with environmental quality in the models by using a first-stage participation estimation with environmental quality as an argument (Mitchell 1989), hypothetical scenarios are still beyond the scope of the travel cost method.

2.3.3. The Contingent Valuation Method

The contingent valuation (CV) method creates a hypothetical market that gives an individual the opportunity to buy the good or service in question. The CV method has been used in a number of different scenarios, including the impact of a proposed power plant on surrounding aesthetics, national freshwater quality, and transportation safety (Mitchell 1989). Unlike both the travel cost and the hedonic pricing methods that use only observable market transactions, the CV method uses a survey instrument (whether it is an in-person interview, phone interview, or mailed survey) to introduce a hypothetical scenario to an individual. The quality and quantity of the good or service is specified in this hypothetical scenario, and the individual is then asked what he/she would pay for the good or service. The survey thus elicits an individual's willingness to pay (WTP) for a good or service. The WTP question of the survey may be expressed as an open-ended question, a bidding game, or as a referendum (e.g. yes/no, join/not join, etc.). The mean or median of the WTP is then used as a measure of the cost or benefit to individuals due to the hypothetical scenario.

2.4. Theoretical and Operational Issues of the Contingent Valuation Methodology

CV analysis is extremely flexible due to the use of a survey instrument for data collection. This use of a survey instrument, though, creates many potential problems. These, along with methods for alleviating them, are discussed in the following sections.

2.4.1. Strategic Bias

Strategic bias is present in CV analysis if respondents intentionally mislead the researcher (Jacobsson 83). This bias is generally seen with questions having large policy implications. Strategically biased answers are intended to influence public policy and, therefore, are not an accurate reflection of an individual's true WTP for the good. For example an individual might overstate her WTP for the protection of a waterway if she believes that by supporting one waterway, the protection of other waterways would be made easier.

Strategically biased answers may also lead to under estimating the value of the good. This problem is referred to as the free rider problem. Free riders are individuals that purposefully reveal a WTP that is less than it is worth to them expecting that others will pay enough to provide it nonetheless (Mitchell 1989). Free riders tend to underbid if they believe that they will actually have to pay the revealed amount, and they also believe that the good will be provided regardless of what their revealed preference is.

2.4.2. Hypothetical Bias

Hypothetical bias is the difference between the stated payments in response to a hypothetical scenario and actual payments when individuals are given the opportunity to pay in reality (Jakobsson 1996). This problem is created when respondents must predict what they would do in the hypothetical scenario. Scenarios that are unrealistic to the respondent may cause the respondent to overstate her willingness to pay because she feels that the she will never actually have to pay the amount specified. Unfortunately, hypothetical bias is generally difficult to estimate. Researchers have found that individual responses that are inconsistent with economic theory (e.g. WTP is greater than income) may be a sign of hypothetical bias.

Duffield and Allen (1988) state that the only way to truly isolate any hypothetical bias in a CV survey is to compare the results of the model to actual cash transactions. In a study of donations to improve stream flows for endangered fisheries in Montana, Duffield and Neher (1996) found that only about one third of the stated willingness to pay is easily collected from individuals. They also point out that this figure may change when different payment vehicles are used and when different resources are valued. The debate over whether CV analysis is able to provide valuation estimates that are close to the true value of the good is still open to research. Duffield and Ward (1992) explain that, to date, studies have shown that the estimates for use values obtained from contingent valuation are close approximations to the actual values, but that non-use values are much more susceptible to over estimation (309).

The best deterrent to hypothetical bias in CV analysis is to provide the respondent with a hypothetical situation and payment vehicle that is as realistic and credible as possible. This is made easier when estimating use-values since they are much more closely related to market type situations (Jakobsson 1996).

2.4.3. Design Bias

One of the most important decisions that a researcher must make in designing a survey instrument to be used in CV analysis concerns how much information to give to respondents. Early literature assumed the valuation process was concerned only with the good in question, not other elements of the hypothetical market (Jakobsson 1996). The survey design itself, though, is now seen as a very important part of the CV process. This suggests that the payment mechanism, information about the good in question, and likelihood of actual provision need to be correctly specified in the design of the survey. The survey questionnaire should adequately inform the respondent without exceeding an appropriate length. Because of this, it is often necessary for extensive pre-testing of the survey instrument in order to see if the information provided is confusing or lacking in detail.

2.4.4. Form of Payment Question

There are three formats for survey questions eliciting WTP. The first, the bidding game format, imitates an auction scenario where respondents are first asked whether or not they would be willing to pay a specified amount. If the answer is "yes", they are then asked if they would pay another, higher amount. This process continues until the respondent gives a negative answer. There are two virtues to this method: it increases the likelihood of capturing the highest price an individual is willing to pay and it enables the respondent to fully consider the value of the good (Mitchell 1989).

These virtues are overshadowed, however, by the potential problem of starting point bias. Starting point bias may affect how the individual proceeds through the bidding game. If the starting point is above the true WTP of the respondent, the good may be overvalued, and if the starting point is well below the respondent's WTP it may yield an under estimation of the value of the good.

A second question format used in CV analysis is the open-ended. The open-ended method simply asks a respondent what he/she would be willing to pay for a good or service. The potential for strategic and hypothetical bias with this method is great. Also, even if it is possible for an individual to provide a WTP amount, it is much more difficult to state a maximum amount without a frame of reference. Because of this, open-ended estimates may be lower than those found with other methods (Jakobsson 1996).

The final, and most common, format employed by CV researchers is dichotomous choice. In this format the researcher first establishes a set of bid levels. Each respondent is then asked whether or not he/she would be willing to pay the specified bid (the bid level is chosen randomly before the interview) for the good. Probabilities that a respondent would answer "yes" to each bid level are then calculated. From the distribution of these probabilities, the mean WTP may be estimated. The problems encountered using the dichotomous choice method are that many more observations are needed for the same statistical precision as the other methods allow, and the researcher must make an assumption about the specification of the valuation function or the indirect utility function (Mitchell 1989). Model specification, and the estimation of median, mean, and truncated mean WTP will discussed be in later sections.

2.4.5. Instrument Bias

The payment mechanism specified in the survey instrument can have a profound effect on the WTP reported by the respondent. Individuals may like or dislike a specific mechanism or simply find it unrealistic. Past studies have found that different payment mechanisms may significantly alter the estimated value in a CV analysis. Mitchell and Carson note that, "a public good does not have a value independent of its method of financing" (124).

Neutrality and realism are the two criteria used for the appropriate specification of payment vehicles. By using a payment vehicle that is both neutral and realistic, the researcher is able to insulate the study from any bias that may occur due to the attitude of the respondent towards the payment vehicle. Because it has these features, an increase in overall trip expenses has been widely used as a payment vehicle when recreation trips are the good being valued. Respondents are familiar with paying expenses and expenses are relatively neutral in comparison to other vehicles of payment (Duffield et al. 1990).

2.4.6. Non-Response Bias

Some level of non-response bias is common in CV surveys and can take the form of *unit* and *item* non-response. Unit non-response is the non-participation of the respondent in the survey. Item non-response refers to a respondent failing or refusing to answer particular questions in the survey. Mailed surveys are most subject to unit non-response bias because it is not certain whether the respondent did not participate in the survey because of the subject matter or for other reasons. To alleviate this, mail surveys that are not completed are generally followed up with telephone inquiries.

Item non-response in CV analysis presents the researcher with a much larger problem. There are four categories of non-response to WTP questions: don't knows, refusals, protest zeros, and responses that fail to meet the standard for minimal consistency (Mitchell 1989). Protest zeros are the most problematic. It is necessary to distinguish those who might truly forego the good from those who simply object in principle to paying for it. To sort out the reasoning behind a respondent's answers, it is common to have follow-up questions to the WTP question that ask why the respondent answered in the manner given.

2.4. The Report of the National Oceanic and Atmospheric Administration (NOAA) Panel on Contingent Valuation

In 1993, the NOAA convened a panel of economists to examine the state of contingent valuation and assess whether it provides reliable information concerning the valuation of non-marketable goods. The appendix of that report gives the guidelines necessary for acceptable and valid CV analysis. It describes all of the above potential biases and the techniques that will minimize them.

2.5.1. General Guidelines

The panel found that the most accurate method of eliciting surveys is the in-person interview method. The in-person interview allows the researcher to randomly select individuals from the entire population associated with the study. Lists, such as telephone directories, that cover only a part of the population restrict mail surveys to those listed. Also, mail surveys can be reviewed before returning the survey. This increases the probability that those interested in the policy will respond in higher numbers than those who do not. Telephone interviews are less likely to maintain response motivation as in-person interviews. The panel found that both coverage and response rates are higher when using the in-person interview method (NOAA 1993).

2.5.2. Survey Design

The panel concluded that the design of surveys should be conservative in order to eliminate extreme responses that may lead to over estimation of WTP (NOAA 1993). Also, while the design should be conservative, it is necessary to describe accurately the program or policy. Pre-testing will allow the researcher to ascertain whether the information is too complex or insufficient. The goal of the survey should be to create a realistic hypothetical scenario that is well formulated and easily communicated via a survey instrument. Accomplishing this goal will undermine hypothetical bias in the CV analysis.

The panel found that the potential for bias in both the open-ended format and the bidding game format was too great for viable CV analysis. The referendum, or dichotomous choice, format is the most desirable. The dichotomous choice format eliminates starting point bias and the incentive for protest bids. It is also desirable because it mimics a voting procedure that is familiar to most individuals. In addition to the "yes"/"no" responses available to respondents, a "don't know" category should also be added. The WTP question should then have a follow-up question to aid in interpreting the response. Also to help interpret the responses, a variety of other questions should be added including income, prior knowledge of site, visitation rates, distance to site, understanding of task, and belief in scenarios (NOAA 1993).

2.6. Models for Analysis of Bivariate Responses

The following section covers the procedures that allow for the average WTP to be derived from CV surveys. The procedures include specifying a functional form for the distribution of willingness to pay, estimating the parameters of the distribution function, and calculating a central tendency of willingness to pay on the basis of the estimated function.

2.6.1. Measure of Surplus and the Logit Model

Hanneman (1984) shows that the probability that an individual will be willing to pay an estimated bid amount may also be viewed as the probability that the respondent's WTP is greater than the bid amount. This can be expressed by the following equation

$$2.1. \qquad P = Pr(W>x) = 1-F(x)$$

where P is the probability of a respondent answering yes to the bid value x, W is the respondent's true WTP, and F(•) is a cumulative distribution function of the willingness to pay values over a population. Using a logistic function to model the willingness to pay yields the following equation

$$2.2. \qquad P = (1+e^{-a-bx})^{-1}$$

Duffield and Allen (1991) show that the above equation may be transformed into the logit model:

$$2.3. \qquad L = \ln(P/(1-P))=a+bx$$

Where L, the "logit", is the log of the odds of an individual answering yes to a specified bid amount x, and a and b are the estimated parameters from the data.

It is common, though, for the above equation not to fit the data for contingent valuation well. This is because the logistic distribution is symmetric and allows for negative values while the WTP distributions are often skewed to the right and positive (Duffield et al. 1990). A way to circumvent this problem is to replace x with *log*(x) yielding

2.4. $$L = \ln(P/1-P) = a+b \ln(x)$$

Variables other than the bid amount (income, etc.) may be thought to affect WTP. If these variables are included, the logit form of the equation is written

2.5. $$L = a+b'X$$

where b' is a vector of parameters and X is a vector of explanatory variables (i.e. income, log(bid), etc.). The multivariate equation in terms of P is written

2.6. $$P = (1+e^{-a-b'x})^{-1}$$

2.6.2. Estimation Techniques and Benefit Measures

The maximum likelihood method is generally the preferred method for estimating logit models. Maximum likelihood estimation (MLE) allows for the estimation of the parameters for nearly all analytical specifications of the probability function

(Cramer 1991). Hanneman (1984) also shows that MLE is preferred to generalized least squares because of its flexibility.

The central tendency of the WTP that will be used to find the total value of the good may be measured once the parameters are estimated. This central tendency may be reported as the mean or median. In many cases, though, the mean may be skewed. This is a result of the non-negative characteristics of the WTP distribution. If the mean is skewed there may be a marked difference between the mean and median. A heavily skewed mean may reflect the values of only a small proportion of the population. While the median does not have this same problem, it may not be used to aggregate over an entire population.

The truncated mean can avoid the problems of the median and mean discussed above. The truncated mean simply assigns a value T to all WTP values above T before computing the mean. The debate over the truncated mean, though, lies with what value to give T. The value T is commonly given the value of the highest accepted bid amount in the survey. Giving the value T the highest bid amount does not allow the welfare measure to be extrapolated beyond the observed data (Duffield and Patterson 1991), and therefore is a commonly used upper limit for the truncation point.

2.7. Review of Other Public Transportation Practices in National Parks

Public transportation is a major form of visitor transportation in many national parks. Zion, Denali, Acadia, and Grand Canyon National Parks all have a public transportation system transporting visitors from outside the parks. Also, Yosemite National Park has a free in-Valley shuttle and many other parks have shuttle services operating inside park boundaries. This section covers the transportation implications of the Yosemite Valley Plan along with plans adopted by Grand Canyon National Park and a study performed in Denali National Park. The information provided in this section is intended to show what other parks have been doing to alleviate transportation problems and how these plans have affected visitors.

2.7.1. The Preferred Alternative of the Yosemite Valley Plan

The "preferred alternative" of the Yosemite Valley Plan emphasizes the need for an alteration in transportation and parking in Yosemite Valley. The selection of the "preferred alternative" was based on two criteria. The first was the alternative's ability to best accomplish the stated purpose. The second was how well the alternative satisfies the goals of the National Park Service.

Under the "preferred alternative", day-use parking would be restricted to 550 cars. This would allow for a consolidation of day-use parking into a single parking structure. When parking within this designated area reached capacity day-use visitors would then park in out-of-Valley parking areas where shuttle service to the Valley would be provided. Out-of-Valley parking structures would be located at Badger Pass for visitors using the South Entrance, Foresta for visitors using the Big Oak or Tioga Pass Entrances, and El Portal for visitors using the Arch Rock Entrance.

The out-of-Valley shuttle buses would operate between April and October. One bus would leave every 6 minutes from the El Portal and Badger Pass parking areas while one shuttle bus would leave every 12 minutes from the Foresta parking area. This system would allow for one out-of-Valley bus to arrive at its destination (Yosemite Village) every 3 minutes. All buses would be equipped with adequate storage areas for recreation equipment (bicycles, etc.). Distance and travel times for the shuttle buses may be found in the following table.

Table 2.7.1. Out-of-Valley Shuttle Distances

Characteristics	**Badger Pass**	**El Portal**	**Foresta**
Route Length (round trip)	35.5 miles	28.1 miles	20.9 miles
Travel Time (round trip)	120 minutes	98 minutes	78 Minutes

2.7.2. Grand Canyon National Park

In 1995, Grand Canyon National Park approved its *General Management Plan*. One of the major issues addressed by the Plan was the expansion of the existing South Rim transit system. The Grand Canyon National Park's management plan outlines a visitor transportation plan that is much like that of the proposed plan for Yosemite National Park. Day-use visitors to the Grand Canyon Village area leave their cars outside the park and are only able to access the park via the public transit system. Those visitors having overnight accommodations will be allowed to drive their personal vehicles to a designated parking area. The plan proposed by Grand Canyon National Park differs from Yosemite's in that a light rail system along with shuttle buses is the public transit system of choice (South Rim Transit 2001).

In 2000, though, two trends emerged at Grand Canyon National Park that have made the park re-evaluate its transit plans. The first is that annual visitation has stagnated. Between the years of 1994 and 1999, visitation grew at a meager 0.8%. The second is the increasing cost of the light rail system (South Rim Transit 2001). This increased cost in the transit system is magnified by the inadequate growth of the visitation that is needed to produce revenue for the transit system. The problems facing Grand Canyon National Park puts new emphasis on proper planning and more innovative ways to help parks predict how different plans may affect visitation and thus the status of the park from a planning perspective.

2.7.3. Denali National Park Assessment of Visitor Satisfaction with Public Transportation Services

In 1971, Denali National Park closed its roads to private vehicles for those visitors not having campground permits. To replace the use of private vehicles, a transportation system was developed to allow continued visitor access. The transportation system, in comparison to other parks at that time, was unique.

While the system has been in place for over 25 years, the National Park Service does not have any definitive knowledge regarding visitor attitudes toward the transportation system. In response to this lack of information, the Park Service employed a survey in 1996 that focused on examining visitor attitudes toward the transportation system.

The survey was presented to 1,385 visitors using the transportation system. Of the 1,385, 860 were found to be usable. The questionnaire asked respondents to rate the quality of the bus for viewing wildlife and perceptions of traffic congestion on the park road (Denali 18). Table 2.7.3. lists the visitor ratings found through the survey instrument.

Table 2.7.2. Visitor Attitudes Toward Denali Transportation System

Factors that contributed to visitor satisfaction	Yes	No
Freedom to view park instead of focusing on driving	623 (72%)	110 (28%)
Wildlife observations	749 (87%)	110 (13%)
Factors that detracted from visitor satisfaction	**Yes**	**No**
Uncomfortable ride	67 (8%)	795 (92%)
Traffic on road	76 (9%)	784 (91%)

Chapter 3: Modeling Methods

This chapter discusses the different models used to estimate mean willingness to pay to visit Yosemite Valley under current conditions and under a hypothetical policy where day use of private automobiles is prohibited. Because the hypothetical scenario affects certain visitors differently, it is necessary to distinguish between overnight visitors (who presumably benefit from the policy) and day-use visitors (who may also benefit but must substitute public transportation for their personal vehicles). Once the mean willingness to pay for each model is found, the losses or gains will be calculated by multiplying the mean willingness to pay by the number of visitors in each class.

3.1. Model Specification

The willingness to pay for a good is determined by the price of the good and availability of substitutes, the quantity consumed, the quality of the good, income, and tastes and preferences. These variables are added to the different models to improve the CV estimates.

In order to determine the change in value of entering Yosemite Valley to visitors due to the hypothetical scenario, it is necessary to calculate the value of entering the Valley under current conditions along with the value of entering the Valley under the hypothetical scenario. To do this, three dichotomous choice questions are asked in the survey instrument. The first is asked of both day-use and overnight visitors and concerns the total amount the respondent would be willing to pay to enter Yosemite Valley under the current conditions. The second CV question asks what an overnight visitor would be willing to pay for a quality improvement in automobile congestion. The third CV question asks day-use visitors what they would be willing to pay for a quality improvement contingent upon them using a shuttle service to enter Yosemite Valley. The explanatory variables used in the modeling are bid amount, number of people in the group, number of trips to Yosemite Valley, perceived congestion, and income. The multivariate model for overnight visitors may be expressed as

$$\text{3.1.} \quad \mathrm{Log}(P/(1-P)) = a_0+a_1*\log(\mathrm{TRIPS})+a_2*\log(\mathrm{PEOPLE})+a_3*\mathrm{CONMOD} +a_4*\mathrm{CONHEAV}+a_5*\log(\mathrm{INCOME})+a_6*\log(\mathrm{BID})$$

where:

P=Probability of a yes response.

BID=Random dollar amount asked a respondent to pay.

TRIPS=Number of trips to Yosemite.

PEOPLE=Number of people in group.

CONMOD=Dummy variable with 1, congestion moderate; and base. case with 0, congestion light.

CONHEAV=Dummy variable with 1, congestion heavy; and base case with 0, congestion light.

INCOME=Annual household income before taxes.

The overnight visitor demand for entering Yosemite Valley under the hypothetical scenario of reduced congestion may be expressed as

$$3.2. \quad \mathrm{Log}(P/(1-P)) = b_0+a_1*\log(\mathrm{TRIPS})+b_2*\log(\mathrm{PEOPLE})+b_3*\mathrm{CONMOD} +b_4*\mathrm{CONHEAV}+b_5*\log(\mathrm{INCOME})+b_6*\log(\mathrm{BID2})$$

where:

BID2=Second (higher) random dollar amount asked a respondent to pay.

Using the logit model, the day-use visitor demand for entering Yosemite Valley under current conditions may be expressed as

$$3.3.\quad \mathrm{Log}(P/(1-P)) = d_0+d_1*\log(TRIPS)+d_2*\log(PEOPLE)+d_3*CONMOD +d_4*CONHEAV+d_5*\log(INCOME)+d_6*\log(BID)$$

And the day-use visitor demand for entering Yosemite Valley via an out-of-Valley shuttle under the hypothetical scenario of reduced congestion may be expressed as

$$3.4.\quad \mathrm{Log}(P/(1-P)) = f_0+f_1*\log(TRIPS)+f_2*\log(PEOPLE) +f_3*CONMOD+f_4*CONHEAV+f_5*SHUTTLE +f_6*\log(INCOME)+f_7*\log(BID2)$$

where:

SHUTTLE=Dummy variable of shuttle use with 1, used shuttle; 0, otherwise.

The bid level specified should play a heavy role in the probability that an individual will answer yes to the dichotomous choice questions. As the bid amount increases the probability of a yes response should go down.

Automobile congestion should play a role in the perceived quality of the visitor experience entering Yosemite Valley. As automobile congestion increases, the value of entering Yosemite Valley should go down. Conversely, when automobile congestion is high, the probability that an individual responds yes to the second dichotomous choice question should increase.

Higher household income should increase the probability of a yes response to a bid amount. Also, visitors preferring less congestion or who are more sensitive to congestion levels would be expected to value reductions in congestion more than those individuals that are not sensitive to the issue.

3.2. Model Estimation and Calculation of Benefits

The bivariate model will be used for calculating the central tendencies of WTP. In the bivariate model, equation 2.4., the log of the bid amount is the only independent variable. The medians and truncated means for the bivariate models are calculated as estimates of willingness to pay for overnight and day-use visitors for both current conditions and hypothetical scenarios. The median may be calculated from a bivariate model using the following equation

3.5. $$\text{Median} = \exp(-b_0/b_1)$$

The equation for calculating the truncated mean is as follows:

$$3.6. \qquad \text{Truncated mean} = \int_0^T (1-F(X))\,dx$$

where:

$F(X) = 1/[1+\exp(-(\alpha+\beta X))]$

T = truncation point

3.2.1. Confidence Intervals

Duffield and Patterson (1991) suggest that the bootstrapping technique can be used to estimate the standard errors for truncated means. With the standard errors obtained from the bootstrapping technique, it is possible to calculate confidence intervals for the truncated means. The confidence intervals may be calculated using the following equation:

$$3.7. \qquad CI = \pm SE_M \bullet t_{.05/2,\, n-k}$$

where t is the t-statistic at the 5% error level.

Chapter 4: Discussion of Data

This chapter discusses the research approval under the National Park Service and Yosemite National Park, the survey instrument, how the survey was administered, and the data collected. The questionnaire used in the study followed the form and layout of the survey instruments used in Duffield and Neher (1990), Duffield and Allen (1988), and Butkay (1989). The survey was administered between July 24, 2001, and September 4, 2001, in Yosemite Valley, Yosemite National Park. A total of 361 observations were gathered over that time. The final draft of the survey questionnaire may be found in Appendix A.

4.1. Survey Instrument

The onsite survey was designed to elicit from respondents a description of the characteristics of their trip to Yosemite Valley. Respondents were asked if they were staying overnight in Yosemite Valley or just visiting for the day, how many people and the number children under the age of sixteen were in their group. The respondents were also asked about the number of trips they would be taking to Yosemite Valley in the survey year along with the number of years they had been coming to Yosemite Valley.

A brief statement was read before proceeding to the first dichotomous choice question. Respondents were told that the next section concerned the value that they placed on their trip to Yosemite Valley. Respondents were told to think about what they were willing and able to pay for other recreational activities that they participate in. This statement was used to prepare the respondents for questions about increases in the costs of their trip and if they would have made the trip if these costs had increased by a specific bid amount. The question was asked in a dichotomous choice format and the random bid amounts ranged from $2.00 to $125.00. The question was asked as follows:

> If your costs had increased by *bid $ amount*, would you still have made the trip?

The survey then focused on automobile congestion and the effect of congestion on the visitor's trip to Yosemite Valley. The respondents were asked to rate both automobile congestion while entering Yosemite Valley and whether the automobile congestion had negatively affected their experience when entering the Valley.

A second dichotomous choice question with a bid range from $10.00 to $150.00 was then presented to overnight respondents. The question was read:

> Suppose there was a 50% reduction in the automobile congestion that you experienced while entering into Yosemite Valley. With such a change in automobile congestion would you have made the trip if your costs had increased by *bid $ amount*?

Before asking day-use visitors the second dichotomous choice question, they were asked about in-Valley-shuttle use and their familiarity with other National Park management policies. The bid levels for the second dichotomous question for day-use visitors ranged from $2.00 to $125.00. The question was read as follows:

> Suppose there was a 50% reduction in automobile congestion that you experienced today and you were only able to enter Yosemite Valley by shuttle. The new shuttle system would be very convenient and always have available seating. If the shuttle into the Valley cost *bid $ amount*, would you
>
> (a) use the shuttle to come into Yosemite Valley.
>
> (b) not come into Yosemite Valley.
>
> (c) don't know.

While the other WTP questions concern additional WTP, or in other words, the questions ask how much more would the individual be willing to pay than he/she actually did, the last WTP question is somewhat ambiguous as to whether it is a total or additional willingness to pay question. As a result the question will later be evaluated as both an addition and total willingness to pay.

The final section of the questionnaire involved questions dealing with the demographic characteristics of the respondents. These questions included zip code, highest grade or degree completed in school, current age, and income level. The interviewer, at the conclusion of the interview process, filled out the last section of the survey. The last section of the survey contained information on location of the interview, gender of the respondent, date, time, and identification number assigned.

4.2. Research Approval

Once the survey instrument was completed, it was sent to the Institutional Review Board (IRB) at the University of Montana. The board reviewed the survey instrument and found it appropriate for appropriate for research use.

The survey instrument was then sent to the National Park Service in May 2001, for National Park Service and Office of Management and Budget (OMB) approval. Each question was analyzed along with the wording used throughout the survey. Besides simple wording changes, the National Park Service required that one question be eliminated from the survey instrument before authorizing approval for research. The question eliminated asked the respondent to give the cost incurred in traveling from the nearest town outside Yosemite National Park to Yosemite Valley. While the intention of the question was to determine what the respondents perceived as the total cost of entering Yosemite Valley from outside the Park, the National Park Service felt that asking respondents to calculate that cost would be overly burdensome to the public.

After the approval for research by the National Park Service and OMB, the survey instrument and plan for research were reviewed by Yosemite National Park, which asked that two changes be made to the survey instrument. The first was that a disclaimer be read before and after the interview that would distance Yosemite National Park and the National Park Service from the research. The National Park Service at Yosemite also insisted on the removal of speech informing the respondents that Yosemite National Park was considering a policy to restrict day-use vehicles from Yosemite Valley. The speech was originally added to provide realism to the hypothetical scenario.

4.3. Site and Data Collection

The direct use value to visitors for entering Yosemite Valley was estimated from information gathered in onsite interviews with individuals currently in Yosemite Valley. Yosemite Valley is the most popular attraction in Yosemite

National Park. It can be accessed by visitors from any entrance into the Park via the Yosemite Valley Loop. The Valley Loop extends to all tourist attractions contained in Yosemite Valley including Curry Village, Yosemite Village, Sunnyside/Camp 4, El Capitan, views of Half Dome, Merced River, Lower Yosemite Falls, and many trailheads originating from the Valley. Yosemite Valley is heavily visited during the summer months by people throughout the world and sees the highest attendance by visitors during these months. Yosemite Valley and the Valley Loop are accessible by personal vehicle, tour bus, the Yosemite Regional Transportation System (YARTS), and by those willing to walk or ride a bicycle into the Valley from outside the Park entrances.

Seven sites (Yosemite Village, Curry Village, trailhead parking, day-use parking, Lower Falls, Sunnyside/Camp 4, and campground reservation) inside Yosemite Valley were chosen for conducting the survey. The sites were chosen in order to allow for a random selection of individuals regardless of how they entered the Valley and are displayed in the maps found in appendix B. To insure that the respondents were chosen randomly, every third group was interviewed. Also, each interview site was given the same amount of interview time and the time of day was rotated evenly among the seven sites.

4.4. Descriptive Data

The survey was administered during the summer months of the year 2001. The survey dates include July 24 through July 27, August 17 through August 19, and August 30 through September 4. Over these 13 days, 361 surveys were completed. The following tables illustrates the descriptive statistics compiled through the surveys of the trip characteristics and the characteristics of the visitor/visitor groups to Yosemite Valley.

Table 4.4.1. Day-Use Visitor Descriptive Statistics

Variable Name	Number	Mean	Stand. Dev.
Number of People	147	3.5918	2.5955
Number of Children	147	.7687	1.2984
First Visit	147	.3605	.4818
Years Visiting	147	8.5782	11.3960
Number of Trips	147	2.2109	8.5161
Sightseeing Activity[1]	147	.9727	.1632
Hiking Activity[1]	147	.7687	.4231
Shopping Activity[1]	147	.6190	.4872
Climbing Activity[1]	147	.0476	.2136
"Other" Activity[1]	147	.0748	.2640
Congestion Light[1]	147	.5034	.5017
Congestion Moderate[1]	147	.4217	.4955
Congestion Heavy[1]	147	.0748	.2640
Congestion Effect[1]: none	147	.4197	.4944
Congestion Effect[1]: little	147	.3877	.4889
Congestion Effect[1]: mod.	147	.1496	.3579
Congestion Effect[1]: great	147	.0475	.0456
Used Shuttle[1]	147	.7210	.4500
Years of Education	147	15.5650	2.2967
Age	147	41.7280	11.6350
Respondent Female[1]	147	.24138	.42940
Income	145	6.0000	1.6933
Distance Traveled	146	798.5000	1366.5000

[1] Mean indicates percentage of respondents answering yes to question.

Note: Some percentages do not add to 1 because respondents were allowed to answer to multiple activities.

Table 4.4.2. Overnight Visitor Descriptive Statistics

Variable Name	Sample Size	Mean	Stand. Dev.
Number of People	214	5.1542	6.0723
Number of Children	214	1.2617	2.3330
First Visit[1]	214	.2289	.4211
Years Visiting	214	12.8600	13.8970
Number of Trips	214	2.9766	11.742
Sightseeing Activity[1]	214	.9439	.2306
Camping Activity[1]	214	.6682	.4719
Hiking Activity[1]	214	.9065	.2917
Shopping Activity[1]	214	.6915	.4629
Climbing Activity[1]	214	.2336	.4241
"Other" Activity[1]	214	.0934	.2917
Congestion Light[1]	214	.5327	.5001
Congestion Moderate[1]	214	.3598	.4810
Congestion Heavy[1]	214	.1074	.3104
Congestion Effect[1]: none	214	.5140	.5009
Congestion Effect[1]: little	214	.3037	.4609
Congestion Effect[1]: mod.	214	.1355	.3430
Congestion Effect[1]: great	214	.0467	.0447
Years of Education	214	15.6540	2.3139
Age	214	40.1780	11.8290
Respondent Female[1]	214	.19626	.39810
Income	212	5.9524	1.8657
Distance Traveled	212	746.6600	1338.6000

[1] Mean indicates percentage of respondents answering yes to question.

Note: Some percentages do not add to 1 because respondents were allowed to answer to multiple activities.

The average group size and number of children were larger for overnight visitors than those for day-use visitors. Overnight visitors were also more prone to participate in activities such as hiking and mountain or rock climbing.

The average income level for both categories of respondents is based on a list of income levels presented to the respondents. Respondents were handed a card with eight different income levels indicated. The card read as follows:

Households income before taxes

a) under $9,999	e) $40,000-$49,999
b) $10,000-19,999	f) $50,000-$74,999
c) $20,000-$29,999	g) $75,000-$100,000
d) $30,000-$39,999	h) over $100,000

Respondents were asked to give the letter corresponding to the income category that best described their household income before taxes. Two day-use respondents and two overnight respondents declined to answer this question for personal reasons. The average income category indicated by day-use and overnight respondents was category "f", or $50,000 to $74,000.

The low numbers of respondents stating that automobile congestion was great was somewhat surprising. This may have been a result, though, of lowered expectations concerning the quality of traffic conditions. Many respondents were quick to point out when asked whether the automobile congestion had negatively affected their trip into the Valley that they had expected poor traffic conditions.

4.4. Protest Responses

Protest bids are generally seen in two forms. The first is a response to a bid amount that is beyond the scope of an individual's income. The second is a protest response by an individual towards the hypothetical scenario. The follow up questions asked did not yield any protest responses towards the hypothetical scenario. The first form of protest bids, though, may still be problematic.

In Duffield et al. (1990), a method for determining protest bids contingent upon an individual's income, number of trips, and bid amount is devised. The first step in the method is to isolate those respondents answering yes to the CV question and then determining their ability to pay by calculating the percentage of their income that the respondents were willing to spend for the recreational activity (here entering Yosemite Valley). In this study, this calculation was as follows:

4.1. % of Income WTP = ((Entrance Fee +Bid)*Trips)/Income

Where:

Entrance Fee = $20.00 per car

Bid = the dollar value asked in the WTP question

Trips = number of trips in year

Income = the median income of the indicated bracket

This percentage of income was calculated for each respondent answering yes to the WTP question. From the above method, the mean percentage and standard deviation was calculated. As in Duffield et al. (1990), the mean and three standard deviations created the cut-off for protest responses. Any individual showing a willingness to pay a percentage of his/her income that was over the cut-off figure was rejected. Table 4.4.3. shows the mean percentage along with the standard deviation for day-use and overnight visitors.

Table 4.4.3. Protest Response Calcilations

	Mean	**Std. Dev.**	**Mean + 3 Std. Dev.**
Percentage Day-Use	.0011	.0023	.0088
Percentage Overnight	.0077	.0643	.2006

Under the criteria above, no day-use responses were rejected as protest bids, but two of the overnight responses were rejected.

Chapter 5: Model Estimation and Calculation of Benefits

The first section of this chapter focuses on the bivariate and multivariate models. The marginal effects and elasticicities of the variables included in the multivariate model are also illustrated. The second section covers the benefit estimates found using the bivariate model. The median and truncated mean values along with the confidence intervals derived from the bivariate model are illustrated. To end this chapter, the total benefits and costs estimated for the visitors to Yosemite Valley are discussed.

5.1. Model Estimation

The variables for the bivariate models, multivariate models, summary statistics, and marginal effects and elasticities of the variables used in the multivariate models may be found in the following tables. The variables used in the multivariate models were chosen based on statistical significance and economic theory. A full multivariate model is reported in the appendix. Also, the protest responses along with incomplete responses were not included in the sample. The marginal effects at the means and were calculated by taking the derivatives of equation

$$P = 1/[1+\exp(-(a+B'X))]$$

found in section 2.6.1. The marginal effects measure the effect of a one unit change in the independent variable on the probability of a yes response to the mean bid amount. In order to calculate the marginal effects for each of the dummy variables (i.e. CONMOD, CONHEV, and SHUTTLE) a different method was used. The above equation was calculated when each dummy variable equaled 1 and 0. The equation with the dummy variable equal to 0 was then subtracted from the equation with the dummy to 1. This difference was the marginal effect. The bivariate models have only the log of the bid amount as the independent variable. The equation used for the bivariate models is the same as that found in equation 2.3.

Table 5.1.1. Multivariate Model: Day-Use Current Conditions

Variable Name	Estimated Coefficient	Standard Error	T Ratio	Marginal Effect	Elasticity
CONSTANT	-3.2709	5.3716	-.60893		
Log(BID1)	-1.4168	.25066	-5.6524	-.0709[1]	-.03912
Log(PEOPLE)	.14244	.38618	.36886	.009604	.01841
Log(TRIPS)	-.68697	.51758	-1.3273	-.07514	-.03071
CONMOD	.44399	.46315	.95864	.10715	.07777
CONHEAV	.23827	.83101	.28672	.0569	.00677
Log(INCOME)	.72019	.48082	1.4978	.02617[2]	.0000045

Note: Sample size equals 145. Percentage of right predictions equals 78%.

[1] Equal to a $10.00 change in bid level.

[2] Equal to the marginal effect at the means of a $10,000 change in income.

Table 5.1.2. Multivariate Model: Day-use Reduced Congestion

Variable Name	Estimated Coefficient	Standard Error	T Ratio	Marginal Effect	Elasticity
CONSTANT	-.32657	5.2658	-.06201		
Log(BID2)	-1.8910	.32391	-5.8379	-.0979[1]	-.04745
Log(PEOPLE)	.41242	.44670	.92325	.01925	.03234
Log(TRIPS)	-1.2970	.63572	-2.0402	-.15256	-.05464
CONMOD	.36878	.51013	.72292	.00045	.00028
CONHEAV	1.1323	.86543	1.3084	.20497	.02137
Log(SHUTTLE)	.84176	.55067	1.5286	.19659	.21732
Log(INCOME)	.55041	.47169	1.1669	.04081[2]	.000068

Note: Sample size equals 145. Percentage of right predictions equals 82%.

1 Equal to a $10.00 change in bid level.

2 Equal to the marginal effect at the means of a $10,000 change in income.

Table 5.1.3. Multivariate Model: Overnight Current Conditions

Variable Name	Estimated Coefficient	Standard Error	T Ratio	Marginal Effect	Elasticity
CONSTANT	-6.7764	4.0876	-1.6578		
Log(BID1)	-1.3875	.22794	-6.0874	-.0468[1]	-.01770
Log(PEOPLE)	.62244	.27829	2.2367	.01749	.02771
Log(TRIPS)	.69163	.33171	2.0850	.04898	.01248
CONMOD	-.29637	.42360	-.69965	-.04472	-.01918
CONHEAV	-.27157	.61284	-.44313	-.04262	-.00543
Log(INCOME)	1.0672	.37294	2.8617	.02315[2]	.000031

Note: Sample size equals 210. Percentage of right predictions equals 80%.

1 Equal to a $10.00 change in bid level.

2 Equal to the marginal effect at the means of a $10,000 change in income.

Table 5.1.4. Multivariate Model: Overnight Reduced Congestion

Variable Name	Estimated Coefficient	Standard Error	T Ratio	Marginal Effect	Elasticity
CONSTANT	-2.7924	4.2168	-.66221		
Log(BID2)	-1.9314	.26762	-7.2169	-.04123[1]	-.01783
Log(PEOPLE)	-.11331	.25158	-.45041	-.003185	-.00465
Log(TRIPS)	-.15449	.33577	-.46010	-.010941	-.00355
CONMOD	.04342	.40531	.10714	.009739	.00385
CONHEAV	.33052	.61276	.53940	.070904	.00833
Log(INCOME)	1.0035	.39230	2.5582	.021777[2]	.000026

Note: Sample size equals 210. Percentage of right predictions equals 85%.

1 Equal to a $10.00 change in bid level.

2 Equal to the marginal effect at the means of a $10,000 change in income.

Table 5.1.5. Bivariate Models: Day-Use and Overnight Visitors

Model	Constant (Std.Err.)	Coefficient (Std.Err.)
Day-Use Current	4.8085 (.8683)	-1.3791 (.2347)
Day-Use Reduc. Cong.	6.1742 (1.0188)	-1.7058 (.2747)
Overnight Current	5.2298 (.7881)	-1.2471 (.2022)
Overnight Reduc. Cong.	6.1742 (1.0188)	-1.7058 (.2747)

Note: Sample size equals 212 for overnight model and 147 for day-use. Percentage of right predictions for both day-use models equals 76%. Percentage of right predictions equals 78% for overnight current model and 75% for overnight reduced congestion.

5.2. Benefit Estimation

The bivariate models were used for benefit estimation. The bivariate model was used instead of the multivariate model since the introduction of other covariates is used only when the bivariate model cannot model the WTP distribution. Duffield et al. (1990) explain that if the bivariate model fits the data well, then the WTP distribution may be well approximated without covariates. The absence of covariates greatly simplifies the computations necessary for estimation and makes the interpretation of benefit estimates more straightforward.

In order to tell whether the bivariate model fits the hypothetical logistic model, a chi-squared goodness of fit test was performed. For the test, the null hypothesis (H_0) was that the bivariate model is a logistic model. Table 5.2.1. shows the outcome of this test.

Table 5.2.1. Goodness of Fit Test

Model	Critical Value	Chi-Squared Value
Day-Use Current Conditions	9.4877	0.7969
Day-Use Reduced Congestion	9.4877	4.3534
Overnight Current Conditions	9.4877	4.1671
Overnight Reduced Congestion	9.4877	3.9570

All of the values obtained from the test were within (less than) the critical value. Based on this, the null hypothesis may not be rejected.

The benefit measures were calculated as the median and truncated mean. The truncation point used was $125.00. The median and truncated means were calculated using the equations found in section 3.2. The standard errors were calculated using the bootstrapping technique with 1000 iterations. Table 5.2.2. lists the medians and truncated means derived from the two day-use models.

Table 5.2.2. Medians and Truncated Means for Day-Use Models

Model	Median (Std.Err.)	Truncated Mean (Std.Err.)
Day-Use Current	32.67 (5.1402)	47.70 (4.8143)
Day-Use Reduc. Cong.	37.32 (5.0924)	49.59 (4.8405)

Note: Upper limit of truncated means is $125.00.

The medians and truncated means for overnight visitors were calculated using the same method as was used for day-use visitor benefit calculations. The standard errors for both the median and truncated mean were calculated using the bootstrapping technique with 1000 iterations. Table 5.2.3. lists the medians and truncated means of the overnight models.

Table 5.2.3. Medians and Truncated Means for Overnight Models

Model	Median (Std.Err.)	Truncated Mean (Std.Err.)
Overnight Current	66.26 (10.9200)	70.98 (4.6048)
Overnight Reduc. Cong.	67.52 (6.3816)	72.51 (4.8405)

Note: Upper limit of truncated means is $125.00.

5.2.3. Confidence Intervals for Truncated Means

Using the standard errors derived from the bootstrapping technique and the equation presented in section 3.2.1., the confidence intervals for the truncated means may be calculated. The confidence intervals for each model may be found on the following table.

Table 5.2.4. Confidence Intervals

Model	Truncated Mean at 95% Confidence Interval
Day-Use Current Conditions	38.26 - 53.13
Day-Use Reduced Congestion	40.10 - 59.07
Overnight Current Conditions	61.95 - 80.00
Overnight Reduced Congestion	63.02 - 81.99

5.3. Total Valuation

Once the mean WTP has been derived from the four models, the total value may be calculated by multiplying the mean WTP by the correct population. Therefore, the first step in calculating the total value of the hypothetical scenario is to calculate the number of overnight and day-use visitor groups to Yosemite Valley.

Table 5.3.1. shows the attendance figures for Yosemite National Park for May through September 2001.

Table 5.3.1. Visitor Attendance Statistics

	May	June	July	August	September	Total
Number of Visitors	315,897	434,014	528,849	591,196	448,519	2,318,475

Source: Resource Management, Yosemite National Park, November 21, 2001.

The total number of visitors must be narrowed to the number of people visiting Yosemite Valley and the number of visitors that do not have overnight accommodations. Gramann (1992) reports that 73.7% of people visiting Yosemite National Park travel to Yosemite Valley. This figure, the average number of visitors per group (3.5 for day-use visitors and 5.1 for overnight visitors), and the percentage of visitors spending at least one night in the Valley (59%) are used to calculate the number of overnight and day-use visitor groups to Yosemite Valley from the attendance figures supplied by Yosemite National Park. The calculated visitor group numbers are listed in table 5.3.2.

Table 5.3.2. Overnight and Day-use Visitors Groups to Yosemite Valley

	Overnight in Valley	Day-Use in Valley
Number of Visitor Groups	195,756	195,146

The total visitor benefit for entering Yosemite Valley under current conditions and under the hypothetical reduction in automobile congestion may be found using the number of visitor groups and the WTP estimates listed above. Because of the ambiguity surrounding the day-use reduced congestion WTP question, two tables will be presented. The first will treat the day-use reduced congestion WTP estimate as additional willingness to pay and the second will treat it as a total willingness to pay estimate. In order to convert any additional WTP estimates to total WTP, the $20.00 entrance fee will be added to all additional WTP estimates. The total values are listed below.

Table 5.3.3. Total WTP: Treating Day-Use WTP as Total WTP

	Current Conditions	Reduced Congestion	Difference
Day-Use	$13,211,384	$9,677,290	-$3,534,094
Overnight	$17,809,880	$18,109,387	$299,507
Total	$31,021,264	$27,786,677	-$3,234,587

Table 5.3.4. Total WTP: Treating Day-Use WTP as Additional WTP

	Current Conditions	Reduced Congestion	Difference
Day-Use	$13,211,384	$13,580,210	$368,826
Overnight	$17,809,880	$18,109,387	$299,507
Total	$31,021,264	$31,689,887	$668,333

Using the confidence intervals listed in table 5.2.4., along with the visitor group numbers found under the current study, the total valuation based on best and worst case scenarios values may be calculated. The worst case is calculated using the highest WTP estimate within the confidence intervals for current conditions and the lowest for the reduced congestion WTP estimate. The best case uses the lowest current willingness to pay WTP within the confidence intervals and the highest for the reduced congestion WTP estimate. As with the tables illustrating total WTP, two tables of best and worst cases will be presented. The scenarios are reported in the following table.

Table 5.3.5. Total Value of Proposed Plan: Best and Worst Cases Based on Truncated Mean and 95% Confidence Intervals Treating Day-use WTP estimate as Total WTP

	Worst Case	Best Case
Day-Use Visitors	-$6,445,672	$158,069
Overnight Visitors	-$3,323,937	$3,922,950
Total	-$9,769,609	$4,081,019

Table 5.3.6. Total Value of Proposed Plan: Best and Worst Cases Based on Truncated Mean and 95% Confidence Intervals Treating Day-use WTP estimate as Additional WTP

	Worst Case	Best Case
Day-Use Visitors	-$2,542,752	$4,060,989
Overnight Visitors	-$3,323,937	$3,922,950
Total	-$5,866,689	$7,983,939

Chapter 6: Conclusions and Future Research

6.1. Overall Conclusions

The total WTP estimates obtained when the day-use reduced congestion WTP estimate was treated as a total WTP estimate show that the visitors to Yosemite Valley place a small value on reduced congestion. Overnight visitors on the average valued a 50% reduction in automobile congestion by only $1.53 per visitor group. This small value may be reflective of the fact that very few respondents (roughly 5%) said that automobile congestion had negatively affected their trip. The perceived inconvenience of shuttle use greatly outweighed any benefit of reduced congestion for day-use visitors. The estimated WTP for day-use visitors shows that a mandatory shuttle service would impose (on the average) a cost of $18.11 on day-use visitors.

When the day-use WTP estimate is treated as an additional WTP estimate, the proposed transportation plan is a net benefit to all visitors, although, this benefit is very small per visitor group ($1.89 per day-use group and $1.53 per overnight group). The small value placed on reduced congestion is not uncommon in other recreation studies. Freimund (2001) states that in many wilderness settings, individuals are reluctant to have restrictions imposed on the accessibility of a recreation site even if it increases the probability of a higher quality trip experience.

The implications of whether the day-use reduced congestion WTP estimate is a total or addition estimate are great. If it is a total WTP estimate, the loss per day-use visitor group is $18.11. This figure is high in proportion to the benefit of $1.53 per overnight visitor group and may be a sign of a problem with the payment vehicle. Respondents may have had a preconceived idea of what the cost of public transportation normally is. This would cause some respondents to base their responses on their value of public transportation instead of how the hypothetical scenario would affect their trip experience.

The low values placed on reduced congestion by respondents may also be a signal of hypothetical bias. It may have been difficult for respondents to visualize a 50% reduction in automobile congestion or a shuttle service that would be very convenient and easily accessible.

This study has focused on the visitor benefits associated with the *Final Yosemite Valley Plan/* SEIS, but there are many other costs and benefits that may be created due to the plan that are not included in this study. Ecological benefits due to the reduction of total automobile use in Yosemite Valley are not included nor are any benefits of increased road and pedestrian safety included. Also, this study does not show the benefits gained by those who do not currently visit Yosemite Valley due to the traffic congestion and would begin to visit Yosemite Valley if the congestion was reduced or the costs to those who would choose not to visit Yosemite Valley if a shuttle was mandatory for day-use visitors.

6.2. Future Research

Studies using different payment vehicles may add greatly to the research of transportation and congestion in national parks. There are different vehicles such as annual passes that may have many possible attributes over other payment vehicles without being prone to bias. Another area for future research could be in studies of before *and* after a proposed plan has been implemented.

It is also important that more research into national park transportation and visitor benefits be done so that comparisons of different findings may be made. The need for planning aimed at reducing automobile congestion will only become more important as more people visit national parks. Studies such as this one performed at other national parks such as Glacier or Yellowstone National Park would not only aid in formulating new management plans, but the studies would also provide more analysis of how different transportation modes affect visitors at different parks.

Appendix A

Survey Instrument

Hi, I am Robert Ferguson from the University of Montana. I am doing a study of transportation in Yosemite Valley as part of a master's thesis. Participation is voluntary and responses will be confidential. The study should take no more than five minutes to complete.

1. Are you here for the day, or are you staying overnight in Yosemite Valley?
   _____ day-use visitor _____ overnight visitor
2. Including yourself how many people are in your group on this trip? _____ people

*If more than one go to **2.1**.*

2.1 How many children under the age of sixteen are in your group? ____ children

3. Is this your first visit to Yosemite Valley?
   _____ yes ______ no

   *If no, go to question **3.1**.*

   3.1 For how many years have you been coming to Yosemite Valley?
   _____ years ______ don't know
4. How many trips will you be taking to Yosemite Valley this year?
   ___________ trips ________ don't know
5. Are you participating in any of the following activities while in Yosemite Valley on this trip?
   ______ sightseeing _______ hiking
   ______ camping _______ shopping
   ______ climbing _______ other
6. Did you enter Yosemite Valley by personal vehicle, public vehicle, or other means on this trip?
   ____ personal vehicle (e.g. auto, R.V., motorcycle, etc.)
   ____ public vehicle or bus (e.g. shuttle, tour bus, etc.)
   ____ other means (e.g. on foot, bicycle, etc.)

These next few questions are concerned with the value you place on this trip to Yosemite Valley. I understand that you do not usually consider your visits to Yosemite in this way, and so to do so, it may be helpful to think about what you are willing and able to pay for other recreational activities such as skiing, boating, visiting museums, and so forth.

7. Do you feel that your trip into Yosemite Valley was worth more than it personally cost you ?
   _____yes _______no

*If "no", go to **9**.*

8. If your costs had increased by __________, would you have still made the trip?
   _______ yes _________no

The next few questions will help the Park to understand how automobile congestion has affected your trip to Yosemite Valley.

9. Would you rate the automobile congestion that you encountered coming into Yosemite Valley from outside the Park on this trip as light, moderate or heavy?
   _____ light _____ moderate _____ heavy
10. Did automobile congestion negatively affect your experience entering Yosemite Valley on this trip? Please choose from:
    _____ not at all _______ very little
    _____ moderately _______ greatly

    *If overnight visitor or did not drive personal vehicle into Yosemite Valley go to question **11**.*
    If day-use visitor accessing Yosemite Valley via personal vehicle go to question **12**.

Due to automobile congestion problems, both Zion National Park and Grand Canyon National Park have instituted management policies aimed at lowering automobile congestion. These management policies include providing increased shuttle service or providing light rail service and prohibiting some private automobiles from entering the most heavily congested areas. If Yosemite National Park were to follow this policy type, automobile congestion may be reduced.

11. *Suppose there was a 50% reduction in the automobile congestion that you experienced while entering into Yosemite Valley. With such a change in automobile congestion would you have made the trip if your costs had increased by ________?*

________ *yes* ________ *no* ________ *don't know*

Go to question **15**.

12. Did you use or do you plan to use the free shuttle service specifically operating inside Yosemite Valley on this trip?

_____ yes ______ no

If no, go to **12.1**.

12.1 Why not?

_____________ *reason*

Due to automobile congestion problems, both Zion National Park and Grand Canyon National Park have instituted shuttle programs to allow visitors access to the parks by means other than private automobile.

13. *Are you familiar with these policies adopted in Zion and Grand Canyon National Parks?*

______ *yes* ______ *no*

If no, read following- *Both Zion and Grand Canyon National Parks have provided increased shuttle service or provided light rail service and have prohibited private automobiles from the most heavily congested areas.*

14. Suppose there was a 50% reduction in automobile congestion that you experienced today and you were only able to enter Yosemite Valley by shuttle. The new shuttle service would be very convenient and would always have available seating. If the shuttle into the Valley cost __________ would you

    (a) use the shuttle to come into Yosemite Valley.
    (b) not come into Yosemite Valley.
    (c) don't know

*If "not come into Yosemite Valley" go to **14.1**.*

14.1 Why? ____________ reason

I have just a few more quick questions to help me understand your responses.

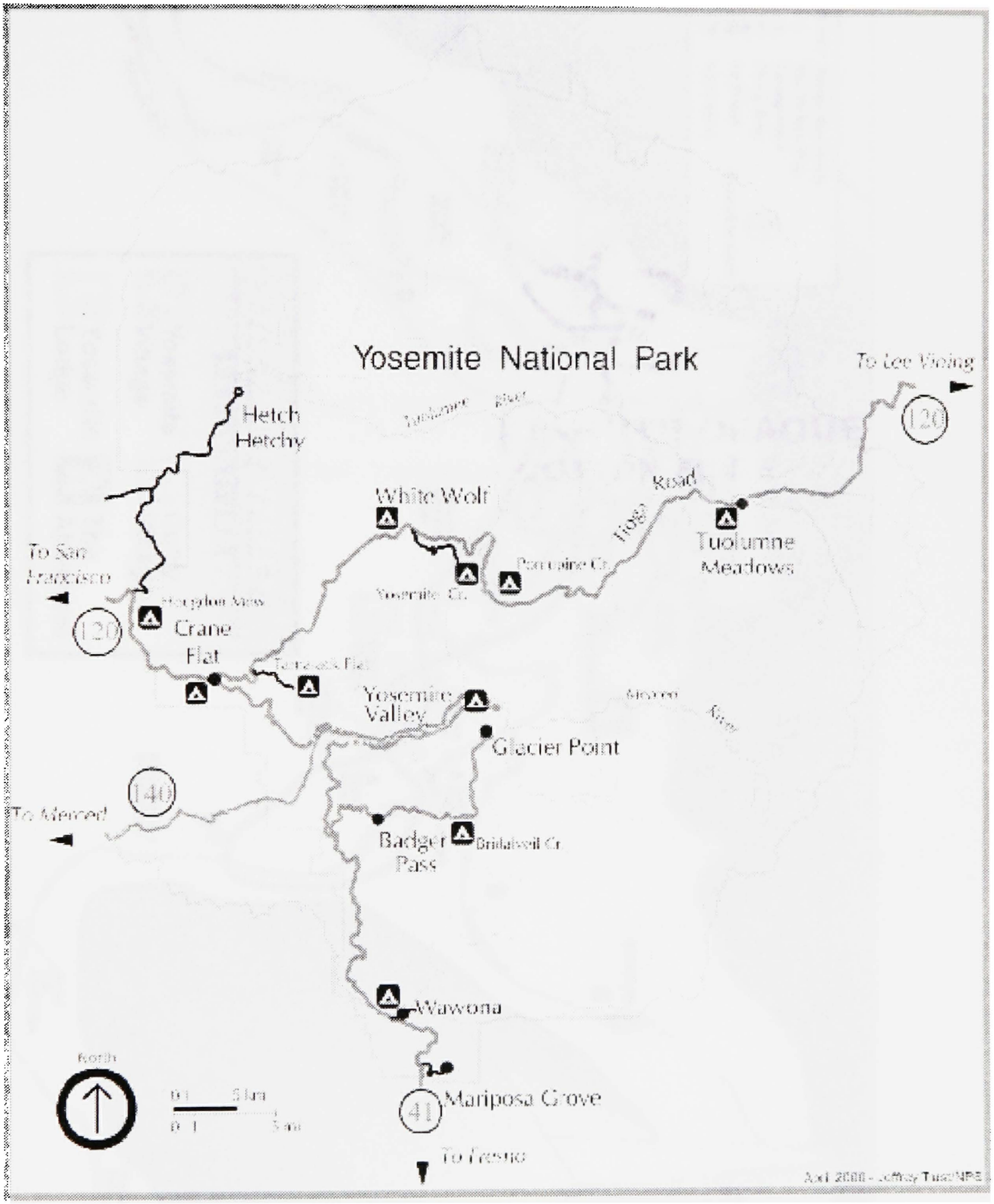
15. What is your zip code? ___________
16. What is your highest grade or degree completed in school? ________________
17. What is your current age? ____________
18. (Hand card.) Could you please tell me the letter that corresponds to your household's income before taxes last year? ________ letter

INTERVIEWER SECTION

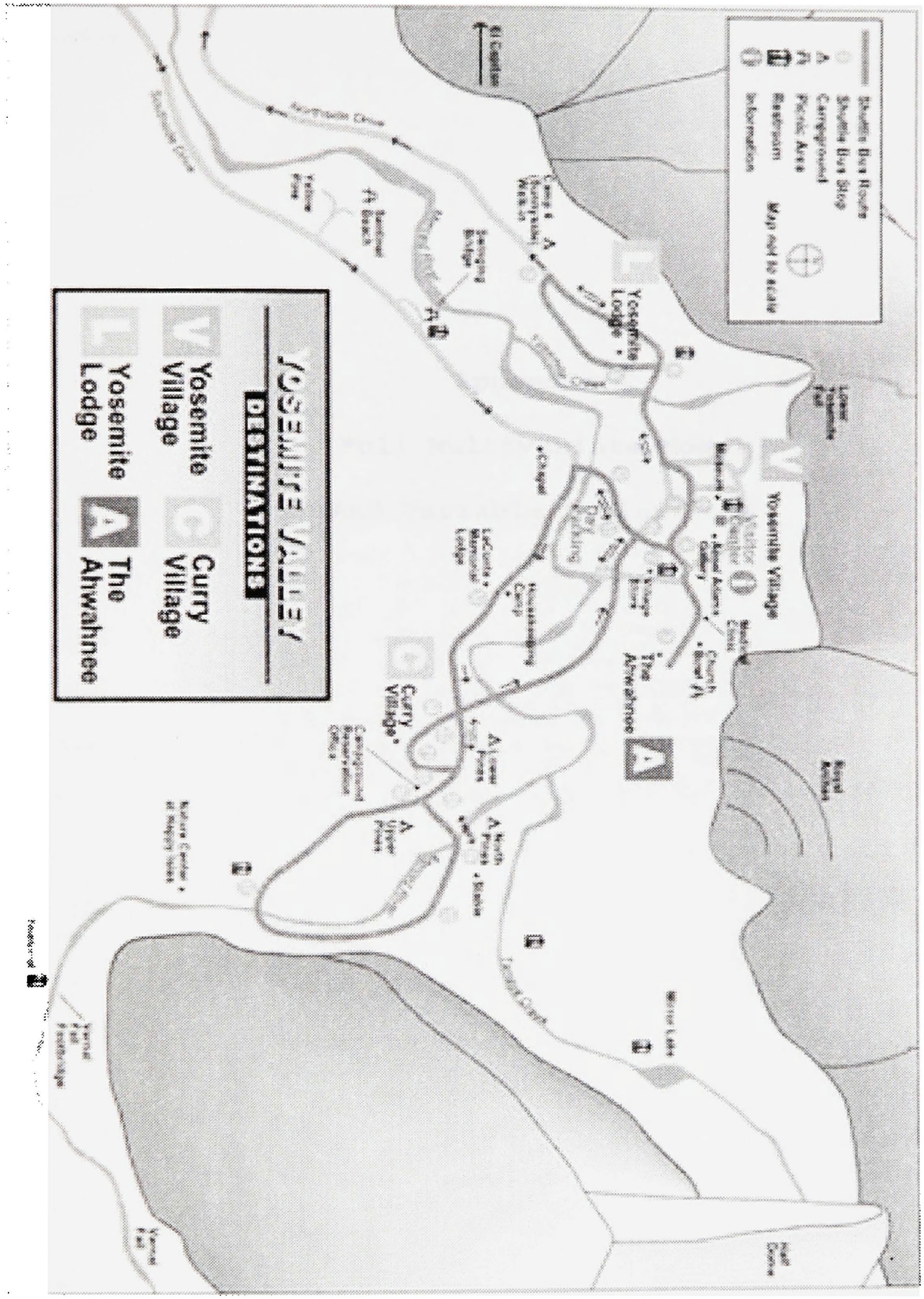
I.D. # ___________
Gender of respondent: _____ male _____ female
Location: __________________
Date: ________ Time: __________

Appendix B

Maps



Source: Yosemite National Park Website, 2001.



Source: Yosemite National Park Website, 2001.

Appendix C

Full Multivariate Model

And Variable Definitions

Variable	Definition
LAMOUNT1	the log of the first bid amount asked
LAMOUNT2	the log of the second bid amount asked
LPEOPLE	the log of the number of people in group
CHILD2	dummy variable with 1, 1-2 children; base case with 0, no children
CHILD3	dummy variable with 1, 1-2 children; base case with 0, no children
VISIT	dummy variable with 1, first time visit; 0, previous visitor
LTRIPS	the log of the number of trips to Yosemite Valley in current year
LHISTORY	the log of number of years visiting Yosemite Valley
HIKE	dummy variable with 1, hiked; 0, did not
SHOP	dummy variable with 1, shopped; 0, did not
CAMP	dummy variable with 1, camped; 0, did not
CLIMB	dummy variable with 1, mountain climbed; 0, did not
OTHER	dummy variable with 1, other activities; 0, did not
CONMOD	dummy variable with 1, automobile congestion moderate; base case with 0, congestion light
CONHEAVY	dummy variable with 1, automobile congestion heavy; base case with 0, congestion light
EFCTLIT	dummy variable with 1, negative effect of congestion light; base case with 0, no effect
EFCTMOD	dummy variable with 1, negative effect of congestion moderate; base case with 0, no effect
EFCTGRE	dummy variable with 1, negative effect of congestion great; base case with 0, no effect
ZION	dummy variable with 1, familiar with policies in other parks; 0, if not
SHUTTLE	dummy variable with 1, rode in-Valley-shuttle; 0, if did not
LINCOME	the log of the median income of the bracket chosen
CURRY	dummy variable for interview location with 1, Curry Village; base case with 0, Yosemite Village
FALLS	dummy variable for interview location with 1, Lower Yosemite Falls; base case with 0, Yosemite Village
TRAIL	dummy variable for interview location with 1, Trailhead Parking; base case with 0, Yosemite Village
SUNNY	dummy variable for interview location with 1, Sunnyside; base case with 0, Yosemite Village
DAY	dummy variable for interview location with 1, Day-Use Parking; base case with 0, Yosemite Village
CAMPG	dummy variable for interview location with 1, Campground Reservation; base case with 0, Yosemite Village
AFTER	dummy variable with 1, interviewed in afternoon; base case with 0, interviewed in morning
EVEN	dummy variable with 1, interviewed in evening; base case with 0, interviewed in morning
LAGE	the log of the age of the respondent
LSCHOOL	log of the number of years of school
WEEKEND	dummy variable with 1, weekend; 0, if not
LMILES	the log of the number of miles from current residence to Yosemite Valley

GENDER	dummy variable with 1, female; 0, male

Full Model: Day-Use Current Conditions

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	T RATIO
LAMOUNT1	-2.3338	0.51808	-4.5047[1]
LPEOPLE	0.89255	0.80163	1.1134
CHILD2	0.61117E-01	0.81630	0.74871E-01
CHILD3	0.30001E-01	1.6725	0.17938E-01
VISIT	-1.2397	0.97412	-1.2726
LTRIPS	-1.6650	0.83971	-1.9828[3]
LHISTORY	-0.74748	0.42403	-1.7628[3]
HIKE	-0.51106	0.79996	-0.63886
SHOP	-0.93937	0.72451	-1.2966
CLIMB	0.17477	1.4533	0.12026
OTHER	2.2662	1.0861	2.0866[2]
CONMOD	1.0184	0.74892	1.3599
CONHEAVY	0.18081	1.6778	0.10777
EFCTLIT	1.4479	0.85466	1.6941[3]
EFCTMOD	0.23996	1.0236	0.23442
EFCTGRE	3.0848	2.2911	1.3464
ZION	-0.43809	0.65754	-0.66626
SHUTTLE	1.0738	0.82378	1.3035
LINCOME	1.1618	0.68012	1.7082[3]
CURRY	1.1923	1.2126	0.98324
FALLS	-0.74400	1.2542	-0.59319
TRAIL	-2.4915	1.5610	-1.5961[3]
SUNNY	1.0125	1.4065	0.71989
DAY	0.83931	1.0533	0.79683
CAMPG	0.78916	1.5010	0.52575
AFTER	0.14142	1.0069	0.14046
EVEN	-0.32582	1.0036	-0.32465
LAGE	-1.2500	1.3511	-0.92516
LSCHOOL	-0.33213	2.5876	-0.12835
WEEKEND	-0.26827	0.84001	-0.31937
LMILES	0.36083	0.27179	1.3276
GENDER	0.52461	0.70791	0.74107
CONSTANT	-1.6275	8.9902	-0.18103

[1] Values are significant at 99% level
[2] Values are significant at 95% level
[3] Values are significant at 90% level

Full Model: Day-Use Reduced Auto Congestion

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	T RATIO
LAMOUNT2	-3.4018	0.75847	-4.4851[1]
LPEOPLE	0.54209	1.0481	0.51723
CHILD2	-0.64224	1.1441	-0.56137
CHILD3	1.8840	2.7498	0.68514
VISIT	-3.5433	1.5047	-2.3548[2]
LTRIPS	-3.7542	1.2189	-3.0799[1]
LHISTORY	-1.0695	0.59907	-1.7853[3]
HIKE	1.6572	1.0006	1.6563[3]
SHOP	-0.96312	0.89071	-1.0813
CLIMB	1.2312	1.9073	0.64549
OTHER	3.7875	1.6090	2.3539[2]
CONMOD	2.9986	1.2334	2.4311[2]
CONHEAVY	4.6871	1.9843	2.3621[2]
EFCTLIT	0.41115	0.94375	0.43565
EFCTMOD	-3.1848	1.6336	-1.9496[3]
EFCTGRE	-1.8478	2.2572	-0.81865
ZION	-0.51704	0.98654	-0.52410
SHUTTLE	1.7293	1.1450	1.5103[3]
LINCOME	0.32612	0.76604	0.42572
CURRY	0.29437	1.4368	0.20489
FALLS	-0.24413	1.7108	-0.14270
TRAIL	-3.2126	2.8495	-1.1274
SUNNY	-0.26612	1.8291	-0.14550
DAY	-0.66974	1.4420	-0.46444
CAMPG	0.51969	1.9667	0.26424
AFTER	-1.7499	1.3903	-1.2587
EVEN	-0.60638	1.1604	-0.52259
LAGE	0.51494	1.6576	0.31065
LSCHOOL	3.4572	2.6996	1.2806
WEEKEND	1.2684	1.2071	1.0508
LMILES	0.81941	0.38368	2.1357[2]
GENDER	1.3891	1.2461	1.1148
CONSTANT	-8.0212	10.645	-0.75353

[1] Values are significant at 99% level
[2] Values are significant at 95% level
[3] Values are significant at 90% level

Full Model: Overnight Current Conditions

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	T RATIO
LAMOUNT1	-1.7840	0.30666	-5.8175[1]
LPEOPLE	1.1336	0.42193	2.6867[1]
CHILD2	0.69237	0.64854	1.0676
CHILD3	-0.99930	0.83190	-1.2012
VISIT	0.20383	0.85785	0.23761
LTRIPS	1.1763	0.46804	2.5133[1]
LHISTORY	0.39937	0.27533	1.4505
HIKE	0.51849	0.78231	0.66276
CAMP	0.54322E-01	0.50545	0.10747
SHOP	0.50212	0.49664	1.0110
CLIMB	-0.24485E-01	0.55319	-0.44262E-01
OTHER	-1.5816	0.79668	-1.9852[3]
CONMOD	-0.68367	0.56842	-1.2028
CONHEAVY	-1.0629	0.96054	-1.1065
EFCTLIT	0.40067	0.55594	0.72070
EFCTMOD	0.63798	0.76931	0.82929
EFCTGRE	-0.18428	1.0346	-0.17811
LINCOME	1.1905	0.50141	2.3743[2]
CURRY	-0.41107	0.91611	-0.44871
FALLS	0.39516	0.81920	0.48237
TRAIL	-0.65683	0.78819	-0.83334
SUNNY	-0.22561E-01	0.92613	-0.24361E-01
DAY	0.60663	0.82909	0.73168
CAMPG	-0.80604	0.77109	-1.0453
AFTER	-0.63893	0.55233	-1.1568
EVEN	-0.49815	0.64894	-0.76763
LAGE	-0.81954	0.96441	-0.84978
LSCHOOL	0.21506	1.5939	0.13493
WEEKEND	-0.53331	0.53868	-0.99002
LMILES	0.23165E-01	0.21610	0.10719
GENDER	-0.30223	0.55050	-0.54900
CONSTANT	-5.5783	6.5006	-0.85812

[1] Values are significant at 99% level
[2] Values are significant at 95% level
[3] Values are significant at 90% level

Full Model: Overnight Reduced Auto Congestion

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	T RATIO
LAMOUNT2	-2.1310	0.31481	-6.7693[1]
LPEOPLE	-0.10713	0.35891	-0.29848
CHILD2	0.26437	0.57445	0.46022
CHILD3	-0.71047	0.80890	-0.87832
VISIT	0.33276	0.78218	0.42543
LTRIPS	-0.13980	0.42202	-0.33127
LHISTORY	0.77200E-02	0.23478	0.32882E-01
HIKE	0.19937	0.69984	0.28488
CAMP	0.12414	0.45351	0.27373
SHOP	-0.12942	0.47207	-0.27416
CLIMB	-0.62369	0.51597	-1.2088
OTHER	-0.20099	0.77270	-0.26012
CONMOD	-0.16481	0.48037	-0.34309
CONHEAVY	-0.35006	0.84732	-0.41314
EFCTLIT	0.22691	0.50252	0.45154
EFCTMOD	0.65345	0.69804	0.93613
EFCTGRE	0.91236	1.0747	0.84892
LINCOME	1.0320	0.48902	2.1103[2]
CURRY	0.15854	0.82705	0.19170
FALLS	-1.0983	0.73708	-1.4901
TRAIL	0.22716	0.69115	0.32867
SUNNY	-0.16154	0.85971	-0.18789
DAY	0.25621	0.75436	0.33965
CAMPG	-0.12498	0.69891	-0.17882
AFTER	0.37148	0.50843	0.73064
EVEN	0.27415	0.58821	0.46608
LAGE	0.29385	0.93310	0.31492
LSCHOOL	-1.5809	1.5371	-1.0285
WEEKEND	-0.13398	0.49124	-0.27273
LMILES	-0.92590E-01	0.18244	-0.50752
GENDER	-0.31326E-01	0.50086	-0.62545E-01
CONSTANT	1.3727	6.0988	0.22508

[1] Values are significant at 99% level
[2] Values are significant at 95% level
[3] Values are significant at 90% level

Appendix D

Logit Model Programs

```
*Bivariate Day-Use Model with Bootstrapping*
set noscan
delete/all
sample 1 147
read (c:day-use.xls) people child visit history trips sights hike shop
climb other enter cost1 amount1 cost2 congest effect shuttle zion
amount2 cost3 miles school age income gender locat morn after even mon
tues wed thur fri sat sun id

gen lamount1=log(amount1)

logit cost2 lamount1 / coef=d

genl med=exp(-d:2/d:1)
print med

sample 1 1
genl upper=125
genl lower=.00001
integ am1 lower upper answer=1-(1/(1+(exp(d:2+d:1*(log(am1))))))
print answer

sample 1 147
copy cost2 lamount1 z
dim answer2 1000
set nodoecho
do #=1,1000
matrix m=samp(z,214)
matrix yes=m(0,1)
matrix bid=m(0,2)
? logit yes bid / coef=b
integ am1 lower upper answer2:#=1-(1/(1+(exp(b:2+b:1*(log(am1))))))

endo
stat answer2
sample 1 1000
sort answer2
stat answer2
sample 1 25
stat answer2
print answer2
sample 976 1000
print answer2
stat answer2
```

```
*Bivariate Overnight Model with Bootstrapping*
set noscan
delete/all
sample 1 212
read (c:overnight2.xls) stay people child visit history trips sights
hike camp shop climb other enter cost1 amount1 cost2 congest effect
amount2 cost3 miles school age income gender locat morn after even mon
tues wed thur fri sat sun id

gen lamount1=log(amount1)
gen lamount2=log(amount2)


logit cost2 lamount1 / coef=a


genl med=exp(-a:2/a:1)
print med


sample 1 1
genl upper=125
genl lower=.00001
integ am1 lower upper answer=1-(1/(1+(exp(a:2+a:1*(log(am1))))))
print answer


sample 1 212
copy cost2 lamount1 z
dim answer2 1000
set nodoecho
do #=1,1000
matrix m=samp(z,212)
matrix yes=m(0,1)
matrix bid=m(0,2)
? logit yes bid / coef=b
integ am1 lower upper answer2:#=1-(1/(1+(exp(b:2+b:1*(log(am1))))))

endo
stat answer2
sample 1 1000
sort answer2
stat answer2
sample 1 25
stat answer2
print answer2
sample 976 1000
stat answer2
print answer2
```

```
*Overnight Visitor Demand*

set noscan
delete/all
sample 1 214
read (c:overnight.xls) stay people child visit history trips sights
hike camp shop climb other enter cost1 amount1 cost2 congest effect
amount2 cost3 miles school age income gender locat morn after even mon
tues wed thur fri sat sun id
skipif (income.eq.-999)
skipif (id.eq.148 .or. id.eq.352)

*Income
if (income.eq.1) income2=9999
if (income.eq.2) income2=15000
if (income.eq.3) income2=25000
if (income.eq.4) income2=35000
if (income.eq.5) income2=45000
if (income.eq.6) income2=62500
if (income.eq.7) income2=87500
if (income.eq.8) income2=100000


gen lpeople=log(people)
gen ltrips=log(trips)
gen lcongest=log(congest)
gen lefct=log(effect)
gen lamount1=log(amount1)
gen lamount2=log(amount2)
gen lincome2=log(income2)


logit cost2 lamount1 lpeople ltrips lcongest lefct lincome2 / coef=a

logit cost3 lamount2 lpeople ltrips lcongest lefct lincome2 / coef=b
```

```
*Day-use Visitor Demand*
set noscan
delete/all
sample 1 147
read (c:day-use.xls) people child visit history trips sights hike shop
climb other enter cost1 amount1 cost2 congest effect shuttle zion
amount2 cost3 miles school age income gender locat morn after even mon
tues wed thur fri sat sun id
skipif (income.eq.-999)


*Income
if (income.eq.1) income2=9999
if (income.eq.2) income2=15000
if (income.eq.3) income2=25000
if (income.eq.4) income2=35000
if (income.eq.5) income2=45000
if (income.eq.6) income2=62500
if (income.eq.7) income2=87500
if (income.eq.8) income2=100000


gen lpeople=log(people)
gen ltrips=log(trips)
gen lcongest=log(congest)
gen lefct=log(effect)
gen lamount1=log(amount1)
gen lamount2=log(amount2)
gen lincome2=log(income2)


logit cost2 lamount1 lpeople ltrips lcongest lefct shuttle lincome2 /
coef=d

logit cost3 lamount2 lpeople ltrips lcongest lefct shuttle lincome2 /
coef=f
```

```
*Day-Use Visitor Demand -- All Variables*
set noscan
delete/all
sample 1 147
read (c:day-use.xls) people child visit history trips sights hike shop
climb other enter cost1 amount1 cost2 congest effect shuttle zion
amount2 cost3 miles school age income gender locat morn after even mon
tues wed thur fri sat sun id
skipif (income.eq.-999)
skipif (miles.eq.-999)

*Child
if (child.eq.0) childno=1
if (child.eq.1 .or. child.eq.2) child2=1
if (child.gt.2) child3=1

*Congest
if (congest.eq.1) conlight=1
if (congest.eq.2) conmod=1
if (congest.eq.3) conheavy=1

*Effect
if (effect.eq.1) efctnon=1
if (effect.eq.2) efctlit=1
if (effect.eq.3) efctmod=1
if (effect.eq.4) efctgre=1

*Income
if (income.eq.1) income2=9999
if (income.eq.2) income2=15000
if (income.eq.3) income2=25000
if (income.eq.4) income2=35000
if (income.eq.5) income2=45000
if (income.eq.6) income2=62500
if (income.eq.7) income2=87500
if (income.eq.8) income2=100000

*location
if (locat.eq.1) yosv=1
if (locat.eq.2) curry=1
if (locat.eq.3) falls=1
if (locat.eq.4) trail=1
if (locat.eq.5) sunny=1
if (locat.eq.6) day=1
if (locat.eq.7) campg=1
if (sat.eq.1 .or. sun.eq.1 .or. mon.eq.1 .or. fri.eq.1) weekend=1
stat/all

gen lpeople=log(people)
gen ltrips=log(trips)
gen lhistory=log(history)
gen lmiles=log(miles)
gen lage=log(age)
gen lschool=log(school)
gen lincome=log(income2)
gen lamount1=log(amount1)
gen lamount2=log(amount2)
```

```
logit cost2 lamount1 lpeople child2 child3 visit ltrips lhistory hike
shop climb other conmod conheavy efctlit efctmod efctgre zion shuttle
lincome curry falls trail sunny day campg after even lage lschool
weekend lmiles gender/ coef=d
```

```
logit cost3 lamount2 lpeople child2 child3 visit ltrips lhistory hike
shop climb other conmod conheavy efctlit efctmod efctgre zion shuttle
lincome curry falls trail sunny day campg after even lage lschool
weekend lmiles gender/ coef=f
```

```
*Overnight Visitor Demand- All Variables*
set noscan
delete/all
sample 1 214
read (c:overnight.xls) stay people child visit history trips sights
hike camp shop climb other enter cost1 amount1 cost2 congest effect
amount2 cost3 miles school age income gender locat morn after even mon
tues wed thur fri sat sun id
skipif (miles.eq.-999)
skipif (income.eq.-999)

*Protest Bids
skipif (id.eq.148 .or. id.eq.352)

*Child
if (child.eq.0) childno=1
if (child.eq.1 .or. child.eq.2) child2=1
if (child.gt.2) child3=1

*Congest
if (congest.eq.1) conlight=1
if (congest.eq.2) conmod=1
if (congest.eq.3) conheavy=1

*Effect
if (effect.eq.1) efctnon=1
if (effect.eq.2) efctlit=1
if (effect.eq.3) efctmod=1
if (effect.eq.4) efctgre=1

*Income
if (income.eq.1) income2=9999
if (income.eq.2) income2=15000
if (income.eq.3) income2=25000
if (income.eq.4) income2=35000
if (income.eq.5) income2=45000
if (income.eq.6) income2=62500
if (income.eq.7) income2=87500
if (income.eq.8) income2=100000

*location
if (locat.eq.1) yosv=1
if (locat.eq.2) curry=1
if (locat.eq.3) falls=1
if (locat.eq.4) trail=1
if (locat.eq.5) sunny=1
if (locat.eq.6) day=1
if (locat.eq.7) campg=1
if (sat.eq.1 .or. sun.eq.1 .or. mon.eq.1 .or. fri.eq.1) weekend=1
stat/all

gen lpeople=log(people)
gen ltrips=log(trips)
gen lhistory=log(history)
gen lmiles=log(miles)
gen lage=log(age)
gen lschool=log(school)
```

```
gen lincome=log(income2)
gen lamount1=log(amount1)
gen lamount2=log(amount2)


logit cost2 lamount1 lpeople child2 child3 visit ltrips lhistory hike
camp shop climb other conmod conheavy efctlit efctmod efctgre lincome
curry falls trail sunny day campg after even lage lschool weekend
lmiles gender/ coef=a

logit cost3 lamount2 lpeople child2 child3 visit ltrips lhistory hike
camp shop climb other conmod conheavy efctlit efctmod efctgre lincome
curry falls trail sunny day campg after even lage lschool weekend
lmiles gender/ coef=b
```

Bibliography

Arrow, Kenneth, Robert Solow, Paul R. Portney, Edward E. Leamer, Roy Radner, Howar Schuman. 1993. "Report of the NOAA Panel on Contingent Valuation," National Oceanic and Atmospheric Administration, U.S. Department of Commerce.

Butkay, S. M. 1989. *The Economic Value of Instream Flows for Recreation: A Contingent Valuation Approach.* Masters Thesis, University of Montana.

Cramer, J. S. 1991. *The Logit Model for Economists.* Routledge, Chapman and Hall Inc., New York, NY.

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.

Duffield, John and Chris Neher. 1996. "Economics of Wolf Recovery in Yellowstone National Park," Trans. 61st No. Am. Wildlife and Natural Resource Conf., pp. 285-292.

Duffield, John, Chris Neher, Dave Patterson, and Stewart Allen. 1990. *Instream River Flows in the Missouri River Basin: A Recreation Survey and Economic Study.* Montana Department of Natural Resources and Conservation.

Duffield, John and Stewart Allen. 1988. *Angler Preference Study Final Economics Report.* Montana Department of Fish, Wildlife and Parks.

Freimund, Wayne A. and David N. Cole. 2001. *Visitor Use Density and Wilderness Experience: Proceedings*. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research.

Gramann, James H. 1992. *Visitors, Alternative Futures, and Recreation Displacement at Yosemite National Park*. College Station, TX: Texas A&M University.

Grand Canyon National Park. *South Rim Transit*. Slate July 2001. 9 Oct. 2001 http://www.nps.gov/grca/publications/transit.

Hanneman, W. M. 1984. "Welfare Evaluations in Contingent Valuation Experiments with Discrete Responses," American Economic Journal of Agricultural Economics 66:332-41.

Jakobsson, Kristin M. and Andrew K. Dragun. 1996. *Contingent Valuation and Endangered Species*. Edward Elgar Publishing Limited, Cheltenham, United Kingdom.

Miller, Craig A. and R. Gerald Wright. 1999. "An Assessment of visitor satisfaction with public transportation services at Denali National Park & Preserve," Park Science 19 (2):18-19.

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.

Neher, C. J. 1989. *The Economic Value of Instream Flows in Montana: A Travel Cost Method*. Masters Thesis, University of Montana.

Power, Thomas Michael. 1996. *Environmental Protection and Economic Well-Being*. M.E. Sharpe, Inc., New York, NY.

Ward, K.M. and J.W. Duffield. 1992. Natural Resource damages: Law and economics. John Wiley and Sons, Inc., New York, NY.

Yosemite National Park. *Final Yosemite Valley Plan/ Supplemental Environmental Impact Statement*, Slate 22 Jan. 2001. 8 Oct. 2001 http://www.nps.gov/yose/planning/yvp/seis/index.html.