ESTIMATING THE VALUE OF RECREATION IN

THE WILDERNESS AREAS OF US NATIONAL FORESTS

by

ALEXIS HEDGES

(Under the Direction of Craig Landry)

ABSTRACT

The value of recreation in wilderness areas of US Forest Service lands is estimated using a single-site travel cost model estimated with a Poisson distribution. Visitors are divided into their main activity groups, and ecoregions are included as covariates in order to observe more details in demand patterns. The results indicate that consumer behavior varies across main activity types and ecoregions. Aggregating over the number of annual US Forest Service Wilderness Area visitors found by the National Visitor Use Monitoring Program suggests that the annual aggregate value to all visitors is $196,842,000 when opportunity cost is not considered in the model and $605,162,000 when the opportunity cost of time is included.

INDEX WORDS: Travel cost model, Poisson model, US Forest Service, recreation demand, wilderness

ESTIMATING THE VALUE OF RECREATION IN

THE WILDERNESS AREAS OF US NATIONAL FORESTS

by

ALEXIS HEDGES

B.S., University of Georgia, 2015

A Thesis Submitted to the Graduate Faculty of The University of Georgia in Partial

Fulfillment of the Requirements for the Degree

MASTER OF SCIENCE

ATHENS, GEORGIA

2018

ESTIMATING THE VALUE OF RECREATION IN

THE WILDERNESS AREAS OF US NATIONAL FORESTS

by

ALEXIS HEDGES

Major Professor: Craig Landry

Committee: John Bergstrom

Jeffrey Mullen

J.M. Bowker

Electronic Version Approved:

Suzanne Barbour

Dean of the Graduate School

The University of Georgia

May 2018

TABLE OF CONTENTS

# SECTION 1

# INTRODUCTION

Beginning with Congress's establishment of Yellowstone National Park in 1872, the protection of our national forests has long been a part of the history of the United States. In 1905, the USDA Forest Service was established in order to map the national forests, issue grazing permits for ranchers, and otherwise manage and protect these lands. In the 1907 public version of *The Use of National Forests*, it is stated that the national forests "are great recreation grounds for a very large part of the people of the West, and their value in this respect is worth considering," showing that even as early as then, a need for a valuation method for the recreational benefit of the forests was presenting itself (Williams 2005). However, the ideas to drive such an analysis would not yet come about for nearly another half of a century, when Harold Hotelling would provide the impetus required to begin a whole new approach to travel valuation research. By utilizing these methods, we can derive an estimate of consumers' value of these protected lands for recreational pursuits.

The valuation of public lands, such as public forests, was once treated as a rather straightforward task. The usual measure of value was economic profitability. This value resulted primarily from timber harvest potential, but at other times from the potential for resource mining. Any benefits from the property that couldn't be traded on a market would not be included in calculations of property values. Non-market goods such as recreation were entirely omitted from the analysis of public land valuation for the first several decades of the National Forests' existence, in no small part due to the difficulties presented by such an analysis in a time before the tools and methodology used in modern travel cost literature had become available. The prevalence of outdoor recreation outfitting stores provides us with a clear example of how much value the public derives from access to such amenities, and so an accurate estimation of the magnitude of these values can help to guide policy decisions regarding the provision and management of these lands.

In 1960, the Multiple-Use Sustained-Yield Act was signed into law, changing the focus of the Forest Service from the 1897 Organic Act's vision of managing timber while protecting the forests and water to a new way forward (Williams 2005). The Forest Service would now treat all resources provided by the national forests, including recreational value, as equal in contribution to the timber when assessing the forests' value. All benefits from public lands would now be included in calculations based on their respective social benefits. However, the value of recreation can be difficult to determine. Much more is involved in the costs faced by the consumer than simply the park fees and permits they purchase to enter and participate in their preferred activities.

The Wilderness Act of 1964 established a new protective status for lands which have yet to see development (Williams 2005). Wilderness areas provide important ecosystem benefits. For most of the United States, the present environment has been tampered with at some point in its history, whether from "historic fire suppression, livestock grazing, [or] exotic species introduction" (U.S. Forest Service). These lands are established "for the use and enjoyment of the American people in such manner as will leave them unimpaired for future use and enjoyment as wilderness," as per The Wilderness Act (1964), and so provide unique opportunities for recreation which cannot be found elsewhere. All motorized vehicle use is prohibited, which not only protects the land for future use, but also protects the experience for those who wish to experience a more natural kind of outing. When we have evaluated the visitors' willingness to pay for wilderness area recreation, we can better assess future policies regarding the protection and observation of these wilderness areas.

The choice of recreation by a consumer involves the consequence of foregone wages, of car travel, and of any purchases necessary to have an enjoyable time. While there is the possibility for some employees to have paid vacations, or for them to take their holidays during time that they would have not been working anyways, it can be assumed that there is an opportunity that has been given up in order for the holiday to have been had. Travel by car comes at a cost per mile for the gas used and wear on the vehicle, for which AAA has an average estimate. In addition to the cost of time and of travel, there are the costs associated with park entry, permits for any activities planned, gear for the activities enjoyed, and anything else that the recreating party may desire. In order to find the value of recreation at a location, travel cost models have long been employed in order to approximate the willingness to pay for recreation of those who choose to participate.

The travel cost model relies on the assumption that the economic value of recreation can be determined by measuring how much individuals spend to take advantage of the recreation opportunities. Methods of estimating these models have faced many changes over time, with early models implementing standard OLS regression applied to observations grouped into zones of observations representing approximately equivalent travel costs. Modern models use regression procedures designed for integer data, rather than requiring the complicated interpretation of decimal outcomes, and often regard each observation individually instead of implementing the aggregates of the past. When estimating travel cost models, researchers will often include the demand for at least one alternative site. This is because demand theory, specifically regarding theory of demand systems, dictates that substitute goods must be included when estimating demand to obtain a better picture of the choices faced by the consumer. However, some modern research uses other means by which to incorporate the opportunity set faced by individuals.

In 2000, the Forest Service began the National Visitor Use Monitoring Program. This program seeks to survey one fourth of the national forests every year on a four year cycle such that, within that period, all national forests should have enough data to approximate visitation rates. Visitation data are collected along with surveys to collect demographic data about who makes up the average visitor to the different parks, and from where the visitors are coming. By applying travel cost model techniques to the visitor data collected, we can estimate the value of recreation that can be found in the National Forests. Due to how the data are collected, information can not only be obtained about the forests as a whole, but also about the different areas of the forests. For the analysis presented in this thesis, I will be looking specifically at the wilderness areas contained within the National Forests. Wilderness areas are defined as the areas in national forests where vehicular travel of any sort is not allowed, and the natural processes of the forest ecosystem are allowed to play out as much as is possible, including allowing forest fires to run their own course (U.S. Forest Service).

# SECTION 2

# LITERATURE REVIEW

## History of the U.S. Forest Service

The U.S. Forest Service as it stands today is an agency under the U.S. Department of Agriculture, but this has not always been the case during the organization's more than a century of history (Williams 2005). The institution has undergone name changes, duty transformations, and structural shifts which have served to improve our protection of not only the economic benefits which lie in forested lands, but the many other benefits to society presented by their conservation. While the initial reports and programs primarily represented a goal of protecting the future economic value of timber by preserving young trees from harvest on public lands such that they may grow into better assets, the motivation behind policy would become much more diverse as the years progressed.

In 1876, an amendment to the Appropriations Act of 1876 created the first position within the Federal government devoted to forestry, and in 1881 the Department of Agriculture Division of Forestry was established for the temporary study of "forestry matters in the United States and abroad" (Williams 2005). It wouldn't be until 1891 when The Forest Reserve Act would give the ability to create reserves from public forested lands, which later that same month would be put to use to create the Yellowstone Park Forest Reserve. Shortly thereafter the power to set aside these lands would move from the hands of the President to Congress. The Weeks Act of 1911 would later provide the government with the ability to purchase private watersheds for protection, thus increasing the number of national forests in the Eastern United States.

In 1905, the Bureau of Forestry became the Forest Service, and the first *Use Book* was published to detail the laws and regulations by which forests should be managed (Williams 2005). Mapping, administration tasks, and protection were the three major goals of the early forest rangers, and a portion of all revenues made from the sale of permits and timber would go to the states for the funding of public services. In the early days of the Service were focused on the protection and responsible usage of natural resources, with recreation coming more as an afterthought. The Organic Act of 1897 made recreational activities on forest reserves legal, and the first Forest Service campground was established in 1918, in the Mt. Hood National Forest. Some cooperative campgrounds would soon thereafter be put in place by communities in want of better recreational services to be available in their nearby forests. Recreational sites in the National Forests developed rapidly, from a cautious development policy in the 1920's came 1,500 campgrounds by 1925, although development was kept to a minimum in these sites (Williams 2005). Towards the later part of the 1930's, more development of these recreational sites would occur, mostly through the efforts of the Civilian Conservation Corps. The classification of these developed and undeveloped areas of the forests will be left for a later subsection, but this move helped to make the National Forests more accessible to both the avid and casual recreationists.

As aforementioned, the 1960's saw rise to a more varied approach to the valuation of public lands, with the implementation of the Multiple-Use Sustained-Yield Act of 1960 (MUSY) and the Wilderness Act of 1964. While these laws treat the use of land in two different ways, they are joined by the common thread of valuing lands for more than the economic resources they represent. The Wilderness Act represents a more preservationist ideology than the MUSY, they both change the tone of Forest Service policy and management to put a larger emphasis on nonmarket values than seen before. These together would shape a more diversified approach to public lands management.

Two more important pieces of legislation for the management of public lands were the 1974 Forest and Rangeland Renewable Resources Act (RPA) and the 1976 National Forest Management Act (NFMA) (Bowker et al. 2009a). The RPA established for the first time that the management of natural resources required long-term pre-planning by the Forest Service presenting five-year plans for the production of forest resources, and Congress providing the necessary funding (Williams 2005). The NFMA would come as an amendment to the RPA and an adjustment to the Organic Act of 1897 by "[mandating] intensive long-range planning for the national forests" in response to widespread clearcutting of the Monongahela National Forest (Williams 2005).

The US Forest Service has seen many changes in policy regarding the production and protection of forest resources. Protection of our resources for the enjoyment of future generations is now a primary goal, and with careful planning of long-term management goals now being at the forefront of policy decisions, establishing the value represented by all uses of these resources from consumption to recreation, will aid in the crafting of policies which will guide the optimal use of these lands for years to come.

Valuation of Public Lands

Land should always be put towards its highest and best use as per appraisal standards. This is as true for public lands as it is for private lands. Effectively analyzing the value of public lands helps us to better evaluate protection policies and come to the most optimal conclusions possible. While the availability of wilderness areas may not turn a direct financial profit, there are plenty more values to be found in the land, be it for use or nonuse. Whether the decision is being made to protect new lands, or to privatize protected lands for other uses, having the most accurate figures for the estimated net worth of the future stream of benefits for each potentiality is important.

The valuation of public lands depends highly on the assumptions the analyst chooses. Private lands can be priced using the economic benefits available to the owner, whether in the benefits to growing crops or to harvesting and possibly replanting timber. The value found in private lands can also come from the structures on the property, as the buyer is looking to save money that would otherwise have been spent renting, and for the many consumers looking for a residence or retail establishment, the structures are the main focus. Considerations for public lands are much different in that the focus no longer lies in the financial interest found in developing the land, but in the benefits to withholding the land from development.

During the years following Civil War in the United States, the focus of land management was put almost entirely on economic interests that could be found in the land (Williams 2005). Indeed, the valuation of land was not a formal practice, but more of the action of observing the quantity of goods present which could be put to market and were lying in wait for an individual to come along and harvest them. All valuation of public lands was performed by those who sought to capitalize on them rather than by those who might protect them, as no legal or financial system was yet put in place to protect public lands from exploitation. Despite these actions being to the detriment of North American wildlife and ecosystems, an approximation of the US Forest Service was not established until 1876, and as discussed previously would not be granted many management permissions for a while yet. During the early years of enforcement, public lands were still primarily valued by their economic profitability rather than any nonmarket benefits.

The potential financial value of market goods is no longer the only point of interest for public lands in modern evaluations. Undeveloped and underdeveloped lands which leave space for wilderness serve many important roles which do not have a market for trade. Rivers without human interference can serve as insurance against floods and as important habitats. Wetlands can filter water better than more expensive manmade structures, such as the Congaree Bottomland Hardwood Swamp in South Carolina, which would require a $5 million treatment plant to do the same work in its place (Office of Water, "Economic Benefits of Wetlands"). These and more environs serve valuable ecosystem services which no feasible amount of money could serve to replace.

Two driving sources of economic value are use values and passive-use values (Bowker et al. 2005). Direct use is associated with an individual being present at a site and actively using the amenities present. This type of use can be subdivided into consumptive and non-consumptive uses. Consumptive uses include participation in activities which involve the taking of present resources (such as fishing, hunting, or timber collection) and must prevent another from using that resource. Indirect uses include activities which leave the site as it was upon arrival (such as hiking or camping) and therefore do not prevent another's enjoyment of the same resource. Use values are important for our purpose, especially as the travel cost model to be estimated intends to estimate the non-consumptive use value of recreational activities in National Forests. While some consumptive activities are enjoyed, such as fishing and hunting, the fruits of these labors are not considered for their economic benefit for the purposes of this analysis. The non-consumptive benefit of outdoor recreation is what is sought by the implementation of a travel cost analysis, which is the participation in any outdoor activity rather than any reward taken home.

Non-use values are those that people get from knowing that something exists, even if they themselves are not enjoying it at the time. There are three basic sources of non-use value (Harris & Roach 2013). The first is option value, which comes from seeing a potential future use in the subject which has not yet been realized. The second is existence value, which is the result of getting a benefit from simply knowing that something exists even though it may not ever have a direct benefit to the beholder. The third is bequest value, the name given to the value one gets from knowing that their descendants may benefit from the subject's existence in the future and therefore desiring to protect it today. According to Charity Navigator, an estimated 3% of all charitable donations were given to Environmental and Animal related causes, suggesting that people value the protection of these limited resources for use and non-use values. For the present analysis, we will be focusing on use values derived from wilderness area recreation.

With the introduction of the MUSY, public lands would be valued in nonmarket benefits as well as marketable goods. Public lands pose opportunities which cannot be commoditized, such as outdoor recreation and environmental benefits, which had previously not been accounted for. In large part, these had not been involved in the discussion as they are harder to measure by not being traded among consumers but rather being used in place. Many outdoor recreational activities such as hiking and camping, while being congestible, are not in every case excludable and are most certainly not tradable in the way that market goods are. When goods are traded in a marketplace, economic theory assumes that an individual would pay for a good no more than the value that they find in owning it, and that a firm would not charge less than they would be willing to accept for it and will try to earn as much as is possible for the good they are selling. However, when no market exists for a good, an alternative method must be implemented to ascertain the value it represents to consumers or participants.

Surveys are often conducted to determine what households are willing to pay or willing to accept for changes positive or negative in the provision of nonmarket goods like environmental quality (Boyle 2017, Holmes et al. 2017). Many methods now exist for obtaining the monetary value represented by these responses, which should be placed on these goods when making policy decisions. One of the now more common methods wouldn't be seen until 1947 though, when the National Park Service sent out a letter seeking a methodology for estimating the value of outdoor recreation. The response to this call to action would shape analysis methods for valuing recreation on public lands for decades and beyond. While it is known that outdoor recreation provides value to many, a formal method for accurately estimating the magnitude of these values had not yet been established. Harold Hotelling's travel cost model would revolutionize nonmarket valuation methods because of its adaptability and ease of application (Parsons 2017).

Development of the Travel Cost Model

Nonmarket goods are often valued through contingent valuation methods. These involve surveys and stated preferences, typically in the form of selecting from a series of dollar values which the respondent would be willing to pay in order to either gain or maintain their access to or the protection of a good, service, or aspect of one of the prior. For example, contingent valuation surveys can be used to assess recreationists' willingness to pay for fishery improvements (Johnston et al. 2012). These surveys have a few issues, in that they are reliant on truthful responses. As well, the response could be dishonest without the person meaning to do so, depending upon how well informed they are on the matter, or if an event had happened recently to make them feel more strongly about the situation than they typically would.

In 1947, Harold Hotelling responded to a letter from the National Park Service with a suggestion of how to find the value of benefits national park visitors receive from their trips. It was highly unlikely in the eyes of the National Park Service that visitors only receive a benefit level represented by the park entrance fees, and Hotelling agreed – the cost of travel associated with the visit should also be taken into account, including both the transportation expenditures and the opportunity costs of time represented by foregone earnings from not working during the time spent traveling (Arrow & Lehmann 2005). People travel for many miles in order to experience different National Parks or National Forests, and the method proposed by Hotelling would divide the visitors into groups based upon how far they traveled for their visit, and thus derive a valuation based upon the travel costs faced by the different groups of visitors. In the decades to come, the originally suggested model would be applied, and several adjustments and additions added to where we eventually reach the travel cost model known and utilized today. The model uses the core theory that the value an individual receives from either a good or service is approximately equal to what they would be willing to pay for it, and this theory holds no less reasonable for a vacation to a National Forest than it would for a toy at a store or a book on a shelf. What remains to be seen is how one can best approximate the total cost an individual spent on their trip.

In early implementations of the theory, researchers would group observations of visitors (from here on out referred to as observations) in groups based on the estimated distance of their origin location from the site (Kim et al., 2010). The data would be grouped partially such that it would be much more accessible for evaluation. By aggregating observations, individual heterogeneity is lost in all ways but in the zone of origin, such that if individuals were found to be from the same region, then all would be presumed to value trips to the site at the same level as one another. While using grouped observations would reduce the specificity of the results and the flexibility of the analysis, it would be a while yet until the model was adapted in order to accommodate individual observations.

Individual travel cost models treat each observation as independent of others and can thus account for more variation in observations than the zonal counterpart. With the individual observations, the model can now account for heterogeneity among the individuals. As different income groups, demographic groups, family dynamics, and more tend to follow different patterns of vacationing and valuation of wilderness areas, being able to accommodate this in our model will be useful. However, the individual framework does have issues of self-selection bias in that survey respondents must be present at the site to be surveyed, and so zeros will not be observed, and those who visit more are inherently more likely to be selected. Therefore, some modifications are made to the collected observations in order to adjust for these issues.

There are a number of guiding assumptions that must be met for a travel cost model to be deemed applicable, and if any are violated then the model is no longer viable for the data (Haab & McConnell 2003). First, the travel obligation must be considered a cost, for the benefits gained from the site itself must be the only utility being calculated. Second and similarly, time spent traveling must be neutral, such that one doesn't make the decision between two sites because of the voyage to one being more scenic or otherwise preferred over the trip to the other. Third, the decision process must be made among destinations of similar enough distances from the traveler's point of origin—if the decision is being made between distinctly different trip lengths, many reconsiderations must be made which overcomplicate the analysis. These could be in regards to how long to stay at the destination, how much time to take off of work, and so on. Fourth, the trips included in analysis must only serve the single purpose of recreating at the site of interest. The pursuit of any other tasks on the same trip contaminate the observation, in that the researcher can no longer determine how much of the cost of travel should apply to each separate purpose and thus the observation is no longer useful. Fifth and finally, the quantity consumed in the base equation taken must be the same for each individual in the data set, as in each trip taken must be valuing the same product (Haab & McConnell 2003). In this assessment, I will be assigning value to wilderness as a whole, and so this assumption is valid.

When measuring site demand, it is often best to allow for substitution in the model framework. Random utility models are a frequent choice of researchers for their flexibility in estimation (Parsons 2017). The guiding framework behind these models dictates that as travelers seek to maximize the utility gained by their trip, they will choose the destination that provides the highest net utility when accounting for costs and benefits. The utility from a trip is estimated by applying the input variables which should affect preferences, and the trip decision as the output (Walker & Ben-Akiva, 2002). Parameters are thus estimated in order to obtain an idea of how the different inputs affect the ultimate decision of destination. While it is optimal to account for substitutability between sites when estimating a single-site travel cost model by including a variable for the availability of substitution, the lack of observations with information on availability of substitution opportunities prevents our models from converging in some cases and from fitting well in others. For this reason, the models included in this paper will not account for the substitution effect, but is still expected to provide useful insights.

Estimation of a travel cost model depends on whether the number of trips taken by an individual should be treated as a continuous variable or count variable (Haab & McConnell 2003). Many researchers choose to treat trips as a count variable, as all observations of trip counts will be whole numbers. From there, the decision lies in the type of model to be used in order to estimate parameters for the variables. Two common choices are the Poisson model and the negative binomial model, as they are both useful for estimating the number of occurrences of an event within an allotted time period. One of the assumptions of the Poisson model is that the mean and variance must equal one another, which is not always the case. However, as long as the data are not found to be excessively overdispersed (meaning that the variance is not found to be excessively higher than the mean), the model can be estimated so long as the researcher considers the effect of underestimated standard errors (Haab & McConnell 2003). A means correction for data affected by avidity bias, derived from the procedures suggested in Thomson 1991, is performed on the individual characteristics and shows that the means and variances of our data are not far enough from one another to interfere with our Poisson estimation, as can be seen in Appendix B.

Travel cost models have come a long way since the method's conception. As data analysis methods and technology improve, so does our understanding of how to best estimate and interpret the surplus consumers receive from their various trips to assorted destinations, as well as understand and interpret the choices many consumers face when they decide not to partake in the travel that others do. This application of the method will utilize the National Visitor Use Monitoring Program (NVUM) data to estimate consumer surplus of visitors to the US Forest Service Wilderness Areas (US Forest Service 2018).

### Other Applications of the NVUM

The results of the NVUM have been used towards a variety of different research goals, as the accuracy and completeness of the data makes it applicable in many different ways. Applications range from analyses of recreation patterns to others of spending patterns, with results both interesting and compelling. The goal of this research is to add to the existing literature surrounding these observations. By taking a look at the research already available, we can get a better idea of what has already been observed and what remains to still be analyzed.

Expenditure data obtained from some respondents to the NVUM surveying techniques can be used for a variety of different ends. By separating visitors by both their primary recreation activities and their trip types, one can observe interesting patterns in destination expenditures (White & Stynes, 2008). For example, while it may be intuitive that overnight visitors will spend more than day visitors on average, or that nonlocals typically spend more on average than locals, it may not be so that nonlocal overnight visitors often spend much more than nonlocal day visitors as found by White and Stynes. It's also interesting to note that many of these statistics are found to be significantly different from the average spending levels within their trip type delineations, suggesting that these results are unlikely a result of sampling error and will be found to exist in the population as well as the sample. As some of the models we will be implementing in this analysis will be intended to draw out such differences in recreation demand, this research provides interesting insights into the different types of recreation participants.

Bowker et al. (2009b) apply these data in two different ways in order to compare and contrast the resulting consumer surplus values. Both methods utilized in the paper are intended to correct for the complexities inherent in on-site surveys which have already been discussed in this paper. These challenges, while making OLS estimation inappropriate, are remedied through implementing a truncated negative binomial estimator in its place. The two model specifications for approximating wilderness demand include a travel cost model and an on-site cost model. The travel cost model estimates annual trip demand as a function of travel cost, demographic characteristics, and site characteristics, similar to the methods which shall be implemented in this paper. The on-site cost model in Bowker et al. 2009b estimates annual days on site as a function of distance traveled to the destination, daily on-site costs, and the sets of characteristics for the visitors and the sites as before.

Some NVUM respondents were asked of the main activity the individual would be participating in if they were not at that forest; two possible answers were recreation at a different forest, either participating in the same activity or a different one. This response was used to represent substitutability of the individual's visit in the two models in Bowker et al.'s 2009 paper. The intent to apply the same approach in this paper was unsuccessful, as not all survey respondents were asked this question. Observations fell below what can be reliably used for our models when the substitute activity subgroup were selected out of the list of responses with income information.

# SECTION 3

# DATA

## NVUM Methodology

The National Visitor Use Monitoring Program (NVUM) was conceived as a means to better, more uniform data on National Forest System lands (Zarnoch et al. 2011). The methodology implemented by the program is uniform at all locations such that the data collected will be with as few errors as possible. When survey methods are too general, the potential for site-by-site variation can be high which can lead to less accurate information. Prior to the NVUM, site visitation counts would be collected from individual ranger districts of which each would use their own methodology for estimation, "ranging from absolute knowledge to little more than guesses" (Zarnoch et al. 2011). The NVUM achieves two ends – it establishes a concrete method for obtaining accurate and normalized estimates of forest visitation, and it procures demographic information about visitors in the individual surveys conducted.

National Forest visitation counts are estimated by two different methods. Some sites require a permit, fee, or other form of pseudo-self-reporting of park visitation (Zarnoch et al. 2011). As long as the form of registration is required, or if the information source is a permanently installed traffic counter, this information can serve as a proxy to forest entrance rates and therefore supersede the need for vehicle counts. Obtaining site visitation from proxy sites using this type of information helps to cut costs and better allocate resources towards estimating visitation for forests that do not have this type of proxy information available, as this is a more involved process than the former. While a six-hour sampling period is used in order to aid in creating calibration for the proxy counts in order to estimate the most accurate daily site visits, this method requires fewer resources than the estimation method for nonproxy sites.

Visitation estimation at nonproxy sites is more resource intensive, as it requires accurate counts of vehicles exiting the park (Zarnoch et al. 2011). The survey involves two parts, the first being a six-hour hand tally of all vehicles exiting the park for the final time that day. These are referred to as last-exiting recreationists (LER), as the survey methodology seeks to minimize the chance of double counting vehicles upon entry and exit, or potentially upon reentry. A quick survey is conducted to confirm that the exiting party is leaving the forest for their final time that day in order to confirm this for the record. This count is incorporated into an adjustment factor which is used to estimate the percentage of exiting vehicles which are LER. This factor is applied to the second part of the survey, which is a 24-hour traffic camera set up to count exiting vehicles. By applying the correction factor, it can then be estimated how many of the vehicles exiting throughout the day are likely to be LER and therefore contributing to the total visitation count for that day.

Individual surveys are conducted as frequently as is possible during the six-hour sampling periods in order to obtain LER status of exiting visitors (English et al. 2002). Once the party is determined to qualify for questioning, one member of the party is asked to answer more questions such as prior visitation habits and general demographic information. One fourth of participants are also administered a brief economics questionnaire, while another fourth was provided with a facilities satisfaction questionnaire (English et al. 2002). These survey responses are included in the NVUM data set. The results of the economics questionnaire administered to one quarter of the respondents provide us with the income data necessary for our analysis. The data set contains enough survey responses containing economic data in order to estimate models for all recreation activities and visitor types included in this thesis. These models will be discussed in more detail later in the paper.

The NVUM operates on a four-year cycle such that a quarter of the total number of National Forests will be sampled each year (Zarnoch et al. 2011). Each region of the Forest Service receives 200 sampling days per reporting unit surveyed, and each unit receives an allotment of sampling days (English et al. 2002). No more than fifty of these sampling days may go towards proxy sites, and after these days have been allotted by a specified process, all of the remaining sampling days go to nonproxy sites. This is done because, as aforementioned, monitoring methods for these sites are more labor-intensive and therefore require a higher allocation of resources. Sampling days and hours are allotted in order to get a varied data set and thus be able to calculate accurate variances for the estimates.

There are four site-types within National Forests, and while not all forests exhibit each of the four, all forest recreation areas fall under one of the four classifications. Day-use developed sites (DUDS) can have a wide range of modifications made to them and provide "visitor comfort, convenience, and education opportunities" to visitors (Zarnoch et al. 2011). Overnight-use developed sites (OUDS) can also have infrastructure in place like the DUDS, but must be intended for use by overnight visitors and thus include campsites, cabins, and other such amenities. General forest area sites (GFA) do not fall under the other three classifications, and are usually places where recreationists can access undeveloped areas like hiking and hunting trails. Wilderness sites (WILD) are the fourth and final site type, and will be the subject of this paper's analysis. These "include lands and waters that are part of the National Wilderness Preservation System" (Zarnoch et al. 2011), which are included in the lands protected from development by the 1964 Wilderness Act, signed into law by President Johnson in order to ensure some lands will remain wild for our enjoyment and the protection of the environment (wilderness.org).

The National Visitor Use Monitoring Program provides a uniform methodology for the estimation of visitor counts for National Forests. Total visitation approximations for the forests are estimated by collecting total visitation counts through the use of both vehicle counts and proxy data, and applying a correction calculation in order to convert these figures into estimations of the total number of unique visitors (rather than people leaving just to come back later). The data collected can also be used to calculate variances for these estimates, as samples are collected from days with a variety of visitation volumes to get a good idea of patterns in the variation.

<u>Cost of Living Index</u>

I will also be implementing the Council for Community and Economic Research's Cost of Living Index (COLI) for the years 2005 through 2014 in the model estimation. By applying a normalization which uses approximated price information for the visitors' zip codes of origin, we can get a better idea of the choice decisions they face when choosing their destination of recreation (LaFrance 1985). While the COLI is estimated for select core-based statistical areas (CBSAs), rather than for the zip codes needed to be applicable to the NVUM sample, we use geospatial techniques in order to interpolate data for the zip codes outside of the CBSAs. Albeit not the most accurate measure for obtaining pricing data, this will allow us to obtain a means by which to normalize the reported incomes and travel costs such that the figures better represent the purchasing power for their year and region.

The COLI is a product made by the Council for Community and Economic Research, using price data collected via a specified process performed by a large volume of volunteers. The data are collected on a quarterly basis, and since 2007, has been reported as a series of three quarterly figures and one annual average. A published manual describes in detail the pricing practices to be followed by the volunteers such that the information collected represents an approximation of the same standard of living in all participating areas (C2ER 2015). Once the prices are collected, they are averaged by categories using weights in order to be used for the estimation of an index. The weights are intended to represent the average consumer's spending habits and are reevaluated annually and adjusted as needed in order to represent a typical consumption bundle. The average of these averages is then found and used as the base for a calculation of the price indexes. An index is calculated for groceries, housing, utilities, transportation, miscellaneous, and a composite of the five, with those falling above 100 representing above average prices and thus a higher cost of living, and those below 100 representing below average prices and a lower cost of living.

For the applicable years before 2007, an annual index had to be calculated such that it would be comparable to the data of the other eight years in the data set. By using methods similar to those used by C2ER, I averaged the prices for the first three quarters of every CBSA with all three relevant observations for 2005 and 2006. While this does mean losing the fourth quarter of data that these years have as an advantage over the other years in the data, it is important that the sample to be used matches in methods as closely as possible in order to provide the most accurate data for analysis. As there are some concerns that pricing patterns may change during the fourth quarter in comparison to the other three, the choice of omission of that quarter is performed in the hopes that this avoids any unnecessary and unaccounted-for variance in the data.

The COLI is not intended to be compared across years, as this is an index and therefore dependent upon the sample set for that year's observations (COLI.org). In order to help overcome this, each year is multiplied by its CPI inflation rate with 2014 functioning as the base year in order to match other complimentary analyses. By using the inflation rate in the calculations, we can treat the index as rising along with inflation and therefore adjust incomes accordingly. While adjusting indexes in such a way is ill-advised, this was the best choice of action I could arrive at in order to accommodate the NVUM sample which is distributed both spatially and temporally. With the spatial distribution of survey respondents being as broad as it is, it would not be accurate to assume that the value of a dollar is the same across all observations. Therefore, adjusting incomes by dividing by the inflation-adjusted price index will deflate incomes facing high prices and inflate incomes facing lower prices. Using inflation-adjusted price indexes for this task is conceptually the same as adjusting income for inflation and cost of living separately.

It is important to include price indexes for other goods of common consumption in the estimation of the travel cost model, as there are problems of integration for incomplete demand systems that would interfere with the estimation of consumer surplus for National Forest visitors (LaFrance 1984). A demand system requires price and expenditure data for all goods purchased by the observed party in order to be integrable, and the estimation of consumer surplus is performed by taking the integral of the demand curve from the price paid to the choke price, which is not observed. The NVUM collects information about site visitation patterns and visitor demographics, but there is still other information which will be useful in our analysis. By applying the composite price index to normalize the income data, we can better represent the decision criteria faced by the consumer based upon how far each dollar stretches when shopping at home. Including the price indexes of other good bundles as covariates in the model will help to correct the issues that the incomplete demand system presents.

Ecoregions

Environmental management requires a thorough understanding of the ecosystem, its functions, and its features. Recreation demand can also be influenced by such matters, albeit a less thorough understanding is often found driving such decisions. Ecoregions were developed from ecosystem research by James Omernik in 1987 in order to aid in management decisions by mapping patterns in environmental characteristics displayed by geographic areas within the continental US (Omernik 1987).

Qualitative destination characteristics can affect demand as much as individuals' characteristics. Thus, having a means by which to determine the environmental amenities available at the recreation site will help to more accurately determine the causes of variation in recreation demand. While some ecoregions may be more suited to certain activities than other, some individuals may enjoy the same activity as another but in different landscapes. We hope to capture some of this variability in our models by including dummy variables for the different ecoregions present in the national forest visited.

Ecoregions are defined cross the United States, and so while some forests may offer more than one different environ, every forest will offer at least one, which will aid in our ability to observe variation in demand patterns.

Ecoregions are defined in the United States at four different levels (Omernik 1987), according to the data available from the EPA. These increase in specificity in ascending order, with the levels three and four being defined at a finer scale than levels one and two. For our analysis, we will use level one, as it provides us with enough specificity to assess what environmental amenities are available at the forest while still exhibiting a broad enough scope for us to be able to observe patterns in demand. As national forests are not exhibiting only one ecoregion at a time, we do not exclude an ecoregion to act as a base case in our models. This situation does not exhibit the potential for a dummy variable trap as is found in mutually exclusive categorical variables.

# SECTION 4

# METHODS

## Data Assembly

The NVUM collects zip codes of respondents to serve as home address identifiers, so the COLI values must be converted from metropolitan statistical areas (MSA) into zip codes in order to be applicable for our needs. There are two main hurdles to overcome in achieving this goal: some MSA's would have multiple price indexes calculated for different regions within their extent, and not all zip codes are contained within an MSA. With the help of some assumptions and ArcMap software, we are able to overcome these obstacles to arrive at an approximate map of price indexes for each year within the scope of our data, 2005-2014.

After manually calculating the annual averages for 2005 and 2006 as discussed previously, the MSA codes were inspected for duplicate data points. When this situation was observed, the urban area name would be used in place of the MSA, and each urban area would be given a unique identifier to ease the migration into ArcMap. Layers for MSA delineations and zip code boundaries were merged in order to identify the MSA code each zip code lies within. The MSA codes were compared to those in the COLI to correct any that did not match, and any MSAs with multiple data points would be recoded to match the assigned unique identifiers based upon the urban areas the data was collected from, and then each year's COLI was assigned to the MSA-coded zip codes. Zip codes found outside of MSAs were assigned COLI data from the nearest zip code with data, and only after each map was populated with index values the ten individual COLI maps were merged to maintain as many unique data points as possible.

Some MSAs did not have consistent data throughout the years of observations. By keeping the years of data separate from one another while filling the map with observations, we could get more observations of cost of living indexes that are as close to the region observed as possible. The list of regions with data throughout the time horizon was quite limited, and so while this method of interpolation may not be theoretically consistent, it provides more price context for our observations than we would otherwise have access to. Since each observation in the NVUM is a separate group, and so the chances of observing the same group receiving the income survey more than once is unlikely. After assigning COLI values for each year and commodity bundle to the zip codes in the NVUM dataset, values were then assigned to zip codes without observations based on the closest lower value with an observation. Again, this was performed in order to achieve a reasonable approximation, as the zip codes missing observations were mostly unmapped postal identifiers – in every observed missing data point, the unmapped zip code was from the same region as its immediately preceding value, and so this method can be presumed to be consistent.

Ecoregions were assigned to National Forests using a GIS layer for Level I ecoregions published by the EPA and a layer for National Forests from the US Forest Service. Dummy variables were assigned to each forest code based upon which ecoregions intersect the forest's total area. One reason for this is because identifying specific survey sites and assigning the ecoregions to these locations would be an arduous process, but the stronger reason is that it would be difficult to ascertain what areas the individual participated in reaction in, as that will provide us with a more insightful analysis than merely looking at the ecoregion available where the consumer was intercepted for surveying.

After joining the separate components into one data set by zip code, the set of NVUM observations was cleaned for analysis. Any observations missing crucial identifying information, such as the age or gender of the respondent, or the size of the national forest, were dropped. As well, if the respondent's motivation for their trip was not recreation, then they were dropped as well. Trips originating from outside the contiguous United States or to forests outside of the contiguous United States were also omitted from analysis, due to these observations skewing the results due to the extraordinary distances and to the participants of such trips likely experiencing a different preference structure than the average consumer. Finally, only observations with income data were included in the regressions. After the completion of these adjustments, we are left with 5,295 observations in total for our analysis.

Travel Cost

Travel cost is estimated under two different assumptions in order to provide two sets of estimates for each model. This serves as a robustness check for our willingness to pay estimates. The first method assumes no opportunity cost of time – travel cost is only calculated as the round-trip cost for a medium sedan according to AAA's "Your Driving Costs" publication. By multiplying the distance traveled by the cost per mile, and then doubling this value, we arrive at an estimate for the costs faced by those traveling to National Forests.

The second method of estimating travel costs starts the same as the first, but also includes an accommodation for the opportunity cost of the time spent driving to the site. This is often performed by using one-third of the hourly wage rate, which is calculated by dividing the annual income by 2,000 (Parsons 2017). We estimate the hours spent traveling by dividing the distance traveled by 45 miles per hour for those traveling fewer than 100 miles, under the assumption that time spent on the interstate and on backroads averages out to approximately this speed. For those traveling over 100 miles, the assumed average speed is 55 miles per hour. By multiplying one third of the survey respondent's hourly wage by the hours spent traveling in either direction for their trip, we have an estimate of the opportunity cost of the trip.

Analysis

As mentioned previously, a maximum likelihood estimation of the Poisson distribution is the model of choice for this paper. The Thomson means adjustment for data affected by avidity bias shows that the data are not overdispersed to the effect of interfering with our ability to estimate the model (Landry 2016). Our estimated population standard deviations are actually smaller than our estimated population means, meaning that our data may be underdispersed rather than the alternative. However, this dispersion difference does not appear to be by a large enough margin to interfere with our estimates. Therefore, we can assume that our estimates will provide consistent results in parameters, including their standard deviations and test statistics.

Models are estimated for overall visitation, overnight visitors, and day visitors. The latter two are separated for model estimation due to the preference structure for the two types of trips can reasonably be assumed distinct from one another. Overnight visitors must take more time off from work and may have time to travel further than day visitors. Due to these reasons, they likely experience a different preference structure than day visitors. This assumption is made by a multitude of other researchers (Bowker et al. 2009a, Bowker et al. 2009b, White & Stynes 2008), and so we shall continue to implement the same separation of visitor types in our estimation. As we are only investigating wilderness visitors, we need not worry about delineations between the other types of visitor sites in the national forests.

We further distinguish between the observations of the NVUM by separating the different recreation activity the respondent participated in during their trip. The activities we include in our estimations are backpacking, hiking, fishing and hunting, horseback riding, relaxing, and viewing nature and wildlife. While backpacking and hiking seem theoretically similar, they did not exhibit preference structures similar enough to allow for incorporating the two groups of observations into one as fishing and hunting or viewing nature and wildlife were. These activities provide us with a varied look at demand patterns for those enjoying wilderness recreation without overcomplicating the analysis.

With these six groups of individuals, along with the day use and night use delimiters, we come to eleven resulting models to compare between the different preference structures for wilderness demand. The resulting number of models is eleven rather than twelve due to the model representing day backpackers did not have enough observations or similarities between observations for the model to converge as the others were able to. Four baseline models are also estimated to provide more points of comparison – one including only the major travel cost model components, one with ecoregion variables added to the estimation model, and then one each for day and night visitors. By estimating these models, we will be able to observe whether the variation in parameter estimates can be primarily attributed to the type of trip, or which type of activity the party participated in while on their trip. We will analyze how travel cost affects site demand by applying the Poisson estimation model to the previously discussed subsets of observations.

## Model

The Poisson is estimated by the formula $y = e^{x\beta}$, in which the compressed nomenclature $x\beta = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_k X_k$, where k is the total number of covariates. Our primary variable of interest is the travel cost, as it will be the basis of our consumer surplus estimation. We are also interested in the effect of the ecoregion variables on the propensity for return trips. To account for variation in site characteristics, we include variables for the population density, the size of the site, and the wilderness miles present at the site. To account for variation in the individuals visiting the sites, we include the survey respondent's gender and age, the size of the group they are traveling with, their household income, and the COLI price indexes for housing, food, and transportation for their local area. The price indexes are divided by the composite price index, such that the effect of categorical prices is relative to the composite price in the area.

We will be calculating income elasticities and consumer surpluses for the estimated models. The elasticity of a Poisson variable can be calculated as $\frac{\partial y}{\partial x} * \frac{\bar{x}}{\bar{y}} = e^{x\beta}\beta * \frac{\bar{x}}{\bar{y}} = \beta * \bar{x}$, which we will apply to income such that we can compare the effect of income changes on the demand for the different types of return trips.

The consumer surplus, as aforementioned, is found by integrating the equation with respect to the price variable. The consumer surplus is $\int_{tc^0}^{tc^*} e^{x\beta} dx_{tc} = \frac{1}{\beta_{tc}} e^{x\beta}$. As the predicted number of trips is $y = e^{x\beta}$, the average consumer surplus per trip is thus $\frac{1}{\beta_{tc}} e^{\bar{x}\beta} \div \bar{y} = \frac{1}{\beta_{tc}}$. As the reporting unit for the NVUM is a group, this value is per group, and so dividing by the average group size will provide us with the average consumer surplus per-individual, per-visit.

The variables included in the models to be estimated are the COLI-adjusted travel cost, site characteristics, and group characteristics. The site characteristics include the size of the forest and wilderness areas, the population density, and the level 1 ecoregions available at the site. The group characteristics include the COLI-adjusted income, the respondent's age and gender, household income, price indexes for food, transportation, and housing adjusted by the composite COLI for their home area, and nights spent on-site when applicable. While nights on-site may be considered endogenous to the dependent variable, the number of annual trips taken, the model estimates were not observed to be sensitive to the inclusion of this variable.

# SECTION 5

# RESULTS

## Initial Observations

The two sets of initial model estimations are contained in Table 3.1. These are each estimated using the total set of observations. The basic model excludes the ecoregions as covariates – the variables included in this model will here on out be referred to as the core model variables. This model reflects the visitation habits of 5,294 observations, taking an average of 1.966 annual return trips to the same destination for the same activity. Each observation represents one group's visitation habits to the site. These original estimates find that an increasing household income decreases demand for trips, with an income elasticity of -0.029. While it is difficult to theoretically justify what may make wilderness visits an inferior good, other researchers have also found this result (Bowker 2009). Therefore, we can presume this is not a weakness of our estimation, but rather a common pattern in wilderness visitation. We also find that men take fewer main activity trips to the same site than women, while older individuals take more return trips than younger. The size of the wilderness area has a positive effect on return visitation at the 95% significance level, but larger forests attract fewer return visits. The number of nights spent on site doesn't have any significant effect on return visits, but the larger groups return for fewer trips.

Including opportunity cost in the travel cost calculation provides us with some slightly different results. The coefficient on travel cost is now smaller in magnitude, which represents a larger consumer surplus represented. However, the coefficient on income is now positive, meaning that wilderness recreation can be considered a normal good with this specification. The income elasticity of demand for wilderness recreation is now 0.18. Many of the coefficients retain the same direction and similar magnitudes, but nights spent on-site now has a significant and negative effect, and the size of the wilderness area how has a slightly more significant positive effect.

When ecoregions are added as covariates in Table 3.2, we observe some signs change in the core model variables from the first model. We are still analyzing 5,294 observations with this estimation, who still take 1.966 annual trips on average. Forest size continues to have a negative effect on return trips taken, but miles of wilderness and nights spent on site have no significant effect. Age, gender, and income all maintain the same direction of effects to the first model estimated, with age having a positive coefficient, and gender and income are each negative. For the average visitor, the travel cost elasticity is 2.591, meaning that adding one percent to the travel cost decreases trips demanded by 2.591%. Income elasticity is -0.054, which means wilderness visits are nearly inelastic with respect to income. Adding opportunity cost to the travel cost value does not change many of the covariates in the model, but travel cost elasticity becomes 2.33, and income elasticity becomes 0.146. The change in income elasticity means that when opportunity cost is accounted for in this model, wilderness recreation becomes a normal good.

Of the ecoregions, Mediterranean California and Temperate Sierras are shown to have no effect on the number of trips taken, while Southern Semi-Arid Highlands has a positive effect only at the 95% significance level. Eastern Temperate Forests, Great Plains and North American Deserts each demonstrate a positive effect on the outcome, while

Northern Forests, Northwestern Forested Mountains, and Marine West Coast Forests each have negative effects.

Variations among Visit Types

The regression results for day and night visitors are contained in Table 3.3. This model does not include the coefficient for nights spent on-site, due to day visitors spending no days on site by definition. Day visitors consist of 2,678 observations who on average take 2.933 return trips to the same forest for the same activity. The core model variables exhibit the same signs as Model 2, but with some differences in the magnitude of the coefficients. While many exhibit no significant difference in magnitude, the coefficient on travel cost is more negative, while the coefficient on population density near the site is now insignificant. For the average day tripper, this value is 1.336, meaning that day trippers are less likely to be discouraged by longer distances when planning return trips to national forests. Income elasticity for day trippers is 0.05, which indicates that they are relatively inelastic to changes in income when demanding return trips. When opportunity cost is added, many of our coefficients retain similar values. However, travel cost elasticity becomes 1.398, while income elasticity becomes 0.248. The change in the travel cost elasticity is negligible, while the change in income elasticity shows wilderness recreation to be slightly more income elastic.

Overnight visitors exhibit 2,600 observations taking 1.468 return visits annually on average. The effects of both forest size and amount of wilderness are both positive in this model. The coefficient on gender is no longer significant, while that on age is still positive. The travel cost elasticity for overnight return visits is 0.750, which is relatively inelastic.

This means that the average overnight visitor is less deterred by changes in travel cost than the average wilderness visitor, to the extent that a one percent change in travel cost decreases the demand for return trips by less than one percent. This is reasonable to assume, as they will be anticipating a greater benefit to their longer trip than a day visitor. The income elasticity is -0.024, which again, is close to inelastic but slightly negative. The travel cost elasticity with opportunity cost added is 0.623, while the income elasticity in this model is 0.168.

The coefficients on the ecoregions exhibit different marginal effects between day-trippers and overnight visitors. Eastern Temperate Forests and Temperate Sierras each attract more return visits from both day users and overnight users. Northern Forests and Southern Semi-Arid Highlands both attract more return trips from overnight users, but fewer from day users. Conversely, North American Deserts attract more return visits from day users and fewer from overnight visitors. Northwestern Forested Mountains exhibit a positive coefficient for both types of visitor, but only significantly so for overnight visitors. As well, Mediterranean California demonstrates a positive effect on eliciting return trips from day visitors, but no significant effect on overnight visitors. None of these effects are significantly changed by adding opportunity cost to the travel cost.

Variations among Recreational Activities

After dividing visitor groups by visit type, we also divide them by recreation activity. In doing so, we hope to further observe differences in use patterns of forest wilderness recreation. As aforementioned, we have regression results for day users who reported participation in hiking, hunting and fishing, relaxing, horseback riding, and viewing nature or wildlife. Night users have also been divided into the same categories, along with backpacking, which is missing from the list of day user activities due to backpacking being an overnight activity, and therefore demonstrating only very few responses from day visitors.

Models predicted for different types of day visitors can be found in tables 3.5 through 3.8. Among day visitors, there are 2,020 observations of hikers taking on average 2.953 annual forest visits, 134 observations of hunters and fishers taking on average 3.600 annual visits, 92 relaxing respondents taking 2.714 visits, 52 horseback riders taking 5.504 annual trips on average, and 166 viewers of nature and wildlife taking 2.122 annual trips. The most travel cost elastic demand of the day visitors is observed among hunters and fishers with an elasticity of 1.975 without opportunity cost and 2.198 with. The least elastic demand is observed among viewers of nature and wildlife at an elasticity of 0.240 without opportunity cost and 0.302 with. This is a far smaller elasticity than any other observed among the day visitors, with the next smallest falling at 0.805 for the respondents reporting relaxation as their primary activity. However, among the models with opportunity cost included, horseback riders also exhibit relative price inelasticity at 0.470. Among the models without opportunity cost, the smallest income elasticity is -0.180 for hunters and fishers, while the largest is 0.781 for relaxers. The two primary activities demonstrating normalcy in their income elasticities among the models without opportunity cost are horseback riders and those enjoying relaxation. Among the opportunity cost models, viewers of nature and wildlife are shown to be almost inelastic, with an elasticity of 0.024, while participants in relaxation exhibit nearly unit elastic demand with an income elasticity of 0.870.

Day hikers are most drawn to North American Deserts and are most deterred by Marine West Coast Forests when looking for a destination to return to for more hiking trips. Hunters and fishers during the day prefer Temperate Sierras, Eastern Temperate Forests, and Northwestern Forested Mountains, but are least likely to return for more visits to Southern Semi-Arid Highlands and North American Deserts. It is likely that the coefficient on Temperate Sierras results from outliers reporting significantly higher numbers of return trips than average, as the coefficient on this variable is quite high compared to the others at 2.238 in the model without opportunity cost and 2.412 in the model with. Day visitors reporting relaxation as their primary activity are drawn to return to Mediterranean California but return less often to all other ecoregions, aside from the North American Deserts, which exhibit an insignificant coefficient. Horseback riders are not observed in Northern Forests or Marine West Coast Forests, but the day visitors of the group report fewer return trips to the Great Plains and North American Deserts. The five other ecoregions exhibit positive effects on drawing return trips from day horseback riders. Those who were surveyed while enjoying viewing nature and wildlife during the day report fewer trips to all ecoregions but Mediterranean California and Southern Semi-Arid Highlands, the latter of which has an insignificant coefficient.

Models predicting the behavior of overnight visitors can be found in tables 3.10-3.15. Overnight visitors exhibit different patterns than their day visitor counterparts. Backpackers consist of 435 observations taking 0.555 return visits on average, hikers represent 1,350 observations taking an average of 1.471 annual trips, hunters and fishers consist of 191 observations taking 1.526 visits on average, 181 observations of relaxers take 1.488 trips on average, horseback riders consist of 68 observations taking 2.117

annual trips on average, and 162 observations of wildlife and nature viewers take 1.278 return trips annually. Overnight visitors exhibit the most travel cost elasticity among horseback riders with an elasticity of 2.265 in the model without opportunity cost and 2.245 in the model with. The least elasticity is observed among hikers with an elasticity of 0.655 in the model without opportunity cost and 0.541 in the model with. Overnight visitors participating in viewing nature and wildlife also exhibit a high travel cost elasticity. All overnight visitors but hikers exhibit elastic demand Income elasticity is highest for overnight visitors participating in nature and wildlife viewing, with an elasticity of 1.501 in the model without opportunity cost and 1.940 in the model with. Overnight hunting and fishing is the only trip type observed to be an inferior good in the models both with and without opportunity cost, with an elasticity of -0.411 in the first and -0.083 in the latter. While the latter is essentially inelastic, this is still an interesting result.

Overnight backpackers report more return trips to the Northwestern Forested Mountains and report the fewest return trips to the Great Plains and Temperate Sierras. Hikers taking overnight trips are strongly drawn to Southern Semi-Arid Highlands, but no ecoregions coefficients are negative and significant for them. Those taking overnight hunting and fishing trips report higher volumes of return trips to Southern Semi-Arid Highlands, but fewer trips to Mediterranean California and Marine West Coast Forests. Overnight visitors reporting relaxation as their primary activity report more return visits when the Temperate Sierras, Northwestern Forested Mountains, or Eastern Temperate Forests ecoregions are present, but fewer to North American Deserts and Marine West Coast Forests. There is likely a large amount of variation in return trips reported for these groups, as most of these coefficients exhibit very large magnitudes. Horseback riders taking overnight visits are again not observed in Northern Forests or Marine West Coast Forests, but visitation rates are negatively affected by North American Deserts and Great Plains. The other ecoregion coefficients are not statistically significant for this group. Overnight visitors reporting viewing nature or wildlife as their primary activities frequent Southern Semi-Arid Highlands and North American deserts, but don't return for as many trips to the Temperate Sierras or Northwestern Forested Mountains.

Consumer Surplus

Different visitor types and different main activities not only affect the demand for trips or the effects of the ecoregions, but also affect the consumer surplus experienced by the visitors. As aforementioned, the effect of changes in travel cost on visitation rates changes between the different models. By taking the integral of the area under the curve for each demand model, we can estimate the consumers' surplus. Our first model including the ecoregions as covariates, Model 3.2, finds per trip per group consumer surplus values at $57.495. For the model including opportunity costs, the mean is found to be $176.76. The per-individual, per-visit consumer surplus is $21.92 in the model without opportunity cost, and $67.39 in the model with.

Day visitors experience a per-trip, per group surplus of $30.87, whereas overnight visitors experience a surplus of $2772.55. When opportunity costs are included, the mean values become $82.45 and $907.26 respectively. The per-individual, per-visit consumer surplus for day visitors is $11.89 without opportunity cost, and $31.76 with opportunity cost. For overnight visitors, these values are $98.54 and $328.00 respectively.

Day visitors participating in hiking experience a revealed consumer surplus of $31.44, whereas their overnight counterparts experienced a surplus of $362.46. When opportunity cost is introduced, the mean for day visitors is $85.50, while for overnight visitors they are $1,245. The per-individual, per-visit consumer surplus this represents is $12.22 for day hikers without opportunity cost, and $33.23 with. For overnight hikers, these values are $133.01 and $457.13.

Day backpackers are not a consideration, but overnight backpackers experience a surplus of $104.53 when opportunity cost is not included and $210.17 when opportunity cost is included. The per-individual, per-visit consumer surplus is $37.89 without opportunity cost and $76.18 when opportunity cost is included.

Day hunters and fishers experience a surplus of $32.03, whereas overnight participants are revealed to experience a surplus of $122.91. When opportunity cost is included, the day visitors experience a mean surplus of $32.03. The overnight visitors experience a mean of $307.82 with opportunity cost included. The per-individual, per-visit consumer surplus for day hunters and fishers is $14.05 without opportunity cost and $32.60 with opportunity cost. The value for overnight hunters and fishers is $43.16 without opportunity cost, and $108.08 with opportunity cost.

Day relaxers find $42.30 of surplus per group on average, whereas overnight enjoyers experience $57.42. With opportunity cost included, the mean for day visitors participating in relaxing is $138.43. The mean for overnight visitors of the same main activity is $312.77. Day visitors experience an individual per trip consumer surplus of $14.97 and $48.98, with and without opportunity cost respectively. The overnight equivalent values are $49.55 and $119.33.

Horseback riders on day trips experience a surplus of $16.48, whereas overnight riders find a surplus of $57.42. When opportunity cost is implemented, the day horseback riders experience a mean surplus of $74.77. The overnight horseback riders experience $171.47 with opportunity cost included in the model. The average per-individual, per-visit consumer surplus for day horseback riders is $7.71 or $34.97 with the latter value including opportunity cost in the travel cost calculation. For overnight horseback riders, these values are $23.70 and $70.77 respectively.

The last pair of models are for wildlife and nature viewers, the day trippers of which reveal by their actions to experience a surplus of $180.83, and the overnight visitors $145.. With opportunity cost included, the day visitors experience a consumer surplus of $345.77, while overnight visitors experience a surplus of $553.95. The per-individual, per-visit consumer surplus for day visitors is $65.33 without opportunity cost and $124.92 when it is included. Overnight visitors experience respective values of $47.29 and 180.38.

# SECTION 6

# CONCLUSIONS

Wilderness areas represent a great many benefits, not the least of which being recreational benefits as have been revealed by the visitation patterns discussed in this paper. Further research could be explored to better assess the other benefits, including the value of environmental services provided by these wild regions or the nonuse values held by individuals who appreciate that some lands are protected from development, even if these individuals may not themselves participate in outdoor recreation. However, the analysis provided by this research represents a well-rounded series of estimates for the value represented by wilderness areas, for the general set of visitors and for the different subsets of users. The recreation values found in this analysis are similar to those found in prior studies (Bowker 2005), with some recreation activities finding significantly higher benefits than others. Differences in patterns for different recreation activity participants have been found in other studies (White & Stynes 2008).

With total annual visits to wilderness areas in 2016 estimated at 8,980,000, and our estimated per-individual, per-visit value of $21.92 when opportunity cost is not included, the results found in this thesis would suggest an annual consumer surplus of approximately $196,842,000 resulting from the more conservative estimate. Choosing to include opportunity cost results in the individual surplus of $67.39, which results in an aggregate annual surplus for wilderness of $605,162,000.

# REFERENCES

Arrow, K.J. and E.L. Lehmann. "Harold Hotelling." National Academy of Sciences. 2005. Biographical Memoirs: Volume 87. Washington, DC: The National Academies Press. doi: 10.17226/11522.

Bowker, J. Michael; Harvard, J.E., III; Bergstrom, John C.; Cordell, H. Ken; English, Donald B.K.; Loomis, John B. 2005. "The net economic value of wilderness." In: *The Multiple Values of Wilderness*: 161-181

Bowker, J.M.; Starbuck, C.M.; English, D.B.K.; Bergstrom, J.C.; Rosenburger, R.S.; McCollum, D.C. 2009. "Estimating the Net Economic Value of National Forest Recreation: An Application of the National Visitor Use Monitoring Database." Faculty Series Working Paper, FS 09-02, September 2009; The University of Georgia, Department of Agricultural and Applied Economics, Athens, GA 30602 <http://ageconsearch.umn.edu/handle/59603>

Bowker, J.M.; Askew, A.; Seymour, L.; Zhu, J.P.; English, D.; Starbuck, C.M. 2009. "Wilderness Recreation Demand: A Comparison of Travel Cost and On-Site Cost Models." In: Zinkhan, C.; Stansell, B., eds. Southern Forest Workers: proceedings of the annual meeting; 2009. Chapel Hill, NC: The Forestland Group. 156-164.

Boyle, K.J. "Contingent Valuation in Practice." *A Primer on Nonmarket Valuation*, edited by Patricia A Champ et al., 2nd ed., vol. 13, Springer Science, 2017, pp. 83-131. The Economics of Non-Market Goods and Resources.

coli.org. “About.” *C2ER Cost of Living Index*, The Council for Community and Economic Research, 23 Sept. 2016, <coli.org/about/>.

C2ER. "C2ER Cost of Living Index Manual." The Council for Community and Economic Research, December 2015, <http://coli.org/wp-content/uploads/2016/06/2016-COLI-Manual.pdf>.

EDW. “US Forest Service Proclaimed Forests and Grasslands.”21 January 2018, web, https://apps.fs.usda.gov/arcx/rest/services/EDW/EDW_ProclaimedForestsAndGrasslands_01/MapServer.

EDW. “US Forest Service Wilderness Areas.” 20 January 2018, web, https://apps.fs.usda.gov/arcx/rest/services/EDW/EDW_Wilderness_01/MapServer

English, Donald B.K., et al. "Forest Service National Visitor Use Monitoring Process: Research Method Documentation." USDA Forest Service, 2002, web, <https://www.fs.usda.gov/treesearch/pubs/5000>.

Haab, Timothy C., and Kenneth E. McConnell. *Valuing Environmental and Natural Resources: the Econometrics of Non-Market Valuation.* Elgar, 2003.

Harris, J.M., and B. Roach. “Valuing the Environment.” *Environmental and Natural Resource Economics: A Contemporary Approach*, 3rd ed., Routledge, 2015, pp. 107–148.

Hjerpe, Evan; Holmes, Tom; White, Eric 2017. National and community market contributions of wilderness. Society & Natural Resources. 30(3): 265-280. 16 p. DOI:10.1080/08941920.2016.1196280

Holmes, T.P., W.L. Adamowicz, and F. Carlsson. “Choice Experiments.” *A Primer on Nonmarket Valuation*, edited by Patricia A Champ et al., 2nd ed., vol. 13, Springer Science, 2017, pp. 133-186. The Economics of Non-Market Goods and Resources.

Kim, Seung Gyu, J.M. Bowker, Seong-Hoon Cho, Dayton M. Lambert, Donald B.K. English, and C. Meghan Starbuck. "Estimating Travel Cost Model: Spatial Approach." *AAEA Annual Meeting 2010*, AgEcon Search, July 2010, web, <http://ageconsearch.umn.edu/record/61774/files/Kim_050510.pdf>.

Johnston, R.J., E.T. Schultz, K. Segerson, E.Y. Besedin, and M. Ramachandran. "Enhancing the Content Validity of Stated Preference Valuation: The Structure and Function of Ecological Indicators." *Land Economics*, no. 1, 2012, p. 102. EBSCO*host*, proxy-<remote.galib.uga.edu/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=edsjsr&AN=edsjsr.41307682&site=eds-live>.

LaFrance, Jeffrey. "Linear Demand Functions in Theory and Practice." *Journal of Economic Theory*, vol. 37, Oct 1985, web, <https://www.sciencedirect.com/science/article/pii/0022053185900341>.

Landry, Craig E., Alyson R. Lewis, Haiyong Liu, and Hans Vogelsong. “Addressing Onsite Sampling in Analysis of Recreation Demand: Economic Value and Impact of Visitation to Cape Hatteras National Seashore.” *Marine Resource Economics*, vol. 31, no. 3. May 2016. Web. < http://dx.doi.org/10.1086/686892>.

"National Wilderness Preservation System." The Wilderness Society, N.d., web, <http://wilderness.org/article/national-wilderness-preservation-system>.

Office of Water. "Economic Benefits of Wetlands." The United States Environmental Protection Agency, May 2006. Web. <https://nepis.epa.gov/Exe/ZyPDF.cgi/2000D2PF.PDF?Dockey=2000D2PF.PDF>.

Omernik, J.M. 1987. "Ecoregions of the conterminous United States." Annals of the Association of American Geographers 77:118-125.

Parsons, George R. "Travel Cost Models." *A Primer on Nonmarket Valuation*, edited by Patricia A Champ et al., 2nd ed., vol. 13, Springer Science, 2017, pp. 187–233. The Economics of Non-Market Goods and Resources.

Thomson, Cynthia J. "Effects of the Avidity Bias on Survey Estimates of Fishing Effort and Economic Value." *American Fisheries Society Symposium 12*: 356-366, 1991.

U.S. Forest Service. "National Visitor Use Monitoring Survey Results National Summary Report: Data collected FY 2012 through FY 2016." *US Forest Service*, 2016. <https://www.fs.fed.us/recreation/programs/nvum/pdf/5082016NationalSummaryReport062217.pdf>.

U.S. Forest Service. "National Visitor Use Monitoring Program." *US Forest Service*. Last modified 16 Feb 2018. Web. 23 April 2018. <https://www.fs.fed.us/recreation/programs/nvum/>.

Walker, Joan and Moshe Ben-Akiva. "Generalized Random Utility Model." *Mathematical Social Sciences*, vol. 43, no. Random Utility Theory and Probabilistic measurement theory, 01 Jan. 2002, pp. 303-343. EBSCO*host*, doi:10.1016/S0165-4896(02)00023-9.

Wilderness Act of 1964, Pub. L. No. 88-577, 16 Stat. 1131. (1964). <http://www.wilderness.net/NWPS/documents/publiclaws/PDF/16_USC_1131-1136.pdf>

"Wilderness." *Wilderness | US Forest Service*. US Forest Service, <www.fs.fed.us/managing-land/wilderness>.

White, Eric M.; Stynes, Daniel I. 2008. "National forest visitor spending averages and the influence of trip-type and recreation activity". *Journal of Forestry*. Jan/Feb: 17-24. <https://www.fs.usda.gov/treesearch/pubs/30456>.

Williams, Gerald W. "The USDA Forest Service - The First Century." USDA Forest Service, Washington, D.C., April 2005, web, <https://www.fs.fed.us/sites/default/files/media/2015/06/The_USDA_Forest_Service_TheFirstCentury.pdf>

Zarnoch, Stanley J., et al. "The National Visitor Use Monitoring Methodology and Final Results for Round 1." USDA Forest Service, 2011, web, <https://www.fs.usda.gov/treesearch/pubs/39683>.

# APPENDIX A

## SUMMARY STATISTICS

Table 1.1: All Observations

| | Observations | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Total Main Activity Visits | 5300 | 11.50491 | 29.92522 | 1 | 365 |
| COLI-Adjusted Travel Cost | 5295 | 99.75552 | 187.3348 | .1305659 | 1334.002 |
| COLI-Adjusted Travel Cost with Opp. Cost | 5295 | 275.7295 | 590.4336 | .2879426 | 5518.023 |
| Nights On-Site | 5300 | 2.12283 | 6.121513 | 0 | 99 |
| Population Density | 5300 | 3981.516 | 499.3629 | 2833.186 | 5167.73 |
| Forest Size in Hectares | 5300 | 194003.1 | 230163 | 7865.08 | 1031957 |
| Miles of Wilderness | 5300 | 354.5888 | 350.2465 | 6.3 | 1712.683 |
| Gender of Respondent | 5300 | .6616981 | .4731765 | 0 | 1 |
| Age of Respondent | 5300 | 43.71377 | 14.43495 | 18 | 75 |
| Group Size | 5299 | 2.514814 | 1.750133 | 0 | 45 |
| Price Index of Housing | 5295 | .9541882 | .1966441 | .5990388 | 1.813731 |
| Price Index of Food | 5295 | .9012247 | .1819225 | .3184529 | 2.201025 |
| Price Index of Transportation | 5295 | .8911819 | .1401105 | .260778 | 1.309638 |
| COLI-Adjusted Household Income | 5295 | 82.56948 | 50.16594 | 8.353435 | 293.4908 |
| Northern Forests | 5300 | .0588679 | .2353995 | 0 | 1 |
| Northwestern Forested Mountains | 5300 | .6056604 | .4887545 | 0 | 1 |
| Marine West Coast Forest | 5300 | .0862264 | .2807246 | 0 | 1 |
| Eastern Temperate Forests | 5300 | .1816981 | .3856319 | 0 | 1 |
| Great Plains | 5300 | .1586792 | .3654112 | 0 | 1 |
| North American Deserts | 5300 | .4926415 | .499993 | 0 | 1 |
| Mediterranean California | 5300 | .100566 | .3007816 | 0 | 1 |
| Southern Semi-Arid Highlands | 5300 | .0454717 | .208356 | 0 | 1 |
| Temperate Sierras | 5300 | .0958491 | .2944119 | 0 | 1 |

Table 1.2: Day Visitors

| | Observations | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Total Main Activity Visits | 2678 | 19.15347 | 39.82704 | 1 | 365 |
| COLI-Adjusted Travel Cost | 2678 | 27.10407 | 73.77743 | .1305659 | 1192.404 |
| COLI-Adjusted Travel Cost with Opp. Cost | 2678 | 74.31616 | 240.0475 | .2879426 | 4247.307 |
| Nights On-Site | 2678 | 0 | 0 | 0 | 0 |
| Population Density | 2678 | 4011.649 | 493.8025 | 2833.186 | 5167.73 |
| Forest Size in Hectares | 2678 | 235006.8 | 262491.2 | 7865.08 | 1031957 |
| Miles of Wilderness | 2678 | 348.7332 | 340.793 | 6.3 | 1712.683 |
| Gender of Respondent | 2678 | .6553398 | .4753461 | 0 | 1 |
| Age of Respondent | 2678 | 43.61389 | 14.51326 | 18 | 75 |
| Group Size | 2678 | 2.337318 | 1.330678 | 0 | 15 |
| Price Index of Housing | 2678 | .9339725 | .1621669 | .5990388 | 1.740113 |
| Price Index of Food | 2678 | .9215877 | .1774996 | .4072397 | 2.09482 |
| Price Index of Transportation | 2678 | .9030819 | .1141296 | .3414505 | 1.233162 |
| COLI-Adjusted Household Income | 2678 | 78.14757 | 48.52282 | 8.353435 | 266.3944 |
| Northern Forests | 2678 | .0414488 | .1993632 | 0 | 1 |
| Northwestern Forested Mountains | 2678 | .5612397 | .4963282 | 0 | 1 |
| Marine West Coast Forest | 2678 | .1135176 | .3172836 | 0 | 1 |
| Eastern Temperate Forests | 2678 | .1807319 | .3848677 | 0 | 1 |
| Great Plains | 2678 | .2001494 | .4001867 | 0 | 1 |
| North American Deserts | 2678 | .4970127 | .5000845 | 0 | 1 |
| Mediterranean California | 2678 | .1075429 | .3098601 | 0 | 1 |
| Southern Semi-Arid Highlands | 2678 | .0739358 | .2617152 | 0 | 1 |
| Temperate Sierras | 2678 | .1053025 | .3070001 | 0 | 1 |

Table 1.3: Overnight Visitors

| | Observations | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Total Main Activity Visits | 2605 | 3.679079 | 8.334632 | 1 | 150 |
| COLI-Adjusted Travel Cost | 2605 | 175.0878 | 233.9214 | .4391331 | 1334.002 |
| COLI-Adjusted Travel Cost with Opp. Cost | 2605 | 484.5759 | 751.6508 | 1.362192 | 5518.023 |
| Nights On-Site | 2605 | 4.319002 | 8.171076 | 0 | 99 |
| Population Density | 2605 | 3949.955 | 502.1903 | 2833.186 | 5167.73 |
| Forest Size in Hectares | 2605 | 151265.3 | 181324.4 | 7865.08 | 1031957 |
| Miles of Wilderness | 2605 | 361.0074 | 359.9803 | 6.3 | 1712.683 |
| Gender of Respondent | 2605 | .6683301 | .4709035 | 0 | 1 |
| Age of Respondent | 2605 | 43.85797 | 14.36037 | 18 | 75 |
| Group Size | 2605 | 2.691747 | 2.069591 | 1 | 45 |
| Price Index of Housing | 2605 | .9751556 | .2249678 | .5990388 | 1.813731 |
| Price Index of Food | 2605 | .8802722 | .1845337 | .3184529 | 2.201025 |
| Price Index of Transportation | 2605 | .8788819 | .1619125 | .260778 | 1.309638 |
| COLI-Adjusted Household Income | 2605 | 87.11173 | 51.40323 | 12.57944 | 293.4908 |
| Northern Forests | 2605 | .0771593 | .2668953 | 0 | 1 |
| Northwestern Forested Mountains | 2605 | .6522073 | .4763613 | 0 | 1 |
| Marine West Coast Forest | 2605 | .0575816 | .2329952 | 0 | 1 |
| Eastern Temperate Forests | 2605 | .1815739 | .385567 | 0 | 1 |
| Great Plains | 2605 | .1147793 | .3188166 | 0 | 1 |
| North American Deserts | 2605 | .4894434 | .4999845 | 0 | 1 |
| Mediterranean California | 2605 | .093666 | .2914195 | 0 | 1 |
| Southern Semi-Arid Highlands | 2605 | .015739 | .1244877 | 0 | 1 |
| Temperate Sierras | 2605 | .0863724 | .280967 | 0 | 1 |

Table 1.4: Day Hikers

| | Observations | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Total Main Activity Visits | 2020 | 18.88812 | 39.91069 | 1 | 365 |
| COLI-Adjusted Travel Cost | 2020 | 26.46524 | 73.65222 | .1305659 | 1192.404 |
| COLI-Adjusted Travel Cost with Opp. Cost | 2020 | 74.45112 | 249.4616 | .2879426 | 4247.307 |
| Nights On-Site | 2020 | 0 | 0 | 0 | 0 |
| Population Density | 2020 | 4027.694 | 486.5145 | 2833.186 | 5167.73 |
| Forest Size in Hectares | 2020 | 245245.1 | 270728.1 | 7865.08 | 1031957 |
| Miles of Wilderness | 2020 | 362.2553 | 345.3404 | 6.3 | 1712.683 |
| Gender of Respondent | 2020 | .6376238 | .4808057 | 0 | 1 |
| Age of Respondent | 2020 | 43.80495 | 14.3081 | 18 | 75 |
| Group Size | 2020 | 2.343735 | 1.318739 | 1 | 15 |
| Price Index of Housing | 2020 | .9395832 | .1677456 | .5990388 | 1.740113 |
| Price Index of Food | 2020 | .9194134 | .1853584 | .4072397 | 2.09482 |
| Price Index of Transportation | 2020 | .8972214 | .1135682 | .3414505 | 1.17215 |
| COLI-Adjusted Household Income | 2020 | 79.70085 | 48.64579 | 8.353435 | 266.3944 |
| Northern Forests | 2020 | .029703 | .1698087 | 0 | 1 |
| Northwestern Forested Mountains | 2020 | .5732673 | .4947252 | 0 | 1 |
| Marine West Coast Forest | 2020 | .1316832 | .3382297 | 0 | 1 |
| Eastern Temperate Forests | 2020 | .1524752 | .35957 | 0 | 1 |
| Great Plains | 2020 | .1960396 | .3970971 | 0 | 1 |
| North American Deserts | 2020 | .5316832 | .4991187 | 0 | 1 |
| Mediterranean California | 2020 | .1108911 | .314075 | 0 | 1 |
| Southern Semi-Arid Highlands | 2020 | .0871287 | .2820934 | 0 | 1 |
| Temperate Sierras | 2020 | .1158416 | .3201141 | 0 | 1 |

Table 1.5: Day Hunters and Fishers

| | Observations | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Total Main Activity Visits | 134 | 17.31343 | 28.57003 | 1 | 250 |
| COLI-Adjusted Travel Cost | 134 | 32.29409 | 80.86405 | .9507486 | 646.2514 |
| COLI-Adjusted Travel Cost with Opp. Cost | 134 | 82.62982 | 214.9494 | 2.298459 | 1716.856 |
| Nights On-Site | 134 | 0 | 0 | 0 | 0 |
| Population Density | 134 | 3980.735 | 494.5511 | 2900.985 | 5016.323 |
| Forest Size in Hectares | 134 | 234921.4 | 242109.8 | 7865.08 | 1011424 |
| Miles of Wilderness | 134 | 287.9688 | 296.5601 | 9 | 1176.502 |
| Gender of Respondent | 134 | .8880597 | .3164761 | 0 | 1 |
| Age of Respondent | 134 | 43.73881 | 14.73828 | 18 | 75 |
| Group Size | 134 | 1.962687 | 1.021621 | 1 | 5 |
| Price Index of Housing | 134 | .8979682 | .1284436 | .6885722 | 1.529399 |
| Price Index of Food | 134 | .9386389 | .1395085 | .7023817 | 2.09482 |
| Price Index of Transportation | 134 | .9305105 | .0985409 | .7331096 | 1.233162 |
| COLI-Adjusted Household Income | 134 | 71.48309 | 46.82604 | 20.14545 | 226.941 |
| Northern Forests | 134 | .0597015 | .237822 | 0 | 1 |
| Northwestern Forested Mountains | 134 | .5373134 | .5004767 | 0 | 1 |
| Marine West Coast Forest | 134 | .0373134 | .1902399 | 0 | 1 |
| Eastern Temperate Forests | 134 | .3731343 | .4854521 | 0 | 1 |
| Great Plains | 134 | .2835821 | .4524277 | 0 | 1 |
| North American Deserts | 134 | .3283582 | .4713781 | 0 | 1 |
| Mediterranean California | 134 | .0447761 | .2075881 | 0 | 1 |
| Southern Semi-Arid Highlands | 134 | .0149254 | .1217093 | 0 | 1 |
| Temperate Sierras | 134 | .0223881 | .1484971 | 0 | 1 |

Table 1.6: Day Relaxers

| | Observations | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Total Main Activity Visits | 92 | 23.47826 | 55.84505 | 1 | 365 |
| COLI-Adjusted Travel Cost | 92 | 24.43282 | 77.11939 | 1.144954 | 743.626 |
| COLI-Adjusted Travel Cost with Opp. Cost | 92 | 77.93954 | 357.5443 | 2.047716 | 3448.098 |
| Nights On-Site | 92 | 0 | 0 | 0 | 0 |
| Population Density | 92 | 3980.523 | 447.3755 | 3108.188 | 4861.323 |
| Forest Size in Hectares | 92 | 206378.9 | 240607.1 | 8994.535 | 1011424 |
| Miles of Wilderness | 92 | 358.2175 | 355.5968 | 10.061 | 1712.683 |
| Gender of Respondent | 92 | .6413043 | .4822457 | 0 | 1 |
| Age of Respondent | 92 | 39.69565 | 13.71911 | 18 | 75 |
| Group Size | 92 | 2.641304 | 1.355344 | 1 | 8 |
| Price Index of Housing | 92 | .9098169 | .1289019 | .7278788 | 1.304417 |
| Price Index of Food | 92 | .9101293 | .1830992 | .5210096 | 2.09482 |
| Price Index of Transportation | 92 | .8922628 | .1296733 | .4851288 | 1.17215 |
| COLI-Adjusted Household Income | 92 | 69.6721 | 41.76342 | 14.79674 | 215.045 |
| Northern Forests | 92 | .0217391 | .1466296 | 0 | 1 |
| Northwestern Forested Mountains | 92 | .5108696 | .5026209 | 0 | 1 |
| Marine West Coast Forest | 92 | .076087 | .26659 | 0 | 1 |
| Eastern Temperate Forests | 92 | .1956522 | .3988756 | 0 | 1 |
| Great Plains | 92 | .2065217 | .4070274 | 0 | 1 |
| North American Deserts | 92 | .5434783 | .5008354 | 0 | 1 |
| Mediterranean California | 92 | .1195652 | .3262303 | 0 | 1 |
| Southern Semi-Arid Highlands | 92 | .0652174 | .248262 | 0 | 1 |
| Temperate Sierras | 92 | .1521739 | .3611576 | 0 | 1 |

Table 1.7: Day Horseback Riders

| | Observations | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Total Main Activity Visits | 52 | 27.25 | 35.76825 | 1 | 150 |
| COLI-Adjusted Travel Cost | 52 | 13.23735 | 10.2812 | .7170119 | 51.73402 |
| COLI-Adjusted Travel Cost with Opp. Cost | 52 | 37.64386 | 40.14098 | 1.932338 | 242.1544 |
| Nights On-Site | 52 | 0 | 0 | 0 | 0 |
| Population Density | 52 | 3975.104 | 415.8679 | 3152.698 | 4981.097 |
| Forest Size in Hectares | 52 | 186037.2 | 270822.5 | 15179.64 | 1031957 |
| Miles of Wilderness | 52 | 261.7791 | 282.6541 | 10.381 | 1005.22 |
| Gender of Respondent | 52 | .4230769 | .4988675 | 0 | 1 |
| Age of Respondent | 52 | 48.90385 | 14.02835 | 18 | 75 |
| Group Size | 52 | 2.134615 | .9081083 | 1 | 5 |
| Price Index of Housing | 52 | .9021819 | .1334628 | .7278788 | 1.508124 |
| Price Index of Food | 52 | .9720328 | .1937926 | .5210096 | 1.723835 |
| Price Index of Transportation | 52 | .9554047 | .1168939 | .4851288 | 1.17215 |
| COLI-Adjusted Household Income | 52 | 80.93706 | 48.08601 | 20.6793 | 198.6735 |
| Northern Forests | 52 | 0 | 0 | 0 | 0 |
| Northwestern Forested Mountains | 52 | .4615385 | .5033822 | 0 | 1 |
| Marine West Coast Forest | 52 | 0 | 0 | 0 | 0 |
| Eastern Temperate Forests | 52 | .3461538 | .4803845 | 0 | 1 |
| Great Plains | 52 | .1346154 | .3446423 | 0 | 1 |
| North American Deserts | 52 | .3846154 | .4912508 | 0 | 1 |
| Mediterranean California | 52 | .1346154 | .3446423 | 0 | 1 |
| Southern Semi-Arid Highlands | 52 | .0192308 | .138675 | 0 | 1 |
| Temperate Sierras | 52 | .0961538 | .2976783 | 0 | 1 |

Table 1.8: Day Nature and Wildlife Viewers

| | Observations | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Total Main Activity Visits | 166 | 12.1747 | 24.2367 | 1 | 200 |
| COLI-Adjusted Travel Cost | 166 | 35.2906 | 79.19338 | 1.646741 | 788.8712 |
| COLI-Adjusted Travel Cost with Opp. Cost | 166 | 84.79048 | 184.3011 | 3.402057 | 1629.956 |
| Nights On-Site | 166 | 0 | 0 | 0 | 0 |
| Population Density | 166 | 3836.298 | 568.9827 | 2833.186 | 5167.73 |
| Forest Size in Hectares | 166 | 168027.1 | 195765.8 | 7865.08 | 1031957 |
| Miles of Wilderness | 166 | 247.4621 | 303.2206 | 6.3 | 1712.683 |
| Gender of Respondent | 166 | .6445783 | .4800891 | 0 | 1 |
| Age of Respondent | 166 | 43.03614 | 16.38399 | 18 | 75 |
| Group Size | 166 | 2.445783 | 1.22848 | 0 | 7 |
| Price Index of Housing | 166 | .9030075 | .1274057 | .7315915 | 1.564037 |
| Price Index of Food | 166 | .9250744 | .1224913 | .6052678 | 1.723835 |
| Price Index of Transportation | 166 | .9378799 | .1078365 | .6677684 | 1.17215 |
| COLI-Adjusted Household Income | 166 | 75.49918 | 52.34825 | 18.52731 | 266.3944 |
| Northern Forests | 166 | .1807229 | .3859527 | 0 | 1 |
| Northwestern Forested Mountains | 166 | .4457831 | .4985558 | 0 | 1 |
| Marine West Coast Forest | 166 | .0783133 | .2694768 | 0 | 1 |
| Eastern Temperate Forests | 166 | .2289157 | .4214061 | 0 | 1 |
| Great Plains | 166 | .1445783 | .3527392 | 0 | 1 |
| North American Deserts | 166 | .3614458 | .4818729 | 0 | 1 |
| Mediterranean California | 166 | .0662651 | .2494975 | 0 | 1 |
| Southern Semi-Arid Highlands | 166 | .0421687 | .2015819 | 0 | 1 |
| Temperate Sierras | 166 | .0843373 | .2787339 | 0 | 1 |

Table 1.9: Overnight Backpackers

| | Observations | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Total Main Activity Visits | 435 | 3.324138 | 10.31992 | 1 | 150 |
| COLI-Adjusted Travel Cost | 435 | 109.6604 | 184.6669 | 1.606714 | 1186.719 |
| COLI-Adjusted Travel Cost with Opp. Cost | 435 | 271.1587 | 517.2968 | 3.858122 | 4561.186 |
| Nights On-Site | 435 | 2.643678 | 2.46719 | 0 | 21 |
| Population Density | 435 | 4046.133 | 480.254 | 2833.186 | 5167.73 |
| Forest Size in Hectares | 435 | 180797 | 193878 | 7865.08 | 1011424 |
| Miles of Wilderness | 435 | 390.6689 | 385.1201 | 6.3 | 1712.683 |
| Gender of Respondent | 435 | .7609195 | .4270131 | 0 | 1 |
| Age of Respondent | 435 | 39.07586 | 13.19409 | 18 | 75 |
| Group Size | 435 | 2.675862 | 1.890613 | 1 | 20 |
| Price Index of Housing | 435 | .9903759 | .2281841 | .723219 | 1.751496 |
| Price Index of Food | 435 | .8939907 | .1610614 | .4072397 | 2.09482 |
| Price Index of Transportation | 435 | .8952759 | .1440251 | .3414505 | 1.212829 |
| COLI-Adjusted Household Income | 435 | 76.87032 | 47.58622 | 13.91222 | 245.9896 |
| Northern Forests | 435 | .1126437 | .3165208 | 0 | 1 |
| Northwestern Forested Mountains | 435 | .6413793 | .4801478 | 0 | 1 |
| Marine West Coast Forest | 435 | .0666667 | .249731 | 0 | 1 |
| Eastern Temperate Forests | 435 | .2758621 | .4474623 | 0 | 1 |
| Great Plains | 435 | .0413793 | .1993952 | 0 | 1 |
| North American Deserts | 435 | .3678161 | .4827662 | 0 | 1 |
| Mediterranean California | 435 | .1448276 | .3523321 | 0 | 1 |
| Southern Semi-Arid Highlands | 435 | .0045977 | .0677282 | 0 | 1 |
| Temperate Sierras | 435 | .016092 | .1259741 | 0 | 1 |

Table 1.10: Overnight Hikers

| | Observations | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Total Main Activity Visits | 1355 | 3.663469 | 7.541639 | 1 | 100 |
| COLI-Adjusted Travel Cost | 1350 | 205.3213 | 256.9425 | .4391331 | 1334.002 |
| COLI-Adjusted Travel Cost with Opp. Cost | 1350 | 588.6469 | 856.4563 | 1.362192 | 5518.023 |
| Nights On-Site | 1355 | 4.973432 | 9.878548 | 0 | 99 |
| Population Density | 1355 | 3971.075 | 485.5787 | 2833.186 | 5167.73 |
| Forest Size in Hectares | 1355 | 160384.8 | 188646 | 7865.08 | 1031957 |
| Miles of Wilderness | 1355 | 341.4914 | 337.865 | 6.3 | 1712.683 |
| Gender of Respondent | 1355 | .6147601 | .4868316 | 0 | 1 |
| Age of Respondent | 1355 | 44.95646 | 14.49241 | 18 | 75 |
| Group Size | 1355 | 2.659041 | 1.955652 | 1 | 45 |
| Price Index of Housing | 1350 | .9818591 | .2337975 | .6155685 | 1.813731 |
| Price Index of Food | 1350 | .8679067 | .2028148 | .3184529 | 2.201025 |
| Price Index of Transportation | 1350 | .8647289 | .1754034 | .260778 | 1.309638 |
| COLI-Adjusted Household Income | 1350 | 91.67388 | 53.90667 | 12.57944 | 293.4908 |
| Northern Forests | 1355 | .0450185 | .2074212 | 0 | 1 |
| Northwestern Forested Mountains | 1355 | .6738007 | .4689943 | 0 | 1 |
| Marine West Coast Forest | 1355 | .0560886 | .2301776 | 0 | 1 |
| Eastern Temperate Forests | 1355 | .1586716 | .3655045 | 0 | 1 |
| Great Plains | 1355 | .1254613 | .3313635 | 0 | 1 |
| North American Deserts | 1355 | .5505535 | .4976214 | 0 | 1 |
| Mediterranean California | 1355 | .0826568 | .2754645 | 0 | 1 |
| Southern Semi-Arid Highlands | 1355 | .0199262 | .1397983 | 0 | 1 |
| Temperate Sierras | 1355 | .1107011 | .3138775 | 0 | 1 |

Table 1.11: Overnight Hunters and Fishers

| | Observations | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Total Main Activity Visits | 191 | 5.157068 | 11.23043 | 1 | 100 |
| COLI-Adjusted Travel Cost | 191 | 146.2832 | 172.3381 | 1.918873 | 887.9612 |
| COLI-Adjusted Travel Cost with Opp. Cost | 191 | 397.9556 | 557.7254 | 3.824805 | 3484.215 |
| Nights On-Site | 191 | 4.39267 | 4.43998 | 0 | 42 |
| Population Density | 191 | 3787.932 | 545.8376 | 2833.186 | 5016.323 |
| Forest Size in Hectares | 191 | 92850.06 | 120912.3 | 7865.08 | 650851.3 |
| Miles of Wilderness | 191 | 463.9883 | 433.8724 | 9 | 1712.683 |
| Gender of Respondent | 191 | .895288 | .3069867 | 0 | 1 |
| Age of Respondent | 191 | 44.43455 | 14.69961 | 18 | 75 |
| Group Size | 191 | 2.65445 | 2.304679 | 1 | 28 |
| Price Index of Housing | 191 | .9457905 | .1853836 | .6725684 | 1.547117 |
| Price Index of Food | 191 | .88932 | .1537096 | .4072397 | 1.654906 |
| Price Index of Transportation | 191 | .8927847 | .1569497 | .3414505 | 1.233162 |
| COLI-Adjusted Household Income | 191 | 81.0208 | 47.04978 | 14.75317 | 245.7102 |
| Northern Forests | 191 | .1413613 | .3493094 | 0 | 1 |
| Northwestern Forested Mountains | 191 | .6963351 | .4610482 | 0 | 1 |
| Marine West Coast Forest | 191 | .0418848 | .2008524 | 0 | 1 |
| Eastern Temperate Forests | 191 | .1099476 | .3136466 | 0 | 1 |
| Great Plains | 191 | .1832461 | .3878849 | 0 | 1 |
| North American Deserts | 191 | .4502618 | .4988275 | 0 | 1 |
| Mediterranean California | 191 | .0366492 | .1883929 | 0 | 1 |
| Southern Semi-Arid Highlands | 191 | .0104712 | .1020593 | 0 | 1 |
| Temperate Sierras | 191 | .0209424 | .1435679 | 0 | 1 |

Table 1.12: Overnight Relaxers

| | Observations | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Total Main Activity Visits | 181 | 3.342541 | 8.358882 | 1 | 100 |
| COLI-Adjusted Travel Cost | 181 | 114.31 | 166.4399 | 1.501839 | 984.8109 |
| COLI-Adjusted Travel Cost with Opp. Cost | 181 | 306.4923 | 572.2932 | 3.014338 | 5475.882 |
| Nights On-Site | 181 | 3.209945 | 2.919306 | 0 | 20 |
| Population Density | 181 | 3962.614 | 515.8768 | 2833.186 | 5044.294 |
| Forest Size in Hectares | 181 | 131242.3 | 167589.5 | 7865.08 | 1011424 |
| Miles of Wilderness | 181 | 343.2464 | 331.0811 | 10.061 | 1712.683 |
| Gender of Respondent | 181 | .5635359 | .4973225 | 0 | 1 |
| Age of Respondent | 181 | 42.77901 | 13.59762 | 18 | 75 |
| Group Size | 181 | 2.624309 | 1.317517 | 1 | 8 |
| Price Index of Housing | 181 | .9856462 | .2379497 | .7330242 | 1.795442 |
| Price Index of Food | 181 | .8885627 | .1990654 | .4072397 | 1.723835 |
| Price Index of Transportation | 181 | .8644125 | .16227 | .3414505 | 1.17215 |
| COLI-Adjusted Household Income | 181 | 81.57821 | 46.18656 | 12.93856 | 212.405 |
| Northern Forests | 181 | .0773481 | .267884 | 0 | 1 |
| Northwestern Forested Mountains | 181 | .6629834 | .4740018 | 0 | 1 |
| Marine West Coast Forest | 181 | .0828729 | .2764548 | 0 | 1 |
| Eastern Temperate Forests | 181 | .1546961 | .3626179 | 0 | 1 |
| Great Plains | 181 | .0883978 | .28466 | 0 | 1 |
| North American Deserts | 181 | .4475138 | .4986169 | 0 | 1 |
| Mediterranean California | 181 | .1657459 | .3728838 | 0 | 1 |
| Southern Semi-Arid Highlands | 181 | .0165746 | .1280251 | 0 | 1 |
| Temperate Sierras | 181 | .1049724 | .3073681 | 0 | 1 |

Table 1.13: Overnight Horseback Riders

| | Observations | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Total Main Activity Visits | 68 | 6.485294 | 9.686878 | 1 | 50 |
| COLI-Adjusted Travel Cost | 68 | 93.55626 | 116.1145 | 6.650386 | 611.7675 |
| COLI-Adjusted Travel Cost with Opp. Cost | 68 | 269.6397 | 398.6265 | 16.55525 | 2483.391 |
| Nights On-Site | 68 | 3.823529 | 3.171426 | 1 | 23 |
| Population Density | 68 | 3906.701 | 324.0446 | 3152.698 | 4728.237 |
| Forest Size in Hectares | 68 | 92659.79 | 77219.83 | 8994.535 | 337517.8 |
| Miles of Wilderness | 68 | 288.6621 | 371.2019 | 10.381 | 1712.683 |
| Gender of Respondent | 68 | .6617647 | .4766266 | 0 | 1 |
| Age of Respondent | 68 | 53.82353 | 12.40238 | 25 | 75 |
| Group Size | 68 | 2.352941 | .9583055 | 1 | 6 |
| Price Index of Housing | 68 | .8798114 | .0985172 | .7278788 | 1.147308 |
| Price Index of Food | 68 | .9431281 | .0913717 | .6188418 | 1.097222 |
| Price Index of Transportation | 68 | .9596229 | .0978458 | .6214181 | 1.147886 |
| COLI-Adjusted Household Income | 68 | 99.0197 | 48.29893 | 37.55932 | 283.7538 |
| Northern Forests | 68 | 0 | 0 | 0 | 0 |
| Northwestern Forested Mountains | 68 | .4411765 | .5002194 | 0 | 1 |
| Marine West Coast Forest | 68 | 0 | 0 | 0 | 0 |
| Eastern Temperate Forests | 68 | .4411765 | .5002194 | 0 | 1 |
| Great Plains | 68 | .25 | .4362322 | 0 | 1 |
| North American Deserts | 68 | .3382353 | .4766266 | 0 | 1 |
| Mediterranean California | 68 | .0735294 | .2629441 | 0 | 1 |
| Southern Semi-Arid Highlands | 68 | .0147059 | .1212678 | 0 | 1 |
| Temperate Sierras | 68 | .0882353 | .2857456 | 0 | 1 |

Table 1.14: Overnight Nature and Wildlife Viewers

| | Observations | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Total Main Activity Visits | 162 | 2.703704 | 7.116501 | 1 | 75 |
| COLI-Adjusted Travel Cost | 162 | 266.2294 | 278.2538 | 1.60587 | 1017.013 |
| COLI-Adjusted Travel Cost with Opp. Cost | 162 | 717.038 | 839.7107 | 4.054331 | 3804.433 |
| Nights On-Site | 162 | 4.401235 | 8.15872 | 0 | 90 |
| Population Density | 162 | 3897.644 | 539.1541 | 2833.186 | 5016.323 |
| Forest Size in Hectares | 162 | 118933.6 | 154204.1 | 13885.11 | 1011424 |
| Miles of Wilderness | 162 | 398.3564 | 402.6068 | 6.3 | 1712.683 |
| Gender of Respondent | 162 | .6296296 | .4844013 | 0 | 1 |
| Age of Respondent | 162 | 45.54938 | 14.66777 | 18 | 75 |
| Group Size | 162 | 2.944444 | 2.98287 | 1 | 28 |
| Price Index of Housing | 162 | .9825103 | .2282781 | .7433775 | 1.795442 |
| Price Index of Food | 162 | .8811214 | .186348 | .5132201 | 2.201025 |
| Price Index of Transportation | 162 | .8877419 | .1421489 | .4851288 | 1.17215 |
| COLI-Adjusted Household Income | 162 | 89.64636 | 49.36767 | 13.43843 | 206.5793 |
| Northern Forests | 162 | .0925926 | .2907595 | 0 | 1 |
| Northwestern Forested Mountains | 162 | .5802469 | .4950487 | 0 | 1 |
| Marine West Coast Forest | 162 | .0925926 | .2907595 | 0 | 1 |
| Eastern Temperate Forests | 162 | .1604938 | .3682016 | 0 | 1 |
| Great Plains | 162 | .0925926 | .2907595 | 0 | 1 |
| North American Deserts | 162 | .5 | .5015504 | 0 | 1 |
| Mediterranean California | 162 | .0555556 | .2297717 | 0 | 1 |
| Southern Semi-Arid Highlands | 162 | .0061728 | .0785674 | 0 | 1 |
| Temperate Sierras | 162 | .154321 | .3623763 | 0 | 1 |

# APPENDIX B

## THOMSON MEANS AND VARIANCES

Table 2.1: All Observations

| | Observations | Mean | Std. Dev. |
|---|---|---|---|
| Total Main Activity Visits | 5300 | 1.965524 | .1243776 |
| COLI-Adjusted Travel Cost | 5295 | 148.8904 | 23.9701 |
| COLI-Adjusted Travel Cost with Opp. Cost | 5295 | 412.0374 | 76.63192 |
| Nights On-Site | 5300 | 2.623163 | .504569 |
| Age of Respondent | 5300 | 43.04164 | 1.485141 |
| Gender of Respondent | 5300 | .6555285 | .0487286 |
| Group Size | 5299 | 2.710365 | .2013313 |
| Price Index of Housing | 5295 | .9616066 | .0225998 |
| Price Index of Food | 5295 | .8931434 | .0202829 |
| Price Index of Transportation | 5295 | .8869864 | .0159652 |
| COLI-Adjusted Household Income | 5295 | 84.15723 | 5.223872 |

Table 2.2: Day Visitors

| | Observations | Mean | Std. Dev. |
|---|---|---|---|
| Total Main Activity Visits | 2678 | 2.93287 | .3920695 |
| COLI-Adjusted Travel Cost | 2678 | 41.23795 | 21.30846 |
| COLI-Adjusted Travel Cost with Opp. Cost | 2678 | 115.5032 | 72.80794 |
| Gender of Respondent | 2678 | .6426631 | .0885326 |
| Age of Respondent | 2678 | 41.7635 | 2.685524 |
| Group Size | 2678 | 2.596301 | .2429745 |
| Price Index of Housing | 2678 | .9273772 | .0296291 |
| Price Index of Food | 2678 | .9292222 | .0395911 |
| Price Index of Transportation | 2678 | .9086978 | .0223374 |
| COLI-Adjusted Household Income | 2678 | 78.58521 | 8.932454 |

Table 2.3: Overnight Visitors

| | Observations | Mean | Std. Dev. |
|---|---|---|---|
| Total Main Activity Visits | 2605 | 1.4678681 | .0385218 |
| COLI-Adjusted Travel Cost | 2600 | 204.8989 | 14.07199 |
| COLI-Adjusted Travel Cost with Opp. Cost | 2600 | 566.3234 | 45.51076 |
| Nights On-Site | 2605 | 3.985677 | .3055795 |
| Gender of Respondent | 2605 | .6626914 | .0263733 |
| Age of Respondent | 2605 | 43.72449 | .8028288 |
| Group Size | 2605 | 2.765982 | .1215039 |
| Price Index of Housing | 2600 | .9793237 | .0133611 |
| Price Index of Food | 2600 | .874522 | .0104724 |
| Price Index of Transportation | 2600 | .8757566 | .009337 |
| COLI-Adjusted Household Income | 2600 | 87.02133 | 2.888756 |

Table 2.4: Day Hikers

| | Observations | Mean | Std. Dev. |
|---|---|---|---|
| Total Main Activity Visits | 2020 | 2.952858 | .4453826 |
| COLI-Adjusted Travel Cost | 2020 | 39.63245 | 23.92945 |
| COLI-Adjusted Travel Cost with Opp. Cost | 2020 | 116.1077 | 88.09345 |
| Gender of Respondent | 2020 | .6316583 | .1002597 |
| Age of Respondent | 2020 | 41.85411 | 2.94784 |
| Group Size | 2020 | 2.57277 | .2738997 |
| Price Index of Housing | 2020 | .9332847 | .0351987 |
| Price Index of Food | 2020 | .9322368 | .0494576 |
| Price Index of Transportation | 2020 | .9011784 | .0254413 |
| COLI-Adjusted Household Income | 2020 | 79.86155 | 9.980646 |

Table 2.5: Day Hunters and Fishers

| | Observations | Mean | Std. Dev. |
|---|---|---|---|
| Total Main Activity Visits | 134 | 3.5969294 | 1.779712 |
| COLI-Adjusted Travel Cost | 134 | 63.30551 | 110.4309 |
| COLI-Adjusted Travel Cost with Opp. Cost | 134 | 162.8228 | 294.054 |
| Gender of Respondent | 134 | .8238646 | .2710399 |
| Age of Respondent | 134 | 43.74614 | 9.635786 |
| Group Size | 134 | 2.27997 | .6970018 |
| Price Index of Housing | 134 | .9053345 | .0880607 |
| Price Index of Food | 134 | .9508029 | .0974515 |
| Price Index of Transportation | 134 | .9454933 | .0613109 |
| COLI-Adjusted Household Income | 134 | 77.14362 | 29.82883 |

Table 2.6: Day Relaxers

| | Observations | Mean | Std. Dev. |
|---|---|---|---|
| Total Main Activity Visits | 92 | 2.714302 | 2.506979 |
| COLI-Adjusted Travel Cost | 92 | 33.96185 | 94.70407 |
| COLI-Adjusted Travel Cost with Opp. Cost | 92 | 107.1853 | 438.5601 |
| Gender of Respondent | 92 | .5282398 | .6488519 |
| Age of Respondent | 92 | 40.36653 | 18.36096 |
| Group Size | 92 | 2.825639 | 1.497683 |
| Price Index of Housing | 92 | .8985318 | .1228619 |
| Price Index of Food | 92 | .9025459 | .1466873 |
| Price Index of Transportation | 92 | .898527 | .1479275 |
| COLI-Adjusted Household Income | 92 | 68.52983 | 52.25779 |

Table 2.7: Day Horseback Riders

| | Observations | Mean | Std. Dev. |
|---|---|---|---|
| Total Main Activity Visits | 52 | 5.503562 | 5.49446 |
| COLI-Adjusted Travel Cost | 52 | 13.57583 | 9.897943 |
| COLI-Adjusted Travel Cost with Opp. Cost | 52 | 35.10499 | 29.55627 |
| Gender of Respondent | 52 | .4067945 | .5814249 |
| Age of Respondent | 52 | 39.13828 | 17.23303 |
| Group Size | 52 | 2.138289 | .6831152 |
| Price Index of Housing | 52 | .9311713 | .1418755 |
| Price Index of Food | 52 | .9204129 | .2992693 |
| Price Index of Transportation | 52 | .9125378 | .2425451 |
| COLI-Adjusted Household Income | 52 | 70.81033 | 39.75608 |

Table 2.8: Day Nature and Wildlife Viewers

| | Observations | Mean | Std. Dev. |
|---|---|---|---|
| Total Main Activity Visits | 166 | 2.1215243 | .7919589 |
| COLI-Adjusted Travel Cost | 166 | 43.37902 | 45.80995 |
| COLI-Adjusted Travel Cost with Opp. Cost | 166 | 103.8311 | 110.399 |
| Gender of Respondent | 166 | .6409805 | .2811023 |
| Age of Respondent | 166 | 39.79918 | 9.424323 |
| Group Size | 166 | 2.768086 | .7076772 |
| Price Index of Housing | 166 | .9105976 | .0795559 |
| Price Index of Food | 166 | .9102223 | .0536513 |
| Price Index of Transportation | 166 | .9496995 | .0613543 |
| COLI-Adjusted Household Income | 166 | 71.72401 | 29.36325 |

Table 2.8: Overnight Backpackers

| | Observations | Mean | Std. Dev. |
|---|---|---|---|
| Total Main Activity Visits | 435 | 1.453225 | .0801844 |
| COLI-Adjusted Travel Cost | 435 | 129.471 | 26.52125 |
| COLI-Adjusted Travel Cost with Opp. Cost | 435 | 322.4399 | 74.48981 |
| Nights On-Site | 435 | 2.725233 | .3054053 |
| Gender of Respondent | 435 | .7497066 | .0535665 |
| Age of Respondent | 435 | 39.16084 | 1.664497 |
| Group Size | 435 | 2.759096 | .2115889 |
| Price Index of Housing | 435 | 1.002939 | .0305221 |
| Price Index of Food | 435 | .8908373 | .0209715 |
| Price Index of Transportation | 435 | .8895575 | .0183173 |
| COLI-Adjusted Household Income | 435 | 78.54028 | 6.135396 |

Table 2.9: Overnight Hikers

| | Observations | Mean | Std. Dev. |
|---|---|---|---|
| Total Main Activity Visits | 1355 | 1.471311 | .0538952 |
| COLI-Adjusted Travel Cost | 1350 | 238.0453 | 20.81943 |
| COLI-Adjusted Travel Cost with Opp. Cost | 1350 | 676.7115 | 69.89124 |
| Nights On-Site | 1355 | 4.358713 | .4607301 |
| Gender of Respondent | 1355 | .6105632 | .037524 |
| Age of Respondent | 1355 | 44.68837 | 1.125121 |
| Group Size | 1355 | 2.724789 | .1736317 |
| Price Index of Housing | 1350 | .9807598 | .0191486 |
| Price Index of Food | 1350 | .8628573 | .0160773 |
| Price Index of Transportation | 1350 | .8640509 | .0141491 |
| COLI-Adjusted Household Income | 1350 | 90.42616 | 4.182951 |

Table 2.10: Overnight Hunters and Fishers

| | Observations | Mean | Std. Dev. |
|---|---|---|---|
| Total Main Activity Visits | 191 | 1.526416 | .2149111 |
| COLI-Adjusted Travel Cost | 191 | 166.3141 | 51.09388 |
| COLI-Adjusted Travel Cost with Opp. Cost | 191 | 458.0894 | 174.6307 |
| Nights On-Site | 191 | 4.359106 | 1.092875 |
| Gender of Respondent | 191 | .8921919 | .0881295 |
| Age of Respondent | 191 | 44.1416 | 4.075986 |
| Group Size | 191 | 2.848093 | .7986223 |
| Price Index of Housing | 191 | .9512488 | .0545478 |
| Price Index of Food | 191 | .8788342 | .0461707 |
| Price Index of Transportation | 191 | .8809164 | .0448533 |
| COLI-Adjusted Household Income | 191 | 82.2678 | 13.26849 |

Table 2.11: Overnight Relaxers

| | Observations | Mean | Std. Dev. |
|---|---|---|---|
| Total Main Activity Visits | 181 | 1.488368 | .1296929 |
| COLI-Adjusted Travel Cost | 181 | 132.6099 | 33.07287 |
| COLI-Adjusted Travel Cost with Opp. Cost | 181 | 357.7173 | 108.2615 |
| Nights On-Site | 181 | 3.364616 | .5849167 |
| Gender of Respondent | 181 | .5422287 | .0942669 |
| Age of Respondent | 181 | 43.13268 | 2.565574 |
| Group Size | 181 | 2.62113 | .2556726 |
| Price Index of Housing | 181 | 1.002247 | .0497139 |
| Price Index of Food | 181 | .8821623 | .0412689 |
| Price Index of Transportation | 181 | .8528151 | .0310222 |
| COLI-Adjusted Household Income | 181 | 81.25473 | 8.374836 |

Table 2.12: Overnight Horseback Riders

| | Observations | Mean | Std. Dev. |
|---|---|---|---|
| Total Main Activity Visits | 68 | 2.117096 | .620143 |
| COLI-Adjusted Travel Cost | 68 | 130.9498 | 77.26106 |
| COLI-Adjusted Travel Cost with Opp. Cost | 68 | 387.772 | 262.748 |
| Nights On-Site | 68 | 4.017276 | 1.128519 |
| Gender of Respondent | 68 | .7467049 | .1983632 |
| Age of Respondent | 68 | 53.60854 | 6.191018 |
| Group Size | 68 | 2.42298 | .4033416 |
| Price Index of Housing | 68 | .8834196 | .046284 |
| Price Index of Food | 68 | .9197757 | .0511481 |
| Price Index of Transportation | 68 | .9502824 | .0505859 |
| COLI-Adjusted Household Income | 68 | 103.786 | 21.12615 |

Table 2.13: Overnight Nature and Wildlife Viewers

| | Observations | Mean | Std. Dev. |
|---|---|---|---|
| Total Main Activity Visits | 166 | 1.278016 | .0881989 |
| COLI-Adjusted Travel Cost | 166 | 309.8045 | 51.84682 |
| COLI-Adjusted Travel Cost with Opp. Cost | 166 | 846.8397 | 163.4538 |
| Nights On-Site | 166 | 3.881993 | .8035052 |
| Gender of Respondent | 166 | .6084432 | .0882651 |
| Age of Respondent | 166 | 45.95435 | 2.59009 |
| Group Size | 166 | 3.070921 | .5986556 |
| Price Index of Housing | 166 | .9880885 | .0415143 |
| Price Index of Food | 166 | .8871978 | .0318199 |
| Price Index of Transportation | 166 | .8939381 | .0246715 |
| COLI-Adjusted Household Income | 166 | 91.50227 | 9.286812 |

# APPENDIX C

## ESTIMATED MODELS

Table 3.1: Core Models

| | Basic | Basic with Opp. Cost |
|---|---|---|
| COLI-Adjusted Travel Cost | -0.0179*** | -0.00588*** |
| | (0.000196) | (0.0000713) |
| Nights On-Site | 0.000340 | -0.00725*** |
| | (0.00119) | (0.00145) |
| Population Density | -0.000213*** | -0.000221*** |
| | (0.0000106) | (0.0000105) |
| Forest Size in Hectares | -0.000000148*** | -9.02e-08*** |
| | (2.18e-08) | (2.18e-08) |
| Miles of Wilderness | 0.0000332* | 0.0000401** |
| | (0.0000129) | (0.0000129) |
| Gender of Respondent | -0.252*** | -0.261*** |
| | (0.00873) | (0.00872) |
| Age of Respondent | 0.0132*** | 0.0134*** |
| | (0.000303) | (0.000303) |
| Group Size | -0.364*** | -0.371*** |
| | (0.00465) | (0.00466) |
| Price Index of Housing | 0.0430 | -0.0897** |
| | (0.0287) | (0.0283) |
| Price Index of Food | 0.331*** | 0.329*** |
| | (0.0297) | (0.0296) |
| Price Index of Transportation | 0.563*** | 0.461*** |
| | (0.0451) | (0.0446) |
| COLI-Adjusted Household Income | -0.000346*** | 0.00214*** |
| | (0.0000930) | (0.0000968) |
| Constant | 3.392*** | 3.385*** |
| | (0.0512) | (0.0509) |
| N | 5294 | 5294 |
| chi2 | 41722.9 | 38694.1 |
| r2_p | 0.230 | 0.213 |

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 3.2: Core Models with Ecoregions

| | Ecoregions | Ecoregions with Opp. Cost |
|---|---|---|
| COLI-Adjusted Travel Cost | -0.0174*** | -0.00566*** |
| | (0.000197) | (0.0000711) |
| Nights On-Site | 0.000146 | -0.00720*** |
| | (0.00119) | (0.00145) |
| Population Density | -0.000100*** | -0.000115*** |
| | (0.0000124) | (0.0000123) |
| Forest Size in Hectares | -0.000000274*** | -0.000000195*** |
| | (3.07e-08) | (3.05e-08) |
| Miles of Wilderness | -0.00000799 | -0.0000138 |
| | (0.0000146) | (0.0000146) |
| Gender of Respondent | -0.252*** | -0.259*** |
| | (0.00875) | (0.00875) |
| Age of Respondent | 0.0128*** | 0.0130*** |
| | (0.000304) | (0.000304) |
| Group Size | -0.358*** | -0.366*** |
| | (0.00464) | (0.00465) |
| Price Index of Housing | -0.00969 | -0.148*** |
| | (0.0308) | (0.0304) |
| Price Index of Food | 0.240*** | 0.219*** |
| | (0.0318) | (0.0316) |
| Price Index of Transportation | 0.441*** | 0.384*** |
| | (0.0473) | (0.0468) |
| COLI-Adjusted Household Income | -0.000646*** | 0.00173*** |
| | (0.0000938) | (0.0000979) |
| Northern Forests | -0.282*** | -0.317*** |
| | (0.0278) | (0.0279) |
| Northwestern Forested Mountains | -0.0635** | -0.0807*** |
| | (0.0228) | (0.0227) |
| Marine West Coast Forest | -0.469*** | -0.443*** |
| | (0.0209) | (0.0209) |
| Eastern Temperate Forests | 0.0738** | 0.0254 |
| | (0.0238) | (0.0238) |
| Great Plains | 0.137*** | 0.148*** |
| | (0.0119) | (0.0119) |
| North American Deserts | 0.182*** | 0.181*** |
| | (0.0111) | (0.0111) |
| Mediterranean California | 0.0290 | 0.0170 |
| | (0.0220) | (0.0220) |
| Southern Semi-Arid Highlands | 0.0493* | 0.0473* |
| | (0.0224) | (0.0224) |
| Temperate Sierras | 0.0165 | 0.00607 |
| | (0.0226) | (0.0225) |
| Constant | 3.189*** | 3.219*** |
| | (0.0589) | (0.0586) |
| N | 5294 | 5294 |
| chi2 | 43570.3 | 40543.4 |
| r2_p | 0.240 | 0.224 |

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 3.3: Day Users

| | Day Users | Day Users with Opp. Cost |
|---|---|---|
| COLI-Adjusted Travel Cost | -0.0324*** | -0.0121*** |
| | (0.000464) | (0.000170) |
| Population Density | -0.00000572 | -0.0000206 |
| | (0.0000141) | (0.0000141) |
| Forest Size in Hectares | -0.000000770*** | -0.000000776*** |
| | (3.38e-08) | (3.37e-08) |
| Miles of Wilderness | -0.000115*** | -0.000120*** |
| | (0.0000163) | (0.0000162) |
| Gender of Respondent | -0.234*** | -0.235*** |
| | (0.00940) | (0.00940) |
| Age of Respondent | 0.0106*** | 0.0105*** |
| | (0.000325) | (0.000326) |
| Group Size | -0.351*** | -0.349*** |
| | (0.00500) | (0.00500) |
| Price Index of Housing | 0.300*** | 0.228*** |
| | (0.0366) | (0.0366) |
| Price Index of Food | 0.357*** | 0.378*** |
| | (0.0369) | (0.0370) |
| Price Index of Transportation | -0.404*** | -0.559*** |
| | (0.0599) | (0.0596) |
| COLI-Adjusted Household | 0.000154 | 0.00316*** |
| Income | (0.0000993) | (0.000106) |
| Northern Forests | -0.293*** | -0.303*** |
| | (0.0320) | (0.0320) |
| Northwestern Forested | 0.0305 | 0.0278 |
| Mountains | (0.0248) | (0.0248) |
| Marine West Coast Forest | -0.621*** | -0.603*** |
| | (0.0227) | (0.0227) |
| Eastern Temperate Forests | 0.218*** | 0.219*** |
| | (0.0259) | (0.0259) |
| Great Plains | -0.00272 | -0.00315 |
| | (0.0125) | (0.0125) |
| North American Deserts | 0.143*** | 0.150*** |
| | (0.0121) | (0.0121) |
| Mediterranean California | 0.195*** | 0.221*** |
| | (0.0248) | (0.0248) |
| Southern Semi-Arid Highlands | -0.0886*** | -0.111*** |
| | (0.0240) | (0.0241) |
| Temperate Sierras | 0.0503* | 0.0491* |
| | (0.0244) | (0.0244) |
| Constant | 3.683*** | 3.692*** |
| | (0.0660) | (0.0658) |
| N | 2677 | 2677 |
| chi2 | 22348.9 | 22397.4 |
| r2_p | 0.185 | 0.185 |

Standard errors in parentheses
$^{*}$ $p < 0.05$, $^{**}$ $p < 0.01$, $^{***}$ $p < 0.001$

Table 3.4: Overnight Users

| | Night Users | Night Users with Opp. Cost |
|---|---|---|
| COLI-Adjusted Travel Cost | -0.00366*** | -0.00110*** |
| | (0.000115) | (0.0000383) |
| Nights On-Site | 0.0213*** | 0.0207*** |
| | (0.000769) | (0.000780) |
| Population Density | -0.000218*** | -0.000233*** |
| | (0.0000338) | (0.0000337) |
| Forest Size in Hectares | 0.000000867*** | 0.000000873*** |
| | (9.14e-08) | (9.07e-08) |
| Miles of Wilderness | 0.000357*** | 0.000355*** |
| | (0.0000374) | (0.0000375) |
| Gender of Respondent | 0.0487 | 0.0629* |
| | (0.0261) | (0.0261) |
| Age of Respondent | 0.00971*** | 0.00909*** |
| | (0.000902) | (0.000901) |
| Group Size | -0.125*** | -0.128*** |
| | (0.00999) | (0.00998) |
| Price Index of Housing | -0.634*** | -0.695*** |
| | (0.0767) | (0.0765) |
| Price Index of Food | 0.585*** | 0.563*** |
| | (0.0864) | (0.0853) |
| Price Index of Transportation | 0.560*** | 0.464*** |
| | (0.112) | (0.112) |
| COLI-Adjusted Household Income | -0.000279 | 0.00193*** |
| | (0.000261) | (0.000266) |
| Northern Forests | 0.157** | 0.179** |
| | (0.0584) | (0.0583) |
| Northwestern Forested Mountains | 0.590*** | 0.621*** |
| | (0.0719) | (0.0715) |
| Marine West Coast Forest | 0.113* | 0.166** |
| | (0.0573) | (0.0573) |
| Eastern Temperate Forests | 0.457*** | 0.486*** |
| | (0.0658) | (0.0654) |
| Great Plains | 0.0745 | 0.0512 |
| | (0.0413) | (0.0414) |
| North American Deserts | -0.179*** | -0.187*** |
| | (0.0317) | (0.0317) |
| Mediterranean California | 0.00954 | 0.0359 |
| | (0.0518) | (0.0516) |
| Southern Semi-Arid Highlands | 0.620*** | 0.534*** |
| | (0.102) | (0.102) |
| Temperate Sierras | 0.444*** | 0.459*** |
| | (0.0897) | (0.0896) |
| Constant | 0.889*** | 0.853*** |
| | (0.165) | (0.165) |
| N | 2600 | 2600 |
| chi2 | 3177.2 | 2806.2 |
| r2_p | 0.121 | 0.107 |

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 3.5: Day Hikers

| | Day Hikers | Day Hikers with Opp. Cost |
|---|---|---|
| COLI-Adjusted Travel Cost | -0.0318*** | -0.0117*** |
| | (0.000541) | (0.000196) |
| Population Density | -0.000150*** | -0.000164*** |
| | (0.0000170) | (0.0000170) |
| Forest Size in Hectares | -0.000000793*** | -0.000000769*** |
| | (4.27e-08) | (4.26e-08) |
| Miles of Wilderness | -0.000198*** | -0.000206*** |
| | (0.0000195) | (0.0000194) |
| Gender of Respondent | -0.198*** | -0.204*** |
| | (0.0109) | (0.0109) |
| Age of Respondent | 0.0154*** | 0.0154*** |
| | (0.000380) | (0.000381) |
| Group Size | -0.349*** | -0.347*** |
| | (0.00581) | (0.00582) |
| Price Index of Housing | 0.521*** | 0.444*** |
| | (0.0427) | (0.0427) |
| Price Index of Food | 0.164*** | 0.192*** |
| | (0.0443) | (0.0444) |
| Price Index of Transportation | 0.259*** | 0.118 |
| | (0.0727) | (0.0722) |
| COLI-Adjusted Household | -0.000575*** | 0.00228*** |
| Income | (0.000116) | (0.000124) |
| Northern Forests | -0.0619 | -0.0848* |
| | (0.0366) | (0.0367) |
| Northwestern Forested | -0.223*** | -0.237*** |
| Mountains | (0.0284) | (0.0284) |
| Marine West Coast Forest | -0.390*** | -0.385*** |
| | (0.0247) | (0.0247) |
| Eastern Temperate Forests | 0.0800* | 0.0488 |
| | (0.0321) | (0.0321) |
| Great Plains | 0.0724*** | 0.0733*** |
| | (0.0147) | (0.0147) |
| North American Deserts | 0.223*** | 0.225*** |
| | (0.0144) | (0.0145) |
| Mediterranean California | 0.0763* | 0.0665 |
| | (0.0372) | (0.0370) |
| Southern Semi-Arid Highlands | -0.224*** | -0.251*** |
| | (0.0269) | (0.0269) |
| Temperate Sierras | -0.0666* | -0.0776** |
| | (0.0269) | (0.0269) |
| Constant | 3.567*** | 3.577*** |
| | (0.0762) | (0.0761) |
| N | 2019 | 2019 |
| chi2 | 17732.9 | 17705.2 |
| r2_p | 0.196 | 0.196 |

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 3.6: Day Hunters and Fishers

| | Day Hunters/Fishers | Day Hunters/Fishers with Opp. Cost |
|---|---|---|
| COLI-Adjusted Travel Cost | -0.0312*** | -0.0135*** |
| | (0.00221) | (0.000999) |
| Population Density | -0.000304*** | -0.000350*** |
| | (0.0000743) | (0.0000740) |
| Forest Size in Hectares | 0.00000199*** | 0.00000206*** |
| | (0.000000210) | (0.000000209) |
| Miles of Wilderness | 0.000132 | 0.0000922 |
| | (0.000121) | (0.000120) |
| Gender of Respondent | 0.00418 | 0.0660 |
| | (0.0932) | (0.0938) |
| Age of Respondent | -0.0172*** | -0.0171*** |
| | (0.00165) | (0.00164) |
| Group Size | -0.238*** | -0.227*** |
| | (0.0267) | (0.0265) |
| Price Index of Housing | -0.0377 | -0.00315 |
| | (0.246) | (0.239) |
| Price Index of Food | -0.268 | -0.275 |
| | (0.229) | (0.244) |
| Price Index of Transportation | 1.610*** | 1.609*** |
| | (0.276) | (0.282) |
| COLI-Adjusted Household Income | -0.00233*** | 0.00246** |
| | (0.000661) | (0.000764) |
| Northern Forests | 0.0164 | 0.0469 |
| | (0.132) | (0.132) |
| Northwestern Forested Mountains | 1.409*** | 1.508*** |
| | (0.208) | (0.209) |
| Marine West Coast Forest | -0.0238 | 0.0526 |
| | (0.160) | (0.162) |
| Eastern Temperate Forests | 0.879*** | 0.941*** |
| | (0.191) | (0.190) |
| Great Plains | -0.0531 | -0.0756 |
| | (0.0566) | (0.0565) |
| North American Deserts | -0.250*** | -0.309*** |
| | (0.0751) | (0.0749) |
| Mediterranean California | 0.202 | 0.335 |
| | (0.197) | (0.198) |
| Southern Semi-Arid Highlands | -2.805*** | -2.752*** |
| | (0.563) | (0.563) |
| Temperate Sierras | 2.238*** | 2.412*** |
| | (0.333) | (0.334) |
| Constant | 3.069*** | 2.795*** |
| | (0.469) | (0.469) |
| N | 134 | 134 |
| chi2 | 1066.8 | 1031.0 |
| r2_p | 0.254 | 0.245 |

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 3.7: Day Relaxers

| | Day Relaxers | Day Relaxers with Opp. Cost |
|---|---|---|
| COLI-Adjusted Travel Cost | -0.0237*** | -0.00727*** |
| | (0.00283) | (0.00103) |
| Population Density | -0.00101*** | -0.00103*** |
| | (0.0000807) | (0.0000798) |
| Forest Size in Hectares | -0.00000360*** | -0.00000359*** |
| | (0.000000278) | (0.000000280) |
| Miles of Wilderness | -0.000510*** | -0.000544*** |
| | (0.000117) | (0.000117) |
| Gender of Respondent | -0.136* | -0.165** |
| | (0.0556) | (0.0555) |
| Age of Respondent | -0.0358*** | -0.0352*** |
| | (0.00241) | (0.00241) |
| Group Size | -0.744*** | -0.758*** |
| | (0.0300) | (0.0299) |
| Price Index of Housing | 0.825** | 0.854** |
| | (0.304) | (0.307) |
| Price Index of Food | 2.213*** | 2.216*** |
| | (0.258) | (0.257) |
| Price Index of Transportation | -4.036*** | -4.142*** |
| | (0.348) | (0.350) |
| COLI-Adjusted Household Income | 0.0114*** | 0.0127*** |
| | (0.000851) | (0.000894) |
| Northern Forests | -4.934*** | -4.967*** |
| | (0.742) | (0.744) |
| Northwestern Forested Mountains | -1.181*** | -1.175*** |
| | (0.239) | (0.243) |
| Marine West Coast Forest | -2.080*** | -2.082*** |
| | (0.242) | (0.242) |
| Eastern Temperate Forests | -1.476*** | -1.437*** |
| | (0.223) | (0.225) |
| Great Plains | -1.930*** | -1.900*** |
| | (0.0974) | (0.0971) |
| North American Deserts | -0.0800 | -0.0169 |
| | (0.0740) | (0.0728) |
| Mediterranean California | 1.010*** | 1.039*** |
| | (0.141) | (0.142) |
| Southern Semi-Arid Highlands | -2.555*** | -2.520*** |
| | (0.251) | (0.254) |
| Temperate Sierras | -1.817*** | -1.928*** |
| | (0.252) | (0.254) |
| Constant | 12.84*** | 12.81*** |
| | (0.556) | (0.557) |
| N | 92 | 92 |
| chi2 | 3710.9 | 3688.8 |
| r2_p | 0.623 | 0.619 |

Standard errors in parentheses
$^{*}$ $p < 0.05$, $^{**}$ $p < 0.01$, $^{***}$ $p < 0.001$

Table 3.8: Day Horseback Riders

| | Day Horseback Riders | Day Horseback Riders with Opp. Cost |
|---|---|---|
| COLI-Adjusted Travel Cost | -0.0605*** | -0.0134*** |
| | (0.00456) | (0.00117) |
| Population Density | 0.000311 | 0.000119 |
| | (0.000196) | (0.000195) |
| Forest Size in Hectares | -0.00000172** | -0.00000119 |
| | (0.000000646) | (0.000000651) |
| Miles of Wilderness | -0.000657** | -0.000806*** |
| | (0.000215) | (0.000216) |
| Gender of Respondent | -0.399*** | -0.469*** |
| | (0.0843) | (0.0833) |
| Age of Respondent | 0.0471*** | 0.0438*** |
| | (0.00370) | (0.00366) |
| Group Size | 0.180*** | 0.0853* |
| | (0.0445) | (0.0415) |
| Price Index of Housing | -4.949*** | -5.680*** |
| | (0.551) | (0.544) |
| Price Index of Food | 1.698*** | 1.611*** |
| | (0.453) | (0.452) |
| Price Index of Transportation | -3.334*** | -2.832*** |
| | (0.659) | (0.629) |
| COLI-Adjusted Household Income | 0.00330*** | 0.00619*** |
| | (0.000635) | (0.000616) |
| Northern Forests | 0 | 0 |
| | (.) | (.) |
| Northwestern Forested Mountains | 2.161*** | 2.795*** |
| | (0.551) | (0.564) |
| Marine West Coast Forest | 0 | 0 |
| | (.) | (.) |
| Eastern Temperate Forests | 2.369*** | 2.777*** |
| | (0.465) | (0.481) |
| Great Plains | -0.716*** | -0.796*** |
| | (0.187) | (0.187) |
| North American Deserts | -0.745*** | -0.986*** |
| | (0.155) | (0.151) |
| Mediterranean California | 2.069*** | 2.196*** |
| | (0.187) | (0.184) |
| Southern Semi-Arid Highlands | 2.156*** | 2.012*** |
| | (0.290) | (0.292) |
| Temperate Sierras | 2.669*** | 3.379*** |
| | (0.550) | (0.555) |
| Constant | 3.861*** | 4.290*** |
| | (0.977) | (0.977) |
| N | 52 | 52 |
| chi2 | 1565.9 | 1521.5 |
| r2_p | 0.733 | 0.712 |

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 3.9: Day Nature and Wildlife Viewers

| | Day Nature/Wildlife Viewers | Day Nature/Wildlife Viewers with Opp. Cost |
|---|---|---|
| COLI-Adjusted Travel Cost | -0.00553*** | -0.00291*** |
| | (0.000940) | (0.000454) |
| Population Density | 0.0000449 | 0.0000346 |
| | (0.0000806) | (0.0000804) |
| Forest Size in Hectares | -0.00000116*** | -0.00000115*** |
| | (0.000000194) | (0.000000194) |
| Miles of Wilderness | -0.00114*** | -0.00113*** |
| | (0.000103) | (0.000103) |
| Gender of Respondent | -0.746*** | -0.739*** |
| | (0.0530) | (0.0532) |
| Age of Respondent | -0.00440* | -0.00431* |
| | (0.00192) | (0.00192) |
| Group Size | -0.341*** | -0.333*** |
| | (0.0264) | (0.0264) |
| Price Index of Housing | -2.791*** | -2.778*** |
| | (0.270) | (0.271) |
| Price Index of Food | 1.799*** | 1.714*** |
| | (0.204) | (0.206) |
| Price Index of Transportation | -2.998*** | -2.964*** |
| | (0.336) | (0.336) |
| COLI-Adjusted Household Income | -0.000481 | 0.000330 |
| | (0.000472) | (0.000482) |
| Northern Forests | -2.690*** | -2.716*** |
| | (0.214) | (0.215) |
| Northwestern Forested Mountains | -0.256 | -0.259 |
| | (0.170) | (0.170) |
| Marine West Coast Forest | -0.772*** | -0.765*** |
| | (0.127) | (0.127) |
| Eastern Temperate Forests | -1.191*** | -1.181*** |
| | (0.162) | (0.162) |
| Great Plains | -0.726*** | -0.724*** |
| | (0.0887) | (0.0889) |
| North American Deserts | -0.0572 | -0.0614 |
| | (0.0636) | (0.0638) |
| Mediterranean California | 0.265* | 0.252 |
| | (0.132) | (0.132) |
| Southern Semi-Arid Highlands | 0.266 | 0.234 |
| | (0.177) | (0.179) |
| Temperate Sierras | -0.632*** | -0.625*** |
| | (0.174) | (0.175) |
| Constant | 8.673*** | 8.697*** |
| | (0.402) | (0.403) |
| N | 166 | 166 |
| chi2 | 1729.8 | 1740.7 |
| r2_p | 0.346 | 0.349 |

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 3.10: Overnight Backpackers

| | Overnight Backpackers | Overnight Backpackers with Opp. Cost |
|---|---|---|
| COLI-Adjusted Travel | -0.00959$^{***}$ | -0.00478$^{***}$ |
| Cost | (0.000880) | (0.000392) |
| Nights On-Site | -0.0829$^{***}$ | -0.0784$^{***}$ |
| | (0.0206) | (0.0200) |
| Population Density | -0.000259$^{**}$ | -0.000323$^{***}$ |
| | (0.0000921) | (0.0000923) |
| Forest Size in Hectares | -0.000000348 | -0.000000417 |
| | (0.000000283) | (0.000000282) |
| Miles of Wilderness | 0.000494$^{***}$ | 0.000528$^{***}$ |
| | (0.0000871) | (0.0000871) |
| Gender of Respondent | 0.834$^{***}$ | 0.852$^{***}$ |
| | (0.0927) | (0.0929) |
| Age of Respondent | 0.00161 | 0.00232 |
| | (0.00263) | (0.00262) |
| Group Size | -0.471$^{***}$ | -0.493$^{***}$ |
| | (0.0358) | (0.0366) |
| Price Index of Housing | -2.555$^{***}$ | -2.601$^{***}$ |
| | (0.264) | (0.266) |
| Price Index of Food | 0.970$^{***}$ | 0.912$^{***}$ |
| | (0.256) | (0.254) |
| Price Index of | 0.917$^{**}$ | 1.098$^{***}$ |
| Transportation | (0.308) | (0.309) |
| COLI-Adjusted Household | -0.00392$^{***}$ | 0.000915 |
| Income | (0.000866) | (0.000961) |
| Northern Forests | -0.132 | -0.0940 |
| | (0.169) | (0.169) |
| Northwestern Forested | 0.495$^{*}$ | 0.461$^{*}$ |
| Mountains | (0.221) | (0.220) |
| Marine West Coast Forest | -0.929$^{***}$ | -0.848$^{***}$ |
| | (0.174) | (0.175) |
| Eastern Temperate Forests | -0.376 | -0.370 |
| | (0.194) | (0.193) |
| Great Plains | -1.144$^{***}$ | -1.253$^{***}$ |
| | (0.226) | (0.227) |
| North American Deserts | -0.235$^{**}$ | -0.160$^{*}$ |
| | (0.0808) | (0.0817) |
| Mediterranean California | -0.693$^{***}$ | -0.697$^{***}$ |
| | (0.150) | (0.149) |
| Southern Semi-Arid | -0.291 | -0.433 |
| Highlands | (1.104) | (1.105) |
| Temperate Sierras | -1.416$^{**}$ | -1.495$^{**}$ |
| | (0.504) | (0.504) |
| Constant | 3.867$^{***}$ | 3.765$^{***}$ |
| | (0.469) | (0.469) |
| N | 435 | 435 |
| chi2 | 1228.2 | 1273.9 |
| r2_p | 0.276 | 0.287 |

Standard errors in parentheses
$^{*}$ $p < 0.05$, $^{**}$ $p < 0.01$, $^{***}$ $p < 0.001$

Table 3.11: Overnight Hikers

| | Overnight Hikers | Overnight Hikers with Opp. Cost |
|---|---|---|
| COLI-Adjusted Travel Cost | -0.00275*** | -0.000799*** |
| | (0.000121) | (0.0000385) |
| Nights On-Site | 0.0201*** | 0.0197*** |
| | (0.000919) | (0.000922) |
| Population Density | -0.000161*** | -0.000180*** |
| | (0.0000472) | (0.0000470) |
| Forest Size in Hectares | 0.00000113*** | 0.00000107*** |
| | (0.000000133) | (0.000000132) |
| Miles of Wilderness | -0.0000180 | 0.000000615 |
| | (0.0000571) | (0.0000573) |
| Gender of Respondent | 0.0311 | 0.0417 |
| | (0.0354) | (0.0354) |
| Age of Respondent | 0.0167*** | 0.0156*** |
| | (0.00128) | (0.00129) |
| Group Size | -0.0769*** | -0.0853*** |
| | (0.0136) | (0.0136) |
| Price Index of Housing | -0.534*** | -0.580*** |
| | (0.0991) | (0.0992) |
| Price Index of Food | 0.270* | 0.251* |
| | (0.117) | (0.116) |
| Price Index of Transportation | 0.459** | 0.379* |
| | (0.150) | (0.150) |
| COLI-Adjusted Household Income | 0.000638 | 0.00294*** |
| | (0.000348) | (0.000354) |
| Northern Forests | 0.807*** | 0.847*** |
| | (0.0816) | (0.0812) |
| Northwestern Forested Mountains | 0.658*** | 0.674*** |
| | (0.113) | (0.112) |
| Marine West Coast Forest | 0.736*** | 0.801*** |
| | (0.0690) | (0.0688) |
| Eastern Temperate Forests | 0.405*** | 0.454*** |
| | (0.105) | (0.103) |
| Great Plains | 0.471*** | 0.464*** |
| | (0.0541) | (0.0541) |
| North American Deserts | -0.0120 | -0.00392 |
| | (0.0434) | (0.0434) |
| Mediterranean California | 0.177* | 0.232** |
| | (0.0793) | (0.0789) |
| Southern Semi-Arid Highlands | 0.823*** | 0.665*** |
| | (0.136) | (0.136) |
| Temperate Sierras | 0.393** | 0.377** |
| | (0.127) | (0.127) |
| Constant | 0.179 | 0.146 |
| | (0.231) | (0.231) |
| N | 1350 | 1350 |
| chi2 | 1952.3 | 1802.7 |
| r2_p | 0.151 | 0.140 |

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 3.12: Overnight Hunters and Fishers

| | Overnight Hunters/Fishers | Overnight Hunters/Fishers with Opp. Cost |
|---|---|---|
| COLI-Adjusted | -0.00815*** | -0.00326*** |
| Travel Cost | (0.000732) | (0.000322) |
| Nights On-Site | 0.0178 | 0.0158 |
| | (0.0105) | (0.0121) |
| Population Density | -0.000393** | -0.000362* |
| | (0.000150) | (0.000146) |
| Forest Size in | 0.000000619 | 0.000000717 |
| Hectares | (0.000000453) | (0.000000442) |
| Miles of Wilderness | 0.000766*** | 0.000783*** |
| | (0.000135) | (0.000133) |
| Gender of | -0.429** | -0.280 |
| Respondent | (0.164) | (0.163) |
| Age of Respondent | -0.0128*** | -0.0117*** |
| | (0.00286) | (0.00286) |
| Group Size | -0.386*** | -0.382*** |
| | (0.0417) | (0.0418) |
| Price Index of | 1.403*** | 1.157*** |
| Housing | (0.349) | (0.339) |
| Price Index of Food | 2.609*** | 2.480*** |
| | (0.368) | (0.338) |
| Price Index of | 2.353*** | 2.209*** |
| Transportation | (0.415) | (0.403) |
| COLI-Adjusted | -0.00499*** | -0.00101 |
| Household Income | (0.00112) | (0.00116) |
| Northern Forests | 0.0889 | 0.137 |
| | (0.171) | (0.170) |
| Northwestern | 0.0379 | 0.136 |
| Forested Mountains | (0.223) | (0.222) |
| Marine West Coast | -0.769** | -0.787** |
| Forest | (0.268) | (0.267) |
| Eastern Temperate | 0.577* | 0.593** |
| Forests | (0.231) | (0.229) |
| Great Plains | -0.466*** | -0.503*** |
| | (0.132) | (0.134) |
| North American | -0.463*** | -0.499*** |
| Deserts | (0.104) | (0.104) |
| Mediterranean | -1.880*** | -1.805*** |
| California | (0.476) | (0.476) |
| Southern Semi-Arid | 1.811*** | 1.775*** |
| Highlands | (0.388) | (0.387) |
| Temperate Sierras | 0.299 | 0.334 |
| | (0.412) | (0.412) |
| Constant | -0.509 | -0.712 |
| | (0.720) | (0.717) |
| N | 191 | 191 |
| chi2 | 1032.6 | 997.3 |
| r2_p | 0.363 | 0.350 |

Standard errors in parentheses
$^{*}$ $p < 0.05$, $^{**}$ $p < 0.01$, $^{***}$ $p < 0.001$

Table 3.13: Overnight Relaxers

| | Overnight Relaxers | Overnight Relaxers with Opp. Cost |
|---|---|---|
| COLI-Adjusted | -0.00774*** | -0.00321*** |
| Travel Cost | (0.00121) | (0.000457) |
| Nights On-Site | -0.119*** | -0.117*** |
| | (0.0284) | (0.0283) |
| Population Density | -0.000770*** | -0.000846*** |
| | (0.000170) | (0.000171) |
| Forest Size in | 0.000000468 | 0.000000315 |
| Hectares | (0.000000634) | (0.000000637) |
| Miles of Wilderness | -0.000627** | -0.000600** |
| | (0.000218) | (0.000217) |
| Gender of | -0.361** | -0.340** |
| Respondent | (0.114) | (0.114) |
| Age of Respondent | 0.0119* | 0.0118* |
| | (0.00470) | (0.00473) |
| Group Size | -0.0159 | -0.0235 |
| | (0.0516) | (0.0520) |
| Price Index of | -2.355*** | -2.511*** |
| Housing | (0.351) | (0.357) |
| Price Index of Food | 2.928*** | 3.543*** |
| | (0.455) | (0.495) |
| Price Index of | -1.423** | -1.842*** |
| Transportation | (0.482) | (0.497) |
| COLI-Adjusted | 0.00395** | 0.00775*** |
| Household Income | (0.00130) | (0.00140) |
| Northern Forests | 0.371 | 0.399 |
| | (0.299) | (0.300) |
| Northwestern | 5.049*** | 5.462*** |
| Forested Mountains | (0.601) | (0.629) |
| Marine West Coast | -1.185*** | -1.128*** |
| Forest | (0.316) | (0.316) |
| Eastern Temperate | 3.824*** | 4.212*** |
| Forests | (0.593) | (0.626) |
| Great Plains | -0.252 | -0.217 |
| | (0.251) | (0.248) |
| North American | -1.095*** | -1.103*** |
| Deserts | (0.146) | (0.146) |
| Mediterranean | 1.728*** | 1.777*** |
| California | (0.142) | (0.144) |
| Southern Semi-Arid | -1.470* | -1.483* |
| Highlands | (0.728) | (0.728) |
| Temperate Sierras | 5.565*** | 5.975*** |
| | (0.645) | (0.675) |
| Constant | 0.460 | 0.0432 |
| | (0.928) | (0.953) |
| N | 181 | 181 |
| chi2 | 604.7 | 620.0 |
| r2_p | 0.361 | 0.370 |

Standard errors in parentheses
$^{*}$ $p < 0.05$, $^{**}$ $p < 0.01$, $^{***}$ $p < 0.001$

Table 3.14: Overnight Horseback Riders

| | Overnight Horseback Riders | Overnight Horseback Riders with Opp. Cost |
|---|---|---|
| COLI-Adjusted | -0.0173*** | -0.00579*** |
| Travel Cost | (0.00237) | (0.000916) |
| Nights On-Site | 0.0354 | 0.0222 |
| | (0.0187) | (0.0185) |
| Population Density | -0.00217*** | -0.00215*** |
| | (0.000514) | (0.000525) |
| Forest Size in | 0.00000440*** | 0.00000536*** |
| Hectares | (0.00000101) | (0.00000101) |
| Miles of Wilderness | 0.00000114 | 0.0000568 |
| | (0.000488) | (0.000496) |
| Gender of | -0.533*** | -0.525*** |
| Respondent | (0.139) | (0.138) |
| Age of Respondent | 0.0122* | 0.00914 |
| | (0.00557) | (0.00550) |
| Group Size | 0.138 | 0.169* |
| | (0.0717) | (0.0717) |
| Price Index of | 1.250 | 1.240 |
| Housing | (1.322) | (1.326) |
| Price Index of Food | 3.852** | 3.631** |
| | (1.195) | (1.211) |
| Price Index of | 4.145*** | 3.915*** |
| Transportation | (1.122) | (1.136) |
| COLI-Adjusted | 0.00621** | 0.0111*** |
| Household Income | (0.00210) | (0.00207) |
| Northern Forests | 0 | 0 |
| | (.) | (.) |
| Northwestern | 0.590 | 0.688 |
| Forested Mountains | (0.597) | (0.596) |
| Marine West Coast | 0 | 0 |
| Forest | (.) | (.) |
| Eastern Temperate | -0.282 | -0.354 |
| Forests | (0.573) | (0.574) |
| Great Plains | -1.219** | -1.276** |
| | (0.393) | (0.392) |
| North American | -2.095*** | -2.314*** |
| Deserts | (0.396) | (0.398) |
| Mediterranean | -0.793 | -0.925* |
| California | (0.420) | (0.423) |
| Southern Semi-Arid | -11.83 | -12.46 |
| Highlands | (869.1) | (1112.2) |
| Temperate Sierras | -0.307 | 0.0834 |
| | (0.852) | (0.864) |
| Constant | 0.833 | 0.711 |
| | (2.018) | (2.097) |
| N | 68 | 68 |
| chi2 | 533.3 | 523.3 |
| r2_p | 0.596 | 0.584 |

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 3.15: Overnight Nature and Wildlife Viewers

| | Overnight Nature/Wildlife Viewers | Overnight Nature/Wildlife Viewers with Opp. Cost |
|---|---|---|
| COLI-Adjusted Travel Cost | -0.00681*** | -0.00224*** |
| | (0.000868) | (0.000279) |
| Nights On-Site | 0.0191*** | 0.0215*** |
| | (0.00381) | (0.00378) |
| Population Density | -0.00132*** | -0.00130*** |
| | (0.000197) | (0.000201) |
| Forest Size in Hectares | 0.00000171* | 0.00000152 |
| | (0.000000782) | (0.000000789) |
| Miles of Wilderness | 0.00243*** | 0.00251*** |
| | (0.000262) | (0.000268) |
| Gender of Respondent | 0.657*** | 0.822*** |
| | (0.188) | (0.190) |
| Age of Respondent | 0.0130* | 0.0106 |
| | (0.00652) | (0.00655) |
| Price Index of Housing | 3.310*** | 3.364*** |
| | (0.397) | (0.412) |
| Price Index of Food | -1.591 | -1.735 |
| | (0.980) | (1.043) |
| Price Index of Transportation | 3.447** | 3.494** |
| | (1.155) | (1.182) |
| COLI-Adjusted Household Income | 0.0164*** | 0.0212*** |
| | (0.00185) | (0.00193) |
| Northern Forests | -0.178 | -0.411 |
| | (0.737) | (0.768) |
| Northwestern Forested Mountains | -2.027* | -2.302** |
| | (0.806) | (0.824) |
| Marine West Coast Forest | 1.036 | 1.033 |
| | (0.547) | (0.553) |
| Eastern Temperate Forests | 0.649 | 0.498 |
| | (0.647) | (0.664) |
| Great Plains | 0.490 | 0.590 |
| | (0.363) | (0.366) |
| North American Deserts | 1.965*** | 2.042*** |
| | (0.296) | (0.301) |
| Mediterranean California | -0.669 | -0.675 |
| | (0.556) | (0.552) |
| Southern Semi-Arid Highlands | 6.246*** | 3.971*** |
| | (1.354) | (1.190) |
| Temperate Sierras | -2.522** | -2.793** |
| | (0.844) | (0.867) |
| Constant | -2.539 | -2.949* |
| | (1.390) | (1.411) |
| N | 162 | 162 |
| chi2 | 715.5 | 714.9 |
| r2_p | 0.537 | 0.536 |

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

# APPENDIX D

## CONSUMER SURPLUS

Table 4.1: Group Consumer Surplus per Trip

| | Mean Consumer Surplus without Opp. Cost | 95% Confidence Interval Lower-Bound | 95% Confidence Interval Upper-Bound |
|---|---|---|---|
| Ecoregions Core Model | 57.495 | 56.344 | 58.484 |
| Day Visitors | 30.87 | 30.19 | 31.61 |
| Overnight Visitors | 272.55 | 258.58 | 288.53 |
| Day Hikers | 31.44 | 30.64 | 32.35 |
| Day Hunters/Fishers | 32.03 | 28.76 | 36.61 |
| Day Relaxers | 42.3 | 35.47 | 52.46 |
| Day Horseback Riders | 16.48 | 14.67 | 18.68 |
| Day Viewers | 180.83 | 141.55 | 251.71 |
| Overnight Backpackers | 104.43 | 90.5 | 123.31 |
| Overnight Hikers | 362.46 | 336.71 | 392.94 |
| Overnight Hunters/Fishers | 122.91 | 107.4 | 146.12 |
| Overnight Relaxers | 129.88 | 102.79 | 174.58 |
| Overnight Horseback Riders | 57.42 | 47.2 | 72.26 |
| Overnight Viewers | 145.24 | 120.25 | 184.55 |

Table 4.2: Individual Consumer Surplus per Trip

| | Mean Group Size | Mean Consumer Surplus without Opp. Cost | 95% Confidence Interval Lower-Bound | 95% Confidence Interval Upper-Bound |
|---|---|---|---|---|
| Ecoregions Core Model | 2.623 | 21.9196 | 21.4807 | 22.2966 |
| Day Visitors | 2.596 | 11.8914 | 11.6294 | 12.1764 |
| Overnight Visitors | 2.766 | 98.5358 | 93.4852 | 104.3131 |
| Day Hikers | 2.573 | 12.2192 | 11.9083 | 12.5729 |
| Day Hunters/Fishers | 2.28 | 14.0482 | 12.6140 | 16.0570 |
| Day Relaxers | 2.826 | 14.9682 | 12.5513 | 18.5633 |
| Day Horseback Riders | 2.138 | 7.7081 | 6.8616 | 8.7371 |
| Day Viewers | 2.768 | 65.3288 | 51.1380 | 90.9357 |
| Overnight Backpackers | 2.759 | 37.8507 | 32.8017 | 44.6937 |
| Overnight Hikers | 2.725 | 133.0128 | 123.5633 | 144.1982 |
| Overnight Hunters/Fishers | 2.848 | 43.1566 | 37.7107 | 51.3062 |
| Overnight Relaxers | 2.621 | 49.5536 | 39.2179 | 66.6082 |
| Overnight Horseback Riders | 2.423 | 23.6979 | 19.4800 | 29.8225 |
| Overnight Viewers | 3.071 | 47.2940 | 39.1566 | 60.0944 |

Table 4.3: Group Consumer Surplus with Opportunity Cost

| | Mean Consumer Surplus with Opp. Cost | 95% Confidence Interval Lower-Bound | 95% Confidence Interval Upper-Bound |
|---|---|---|---|
| Ecoregions Core Model | 176.76 | 172.93 | 180.51 |
| Day Visitors | 82.45 | 80.47 | 84.5 |
| Overnight Visitors | 907.26 | 854.24 | 960.61 |
| Day Hikers | 85.5 | 83.32 | 87.9 |
| Day Hunters/Fishers | 74.32 | 65.79 | 83.93 |
| Day Relaxers | 138.43 | 111.45 | 179.99 |
| Day Horseback Riders | 74.77 | 65.86 | 86.38 |
| Day Viewers | 345.77 | 277.83 | 465.43 |
| Overnight Backpackers | 210.17 | 185.05 | 242.68 |
| Overnight Hikers | 1245.67 | 1157.64 | 1365.4 |
| Overnight Hunters/Fishers | 307.82 | 264.52 | 366.99 |
| Overnight Relaxers | 312.77 | 254.45 | 414.81 |
| Overnight Horseback Riders | 171.47 | 137.87 | 230 |
| Overnight Viewers | 553.95 | 373.5 | 448.43 |

Table 4.4: Individual Consumer Surplus with Opportunity Cost

| | Mean Group Size | Mean Consumer Surplus with Opp. Cost | 95% Confidence Interval Lower-Bound | 95% Confidence Interval Upper-Bound |
|---|---|---|---|---|
| Ecoregions Core Model | 2.623 | 67.3885 | 65.9283 | 68.8181 |
| Day Visitors | 2.596 | 31.7604 | 30.9977 | 32.5501 |
| Overnight Visitors | 2.766 | 328.0043 | 308.8359 | 347.2921 |
| Day Hikers | 2.573 | 33.2297 | 32.3824 | 34.1625 |
| Day Hunters/Fishers | 2.28 | 32.5965 | 28.8553 | 36.8114 |
| Day Relaxers | 2.826 | 48.9844 | 39.4374 | 63.6907 |
| Day Horseback Riders | 2.138 | 34.9719 | 30.8045 | 40.4022 |
| Day Viewers | 2.768 | 124.9169 | 100.3721 | 168.1467 |
| Overnight Backpackers | 2.759 | 76.1762 | 67.0714 | 87.9594 |
| Overnight Hikers | 2.725 | 457.1266 | 424.8220 | 501.0642 |
| Overnight Hunters/Fishers | 2.848 | 108.0829 | 92.8792 | 128.8588 |
| Overnight Relaxers | 2.621 | 119.3323 | 97.0813 | 158.2640 |
| Overnight Horseback Riders | 2.423 | 70.7676 | 56.9005 | 94.9236 |
| Overnight Viewers | 3.071 | 180.3810 | 121.6216 | 146.0208 |