THE VIRGINIA CREEPER TRAIL: AN ANALYSIS OF NET ECONOMIC BENEFITS AND ECONOMIC IMPACTS OF TRIPS

by

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B.S., The University of Georgia, 2001.

A Thesis Submitted to the Graduate Faculty of The University of Georgia in Partial Fulfillment of the Requirements for the Degree of

MASTERS OF SCIENCE

ATHENS, GEORGIA

2004

ACKNOWLEDGMENTS

I would like to thank my family and friends for their support, encouragement and belief in my abilities throughout my graduate career. Without there support I would be lost. I would like to specifically thank my parents, Kevin and Kathy Gill. Thank you for your never-ending love and support in all the things I do. As well, thank you for instilling in me the values of hard work and dedication and for teaching me that the things in life that mean the most are the things that require the most time and effort.

I would also like to thank Tom and Maryann Buckalew for always being there to listen and being great friends. Thank you to my committee: John C. Bergstrom, J.M. Bowker, Donald English, and Jeffery Mullen for providing helpful comments and insight. I would like to particularly thank John Bergstrom, and J.M. Bowker for their persistence, and patience as I made my way through the process of developing and defending this thesis.

I would also like to acknowledge and sincerely thank The Virginia Creeper Trail Club, Virginia Trails, The Virginia Department of Conservation and Recreation, The Virginia Department of Forestry, The National Park Service, The University of Georgia, Department of Agricultural and Applied Economics, and The U.S. Forest Service, Region 8 and Southern Research Station for providing the financial, technical, and logistical support needed to collect the data upon which this thesis was created. Without the support of these contributors, this thesis would not have been possible.

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Chapter I

INTRODUCTION

Outdoor recreation is a source of exercise, relaxation, and socialization for millions of Americans. The American Recreation Coalition reported that nine out of ten Americans actively engage in some form of recreation (American Recreation Coalition 2003). Two popular forms of outdoor recreation are walking and cycling. The *2002 National Survey of Pedestrian and Bicyclist Attitudes and Behaviors* estimated that 164 million Americans over the age of sixteen walked, ran, or jogged in the summer of 2002. During the same period, the survey estimated that 57 million Americans over the age of sixteen rode a bicycle at least once (Bureau of Transportation Statistics 2002).

Pedestrians and cyclists surveyed in the *2002 National Survey of Pedestrian and Bicyclist Attitudes and Behaviors* have strong attitudes and feelings towards recreation. Survey response indicates many pedestrians and cyclists see recreation as a tool to address some of the social issues in the United States. The social issues pedestrians and cyclists believe recreation improves include health, education, parent/child communication, and youth criminal activities (American Recreation Coalition 2003). Individuals and groups sharing these attitudes are searching for ways to bring recreation outlets closer to home and improve awareness of these recreation outlets.

The growing demand for outdoor recreation has led to federal, state, and local involvement in estimating the economic impacts and benefits of outdoor recreation. There are many scientific publications estimating the economic impacts of outdoor recreation resources.

Moore, Gitelson, and Graefe (1994) estimated the economic impacts of three different rail trails located in different geographic regions of the United States. English, Kriesel, Leeworthy and Wiley (1996) estimated the economic impact of recreation trips to the Florida Keys. English and Bowker (1996) estimated the economic impact of five different rivers located in differing geographic regions of the United States. Stoll, Bergstrom, and Jones (1988) estimated the economic impact of recreational boating on the Texas economy.

The literature estimating the demand for, and net benefits of outdoor recreation is extensive. Betz, Bergstrom, and Bowker (2003) estimated the demand for a proposed rail trail in Northeast Georgia. Leeworthy and Bowker (1997) estimated the net economic benefits of recreation trips to the Florida Keys. Bowker, English, Donovan (1996) estimated the value of whitewater rafting trips in the Southeast. Siderelis and Moore (1995) estimated the net benefits of trips to three different rail trails in different regions of the United States. This thesis seeks to follow the existing literature in estimating the economic impacts and net benefits of trips to the Virginia Creeper Trail (VCT).

The next section provides background on the origins of the greenway movement and characteristics of modern greenways. Following this rail trails are introduced. This section includes a brief history of trail trails and their sources of funding. The Virginia Creeper Trail (VCT) is then introduced. The section includes a brief history of the area where the trail is located and the trail itself. The objectives and organization of the thesis conclude the chapter.

Greenways

A greenway is a linear open space established along a natural corridor (Little 1990, p.4). Greenways are seen in many forms and geographic areas. Greenways are found along riverfronts, canals, stream valleys, ridgelines, along abandoned railroads, and beside scenic roads. There are five greenway classifications (Little 1990, p.4-5). Table 1.1 lists the five current greenway classifications.

Table 1.1 – Types of Greenways

1. Greenways created as part of redevelopment programs
2. Recreational greenways based on natural corridors
3. Ecological corridors providing migration, species interchange, and hiking
4. Scenic and historic routes along roads, highways, and waterfronts
5. Comprehensive greenway systems based on landforms, or combinations of existing greenways

The first greenway was The Park and Piedmont Way on the campus of The University of California at Berkeley (Little 1990, p.9). The designer, Frederick Law Olmsted went on to design many other greenways including the Brooklyn-Queens Greenway and the "Emerald Necklace" in Boston. Other notable figures in the evolution of the greenway movement include Benton MacKaye and William Whyte. Benton MacKaye established the Appalachian Trail (AT) as a dam and levee system to combine recreation corridors, and control urban growth (Little 1990, p.19). William Whyte was a landscape architect specializing in open space. His books included *Securing Open Space in America, Cluster Development,* and *The Last Landscape* (Little 1990, p.24).

Beginning in the seventies, citizens and organizations began buying large tracts of green space along the urban fringe in reaction to urban sprawl (Little 1990, p.32). These "linear commons" came to be known as greenways. One advantage in developing a greenway was the decrease in capital needed to purchase land. A long narrow corridor did not hold the private economic value that developers sought and little public funding was available (Little 1990, p.33). Two important benefits seen from developing greenways are edge and linkage.

Edge is the portion of greenway seen while traveling along the corridor. Edge makes a relatively small piece of green space appear much larger than it actually is. Edge effect gives a greenway the effect of having more open space than is actually there. Linkage is the other defining characteristic of the modern greenway. Greenways provide a corridor for linking individual recreation resources into a system of parks (Little 1990, p.35-36).

Rail Trails

A rail trail is a greenway established along the right of way of a railway corridor. Rail trails are a type of natural recreation corridor. This type of greenway is one of the fastest growing recreation mediums in America. The first rail-trail, The Cathedral Aisle Trail, opened September 1, 1939 in Aiken, South Carolina (RTC 2003a). Rail trails are well suited for many popular forms of recreation including, walking, jogging, cycling, rollerblading, and horseback riding.

Rail-trails are not without controversy, expense, and legal problems. When a railroad abandons a rail corridor a major issue is who has legal claim to the land. Many previous landowners feel the land should be returned to them. Landowners argue that since the corridor was abandoned the right of way should be returned to the previous owner. This has proven to be a problem in efforts to establish some rail-trails. In recent years the rail banking has gained popularity as a way to circumvent this problem. Rail banking is a voluntary agreement between a railroad company and trail agency to use the rail corridor as a trail until the railroad needs the corridor again for rail service (RTC Railbanking 2003b). Since the right of way is not abandoned, there is no legal standing for landowners to reacquire ownership of the right of way.

Railbanking gained legal standing with the passage of the 1983 National Trails Act (Little 1990, p.102).

Rail trail conversion was boosted in 1991 with the passage of the Intermodal Surface Transportation Efficiency Act (ISTEA and Trails 1995). ISTEA officially recognized walking and bicycling as modes of transportation. ISTEA increased funding for pedestrian and cycling facilities by incorporating greenway and rail trail projects into state DOT budgets. From 1991 through 1997 approximately $3 billion where earmarked for trail related usage (ISTEA and Trails 1995). ISTEA has eleven specific trail related programs. Table 1.2 lists trail related programs supported by ISTEA.

Table 1.2 – Intermodal Surface Transportation Efficiency Act Trail Related Programs

1. Transportation Enhancements
2. National Recreation Trails Fund Act
3. "Core" Surface Transportation Program
4. Congestion Mitigation & Air Quality Improvement
5. Federal Lands Program
6. Scenic Byways
7. Highway Safety
8. Bridge Program
9. National Highways
10. Federal Transit Fund
11. Demonstration Projects

The Transportation Enhancements (TE) program has had the most impact on rail trail development. This program earmarked 10 percent of all federal transportation dollars to developing pedestrian and cycling facilities. TE's provided funding for projects in ten categories (ISTEA and Trails 1995). Table 1.3 lists the ten projects that are supported by the Transportation Enhancements program. The categories providing the most benefit to rail-trail conversion are Bicycle & Pedestrian Facilities and Preservation of Abandoned Railway Corridors (ISTEA and Trails 1995).

Table 1.3 -Transportation Enhancement Programs

1. Bicycle & Pedestrian Facilities
2. Acquisition of Scenic Easements & Historic Sites
3. Scenic or Historic Highway Programs
4. Landscaping & Scenic Beatification
5. Historic Preservation
6. Rehabilitation & Operation of Historic Transportation Facilities
7. Preservation of Abandoned Railway Corridors
8. Control & Removal of Outdoor Advertising
9. Archaeological Planning & Research
10. Mitigation of Water Pollution Due to Highway Runoff

In 1998 ISTEA became the Transportation Equity Act for the 21st Century (TEA 21). TEA 21 increased TE funding from 10 to 40 percent of federal transportation dollars. TEA 21 also added two more TE programs. Through fiscal year 2002, $6 billion in federal funds have been earmarked for TE programs. Fifty-four percent of these funds are for rail-trails and cycle and pedestrian facilities (RTC 2003c). Due to ISTEA, the number of rail trail projects in the United States has increased. In 1990 there were an estimated 284 rail trails totaling 2,044 miles. Two years after the passage of ISTEA the estimated number of rail-trails was 655 rail trails totaling 6,038 miles. The current estimate of U.S. rail trails stands at 1,202 rail trails totaling 12,552 miles (RTC 2003a).

The Federal Highway Administration (FHWA) manages the TE program. The FHWA annually allocates funding to state DOT's who handle individual disbursement (RTC 2003c). For most rail trail projects the state contributes at least 20 percent of the funds and federal TE dollars account for the remaining 80 percent (RTC 2003c).

As rail trails are established local communities have seen the impact that rail-trails can have on the local economy. Rail trails can help increase land values, strengthen tourism dependent economic sectors, and create civic pride (Howser 1997). Moore, Gitelson, and Graefe (1994) demonstrate the economic impact rail-trails have on local economies. Moore, Gitelson, and Graefe (1994) estimated the economic impact of The Lafayette/Moraga, The Heritage Trail and The St. Marks Trail on their local economies. Their findings estimate average trail related expenditures at $3.97, $9.21, and $11.02 per person/per day for The Lafayette/Moraga, The Heritage Trail, and The St. Marks Trail. This equates to $1.5 million, $1.2 million, and $1.8 million in total economic impact to local economies (Moore, Gitelson, and Graefe 1994).

The rural areas where many rail trails are located were once dependent upon the railroad, or industries directly related to the railroad as a source of revenue. The creation of the federal highway system decreased the need for rail transportation and rail lines were eventually abandoned. Many rural towns lost their economic base. The rail trail movement has helped some rural towns recover a portion of the revenue lost when rail lines closed. Economic impacts from rail trail use include increased sales and tax revenue, new business creation, revitalized business, and increased job opportunities. Rail trails also help to increase tourism, attract relocating corporations and employees, increased environmental benefits, and increased civic pride (Howser 1997).

The positive economic impact has bolstered public opinion about rail trails. In the beginning, many landowners and community members feared rail trails and the people they may bring in. Many felt that rail trails would create a burden on the community due to increases in crime and littering from trail users. Instead, it was found that trail users provide a clean source of revenue that does not require many public services in return. Turco, Gallagher, and Lee

(1998) found that the majority of homeowners opposed to trail development changed their minds within five years, and ten percent of these homeowners sought properties adjacent to the trail.

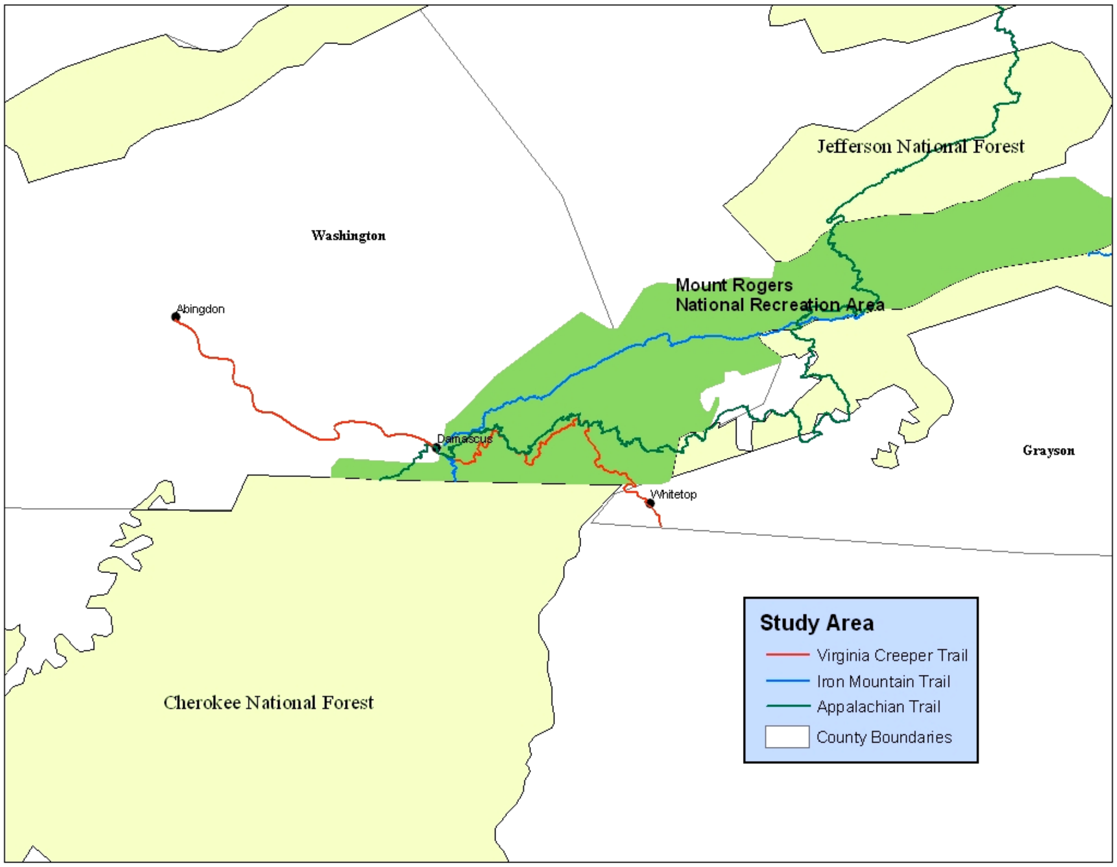
The Virginia Creeper Trail

The VCT is a 34-mile rail trail in Southwest Virginia, beginning in Abingdon, Virginia and ending on Whitetop Mountain. The midpoint of the VCT is in Damascus, Virginia. There are five major trails that intersect in Damascus. These trails are The Appalachian National Scenic Trail, The Virginia Creeper National Recreation Trail, The Transcontinental Bicycle Trail, The Iron Mountain Trail, and The Daniel Boone Trail (About Our Town 2002). Damascus has acquired the moniker, "Trail Town USA." All or parts of these trails are included in the Jefferson National Forest and the Mount Rogers National Recreation Area. Figure 1.1 presents a map of the VCT and surrounding area.

The area experienced significant growth after the Civil War. Many speculators believed that Southwest Virginia contained large deposits of iron ore. In 1886, J.D. Imboden changed the name of a small farm community from Mocks Mill to Damascus. Imboden, a wealthy businessman, organized speculators and created a railroad company to transport the iron ore to Roanoke (Davis & Morgan 1997, p.47-48). It was soon discovered that the area did not hold the amount iron ore expected. The iron deposits were soon exhausted and the speculators left. This allowed for the development of a prosperous timber industry.

Whitetop Mountain held large reserves of virgin timber. In the early 1900's entrepreneurs arrived in Damascus to build sawmills, railroads, and furniture operations. With regular railroad service and large timber reserves, Damascus became a boomtown. During the Depression the area experienced an economic downturn due to over harvesting and railroad use began to decline.

Figure 1.1 – Map of the Virginia Creeper Trail and Surrounding Area



Railroad use further declined after World War II due to mass appeal of the automobile and a reduction in area population in search of factory jobs. After fifty years of showing no profit the railroad corridor was abandoned in 1977 (Davis & Morgan 1997, p.52-66).

Through the coordination of Dr. French Moore, Jr. and Dave Brilhart, M.D, members of the Abingdon community brought forth the idea of transforming the corridor into a rail trail. The proposal faced opposition from local landowners wanting the right-of-way returned to the previous owners. The proposal also faced a time constraint due to plans for the destruction of the bridges and trestles along the corridor (Davis & Morgan 1997, p.69). With the line abandoned and the insurance policy running out, Norfolk & Western wanted the bridges and trestles destroyed due to the risk of a large financial loss if someone got hurt. Without the bridges and trestles the rail trail would be financially impossible.

In 1978 the upper portion of the rail corridor became part of the Mount Rogers National Recreation Area. Soon after Damascus received funding from the Virginia Commission for Outdoor Recreation (VCOR) to buy the right-of-way connected to the federal lands. Soon after the Tennessee Valley Authority (TVA) provided the funding for Abingdon to buy the corridor connecting Abingdon and Damascus (Davis & Morgan 1997, p.69-70).

The VCT is an interesting mix of public and private partnership. The VCT represents a unique collaboration between city government, federal government, and local grassroots effort. Part of this grassroots effort is seen through The Virginia Creeper Trail Club. The Virginia Creeper Trail Club's mission is the promotion, maintenance, and preservation of the VCT corridor (The Virginia Creeper Trail Club 2004).

Study Objectives

The purpose of this thesis is to estimate the economic value and impact of the Virginia Creeper Trail. Specific questions this thesis will seek to answer include: (1) What is the economic impact of the VCT on Washington and Grayson counties, and (2) What are the net economic benefits of trail use to local and nonlocal users. To estimate the economic impact and net economic benefits of VCT trips the following information is needed:

1. The annual estimated use of the VCT by locals and nonlocals
2. Estimated per person expenditures by nonlocals in the local economy
3. Estimated per person per trip consumer surplus for locals and nonlocals taking a trip to the VCT
4. The demographics of VCT users

5. The attitudes and preferences of VCT users with respect to the trail and local area.

Organization of Thesis

This thesis is organized into five chapters. The first chapter provides background information on rail trails and the VCT. This chapter also defines the research objectives and purpose of this thesis. Chapter 2 provides the theoretical basis to discuss economic impact and net economic benefits. Chapter 3 presents the research methodology used to estimate net economic benefits and economic impacts. This chapter includes the methods used for survey design, implementation, and sampling. This chapter also discusses the development of the economic models used. Chapter 4 reports the surveying results and the net economic benefits and economic impact of trips to the VCT. Chapter 5 discusses the conclusions and limitations of the research. This section also includes discussion of policy implications for management decisions regarding rail trails and suggestions for further research.

Chapter II

THEORETICAL BACKGROUND

This chapter presents the theoretical concepts necessary to estimate the net economic benefits and economic impacts of VCT trips. The first section explains the principles of consumer demand theory, and utility maximization. With this information an individual demand function is derived. Next, a description of nonmarket goods is given. This section explains why nonmarket goods are not traded in the marketplace. The theoretical background for the Travel Cost Method (TCM) and its use for estimating the value of nonmarket goods are given. The next section defines economic value and how it is measured.

The concepts necessary to perform economic impact analysis are introduced in the next section. This section identifies the steps necessary to perform economic impact analysis and the common mistakes made in the application of economic impact analysis. Multipliers and their role in determining total economic impacts are then introduced. This section explains how multipliers are used to estimate the induced and indirect effects of expenditures made in the local economy. The chapter concludes with a section explaining how estimated per person consumer surplus and estimated per person expenditures are used to estimate the net economic benefits and total economic impacts of a recreation site like the VCT.

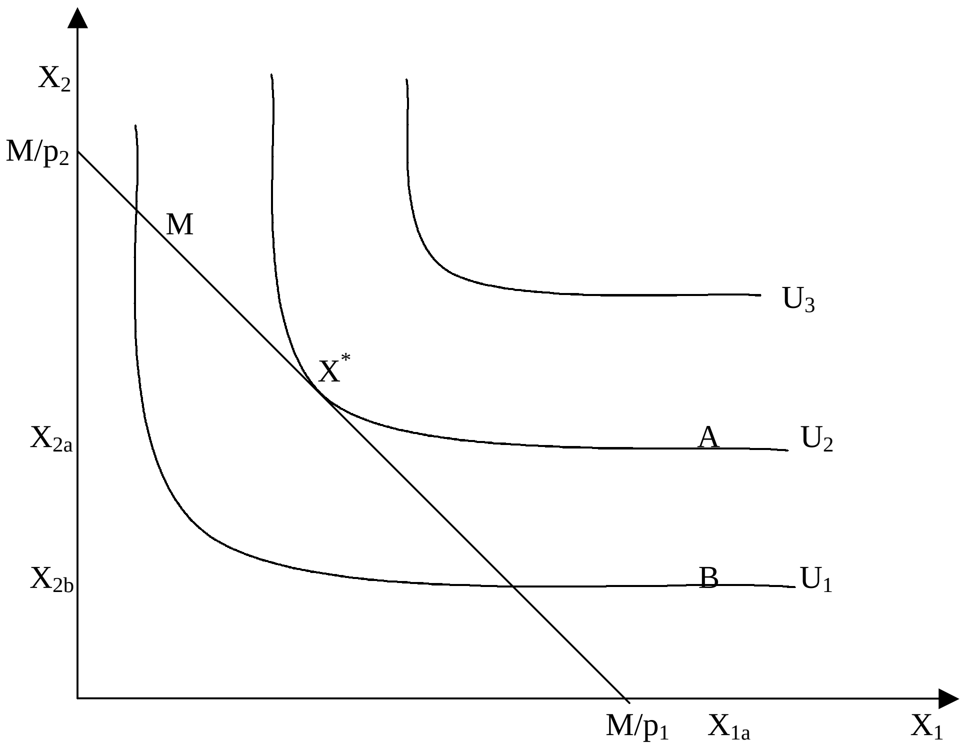
Consumer Demand Theory for Market Goods

A rational consumer attempts to maximize utility subject to his/her budget constraint. An individual's consumption of private and nonmarket goods reflect this behavior (Freeman 1993, p.6). The mix of goods and services an individual consumes is referred as their consumption bundle. A consumption bundle represents the best mix of goods and services the consumer can consume given their preferences and budget constraint. This consumption bundle represents a point on the individual's utility function. The utility function represents an individual's preferences among all goods, services, and amenities available (Randall 1981, p.50).

Given the assumption that individuals can rank their preference for various consumption bundles, the properties of nonsatiation and substitutability emerge. The property of nonsatiation states that "more is better." If a consumer is given the choice of two otherwise identical commodity bundles and bundle A has a larger amount of a normal good X_{1a} than bundle B, assuming rational behavior, the consumer will always choose bundle A. The property of substitutability states that within bundle A, if good X_{1a} is decreased then good X_{2a} can be increased to make the consumer indifferent. The property of substitutability allows for tradeoffs between goods and services, so that a change in the mix of goods within the consumption bundle will not change the level of utility the consumption bundle confers (Freeman 1993, p.42). The properties of nonsatiation and substitutability are shown in Figure 2.1.

In a two-commodity market good X_1 represents the good of interest and good X_2 represents all other goods within the consumption bundle. The budget constraint, defined by one's income, is the downward sloping line from M/p_2 to M/p_1 denoted as M, with a slope of $- p_1/p_2$. Points along the budget line represent feasible consumption bundles for the consumer. In Figure 2.1 the utility maximizing solution, given a two-commodity market, is shown as (X^*).

Figure 2.1 – Utility Maximization Solution in a Two-Commodity Market



The indifference curves, represented by U_i, i=1,2,3 indicate different utility levels. Moving outward from the origin, indifference curves represent increasing levels of utility. Points along an indifference curve represent various combinations of goods X_1 and X_2 that yield the same utility. The slope of an indifference curve is called the Marginal Rate of Substitution (MRS). MRS is the rate at which a consumer will substitute one good for another, with utility held constant (Varian 1999, p.48).

The properties of nonsatiation and substitutability allow a utility function to represent the preference ordering of an individual (Freeman 1993, p.43). The utility function is expressed as:

2.1 $$U = U(x_i, \ldots, x_n)$$

where

U = level of utility

x_n = vector of market goods.

subject to a budget constraint:

2.2 $$m = p_i x_i + p_n x_n$$

where

m = income

p_i = market price of good i.

The Marginal Rate of Substitution between good 1 and good 2 is:

2.3 $$MRS = -\frac{\partial x_2}{\partial x_1} \mid U_{constant}$$

where

∂x_2 = change in good 2

∂x_1 = change in good 1.

Utility functions are measured on an ordinal scale. Ordinal measurement implies that an individual can rank his preferences by the amount of utility gained, but these rankings are not comparable to other individuals (Freeman 1993, p.43).

The point of tangency between the budget constraint and the indifference curve, (X*), represents the utility maximizing solution. At this point the slope of the budget line, - p_1/p_2, equals the MRS. Given the current budget constraint, this point represents the highest utility possible. If the consumer's budget constraint changes, the optimal solution would also change. A decrease in income would shift the budget line inward and an increase in income would shift the budget line outward. If the price of good 2 and income are held constant while the price of good 1 changes over different prices, the resulting optimal solutions form the demand curve. This demand curve expresses the amount of each good the consumer wishes to consume as a function of the good's own price, the price of substitute goods, the budget constraint, a quality measure, and individual characteristics (Freeman 1993, p.99). Figure 2.2 shows an individual demand curve holding X_2, income, substitutes, and individual characteristics constant. At price P_{1a}, the amount of good X_1 demanded is X_{1a}. The ordinary demand function is defined as (Freeman 1993, p.99):

2.4 $$X_n = X(p_n, p_s, m, q, h)$$

where

p_n = price of good n

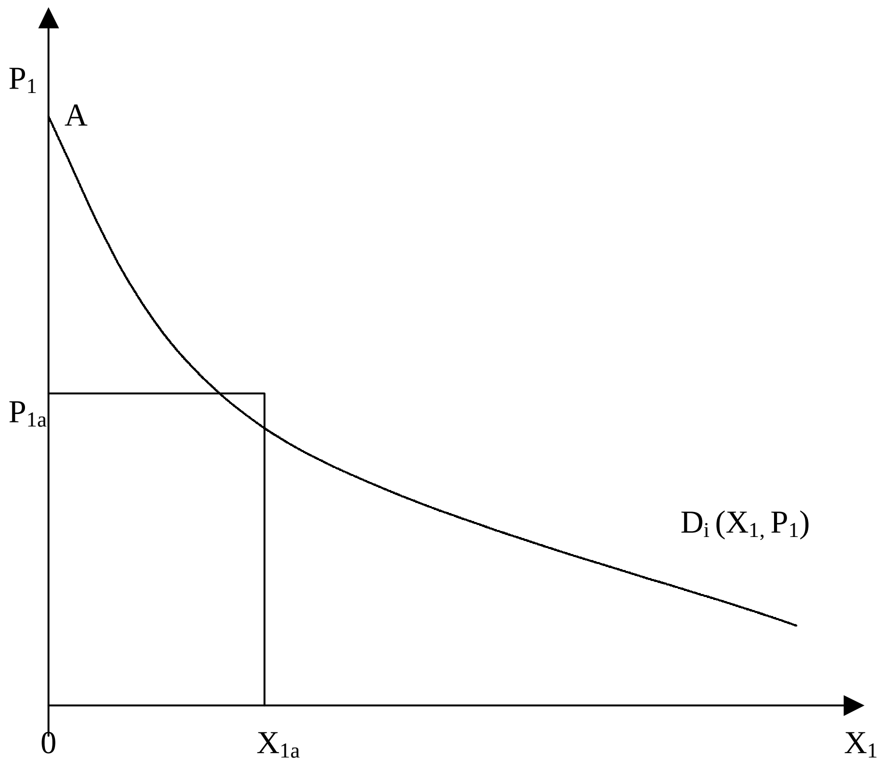
p_s = price of substitute goods

m = income

q = quality measure

h = individual characteristics affecting tastes and preferences.

Figure 2.2 – The Individual Demand Curve



Nonmarket Goods and Travel Cost Demand Theory

An individual's consumption bundle consists of private goods, goods provided by the government, and goods and services from the resource-environment system (Freeman, 1993 p.6). The private goods that an individual consumes are traded in the marketplace. Private goods exhibit rival and exclusive characteristics. The goods and services provided by the government and the resource-environment system are termed nonmarket goods, since they are not traded in the marketplace. Nonmarket goods cannot be efficiently bought and sold in the marketplace due to their nonexclusive and/or nonrival characteristics (Randall, 1987 p.175). Goods that exhibit nonrivalry and/or nonexclusive properties lead to problems with externalities. Externalities occur when a person's welfare is not only affected by his actions, but also the actions of a third party (Randall 1987, p.182). Based on their degree of rivalry and exclusiveness goods can be classified in four categories (Randall, 1987 p.176).

1. **Rival, Exclusive Goods**. These goods are bought and sold in the marketplace. Rival, exclusive goods have well-defined property rights allowing for efficient marketplace allocations.

2. **Rival, Nonexclusive Goods**. These are goods where consumption by a person limits the amount available for other consumers, but there is no payment method to limit consumption. With well-defined property rights the marketplace could efficiently provide these goods.

3. **Nonrival, Exclusive Goods**. These are goods that could be provided by both the public sector and marketplace, but not at a Pareto efficient allocation due to nonrivalry.

4. **Nonrival, Nonexclusive Goods**. Goods in this category can only be provided by the public sector. Consumers cannot be excluded and consumption does not limit the ability to use. There is no incentive to buy or sell these goods.

While there are many types of outdoor recreation that are traded in the marketplace some forms of outdoor recreation are nonmarket goods due to nonrival and/or nonexclusive characteristics. Nonrival, exclusive types of outdoor recreation are recreation activities where a person's use of the recreation area does not affect use by another individual, but access to the site is controlled through points of entry. Examples of nonrival, exclusive recreation resources include large national parks such as Yellowstone National Park. Recreation sites without controlled access points or the inability to exclude users not entering at controlled access points exhibit characteristics of nonrival, nonexclusive goods. Examples of nonrival, nonexclusive recreation resources include linear greenways where users enter and exit anywhere along the trail and their use does not affect the use of others.

Recreation resources can be nonrival, nonexclusive to a congestion threshold and then become rival, nonexclusive. Congestion implies the marginal cost of an additional user is zero to the point where an additional user creates disutility (Randall 1987, p.176-177). On recreation sites with no payment method, congestion acts as a mechanism to limit users (Randall 1987, p.177). Those who value areas with little crowding choose recreation outlets where congestion is not a problem. The type of characteristics a recreation resource exhibits can be dynamic, changing due to seasonal variation in use patterns, time of week, and weather.

The VCT has the characteristics of a nonrival, nonexclusive good. Use of the VCT does not limit use by others and there is no fee for trail use. These characteristics could change if use continued to increase and congestion became a problem or if fees were charged for trail entry. Charging for trail use could be problematic due to users ability to enter the trail at points other than the major access points and due to portions of the trail passing through private property.

The value of a recreational trip derives from the consumer's desire to maximize utility from the recreation experience (Stoll 1983). The value of a recreational experience is a function of market commodities, nonmarket commodities and time (Becker 1965). The following equations expand on the idea of utility maximization for market commodities, presented in

Equations 2.1 and 2.2 and Figure 2.1. Utility maximization of a recreation trip can be expressed as (Freeman 1993, p. 445):

2.5 $$max\ U = U(x_n, r, q)$$

where

x_n = vector of market goods

r = annual recreation trips

q = environmental quality index of site *j* constant for all *i* consumers

subject to a budget constraint

2.6 $$m = p_n x_n + p_r r$$

and a time constraint

2.7 $$t^* = t_w + (t_1 + t_2) r$$

where

m = income

p_n = vector of prices for market goods

p_r = vector of prices for annual recreation trips

t^* = total discretionary time

t_w = work hours

t_1 = round trip travel time

t_2 = onsite time

Equation 2.7 shows the opportunity cost of time invested in recreation use. The opportunity cost of time includes total travel time and total time spent onsite. Since users invest time and money to use the recreation site, a simple aggregation of expenses does not accurately represent the true costs of site use (Randall 1981, p.301). The full price of a visit consists of the access fee, the monetary cost of travel, the time cost of travel, and the opportunity cost of time (Freeman 1993 p. 446):

2.8 $$p_r = f + p_d * d + p_w(t_1 + t_2)$$

where

f = access fee

p_d = monetary cost of travel

d = round trip distance

p_w = wage rate

The individual demand function for a recreational trip constrained by income and time is:

2.9 $$X_r = X(p_n, p_r, m, t^*, q, h)$$

Outdoor recreation sites have at least two important characteristics that are of economic importance. First, outdoor recreation confers economic value through site characteristics and secondly, site access is often a nonmarket good (Freeman 1993 p.443). To measure the value of a recreation site, a method for approximating the cost of site access is needed. The research reported in this thesis uses the Travel Cost Method (TCM) to approximate the costs of using a natural recreation site.

Howard Hotelling first conceptualized TCM in the 1940's, theorizing that the value of outdoor recreation could be inferred by the cost of travel and the purchases made while onsite (Randall 1981, p.300). Clawson and Knetsch first implemented TCM in the 1960's. TCM theory implies a tradeoff between travel cost and site access. Travel cost varies among users and sites, creating the variation necessary to estimate the demand for recreation trips (Freeman 1993 p.444). The variation in trip costs and the weak complimentary relationship between travel cost and site access allows for estimation of an ordinary demand curve for recreation use (Karasin

2004). Weak complimentarity implies that a relationship exists between a market and nonmarket good such that, when demand for the market good is zero the marginal utility of the nonmarket good is also zero (Freeman 1993, p.105). The complimentary relationship between travel cost and site access creates a condition where travel consumer surplus and resource consumer surplus are equivalent (Hof 1993, p.53).

TCM allows for the construction of an ordinary demand curve where trips demanded are a function of individual travel costs and other relevant variables. If an ordinary demand curve can be estimated, then the value of site access can be measured. The measure of this value is net willingness to pay (WTP), or consumer surplus. Ordinary consumer surplus is estimated by integrating the ordinary demand curve from the average travel cost to the choke price (Freeman 1993, p.445).

The TCM operates on six assumptions (Freeman 1993, p.447):

1. Individuals will respond to changes in travel costs in the way they would respond to a change in the access fee.

2. Each trip to the site is for the primary purpose site use.

3. All visits entail the same amount of time onsite.

4. There is no utility/disutility derived from time spent traveling to the site.

5. The wage rate represents the opportunity cost of time.

6. There are no alternative recreation sites available.

TCM is not a perfect technique and there remain unresolved questions in the literature about dealing with these assumptions. One concern is how to deal with multiple purpose trips. A trip taken for the purpose of visiting more than one site results in joint costs. These joint costs make it difficult to determine how much value each individual site confers (Freeman 1993, p.447). There are also unresolved questions surrounding travel to the site. It is assumed that no utility or disutility is derived from travel to the site. When there is utility or disutility from travel to the site this assumption does not hold (Randall 1981, p.301).

Another important decision when applying a travel cost model is how to measure the value of time. To account for the opportunity cost of time, it is standard practice to use a fraction of the wage rate. Application of a fraction of the wage rate to represent the opportunity cost of time varies throughout the literature. Some researchers use varying wage rates to get a range of estimates (Zawacki, Marsinko, and Bowker 2000). Other studies have used 1/3 the wage rate as standard practice (Cesario 1976).

Dealing with the issue of substitute sites remains unresolved in the travel cost literature. The simple travel cost model assumes there are no other recreation sites available. However, research has shown that failure to include relevant substitute sites in the demand equation results in biased consumer surplus estimates (Freeman 1993, p.454). There is no consensus on the treatment of substitute sites in the travel cost literature.

Consumer Surplus and Economic Value

Economic activity increases the well being of individuals in a society, and individuals are their own best judge of how well off they are (Freeman 1993, p6). Economists express well-being as utility. Individuals choose the consumption bundle that maximizes utility, subject to their budget constraint. The choice of a utility maximizing consumption bundle exhibits the properties of nonsatiation and substitutability. The property of substitutability is fundamental to the concept of value. Substitutability allows for trade ratios between goods, revealing the value a consumer has for goods traded between people or markets. This value is measured by net WTP. WTP represents the maximum sum of money an individual would be willing to pay rather than do without a good (Freeman 1993, p.43). Figure 2.2 shows gross WTP as the area under the individual demand curve.

$$2.10 \qquad \textit{Gross } WTP_i = \int_0^a D_i(X_1, P_1)dx_1 = \text{area a, } x^*, x_a, 0.$$

Consumer surplus represents the net WTP for a good, the area under the demand curve and above the price line (Freeman 1993, p.477). Consumer surplus or net WTP is calculated as gross WTP minus expenditures. This is shown in Figure 2.2 as the area a, x^*, p_a.

$$2.11 \qquad \textit{Net } WTP_i \textit{ (consumer surplus)} = \int_{p_a}^a D_i(X_1, P_1)dX_1 - p_a * x_a = \text{area } a, x^*, p_a.$$

By aggregating individual consumer surplus across consumers, the net social benefit of a good can be estimated (Freeman 1993, p.477). Net social benefit is used in benefit-cost analysis to determine the most efficient use of scarce resources. This efficiency criterion derives from the Pareto optimal solution.

A Pareto optimal solution is a solution where no other allocation can make someone better off without making someone else worse off. It is difficult to find a solution that fits the Pareto optimal criterion. As a second best alternative, an allocation that represents a potential Pareto improvement is often sought. A potential Pareto improvement exists when the “winner” of a policy change could compensate the “loser” and still be as well as before (Loomis 1993, p.119-121).

The individual demand curve in Figure 2.2 measures ordinary consumer surplus. Ordinary consumer surplus measures are quantifiable surplus measures based on a constant marginal utility of income (Freeman 1993, p.46). Measurements of welfare change must be theoretically appropriate and empirically observable (Bergstrom 1990). While ordinary consumer surplus measures are easily observed, they are not theoretically exact. Exact welfare changes are measured using Hicksian or compensated consumer surplus measures. Compensated demand functions show consumption at varying prices with income adjusted to keep utility constant (Freeman 1993, p.45).

There four types of Hicksian welfare measures: compensating variation (CV), equivalent variation (EV), compensating surplus (CS), and equivalent surplus (ES). These measures are preferred to ordinary surplus measures because they uphold the ordinal rankings of utility functions. The true measure of consumer surplus is the area under the Hicksian or compensated demand curve and above the price line. Despite potential inaccuracies, it has been standard practice to use ordinary surplus measures as a proxy for compensated surplus measures. Much of the literature estimating recreation demand uses ordinary consumer surplus measures as a proxy for compensated consumer surplus measures. Betz, Bergstrom, and Bowker (2003) used the ordinary demand curve to estimate demand for a proposed rail-trail in Northeast Georgia. Fix and Loomis (1997) used ordinary consumer surplus to estimate the economic benefits of mountain biking at Moab. Siderelis and Moore (1995) also used ordinary consumer surplus to determine the net economic benefits of The Lafayette/Moraga, The Heritage Trail and The St. Marks Trail.

Willig (1976) defended the practice of using ordinary surplus measures as a proxy for compensated surplus measures. Willig showed that when expenditures represent a small portion of total income using ordinary consumer surplus as a proxy for compensated surplus led to small approximation errors (Willig 1976). When recreation expenditures represent a fraction of consumer income and the change in travel cost is small, using Marshallian surplus measures to approximate Hicksian surplus measures are justified based on Willig’s findings (Freeman 1993 p.61). When compared to expenditures made for rent, food, insurance, transportation, vacation, and tuition expenses, trips to many types of recreation resources represent a fraction of consumer income. There are some forms of outdoor recreation where Willig's approximations may not hold. Examples include big game hunting or fishing trips, mountaineering, and motor sports. These are recreation activities that require significant expenditures and time to enjoy and using ordinary consumer surplus estimates, as a proxy for compensated consumer surplus may be inappropriate.

Economic Impact Analysis

This section examines visitor expenditures and the impact on the local economy. Nonlocal expenditures are defined as the area, 0, p_a, X^*, x_a in Figure 2.2. One of the objectives of this thesis is to estimate the economic impact to Washington and Grayson counties of nonlocal trips to the VCT. Nonlocal expenditures related to recreation use impact the local economy in the form of increased output, income, and jobs. These increases are quantified by performing economic impact analysis. Economic impact analysis estimates the changes in regional economic activity that result from some action, measured as changes in visitor spending, regional income, and/or employment (Stynes 2004). There are three components necessary to perform impact analysis:

1. Obtain an accurate number of users and user types.
2. Estimate average spending per person per trip for each user type.
3. Determine the regional multipliers.

Impact analysis can be performed as ex ante or ex post analysis. Ex ante is used when trying to determine impacts from proposed or hypothetical changes and ex post analysis is used for projects that currently exist. In ex post analysis impacts are measured as changes in economic activity resulting from the loss of visitors to the area. This method is frequently used when estimating the impacts of recreation visitors and the impacts they have on the local economy. In ex post impact analysis it is assumed that visits and expenditures related to recreation would be lost to the local economy as a result of site closure. If there are other recreation opportunities within the region that could absorb visitors lost as a result of site closure, this assumption may not hold. Common mistakes made when performing an impact analysis include (Stynes 2004):

1. Confusing economic impacts with benefits to users
2. Not clearly defining the action for which impacts are desired
3. Not defining an appropriate impact region and separating "new" dollars from outside the area from local spending
4. Using an inappropriate economic impact model or multipliers
5. Mismatch between spending and visit information
6. Not margining goods that are purchased or otherwise accounting for spending that is captured by the local region
7. Not isolating tourist spending from local spending

Total economic impact is a combination of direct spending and secondary effects. Direct spending is the total amount spent by nonlocal visitors in the local economy. The equation for the direct effect of tourist spending is (Stynes 2004):

2.12 *Total Expenditures = Number of Visitors*Average Visitor Expenditure*

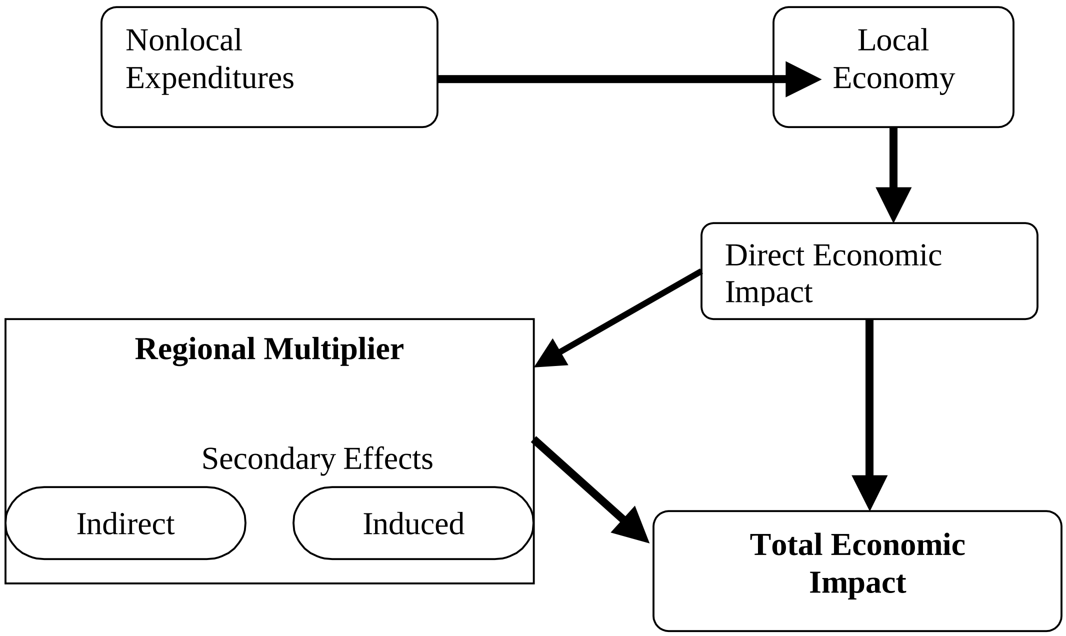
These expenditures represent the direct economic effect the recreation site has on the local region. To estimate the total economic impact of visitor spending, a regional economic impact model is employed. This model produces regional multipliers that estimate the secondary effects of nonlocal expenditures.

Multipliers

The direct impact of visitor expenditure creates a “ripple” effect within the local economy. Initial nonlocal expenditures stimulate local industries and businesses that supply the recreation and tourism sectors. This stimulation provides income to employers and employees that can be spent within the region.   These effects related to visitor expenditures are termed secondary effects. Secondary effects are made up of indirect and induced effects. Indirect effects are changes in sales, income, or jobs to suppliers of the recreation and tourism sectors within the region. Induced effects are increased regional sales that result from income earned in recreation or supply sectors (Stynes 2004). These effects are captured through the use of multipliers. Multipliers measure how much stimulus a dollars of spending creates within the economy. For example, if a sales multiplier equals 1.33, every dollar a recreation visitor spends creates $.33 of indirect and induced effects in the local economy. A multiplier expresses secondary effects as a ratio of total to direct effects. Multipliers are measured for sales, income, and employment (Stynes 2004). Figure 2.3 shows the flow of visitor expenditures through the local economy.

When using multipliers to estimate total economic impact, leakage must be accounted for before applying multipliers to direct effects. Leakage is the portion of sales that leaves the local economy to pay for goods and services not produced in the area. This leakage must be accounted for in order to get an accurate estimate of regional impacts. Only those dollars captured by the local economy should be used to determine total economic impact. The dollars attributed to a local economy from visitor spending is determined by the capture rate. The capture rate is the

Figure 2.3 - The Flow of Visitor Expenditures to Economic Impacts



ratio of direct sales to total spending. The rate at which these affects are captured depends on the amount of money staying in the local economy as final demand. The dollars that are spent to cover the costs of outside production and transportation immediately leave the economy as leakage and cannot be considered when determining the total economic impact. Direct effects are the product of total expenditures and the capture rate (Stynes 2004).

*2.13 Direct Effects = Total Expenditures * Capture Rate*

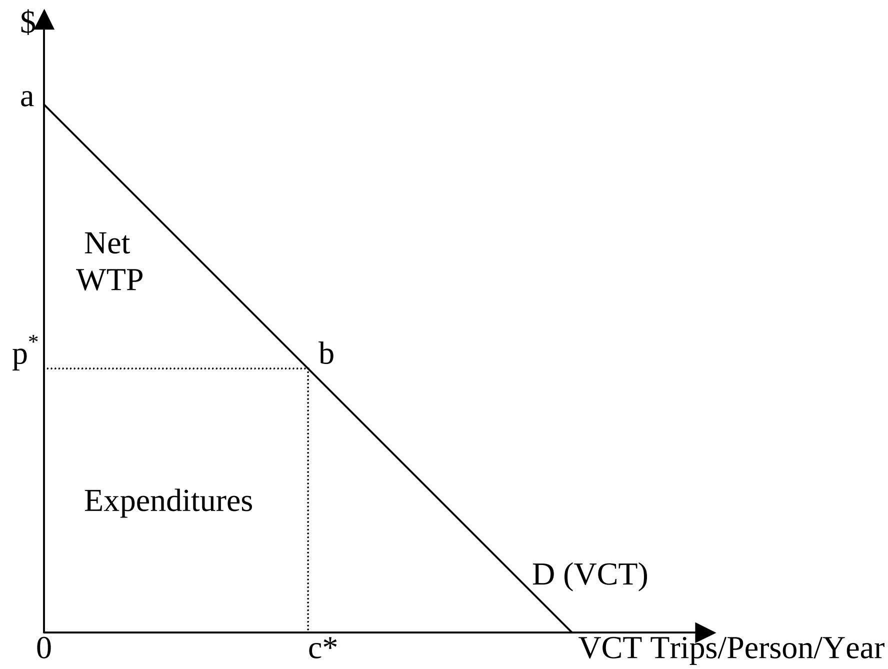
These direct effects are combined with multipliers to estimate total economic impact of visitor expenditures (Stynes 2004):

*2.14 Total Economic Impact = Direct Effects * Regional Multipliers*

Application of Value Measurements to VCT

In this chapter, the value concept of net WTP or consumer surplus and actual expenditures have been defined and discussed theoretically. In the case of the VCT, these concepts are summarized in Figure 2.4. The empirical study described in the next chapter was designed to measure average net WTP or consumer surplus of trips to the VCT. This average WTP is illustrated in Figure 2.4 by area a, b, p* divided by average trips (c^*) taken at the average cost or price of a trip (p*). Average net WTP can then be multiplied by total trips to estimate aggregate net WTP or aggregate net benefits of VCT trips. The empirical study was also designed to measure average expenditures per VCT trip, illustrated in Figure 2.4 by p^{*}* c^{*}(area p*, b, c*, 0) divided by average trips (c*). Average expenditures per trip can then be multiplied by total trips to estimate total recreation expenditures. We can then combine the estimate of total recreation analysis with an economic impact analysis model or technique to estimate the total economic impacts of VCT recreational expenditures on the local region and economy surrounding the VCT.

Figure 2.4 – Net WTP and Expenditures from Annual Per Person VCT Trips



Chapter III

EMPIRICAL METHODOLOGY

To estimate the demand, value and impacts of VCT trips a survey instrument is needed to collect the required information. The first section of this chapter discusses the development and background of this research project. Included in this section are the goals of the overall research initiative and the collaborators involved. The next section describes the design, implementation, collection, entry, and storage of the survey instrument used to estimate net economic benefit and economic impacts of VCT trips.

Next, the Individual Travel Cost Model used to estimate demand for trips to the VCT is discussed. Included in this section are advantages and disadvantages of using the ITCM. The dependent variable and independent variables used in the ITCM are presented. The variables specified for this model are discussed based on economic theory, and previous trail related research. The model's functional form is presented in the next section. This section discusses the advantages of using count data models for estimating demand from on site surveys. This section also presents examples of previous research using count data models to estimate demand.

The last section of this chapter focuses on the estimation of economic impacts of VCT trips. This section presents the expenditure profiles used to determine per person expenditures made by nonlocals in the impact region. The regional multipliers used to estimate the total economic impact of VCT trips are also discussed.

Survey Methodology

Background

The estimation of net economic benefits and economic impacts of trips to the VCT is part of a larger project to determine the economic impacts and benefits of trails in the state of Virginia. The major contributors to this project include; The Virginia Department of Conservation and Recreation, The Northern Virginia Regional Park Authority, The National Park Service, The Virginia Trails Association, The U.S. Forest Service and The Virginia Department of Forestry and The University of Georgia, Department of Agricultural and Applied Economics. The initial idea was to survey users of all the major trails in Virginia. However, it was quickly realized that surveying use at every trail in Virginia would be logistically and financially impossible to complete. To compromise, four representative trails were chosen and surveys were developed to determine the economic impacts and benefits of each trail. The representative trails included; The Virginia Creeper Trail, The New River Blueway (NRB), The Washington and Old Dominion Trail (W&OD), and The Roanoke Valley Greenway System. The four trails chosen represent four different trail types. The Virginia Creeper Trail is a rural destination rail trail. The New River Blueway is a water trail. The Washington and Old Dominion Trail is urban/suburban multi use trail and The Roanoke Valley Greenway System is a local system of interconnected trails. The first trail surveyed in this research project was the VCT. Surveying along the NRB and W&OD began a few months later.

Survey Instrument Design

The data collected for this study consisted of trail exit counts and trail user surveys. Trail counts were obtained using a stratified random sampling approach (Cochran 1977). This is similar to the methodology used by the USDA Forest Service to estimate visitation in national forests (English, Kocis, Zarnoch, Arnold 2002). An expert panel of locals and nonlocals familiar with the trail and trail users identified strata. These experts included people from the recreation retail trade, USDA Forest Service personnel, National Park Service, Virginia Department of Conservation and Recreation, Virginia Trails, and Virginia Creeper Club members (Bowker 2004).

Three strata were identified season, exit type and day type. Sampling took place in two seasons. The winter season took place from November through April and the summer season took place from May through October. High use exits sites and low use exit sites were identified. The high use exits were Abingdon and Damascus, and the low use exits sites included Whitetop Station, Green Cove, Creek Junction, Taylor's Valley, Straight Branch, Alvarado, and Watagua (Bowker 2004). The third stratum was identified as day type. Sample days were divided into three day types Saturdays, Sundays/Fridays/Holidays, and non-holiday weekdays. In the winter season, sampling was done over the complete day. In the summer, days were segmented into mornings, afternoon, and evening. This was done because of the increase in daylight hours (Bowker 2004). The winter season contained 1629 total cells in 6 site-day combinations. With time of day included, the summer season contained 4968 total cells in 6 site-day combinations (Bowker 2004).

Winter Sampling

Winter sampling took place from November 1, 2002 through April 30, 2003. A total of 40 sample days were allocated across the 6 site-day combinations. There were 15 Saturdays, 15 Sunday/Friday/Holidays, and 10 Weekdays selected (Bowker 2004). The sampling dates for each day type were randomly selected. On a sampling day, trained interviewers were assigned to both high exit sites and to two randomly chosen low exit sites. Interviewers failed to show on the selected sampling days about 50 percent of the time (Bowker 2004).

A total of 77 site-day combinations were sampled in the winter season. This represents about 5 percent of the 1629 cells. Coverage for the high exit sites on Saturdays and Sunday/Friday/Holidays was nearly 25 percent (Bowker 2004). Based on the expert panel's ex ante estimate of use, Saturdays and Sunday/Friday/Holidays accounted for more than 80 percent of total use in the winter season (Bowker 2004). To account for some of the missing days at Damascus, a proxy count procedure was used. Counts for missing days in Damascus were based on shuttles sold by one of the local bicycle outfitters and a factor accounting for the outfitter's approximate market share (Bowker 2004).

In addition to the exit counts, interviewers administered a survey to individuals exiting the trail. First, a screener survey (Appendix A - Screener) was used to determine if the trail users were local (living or working in Washington or Grayson counties) or nonlocal. Other information the Screener sought included, race, group size, gender, activity mode, and approximate age. Individuals were also asked if they would be willing to fill out the detailed survey.

The detailed survey consisted of a local version and two nonlocal versions (Appendix A – Local, Nonlocal A, Nonlocal B). These surveys were designed to obtain the information needed to estimate net economic value and economic impacts of the VCT (Bowker 2004). All survey versions included sections about current trip profile, annual use profile, and household demographics. The Local and Nonlocal A versions contained questions about personal benefits from trail use, as well as attitude and preference questions about trail issues, area amenities, trail maintenance, fees, and acceptable use. The Nonlocal B version contained components for trip related expenditures in the local area and for the entire recreation trip (Bowker 2004).

A pre-test of the survey instrument was done, among the study collaborators, Creeper Club members, and trail users on Friday and Saturday, September 20-21, 2002. Based on feedback from this pre-test, the nonlocal survey was broken into two versions in order to keep survey time to a minimum.

Summer Sampling

Summer sampling followed the same procedure as the winter sampling. Summer sampling took place from May 1, 2003 through October 31, 2003. A total of 45 sample days were allocated across the 6 strata. There were 15 Saturdays, 15 Sunday/Friday/Holidays, and 15 Weekdays (Bowker 2004). On a sampling day, trained interviewers were assigned to both high exit sites and to two randomly chosen low exit sites. The only change from the winter season to the summer season was the survey periods were divided into three segments, morning, afternoon, evening (Bowker 2004). These survey periods were randomly selected for each site and day combination. In the summer season, incidence of interviewers failing to show on the selected sampling days fell to around 30 percent of the time (Bowker 2004). A total of 107 site-day combinations were sampled in the summer season. This represents about 2 percent of the 4968 cells.

Coverage for the high-exit sites on Saturdays and Sunday/Friday/Holidays was approximately 10 percent. Similar to winter, some of the missing days at Damascus was filled using a proxy count procedure based on shuttle sales and estimated market share. The survey was administered in the same manner as in the winter season. However, to increase the precision of expenditure estimates for the economic impact portion of the study, the ratio of Nonlocal B to Nonlocal A surveys distributed was increased (Bowker 2004).

Individual Travel Cost Method

The Individual Travel Cost Model (ITCM) was chosen as the method for estimating net economic benefits. ITCM estimates individual demand for a recreation site based on individual travel costs, socioeconomic characteristics, and tastes and preferences. The choice of ITCM was based on the type of data obtained from the VCT survey, previous trail related literature, and the merits of ITCM. ITCM has been shown to provide: 1) statistical efficiency in estimation, 2) theoretical consistency in modeling individual behavior, 3) avoidance of arbitrary zone definitions, and 4) increased heterogeneity among zonal populations (Bowker and Leeworthy 1998).

There is a precedence of using ITCM in trail literature estimating net economic benefits. Englin and Shonkwiler (1995) employed ITCM to estimate long run demand for hiking trails in the Pacific Northwest. Siderelis and Moore (1995) used ITCM to estimate the net benefits of the Heritage Trail, the St. Marks Historic Railroad Trail, and the Lafayette/Moraga Trail. Fix and Loomis (1997) used an ITCM to estimate the economic benefits of mountain biking in Moab, Utah and again in (1998) to compare WTP estimates of mountain biking at Moab using stated and revealed preference techniques. Betz, Bergstrom, and Bowker (2003) used a variant of the ITCM to measure demand of a proposed rail trail in Northeast Georgia.

ITCM requires a well-developed survey questionnaire specifically designed to get individual trip, travel time and distance information. ITCM also requires a significant investment in time and energy related to surveying, data entry and analysis. However, this was not seen as a limiting problem due to adequate funding, expertise in survey development, a strong well-coordinated volunteer base, and adequate time for data entry and analysis.

Variable Selection

In order to estimate the net economic benefit of a VCT trip, the appropriate variables must be specified. Variable specification should be based on economic theory and the previous literature related to recreation trips using similar modeling techniques. Chapter 2 shows that ITCM allows for the estimation of an ordinary demand curve where trips demanded are a function of individual travel costs, substitute prices, income, socioeconomic characteristics, and tastes and preferences. Following the theory of welfare economics, if an ordinary demand curve can be estimated, then the value of the site in question can be measured, due to the weak complimentarity relationship between travel cost and site access. This implies travel consumer surplus and resource consumer surplus are equivalent, thus allowing for the measurement of individual consumer surplus for a trip to the VCT. This individual consumer surplus can be aggregated across users to determine the net economic benefit of the VCT.

Dependent Variable

The dependent variable for the ITCM is the annual number of trips taken to the VCT (TRIPS). The trail literature is fairly consistent in the way this variable is defined. Betz, Bergstrom, and Bowker (2003) used average number of annual intended trips to a proposed rail trail in their trips response model. Fix and Loomis (1997) used annual number of trips to Moab, minus one, as their trips variable. This was the same variable used in Fix and Loomis (1998). Siderelis and Moore (1995) used annual number of visits to the Heritage Trail, St. Marks Trail, and Lafayette/Moraga Trail in their travel cost model.

The annual trips question filled out by VCT survey respondents appeared in the VCT survey as:

[a]Counting this visit, how many times have you visited the Creeper in the past 30 days?
A. 1   B. 2 – 5   C. 6-10   D. 11- 15   E. 16-25   F. 26-35   G. 36-45
H. More than 45

[b]Including this visit, how often have you visited this area to use the Creeper in the last 12 months? ________ times?

[a] The dependent variable question as it appeared in the local survey.

[b] The dependent variable question as it appeared in the nonlocal surveys.

Locals were asked to report trip behavior on a monthly basis and in categorical form rather than report a single number. This was done because they were thought to take trips with greater frequency than nonlocals. Nonlocals were simply asked to report annual number of trips taken to the VCT.

Since locals were asked about VCT trip behavior on a monthly basis, their responses needed to be converted to an annual estimate. The first step was to determine the average number of monthly trips taken by local users. To do this the mid-point for each trip category was determined; this midpoint was then multiplied by the frequency of trips taken for each category. These numbers were summed and divided by the total number of people answering the local trip question to estimate the average number of monthly trips. A significance test was used to determine whether or not there was a statistical difference between the mean number of local trips in the winter and summer seasons.

To determine if there was a significant difference between monthly trips in the winter and summer sampling seasons, a t-test was used. A t-test is a procedure where sample results are used to verify the truth of a null hypothesis (Gujarati 1988, p.109). In this case, the null hypothesis being tested is that there is no statistical difference in the monthly number of local trips taken in the winter and summer seasons.

Using the confidence interval associated with the t-statistic, the probability that the t-statistic lies within the given confidence interval can be estimated for a given significance level. The t-statistic is the value that comes from the data being tested. This confidence interval takes the form 100(1-α), where α is the significance level. This confidence interval is termed the "region of acceptance" of the null hypothesis. The endpoints of the confidence interval, the critical value, establish the "region of rejection" of the null hypothesis (Gujarati 1988, p.109). The critical value is determined by looking in a t-table. The critical value is based on the chosen confidence level and the data's degrees of freedom. A t-statistic that lies outside the "region of acceptance" is said to be statistically significant.

The t-test performed in this thesis was a two-tailed t-test. In a two-tailed t-test, the two extreme tails of the probability distribution are considered. In this type of test the null hypothesis is rejected if the t-statistic lies within either tail (Gujarati 1988, p.111). A two-tailed test was used because there was no a priori expectation that monthly trips in the two sampling seasons would change in a specific way. That is there was no expectation that more trips would be taken in the summer or that less trips would be taken in the winter. A one-tailed t-test would have been used if there were prior evidence or theoretical expectations that monthly trips would have changed in a specific way between sampling seasons.

The t-test takes the form (Trochim 2002):

3.1
$$t = \frac{\overline{X_w} - \overline{X_s}}{\sqrt{\dfrac{\mathrm{var}_w}{n_w} + \dfrac{\mathrm{var}_s}{n_s}}} \langle \hat{t}$$

where

t = the t-statistic

$\overline{X}_w$ = mean number of local winter trips

$\overline{X}_s$ = mean number of local summer trips

var_w = variance of local winter trips

var_s = variance of local summer trips

n_w = number of respondents to winter trips question

n_s = number of respondents to summer trips question

$\hat{t}$ = the critical value, 1.96 at the 95% significance level

The t-test showed no statistical difference in the mean number of trips between the winter and summer season at the 95% significance level. The t statistic was –1.52 and the critical value was –1.96. Based on this result, we fail to reject the null hypothesis. This suggest that there is no significant difference between monthly trips made by locals in the winter and summer seasons.

The results of the significance test can be found in Appendix D. The final step in determining the average number of local trips to the VCT was to adjust the number of monthly trips reported to an annual estimate. This simply involved multiplying the averages for each response category by twelve.

There was not much information in the literature regarding the conversion of trips from a monthly basis to an annual basis. Siderelis and Moore (1995) did not mention how they asked respondents about annual visits to the three rail-trails in their study. In Fix and Loomis (1997) there was no mention of the format in which they asked about annual trips to Moab, however based on Moab's location and its reputation as a major biking destination most users were considered nonlocals. Betz, Bergstrom and Bowker (2003) provided a copy of their trips question. In their study of intended trips to a rail trail in Northeast Georgia, the annual trips question was similar to the trips question asked of nonlocal users in the VCT survey.

Independent Variables

Price

Due to nonrival and/or nonexclusive characteristics outdoor recreation on public land is not traded in the marketplace. There is no traditional market for outdoor recreation and the user fees for many recreation resources are nominal or zero. Therefore, to estimate an ordinary demand curve a proxy for price must be developed. The price variable consists of the full price of a recreation trip made up of the admission fee, the out of pocket cost of travel to the site, the time costs of travel to the site, and the cost of onsite time (Freeman 1993, p.446).

The literature varies on methods for calculating out of pocket travel costs. Bowker, English, and Donovan (1996) used reported household expenditures divided by group size plus the costs of travel, valued at $.092, in their study of guided white water rafting trips. In Zawacki, Marsinko, and Bowker (2000) two different out of pocket calculations were made in estimating demand for nonconsumptive wildlife recreation in the U.S. The first model used all out of pocket expenditures including food, lodging, transportation costs, and fees. The second model incorporated only out of pocket expenditures for transportation and fees. Fix and Loomis (1997) chose to only include variable travel and onsite costs in their study of economic benefits of mountain biking at Moab. Variable travel costs included gas, lodging, airfare, car rental, and miscellaneous expenses. Onsite costs consisted of lodging, fees, and miscellaneous expenditures. Fix and Loomis felt that food was not a variable expense and as such was not reported, nor were durable good expenditures. A similar approach was used in Fix and Loomis

(1998) to compare WTP from revealed and stated preference models for mountain biking at Moab. Siderelis and Moore (1995) applied a measure of direct transportation cost at $.19 per mile to round trip travel distance to represent out of pocket travel costs in their study of the Heritage, St. Marks, and Lafayette/Moraga Trails. Betz, Bergstrom and Bowker (2003) used a similar method for out of pocket travel cost calculation. In their study of demand for a proposed rail trail in Northeast Georgia, Betz, Bergstrom and Bowker (2003) applied a $.12 per mile transportation cost to round trip travel distance. Siderelis and Moore (1995) and Betz, Bergstrom and Bowker (2003) follow the method used by Englin and Shonkwiler (1995) to calculate recreation demand of hiking trails in the Pacific Northwest.

This thesis follows the logic developed in Englin and Shonkwiler (1995), Siderelis and Moore (1995), and Betz, Bergstrom and Bowker (2003) for calculating out of pocket costs as round trip travel distance and direct transportation costs. There is no agreed upon rate at which transportation costs are measured. Bergstrom, Dorfman, and Loomis (2004) used a value of $.315 per mile when determining recreational fishing benefits in the Lower Atchafalaya River Basin in the Gulf Coast region of Louisiana. This higher transportation cost estimate is justified as the fishermen using this resource were driving larger vehicles and towing boats. Bhat et al. (1998) used a transportation cost of $.0625 when estimating the value of land and water based recreation in varying ecoregions in the U.S.

This thesis uses a transportation cost of $.131 to estimate the out of pocket costs of a recreation trip to the VCT. This cost was reported in the 2003 edition of AAA's *Your Driving Costs*, and represents the average cost for three midsize American vehicles. The average cost represents the average per mile driving cost for the 2003 model year Chevrolet Cavalier LS, Ford Taurus SEL, and the Mercury Grand Marquis LS. This cost includes the cost of gas, oil, maintenance, and tires. The transportation cost used in this thesis is within the range of costs reported by Siderelis and Moore (1995) and Betz, Bergstrom and Bowker (2003) in their respective rail-trail demand studies. The round trip mileage for each respondent was multiplied by $0.131 cents per mile to derive the out of pocket travel cost for each trip. Distance traveled was determined by entering the resident zip code and the zip code of the site where they entered the VCT into the commercial mapping software package PC MILER 15.0. This produced a one-way mileage and travel time estimate. To get the round trip mileage and travel time estimate the one-way estimates were doubled.

It has been shown that the opportunity cost of time is an important part of the cost of a recreation trip. Failure to include travel time results in biased consumer surplus estimates (Forster 1989). Since time costs need to be measured in a manner consistent with out of pocket costs and access fees, a defensible shadow price of time must be used to convert time to a monetary value (Freeman 1993, p.449). One method for valuing the shadow price of time is to value time as a function of travel time and an individual's time value, represented as a fraction of their wage rate (Betz, Bergstrom, and Bowker 2003). Valuing time costs as a function of the wage rate and travel time is seen throughout the literature, although there is no consensus on the appropriate fraction of the wage rate to use. Cesario (1976) valued individual time at one-third the wage rate in his article estimating benefits of recreation at parks in the Northeast. McConnell and Strand (1981) use a value of 1/3 the wage rate to measure economic benefits of sportfishing in the Chesapeake Bay. A time value of 1/3 the wage rate was also used by Bergstrom, Dorfman, and Loomis (2004) to estimate recreational fishing benefits on Louisiana's Gulf Coast.

Siderelis and Moore (1995) used a different approach to value time for trips to the Heritage, St. Marks, and Lafayette/Moraga Trails. Siderelis and Moore (1995) chose to measure forgone income based on wage rates associated with various jobs types. These time costs varied from 34%, 52%, and 58% on the Moraga/Lafayette, St. Marks, and Heritage respectively. While one-third the wage rate is commonly used to value time, other studies have used other wage rates. Bhat et al. (1998) used a time value of one-fourth the wage rate in a study of land and water recreation throughout various ecoregions in the U.S. Some studies have set as a range of time values from 0 to ½ the wage rate. An example of this method of time valuation can be seen in Zawacki, Marsinko, and Bowker (2000). In this study of nonconsumptive wildlife recreation, the time value was measured at zero time costs, one-fourth the wage rate, and one-half the wage rate. This logic is also used in Bowker, English, and Donovan (1996) to value guided white water rafting trips.

While valuing time costs as a function of the wage rate and travel time is used extensively throughout the literature, some researchers have had difficulty using an arbitrary portion of the wage rate to determine the value of time. Questions have been raised about the assumption that individuals freely choose between work and leisure hours based on the wage rate (Freeman 1993, p.450). In many instances employees are unable to substitute between labor and leisure hours due to constraints such as the forty hours standard week.

Another concern in valuing time costs is the possibility of utility or disutility from travel, work, or onsite time. The simple travel cost model assumes there is no utility or disutility from travel to the site, however if this is not the case then a fraction of the wage rate may be inappropriate as the shadow price of time (Freeman 1993, p.451). For these reasons Bowker and Leeworthy (1997) chose to use a binary variable indicating whether or not the individual chose to forego income to take a trip to the Florida Keys.

Other studies treat time as a separate variable. Fix and Loomis (1997) chose to include time as a separate variable in their study of mountain biking trips to Moab. Fix and Loomis (1997) chose this method due to the variation in travel time and distance seen in the individual data used for their study. In the study on demand for a proposed rail-trail in Northeast Georgia, Betz, Bergstrom and Bowker (2003) excluded travel time because of correlation problems with travel distance.

This thesis uses two variations on time costs. The first values the opportunity cost of time at 1/4 the wage rate. Cesario (1976) reported that nonworking travel time should be valued between one-fourth and one-half the wage rate. The second uses zero opportunity cost of time. In the second model, only out-of-pocket travel costs are included. This zero time cost estimate provides a baseline measure of consumer surplus and provides an indication of the importance of including time costs when estimating benefits of recreation use.

The distance to cost conversion formula is:

3.2 $$TC = \{(TRVLDIST * \$.131) + [(PERWAGE * .25) * PERMILE * TRVLDIST]\}$$

where

TRVLDIST = roundtrip travel distance

PERWAGE = per person wage rate

PERMILE = time per mile traveled

It should be noted that the opportunity cost of onsite time was not included in the model used in this thesis. Siderelis and Moore (1995) state that travel costs are a necessary input to produce a rail trail experience and do not contribute to satisfaction gained from onsite trail time. It is assumed that time on-site is not part of the estimation of user benefits.

Substitutes

Theory suggests that inclusion of a substitute variable is important in correctly estimating the benefits of recreation trips (Loomis and Walsh 1997, p.87-88). The treatment of substitutes varies throughout the literature. Betz, Bergstrom, and Bowker (2003) used travel costs for substitute sites based on the origin of the trip in their estimate of demand for a proposed rail trail in Northeast Georgia. For residents living near metro Atlanta, travel cost for a trip to the Silver Comet Rail Trail was used. For the remaining sample, travel cost for a trip to a rail trail in suburban Augusta was used. Fix and Loomis (1997) used price in miles to substitute sites with characteristics similar to those found at Moab. The first model estimated travel costs to a site with similar weather patterns and the second model estimated travel costs to a site with desert conditions. The names of these substitute locations were not given. Zawacki, Marsinko, and Bowker (2000) used the average cost of a trip from the residence state to another state for wildlife viewing.

There are also situations where researchers choose not to include a substitute variable. Englin and Shonkwiler (1995) chose not to include a substitute variable in their estimation of the long run demand for hiking trails in the Pacific Northwest. In a study of the demand for deer hunting in California, Creel and Loomis (1990) do not use a substitute variable in their TCM. This was done because the hunter was not allowed to hunt in another zone once a permit for their zone of choice was purchased. Siderelis and Moore (1995) also chose not to include a substitute variable in their study of net benefits associated The Lafayette/Moraga, The Heritage Trail and The St. Marks Trail. The rail trails studied in Siderelis and Moore (1995) were in different geographic locations. This resulted in varied substitute availability between the trails studied. The researchers acknowledge the theoretical importance of substitutes. However, Siderelis and

Moore (1995) state their goal was to determine net benefits of rail trails, not trail activities. Therefore, they considered a substitute site to be another rail trail. In the case of the Heritage Trail the nearest rail trail was 170 miles away and for the St. Marks Trail the nearest rail trail was 350 miles away. In addition, the survey did not directly seek information regarding recreation alternatives and the researchers felt that indirect methods for estimating mileage were inadequate.

Bowker and Leeworthy (1998) used a binary variable to define substitute sites in the study of user values associated with trips to the Florida Keys. The binary variable in this study asked whether or not the respondent would travel to an alternative recreation site or participate in an alternative recreation activity. Bowker, English, and Donovan (1996) used a similar approach to define substitute sites in a study of the value for guided whitewater rafting trips. Bowker, English, and Donovan (1996) acknowledge that the choice of a substitute variable remains an arbitrary decision where it is not always clear if the user is substituting for activity or site characteristics.

In this thesis, a binary variable was chosen to represent substitutes for recreation alternatives to the VCT. The VCT surveys asked local and nonlocal respondents whether or not they felt there was a substitute rail trail for the VCT. A question was also included for nonlocals that asked the respondent to give the name of the substitute site and the state where it was located. The question to determine substitute availability filled out by VCT survey respondents appeared in the VCT survey as:

[a]In the past 30 days, how many trips have you made to other rail trails like the CREEPER?
A. None B. 1 C. 2 – 5 D. 5 – 10 E. 10 – 20 F. More than 20

[b]Including this visit, how often have you visited any other rail trails in the last 12 months?
___________ times

[c]Besides the Creeper, what rail trail do you visit most? Name_____________ State________

[a]The substitute rail trail question as it appeared in the local survey.

[b]The substitute rail trail question as it appeared in the nonlocal survey.

[c]The follow up question asking nonlocals the name and state where the substitute rail trail is located.

Eighty-seven percent of the local population felt there was no available substitute rail trail for the VCT. Sixty two percent of the nonlocal population felt they had a viable alternative to the VCT, but less than forty percent of these respondents actually gave the name of that recreation alternative. Since the substitute question was asked in a different manner to locals and nonlocals, the substitute variable needed to be changed for use in the model. In this case, the variables where changed into binary responses. For ease of entry, local responses where entered by recording each letter as a single digit number starting at one. Therefore, locals who reported no trips to other rail trails were changed to zero and locals who reported at least one trip to another rail trail were changed to one. For the nonlocals the respondent indicated the number of times they visited another rail trail. A nonlocal response of zero was not changed. Nonlocal responses greater than zero were changed to one. These changes were incorporated into a single binary substitute variable.

Socioeconomic Characteristics

Socioeconomic variables help to explain the differences in trips demanded by individuals. Important determinants of demand include income, age, education, race, gender, occupation, vacation days, hours worked, and region of residence (Loomis and Walsh 1997, p.87-88). The literature indicates no standard of what should be included in every travel cost model. Englin and Shonkwiler (1995) used household income, age, gender, and education variables to describe hikers on Pacific Northwestern trails. Fix and Loomis (1997) only used an age variable in their study of mountain bikers at Moab. Fix and Loomis (1997) found income and skill level to be insignificant in their model. Zawacki, Marsinko, and Bowker (2000) included socioeconomic variables describing race, urban characteristics, and age. Betz, Bergstrom, and Bowker (2003) used before tax household income and an age variable. Siderelis and Moore (1995) included household income, group size, and two age classification variables, one representing those under the age of 26 and one representing those over the age of 26.

Non-price variables used in this thesis include, income (INCOME), number in household using the VCT (NUM), age (AGE), and gender (MALE). Siderelis and Moore (1995) and Fix and Loomis (1997) found income to be insignificant in determining demand for trail related activity. However, income was included for theoretical reasons. As discussed in Chapter 2, commodity demand is based on own price, substitute prices, income, and socioeconomic characteristics. The amount of household income plays a role in determining the amount of recreation trips in a household's consumption bundle. If income increases, the budget constraint is shifted outward. In this case, if recreation trips are a normal good, trips demanded can be expected to increase.

The number of individuals in a household who use the VCT could have an effect on the number trips demanded. Trips to the VCT are costly in terms of both time and money. If more people in a household use the VCT, then a trip would cost more money. It is expected that larger households would demand fewer trips. It should be noted that household expenditures were not included in the travel cost models.

The number of members in a household using the VCT (NUM) was chosen over other measures of party size. Other party size measures included group size, and spending party size. NUM was chosen over group size because group size does not necessarily represent those individuals that are in your spending party, particularly when the group size is large. This could be the case with Boy Scout troops or when people took shuttles and traveled the trail with other people. Spending party would be a good choice to use in this case. However, spending party size was only asked for people responding to the nonlocal B questionnaire. Inclusion of spending party size would have reduced model size to no more than 437.

Although the trail literature was inconclusive on the use of age as a non-price variable, age was included as a demand determinant for VCT trips. Rail trails have distinct qualities including long distances, low grades, hard surfaces, straight paths, and the prohibition of motorized vehicles (Siderelis and Moore 1995). These are qualities that may be attractive to older outdoor enthusiasts. If rail trails provide qualities that are attractive to older individuals, as users get older demand for VCT trips would be expected to increase.

A gender variable was also included to determine demand for VCT trips. Loomis and Walsh (1997) claim gender can be an important demand determinant. The trail literature does not provide a lot of direction in the inclusion of a gender variable. A variable for gender was not used in Betz, Bergstrom, and Bowker (2003), Siderelis and Moore (1995), or Fix and Loomis (1997). Englin and Shonkwiler (1995) included gender to estimate long run demand of hiking. In Englin and Shonkwiler (1995), if a respondent indicated they were female the likelihood of trips decreased. If a respondent were female it would be expected that the demand for VCT trips is lower than trips demanded by male users.

Tastes and Preferences

Individual tastes and preferences can affect demand for recreation trips. Englin and Shonkwiler (1995) included variables about trail experiences, trail encounters, and a binary variable describing site characteristics when estimating demand for hiking in the Pacific

Northwest. These binary variables included whether or not water was seen on the hike, and if alpine or grass meadows were present. Creel and Loomis (1990) included length of trip, number of years hunting a zone, season length, whether a deer was harvested, and the number of deer that the hunter let walk in the study of deer hunters in California. Bowker, English, and Donovan (1996) included variables describing previous experience, and onsite time for whitewater rafting trips. These variables were significant based on their t statistics. Siderelis and Moore (1995) included a binary variable indicating primary activity. This variable was mixed in sign and significance depending on the trail in question. Betz, Bergstrom, and Bowker (2003) included binary variables describing previous experience on rail trails, previous experience biking, and whether or not the respondent lived in a rural location. Betz, Bergstrom, and Bowker (2003) thought that users might have different tastes and preferences depending on a suburban or rural residence. Betz, Bergstrom, and Bowker (2003) found previous experience on rail trails and biking to be significant and positive in their model. The variable describing residence was positive, but insignificant.

This thesis included binary variables representing primary trail activity (BIKE) and people who make over 30 annual VCT trips (HIGHUSE) as taste and preference variables. The BIKE variable was incorporated to see if biking affected demand for trips. It is not clear whether or not individual's whose primary activity is biking will demand fewer or more trips. HIGHUSE was included in the model to account for those users making more than 30 annual trips to the VCT. These avid users have a preference for VCT trips that may be significantly different from other users. Table 3.1 summarizes the variables used to estimate trips to the VCT. The next section describes the functional form of the model used to determine the demand for trips to the VCT.

Table 3.1 — Definition of Variables Used to Estimate Demand and Value for VCT Trips

Variable Name	Definition
TRIPS	The annual number of trips taken to the VCT
TC	Distance costs and the opportunity cost of time, valued at ¼ the wage rate, for VCT trips.
SUB	Binary variable indicating whether or not the respondent felt there was a viable substitute for the VCT.
INCOME	Annual household income (1000s)
NUM	Number of people living in the household that use the VCT
AGE	Age of respondent
MALE	Binary variable where male=1 and female=0
BIKE	Binary variable for primary activity on the VCT, 1= biking and 0 = other activities
HIGHUSE	Binary variable for more than 30 annual VCT trips, 1= trips >30 and 0= trips < 30

Functional Form of the Model

In the current literature associated with recreation demand studies, researchers have recognized that the dependent variable, i.e., number of annual trips, is a nonnegative integer that follows a discrete distribution, rather than a continuous distribution (Betz, Bergstrom, and Bowker 2003). Based on this finding, the preferred modeling technique has been the use of count data models where the dependent variable is a non-negative number (Blundell, et al. 1995). Recent studies incorporating count data models include Betz, Bergstrom, and Bowker, 2003; Zawacki, Marsinko, and Bowker, 2000; Leeworthy and Bowker, 1997; Fix and Loomis, 1997; Bowker, English, and Donovan, 1996; Englin and Shonkwiler, 1995; Siderelis and Moore, 1995. Along with improved statistical efficiency, count data models can be corrected for truncation and endogenous stratification, common problems associated with on-site recreation surveys (Englin and Shonkwiler 1995 and Betz, Bergstrom, and Bowker 2003).

The data used in this thesis was collected using on stratified random on-site survey. Data collected in this manner commonly suffer from truncation and endogenous stratification. Truncation occurs when the sampled population does not include non-users. Endogenous stratification results due to the higher probability of sampling someone taking frequent trips (Englin and Shonkwiler 1995). Studies have shown that when count data models are corrected for truncation and endogenous stratification, the total use value of a recreation site to the whole user population can be estimated from on-site data (Englin and Shonkwiler 1995).

Two distribution functions are typically used when employing count data models, Poisson and Negative Binomial. A Poisson distribution gives a probability of “the number of event occurrences and the Poisson parameter corresponding to the expected number of occurrences is modeled as a function of the explanatory variables" (Kennedy 1998, p. 236). Estimation using this technique requires maximum likelihood estimation. The probability function of a Poisson random variable (Y) is defined as:

3.3 $$f(Y = y) = \frac{e^{-\lambda}\lambda^{y}}{y!}$$

where

λ = both the conditional mean and variance of Y.

Parameter λ can in turn be parameterized as (Kennedy 1998, p.237):

3.4 $$\lambda = \exp(x\beta)$$

The Poisson model assumes a constant probability of occurrence at any point in time and the variance of the number of occurrences are equal to the expected number of occurrences (Kennedy 1998 p. 237). Stated another way, it is assumed the conditional mean of (Y) equals its conditional variance:

3.5 $$E[y_i \mid x_i] = Var[y_i \mid x_i] = \lambda_i = \exp(\beta x_i)$$

In practice, the assumption of conditional variance equal to conditional mean can prove restrictive because of overdispersion problems. Overdispersion is a form of heteroscedasticity where the dependent variable's conditional variance is greater than the conditional mean, implying a variance-mean ratio greater than unity (Creel and Loomis 1990). One-way to correct for this problem is to introduce an error term (ε) that has a gamma distribution (Kennedy 1998 p. 247). A gamma distribution is used for continuous random variables constrained to be greater or equal to 0, characterized by parameters of shape and scale (University of Florence, Department of Statistics 2004). This allows the conditional mean and variance to differ, leading to a Negative Binomial Distribution. Under the Negative Binomial conditions (Kennedy 1998 p. 248): the

3.6 $$mean = \lambda$$

3.7 $$variance = \lambda + \alpha^{-1}\lambda^{2}$$

where

α = the common parameter of the gamma distribution

Since the negative binomial is an extension of the Poisson distribution it can be expressed similarly to the Poisson in 3.4.

The survey process used in this thesis leads to data that are truncated at zero. To account for this problem a truncated negative binomial was chosen to estimate the quantity of trips demanded to the VCT. Endogenous stratification was not corrected for in the truncated negative binomial models used in this thesis. Recent studies have shown that adjustment for endogenous stratification does not significantly improve welfare estimates Ovaskainen, Mikkola, and Pouta (2001). In their study of recreation trips to Finnish forest recreation sites, Ovaskainen, Mikkola, and Pouta (2001) found that differences in estimated consumer surplus were small between Negative Binomial Models accounting for endogenous stratification and those that did not. (Ovaskainen, Mikkola, and Pouta 2001) estimated consumer surplus when accounting for endogenous stratification to be \$14-14.40 per trip. The estimated consumer surplus when endogenous stratification was not accounted for was \$13.20-13.40 per trip.

The full model of VCT demand is a semi-logarithmic function:

3.8 $$\ln TRIPS_i = \beta_0 + \beta_1 TC + \beta_2 SUB + \beta_3 INCOME + \beta_4 HIGHUSE + \beta_5 AGE + \beta_6 NUM + \beta_7 BIKE + \beta_8 MALE + u_i$$

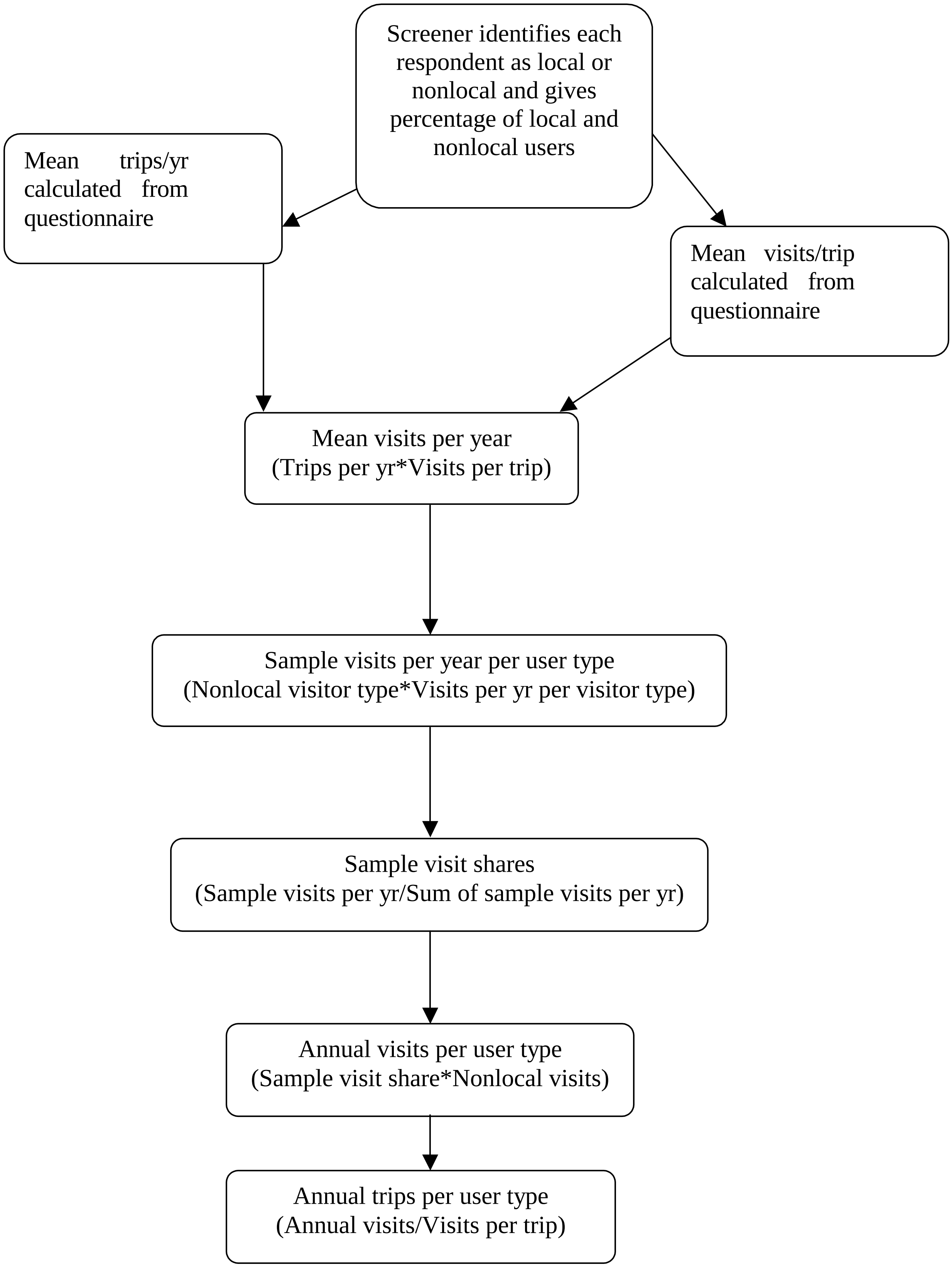
Economic Impacts

In this section the methodology used to estimate the economic impacts of nonlocal trips to the VCT are discussed. The first section offers a discussion of the theory of visitor expenditures. This is followed by the information from the dataset used to determine economic impacts. Following this the model used to determine economic impacts will be discussed. After this an explanation of the conversion of visitors to per person trips used in the impact analysis is discussed. The last section discusses the use of regional multipliers to estimate total economic impacts.

The previous sections of this chapter have examined the dataset and model used to estimate individual consumer surplus for a trip to the VCT. This section focuses on the impact that nonlocal trip expenditures to the VCT have on the local economy. When individuals use a recreation site, the local economy derives benefit from the expenditures made as a result of that trip. These expenditures impact the local economy in the form of increased output sales, income, and jobs (Stynes 2004). These expenditures are represented by the rectangle box in Figure 2, defined as the area $0,p_a,X^*,x_a$. Individual expenditures can be quantified through economic impact analysis. Using economic impact analysis, the total economic impact attributed to recreation use on a local economy can be estimated. An economic impact analysis measures the amount of dollars brought into the economy by individuals that do not reside in the region of impact being studied. There were six steps used to perform the economic impact analysis in this thesis (Stynes 2004): Estimate Use, Estimate nonlocal per person recreation expenditures per major spending categories, Define local impact region, Estimate aggregate recreation expenditures by user type, Estimate direct effects by user type using the capture rate, and Apply multipliers to estimate the total economic impact

Visitor use was estimated based on the stratified random sample, developed by J.M. Bowker, U.S. Forest Service. This sample was described earlier in the chapter. The use estimate based on the stratified random sample gave an estimate of the annual number of visits taken to the VCT. In order to estimate economic impacts this estimate was converted to person trips. Figure 3.1 shows a flow chart describing the conversion of visits to person trips. First, each respondent was classified as local or nonlocal. To determined if a respondent was local or nonlocal, respondents were asked if they lived or worked in Washington or Grayson counties. Based on the answer to the local, nonlocal question, the percentage of local and nonlocal respondents was determined. Next, the mean number of annual trips and mean number of visits per trip per user type was determined. These were questions asked on each survey administered. Mean annual trips and mean visits per trip were multiplied to estimate mean visits per year. Mean visits per year were multiplied by each nonlocal user type to estimate sample visits per year. These nonlocal user types will be discussed in more detail in the next section. The sample visits per nonlocal user type were aggregated to get total sample visits per year. Each sample visit per nonlocal user type was divided by the total sample visits per year to estimate each user type's share of sample visits. The sample visit share for each nonlocal user type was multiplied by annual number of nonlocal visits to estimate annual number of visits per user type. The annual number of nonlocal visits was calculated from the use estimate. Annual visits per nonlocal user type were divided by the mean number of visits per trip per user type to estimate annual trips per user type. The annual trips per user type were aggregated to get annual person trips.

Figure 3.1 – Flow Chart of Nonlocal Annual VCT Visits to Annual VCT Trips



The expenditures of importance in an economic impact analysis are nonlocal expenditures. Nonlocal expenditures represent "new" money being brought into the local economy. Only nonlocal expenditures are used in the impact analysis because the interest is in the impact that "new" money has on the local economy. To estimate nonlocal expenditures, expenditures made by nonlocals in the local economy, based on major expenditure categories were recorded.

Table 3.2 shows the expenditure profile used in the survey instrument. The major expenditure categories included; private lodging, public lodging, food consumed in a restaurant or bar, food consumed outside of a restaurant or bar, primary transportation, other transportation expenditures, bicycle rentals, shuttle or guide service, entry fees, and other expenditures. VCT users were classified by user type. The four user types identified at the VCT were primary day users, nonprimary day users, primary overnight users, and nonprimary overnight users. A primary user is defined as a user who is in the impact region for the primary purpose of visiting the VCT. A nonprimary user is defined as a person in the impact region for another purpose, but chose to spend a portion of time on the VCT.

Based on these nonlocal user classifications, expenditure profiles were developed describing these user classifications in detail. These profiles contained the average per person expenditure made in each of the expenditure categories by each user type. These profiles estimated average expenditures for the entire trip and for expenditures made within twenty-five miles of the VCT. To get per person expenditures each expenditure category was divided by the average spending party size in each user classification. A copy of each expenditure profile is provided in the Appendix B**.**

Table 3.2 - The expenditure profile from the nonlocal B survey of VCT users

	A. Spending by your party within 25 miles of Creeper Trail	B. Spending by your party for the whole trip
Lodging:		
Privately owned (motel, cottage, bed & breakfast)	_______	_______
Publicly owned (state or FS campgrounds)	_______	_______
Food & Beverage:		
Food and drinks consumed at restaurants or bars	_______	_______
Other food and drinks (carry-out, groceries)	_______	_______
Transportation:		
Gasoline, oil, repairs	_______	_______
Other transportation (tolls, airfare, vehicle rental)	_______	_______
Trail Related:		
Bicycle rentals or service	_______	_______
Shuttle or guide service	_______	_______
Trail use, entry, or parking fees	_______	_______
Any other expenses:		
Other services or equipment	_______	_______

It is important to note the treatment of expenditures for nonprimary users. Since these users were not in the local area for the primary purpose of using the VCT, there were two options for treating their spending information. The first option was eliminate these nonprimary users from the impact analysis. The second was to apportion their expenditures based on the ratio of total trail time to total time spent in the area. The second option was chosen and the nonprimary users were incorporated in the impact analysis. These users were kept because, while they were not in the local area primarily to use the VCT they did use the trail and as such some of their expenditures can be attributed to this use.

There are examples of various apportioning strategies found in the literature. English and Bowker (1996) prorated expenditures made on multiple destination whitewater rafting trips by the number of sites visited. Other examples of portioning expenditures in impact studies include Cordell et al. (1990) and Bergstrom et al (1990). Cordell et al. (1990) used portioning to allocate expenditures made by out-of-state visitors to four Southeastern states to recreate at state parks. Cordell et al. (1990) also portioned visitor expenditures to the impact region around the state park visited. Bergstrom et al. (1990) used similar portioning techniques to allocate en route expenditures, impact region expenditures, and equipment expenditures associated with trips for river recreation.

To estimate expenditures attributed to the VCT by nonprimary users, average per person spending per expenditure category were multiplied by the ratio of total trail time to total time spent in the area. For day users the ratio used was on trail time, in minutes, divided by seven hundred and twenty minutes. This represents a 12-hour day. The equation for the portion of expenditures attributed to the trail for nonprimary day users is:

3.9 $$VCTPER = [(TIMESP * CRUSE) / TOTIME]$$

where

VCTPER = percentage of expenditures attributed to the VCT

TIMESP = on trail time in minutes

CRUSE = number of visits to the VCT in a trip

TOTIME = total time in the area, 720 minutes for day users

For overnight users the same equation was applied. However, TOTIME was the number of nights spent in the impact region times twelve hours times sixty minutes:

3.10 $$TOTIME = NIGHTC * 12 * 60$$

where

NIGHTC = the number of nights spent in the impact region

Nonprimary overnight respondents stating they stayed more than fourteen nights in the impact region were rejected from the sample. Respondents staying in the local area more than fourteen nights were greater than the 99th percentile of total responses. Equation 3.9 was multiplied by each expenditure category to get the per category expenditures attributed to the VCT for nonprimary day users and nonprimary overnight users. These expenditures were divided by the spending party size to reach per person expenditures.

Step three in performing the impact analysis was to determine the impact region. The impact region was defined as Washington and Grayson counties. Within this impact region are the towns of Abingdon and Damascus. Abingdon is one of the two trailheads and Damascus is the midpoint of the VCT. Step four in the impact analysis was to estimate aggregate recreation expenditures. To estimate aggregate recreation expenditures Equation 2.12 from Chapter 2 was employed. The average expenditures from each user type were multiplied by the number of person trips per user type. These estimates were aggregated to estimate aggregate recreation expenditures. These aggregate recreation expenditures were multiplied by the capture rate for each user type to determine the direct effects of recreation expenditures. Capture rates are explained in Chapter 2.

The final step used in this thesis to estimate the economic impacts was to multiply estimated direct effects of VCT related expenditures by regional multipliers. Multipliers capture the indirect impacts nonlocal expenditures have on the economy. Multipliers measure how much stimulus a dollars worth of spending creates within the economy. This stimulus can be classified as indirect and induced effects. Indirect effects consider the changes in sales, income, and jobs of the sectors that provide goods to the trail and tourism sectors. Induced effects are measured as increased sales in the economy due to increases in the income of those in the trail, tourism, and support sectors (Stynes 2004).

Once leakages have been accounted for, the direct and indirect impacts for each user classification can be multiplied by the total trips taken by each classification to estimate the total economic impact. These total impacts per user classification can then be aggregated to estimate total economic impact of trips to the VCT, shown in equation 2.14 in Chapter 2. This is also shown graphically in Figure 2.4. In the next chapter the results of the travel cost model and the economic impact analysis will be reported. This chapter also includes the net economic benefits of trips to the VCT, and total economic impact of expenditures made on VCT trips.

Chapter IV

RESULTS

This chapter discusses the results of the sampling procedure and the economic models used in this thesis. The first section presents the results of the winter and summer sampling seasons. Included are the results of the surveying and total use estimates for each season. The totals are then reported for both surveying and use estimates.

Next, the results of the travel cost model are presented. Included are descriptive statistics of the whole sample as well as statistics for the travel cost sample. The variables used in the ITCM are discussed followed by the results of the truncated negative binomial model. Also, included in this section are estimates of per person consumer surplus from the two ITCM models used. This is followed by a presentation of the estimated aggregate net economic value of the VCT. The chapter concludes with a presentation of the results from the economic impact model.

Sampling Results

Winter Counts

Seventy-seven site-day combinations, randomly selected, were sampled for trail use in the winter season across the 6 site-day combinations. These strata consisted of high and low exit Saturdays, high and low exit Sunday/Friday/Holidays, and high and low exit weekdays (Bowker 2004). Based on the seventy-seven site-day combinations, winter visitation for the entire trail is estimated to be 23,614.1 with a 95% confidence interval for mean visitation ranging from 20,628.8 to 26,599.3 (Bowker 2004).

Estimates of winter visitation by day-type and exit-type are reported in Table 4.1. The high exit sites, Abingdon and Damascus, account for about two-thirds of winter visitation and weekends and holidays account for about 70% of winter use. Saturday use is highest among the day-types.

In addition to the exit counts, exiting users completed a total of 681 screener surveys. Of these 681 screeners, 416 detailed surveys were completed. Locals completed 250 detailed surveys and nonlocals completed 166 detailed surveys. These returns translate to a 61% response rate.

Table 4.1. Winter visitation, by stratum, of VCT users

	Saturday	Sun/Fri/Holiday	Weekday	Season Totals
Low Exit	1,747.2	4,860.0	1,884.2	8,491.4
High Exit	3,904.7	5,784.0	5,434.0	15,122.7
Season Totals	5,651.9	10,644.0	7,318.2	23,614.1
Day-type Average	217.4	177.4	77.0	

Summer Counts

One hundred and seven site-day combinations, randomly selected, were sampled for trail use in the summer season across the 6 site-day combinations. In the summer season sampling occurred during a randomly drawn 4-hour time period on any randomly selected site-day combination (Bowker 2004). These four-hour periods were divided into morning, afternoon, and evening periods. Based on the one hundred and seven day-site combinations summer visitation for the entire trail is estimated to be 106,558.2 with a 95% confidence interval for mean summer visitation ranging from 99,276.0 to 113,840.4 (Bowker 2004). Estimates of summer visitation by day-type and exit-type are reported in Table 4.2. Summer day-type averages follow a pattern similar to the winter although, use was higher across all day types and visitation for each day type exceeded estimated use for the winter season.

Table 4.2. Summer visitation, by stratum, of VCT users

	Saturday	Sun/Fri/Holiday	Weekday	Season Totals
Low Exit	11,866.4	8,820.0	7,282.8	27,969.2
High Exit	18,837.7	29,055.5	30,695.8	78,589.0
Season Totals	30,704.1	37,875.5	37,978.6	106,558.2
Day-type Average	1,180.9	676.3	358.3	

Exiting users completed a total of 749 screeners in the summer season. Of these 749 screeners, a total of 620 detailed surveys were completed. Locals completed 181 detailed surveys and nonlocals completed 439 detailed surveys. These returns translate to an 82.7% response rate.

Study Totals

Total visits to the VCT for the one-year period beginning November 1, 2002 through October 31, 2003 are estimated at 130,172.3. The 95% confidence interval for the mean number of visits during the sample period ranges from 119,905.0 to 140,439.4 (Bowker 2004). A total of 1430 screener questionnaires were completed during the one-year sampling period. Of these 1430 screeners, 1036 detailed survey questionnaires were completed. There were 431 detailed surveys completed by locals and 605 detailed surveys completed by nonlocals. The response rate for the entire sampling season was 72%. Of the users screened, locals accounted for 47% of users and nonlocals accounted for 53% of users. Based on these screener percentages, nonlocals made 68,669 visits and locals made 61,503 visits. A visit was defined as an exit from the trail for a nontrivial amount of time (Bowker 2004). To meet the economic modeling objectives of this study, visits by user type were converted to person-trips.

Table 4.3 reports visits by user type and the corresponding person-trips for that user type. Users were classified by four user types: primary purpose day user (PPDU), non-primary purpose day user (NPDU), primary purpose overnight user (PPON), and non-primary purpose overnight user (NPON). For locals, visits and trips are equivalent, but for nonlocals a trip may contain more than one visit. A primary purpose visit is a visit to the local area for the purpose of using the VCT. Locals were assumed to be primary purpose visitors. The methodology described in Chapter 3 was used to convert visits into trips.

After accounting for multiple visits per trip in the nonlocal categories, the annual use estimate of 130,172 annual visits translated to 112,366 annual person-trips (Bowker 2004). Nonlocals accounted for about 45% of annual person trips and locals accounted for 55% of annual person trips.

Table 4.3. Total visitation and person trips for each VCT user type

	Primary Purpose Day User	Non-primary Purpose Day User	Primary Purpose Overnight User	Non-primary Purpose Over-night User
Nonlocal Visits	40,034	9,473	10,305	8,857
Local Visits	61,503	N/A	N/A	N/A
Visits by Type	101,537	9,473	10,305	8,857
Nonlocal Person-trips	33,642	7,578	5,725	3,918
Local Person-trips	61,503	N/A	N/A	N/A
Person-trips by Type	95,145	7,578	5,725	3,918

Of the 112,366 person trips estimated, primary purpose trips account for 100,870 person-trips. This equates to about 90% of annual person-trips to the VCT.

Individual Travel Cost Model

Descriptive Statistics

Results of the sampling indicated some interesting characteristics between locals and nonlocals. Table 4.4 presents descriptive statistics based on the detailed surveys. Demographic results suggest that local and nonlocal users are similar. The average age for local and nonlocal users is 47. Ninety-nine percent of VCT users are white. Sixty percent of those surveyed were male and over 60% of users were college educated. Average household size for locals is 2.6 while nonlocal household size is 2.9. The only demographic information varying between locals and nonlocals is employment and income. Fifty-eight percent of locals are employed full time with an average household income of $59,000. Seventy-seven percent of nonlocals are employed full time with an average household income of $80,500. This variation may be contributed to a higher percentage of locals being retired.

The average one-way travel distance for nonlocals was 260 miles with a maximum travel distance of 2,747 miles. The average one-way travel distance for locals was about eight miles. Nonlocals reported an average of six annual trips and locals reported an average of one hundred forty one annual trips. The primary activity for nonlocals was biking (74%). The primary activity for locals was walking (52%). This is reflective of on trail travel time and distance. Nonlocals spent an average of almost three hours on the trail and traveled about 17 miles. Locals spent around an hour and twenty minutes on the trail. Locals traveled about 5.5 miles on the trail.

Table 4.4 – Descriptive Statistics for local and nonlocal VCT Users

	Locals (n = 431)	Nonlocals (n = 605)
Household size	2.6	2.9
College education %	60	66
Respondent age	47	47
Full-time employ %	58	77
Household Income $1000	59	80.5
Gender % Male	61	65
Race % White	99	99
Travel Distance	8	260
Annual Trips	141	6
On Trail Time (minutes)	80	176
On Trail Distance	5.5	16.7

Truncated Negative Binomial Model

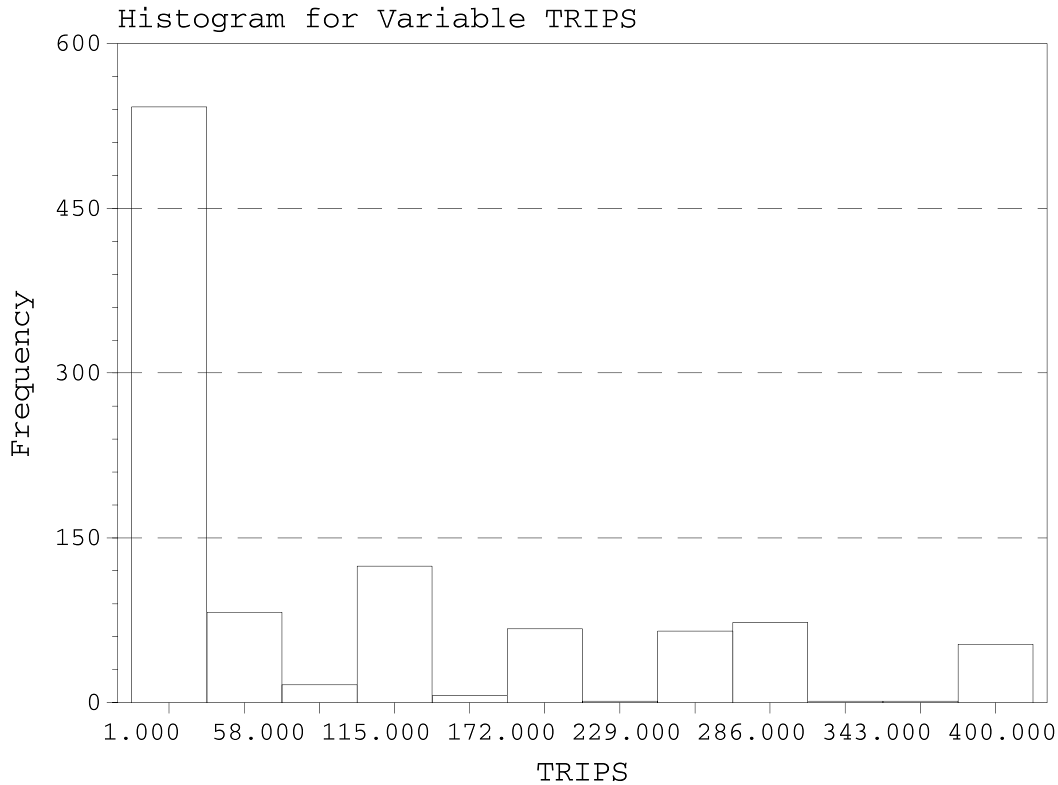
Background

The original truncated negative binomial model included all respondents to the detailed survey questionnaire. However, this model failed to converge. The model was run using LIMDEP econometric software. When the model was selected to run it consistently shutdown the software and all information was lost. To examine trip behavior a histogram of trips was constructed. This histogram is presented in Figure 4.1. Annual local trips were constrained to 365. As discussed in Chapter 3, local users may be introducing avidity bias into the model. Avidity bias occurs when the response of more frequent users over represent survey results (Johnson, Bowker, and Cordell 2001). While it is beyond the scope of this research to determine if avidity bias is present among local and some nonlocal users, it is suspected that the number of trips taken by locals adversely effects the econometric model. In this case, locals living nearby use the trail so often, the econometric model cannot adequately construct a regression accounting for this behavior.

Figure 4.1 shows a downward slope for the number of trips taken up to 30 annual trips. After this the histogram becomes erratic. Users taking more than 30 annual trips do not follow the same behavior patterns as users taking less than 30 annual trips. A binary variable was created to account for the difference in use patterns. This binary variable represents a taste and preference variable. Individuals who take more than 30 annual trips could have a preference for the trail not seen in users taking less than 30 annual trips.

The travel cost model used in this thesis does not include nonprimary trips. A fundamental assumption of the travel cost model is that each trip to the site is for the primary purpose of site use.

Figure 4.1 – Histogram of Annual Trips to the Virginia Creeper Trail



Bin	Lower limit	Upper limit	Frequency	Cumulative Frequency
0	1.000	10.000	542 (.5257)	542(.5257)
1	10.000	20.000	82 (.0795)	624(.6052)
2	20.000	30.000	16 (.0155)	640(.6208)
3	30.000	50.000	124 (.1203)	764(.7410)
4	50.000	75.000	6 (.0058)	770(.7468)
5	75.000	100.000	67 (.0650)	837(.8118)
6	100.000	150.000	1 (.0010)	838(.8128)
7	150.000	200.000	65 (.0630)	903(.8758)
8	200.000	250.000	73 (.0708)	976(.9467)
9	250.000	300.000	1 (.0010)	977(.9476)
10	300.000	350.000	1 (.0010)	978(.9486)
11	350.000**************		53 (.0514)	1031(1.0000)

A multipurpose trip incurs joint costs. These joint costs cannot be properly apportioned to each individual purpose (Freeman 1993, p.447). Examples of similar trimming techniques are found in the travel cost literature. Siderelis and Moore (1995) restricted their sample to include only those individuals who were on a single day primary purpose trip to visit one of the three rail trails in their study. Englin and Shonkwiler (1995) also restricted their sample to include only respondents with the primary purpose of hiking. Englin and Shonkwiler (1995) further restricted their model to include only in-state residents. This was to account for individuals on multi-purpose trips. Bowker, English, and Donovan (1996) employed this trimming technique to limit their sample to primary purpose, single destination whitewater trips.

In the detailed questionnaire, nonlocal respondents were asked whether or not they were in the area for the primary purpose of VCT use. Those who indicated they were not primarily visiting the VCT were omitted from the model. It was assumed that local trips were for the primary purpose of VCT use.

Model Statistics

Table 4.5 lists the mean, standard deviation, minimum, and maximum values for variables used in the truncated negative binomial model. The descriptive statistics used in the truncated negative binomial model are comparable to the descriptive statistics reported for the entire sample. Fifty-four percent of the respondents used in the negative binomial model were male. The average respondent age was 47. The average household size of members using the VCT was 2.39. The mean household income was $70,300. Forty-four percent of respondent said they took more than 30 trips per year to the VCT and 56% of the sample's primary activity was biking.

Table 4.5 – Descriptive Statistics for the Truncated Negative Binomial Model

Variable	Mean	Std.Dev.	Min.	Max.	Cases
TRIPS	71.52	105.42	1.0	365.0	837
TC0	25.75	39.53	0.026	294.22	840
TC4	41.21	64.80	0.158	597.00	835
SUB	0.37	0.48	0.00	1.0	810
INCOME	70302.38	32614.13	20000.00	135000.00	840
AGE	47.00	13.65	21.00	71.00	840
NUM	2.39	1.23	1.00	9.00	831
MALE	0.54	0.49	0.00	1.00	840
HIGHUSE	0.44	0.49	0.00	1.00	840
BIKE	0.56	0.49	0.00	1.00	840

Primary purpose users took an average of 71 annual trips to the VCT. The average cost of a trip with opportunity cost of time excluded was $25.01. The average cost of a trip with time valued at ¼ the wage rate was $40.22. Only 37% reported that they had a substitute for VCT trips.

Table 4.6 shows the parameter estimates for both travel cost models. The models were similar in sign and significance with two exceptions. First, the income variable was significant at the .05 level in the zero opportunity cost model and significant at the .10 level in the ¼ the wage rate model. These income coefficients have a negative sign, counter to what theory suggests. Theory says that if a good is normal an increase in income will lead to increased demand. Pearson's *r* showed a weak and insignificant correlation between trips and income (-.273). One possible reason for this may be due to the presence of retired persons in the sample. The local population had a lower average income than the nonlocal population partly due to a higher percentage of retired persons in the local population. These people have a lower income, yet their demand for VCT trips does not decrease.

Collinearity with other explanatory variables could also cause the income variable to be insignificance and counter-intuitive. Multicollinearity is a linear relationship between two or more explanatory variables in a regression model (Gujarati 1988, p.283-284). Multicollinearity makes it difficult to determine the individual influence that explanatory variables have on the dependent variable.

Multicollinearity leads to less precision in the parameter estimates (Gujarati 1988, p.289). Specifically, multicollinearity increases the standard error of the parameter estimates. Consequences of multicollinearity include, larger variances and covariances of the estimators, wider confidence intervals, and insignificant t-ratios (Gujarati 1988, p.290-292). These implications do not affect the parameter estimates. In the presence of multicollinearity, the parameter estimates can be unbiased estimators of the population.

In this thesis, a pair-wise correlation matrix was used to determine if multicollinearity was present in the model. When using a correlation matrix a good “rule of thumb” to determine if multicollinearity is a problem is a Pearson’s r greater than 0.8. Values greater than 0.8 indicate that multicollinearity may be a serious problem. It should be noted that when using a pair-wise correlation matrix for more than two explanatory variables, correlation between variables might be present even at low-order correlation values (Gujarati 1988, p.299).

One method to correct for multicollinearity is to simply drop one of the correlated explanatory variables from the model. However, dropping an explanatory variable can lead to biased and inconsistent parameter estimates (Gujarati 1988, p.303). This can be a big problem when the variable in question is a theoretically relevant variable. When a relevant variable is omitted from the regression model, that variables effect is captured by the error term. The assumptions of the classic linear regression model state that this error term has a constant variance and the mean of the error term is zero (Gujarati 1988, p.279). Omitting a relevant variable can lead to violations of these assumptions and result in biased parameter estimates and misleading conclusions related to confidence intervals and significance tests (Gujarati 1988, p.403).

The data in this thesis did not show that multicollinearity was a significant problem. The highest correlation was found between HIGHUSE, BIKE, and TC. The Pearson’s r for these variables was -.538 and -.52 respectively. Since these values are well within the range suggested by Gujarati, the model was not altered to account for multicollinearity.

Table 4.6 – Maximum likelihood parameter estimates and standard errors of alternative cost specification models for annual VCT trips

Variable	$.131 per mile No time cost N= 801	$.131 per mile ¼ the wage rate N= 800	Mean
Constant	2.173 (.157)	2.1648 (.1599)	
TC	-.0235*** (.0011)	-.0137*** (.0006)	#
SUB	.0546 (.0684)	.0236 (.0684)	.37
INCOME	-.000002** (.000001)	-.0000018* (.0000011)	70,300
HIGHUSE	2.961*** (.0855)	3.0108*** (.0834)	.46
AGE	.0022 (.0023)	.00209 (.0023)	47
NUM	.0019 (.0261)	-.02705 (.0271)	2.39
BIKE	-.2909*** (.0716)	-.3137*** (.0719)	.55
MALE	.1115* (.0608)	.0999* (.0621)	.54
Overdispersion Parameter	.6360*** (.0567)	.6449*** (.0577)	
Restricted log likelihood	-15,909.1	-15971.1	

*** Significant at the .01 level. **Significant at the .05 level. *Significant at the .10 level.

Mean travel cost for at zero time cost is $25.01 and the mean travel cost at ¼ the wage rate is $40.22.

An examination of correlation coefficients between income and the other explanatory variables did not show evidence of collinearity. The highest correlation was between INCOME and HIGHUSE (r = -.322) in the zero opportunity cost model and between income and travel cost (r = .334) in the ¼ the wage rate model. The other difference seen in the two models was the coefficient sign for the number of individuals in the household (NUM) who use the VCT. NUM was positive in the zero opportunity cost model and had a negative sign in the ¼ the wage rate model. Siderelis and Moore (1995) found a significant inverse relationship to group size and trip demand in their model. However, in this thesis NUM was insignificant in both models.

The remaining variables were similar in sign and significance and the following discussion relates to both models. Both travel cost coefficients were negative and significant. This indicates a downward sloping demand curve. The substitute variable was found to be positive and insignificant. This is counter to what theory suggests. Economic theory suggests that the presence of a substitute leads to a decrease in trip demand. Correlation between the substitute variable and other explanatory variables was examined. No evidence of correlation between the substitute variable and other explanatory variables was found.

The highest correlation was found to be between SUB and HIGHUSE (r = -.482). HIGHUSE was a binary variable to account for individuals taking over 30 annual trips to the VCT. Locals were consistently found to take over 30 trips and this population may feel there is no substitute for the VCT. There is evidence in the literature that has similar findings to this study. Betz, Bergstrom, and Bowker (2003) found their substitute variable to be insignificant. Siderelis and Moore (1995) did not identify any substitutes for the rail trails examined in their study. Age, a demand determinant identified as important by Loomis and Walsh (1997, p.87-88), was found insignificant. Betz, Bergstrom, and Bowker (2003) also found age to be insignificant in their model. Betz, Bergstrom, and Bowker (2003) attributes age insignificance to walking not being as age-dependent as more strenuous recreation activities. Siderelis and Moore (1995) found a significant negative relationship between age and trip demand. However, the age variable used in Siderelis and Moore (1995) was different from the age variable used in this thesis.

The survey instrument used in this thesis asked for age as a set of six categories ranging from 16-25 to 65-76. These categories were converted to midpoints for use in the model. Siderelis and Moore (1995) used an age composition variable. This variable asked for the number of group members under the age of 26 and the number of group members over the age of 26.

The other demographic variable used in this model was a binary variable indicating the user as a male. Loomis and Walsh (1997) claim gender can be an important demand determinant. Englin and Shonkwiler (1995) included gender to estimate long run demand of hiking, where it was found that if a respondent was female the likelihood of trips decreased. MALE was found to be positive and significant at the .10 level for both models.

Aside from the travel cost variable, the taste and preference variables had the most influence on the demand model. A binary variable to account for user taking more than 30 annual trips was positive and significant at the .01 level. This makes intuitive sense. Users who visit the trail frequently exhibit a preference for the trail that may be different from the preferences of the casual user. This is reflected in their higher demand for VCT trips. It should be noted that a correlation matrix between HIGHUSE and BIKE gave a Pearson's $r = -.538$. The Pearson's r between HIGHUSE and the travel cost variables was $r = -.52$.

The other taste and preference variable used in the demand model was a binary variable describing primary activity on the trail. Descriptive statistics found that the primary activity for over 90% of locals and nonlocals were either biking or walking. This activity variable essentially tested to see if there was a significantly different demand pattern for bikers. BIKE was found to be negative and significant at the .01 level. This was expected since bikers were primary nonlocals, traveling farther distances, and walkers were primarily locals, traveling shorter distances.

Previous research supports the findings reported in this thesis on activity type and trip demand. Siderelis and Moore (1995) used a binary variable to define primary activity in their study of three different rail trails. Siderelis and Moore (1995) found that at two out of the three rail trails studied, the models showed that biking was negative and significant. The other trail found that walking was positive and significant. These finding that bikers demand fewer trips are similar to the findings reported in this thesis. It should be noted that the correlation between explanatory variables was highest for taste and preference variables. The Pearson's *r* for HIGHUSE and BIKE was -.538.

Price elasticity of demand (ε_p) is a unitless measure of demand response to price changes. Price elasticity is defined as the percentage change in quantity divided by the percentage change in price (Varian 1999, p.266). Higher price elasticity, in absolute terms, implies demand is more responsive to price changes. Elasticity of greater than one is termed as elastic and elasticity less than one is termed inelastic. Elasticity valued at one is said to be unit elastic. In a truncated negative binomial model, the equation for price elasticity is the price coefficient times the average price:

4.4 $$\varepsilon_p = \beta_{COST} * \overline{P}$$

where

$\overline{P}$ = average travel cost

The price elasticity of demand for the truncated negative binomial model valued with zero opportunity cost of time was ε_p = -.605. The price elasticity of demand for the truncated negative binomial model valued with opportunity cost of time at ¼ the wage rate was ε_p = -.567. These findings compare favorably to price elasticity reported in previous trail related research. Betz, Bergstrom, and Bowker (1998) reported a price elasticity of -.681 for demand of a proposed Northeast Georgia rail trail. The reported price elasticity in this thesis is higher than the price elasticity reported by Siderelis and Moore (1995). Siderelis and Moore (1995) reported price elasticity ranging from -.207 to -.430 for the three rail trails they studied.

Consumer Surplus Estimates

Consumer Surplus estimates were calculated using methods described in Yen and Adamowicz (1993, p.209). Yen and Adamowicz (1993) provide the following equations for calculating per trip consumer surplus:

4.1 $$E(CS) = \frac{-1}{\beta_{\cos t}}$$

4.2 $$Var(CS) = \frac{Var(\beta_{\cos t})}{\beta_{\cos t}^4}$$

where

E (CS) = Expected consumer surplus

$\beta_{\cos t}$ = the travel cost coefficient

Var (CS) = Variance of consumer surplus

Var ($\beta_{\cos t}$) = Variance of the travel cost coefficient

The ninety-five percent confidence interval is calculated using methods described by (Kementa, 1986 p.486):

4.3 $$E(CS) \pm 1.96\sqrt{Var(CS)}$$

Consumer surplus estimates for the average trip to the VCT were calculated from the model restricted to include only primary purpose trips. Two models were used to estimate per trip consumer surplus. The first model used a transportation cost of $.131 to estimate out of pocket costs for a recreation trip to the VCT. This estimate represents a baseline measure of per trip consumer surplus for VCT trips. The second model estimated per trip consumer surplus using ¼ the wage rate as the opportunity cost of time. The per trip consumer surplus estimated at zero opportunity cost of time is $42.54. The ninety-five percent confidence interval for the per trip consumer surplus estimate at zero opportunity cost of time is $38.53 - $46.54. These consumer surplus estimates represent the consumer surplus to the traveling unit. The estimated per trip consumer surplus with opportunity costs of time valued at ¼ the wage rate was $72.63. The ninety-five percent confidence interval for this per trip consumer surplus estimate is $65.98 - $79.28.

Aggregate Net Economic Value

The demand models calculated using the truncated negative binomial model allow for the calculation of individual consumer surplus for a recreation trip. This value can be multiplied by the annual use estimate to estimate the aggregate net value of VCT trips. Aggregate net value is used as an input in benefit-cost analysis (BCA). This thesis does not attempt a BCA for the VCT. However, this thesis does estimate the net economic value of the VCT, based on the consumer surplus estimates obtained from the truncated negative binomial model. The estimated per trip group consumer surplus for travel costs with zero opportunity cost of time was $42.54.

The estimate of per trip group consumer surplus for travel costs with zero opportunity cost of time was $72.63.

In order to meet the modeling objectives of this thesis, the estimate of annual use was converted into person trips. The 130,172 annual visits translate to 112,366 annual person-trips. The consumer surplus estimates also need to be converted to per person estimates. To do this the group consumer surplus estimate was divided by the average number of people in a household that use the VCT (NUM). The per person per trip consumer surplus estimate at zero opportunity cost of time is $22.78. The per person per trip consumer surplus estimate with opportunity cost of time valued at ¼ the wage rate is $38.90.

The demand models used in this thesis included only those respondents indicating they were on a primary purpose trip to the VCT. Primary purpose users represent 100,870 person-trips. The net economic value of primary purpose VCT trips valued at zero opportunity cost of time is, 100,870 * $22.78 = $2,297,818. The net economic value of primary purpose VCT trips with opportunity cost of time valued at ¼ the wage rate is 100,870 * $38.90 = $3,923,843. These aggregate values are consistent with previous trail related studies. Siderelis and Moore (1995) reported a range of $1.9 million (Lafayette/Moraga Trail), $4 million (Heritage Trail) and $8.5 million (St. Mark's Trail) in aggregate value. Adjusted to 2003 dollars these values would be $2.3 million, $5 million and $10.6 million respectively. The trail in Siderelis and Moore (1995) with characteristics similar to the VCT is the Heritage Trail. This trail is a 26-mile rural rail trail in Iowa. The estimated use reported by Siderelis and Moore (1995) for the Heritage Trail was about 135,000 annual visits. These two trails compare favorably with respect to estimated net economic value.

Economic Impacts

To determine the total economic impact of VCT use, six steps were performed. These steps follow the procedures set forth by Professor Daniel Stynes in determining economic impacts of national parks (Stynes 2004). First, total VCT use was estimated based on the stratified random sample of exit counts. Next, expenditures were estimated based on major expenditure categories. There were ten expenditure categories listed on the nonlocal B questionnaire. Table 3.3 shows the expenditure profile from the nonlocal B survey. Next, the local impact region was defined. The local impact region is Washington and Grayson counties. These are the counties where the VCT is located. Next, aggregate recreation expenditures were estimated. Based on the aggregate recreation expenditures, direct effects are determined. The regional multipliers to estimate total economic impact are multiplied by direct effects.

The nonlocal B detailed survey provided the expenditure information necessary to determine aggregate expenditures. The nonlocal B survey asked for information to determine group expenditures within 25 miles of the VCT and group expenditures for the whole trip. The nonlocal B survey also asked the respondent about the size of their spending party. Using this information, average per-person expenditures made within 25 miles of the VCT per user type were estimated. Tables 4.7 - 4.10 show the expenditure profiles used to estimate the economic impacts of VCT related expenditures.

Nonprimary use expenditures were apportioned according to total trail time to total time spent in the impact region. Equation 3.9 in Chapter 3 explains how this apportioning was done for nonprimary day users and overnight users. For nonprimary day users this ratio was TIMESP*CRUSE/TOTIME = .24. For nonprimary overnight users this ratio was TIMESP*CRUSE/TOTIME = .09.

Table 4.7 – Expenditure profile for nonlocal primary VCT day users
N=169, spending party = 3.34

Expenditure type	w/in 25 miles	entire trip	per person w/in 25 miles expenditure	per person per trip expenditure
Private lodging	0.00	14.69	0.00	4.39
Public lodging	0.00	0.09	0.00	0.02
Food in restaurants	21.29	38.13	6.37	11.41
Carry out food	2.65	6.49	0.79	1.94
Primary transportation	11.42	18.68	3.41	5.59
Other transportation	0.06	0.06	0.01	0.01
Bike rentals	11.68	12.98	3.49	3.88
Shuttle/guide	9.17	10.51	2.74	3.14
Use fees	0.14	0.14	0.04	0.04
Other expenses	0.89	1.42	0.26	0.42
Total	57.32	103.22	17.16	30.90

Table 4.8 - Expenditure profile for nonlocal primary VCT overnight users
N=147, spending party = 4.5

Expenditure type	w/in 25 miles	entire trip	per person w/in 25 miles expenditure	per person per trip expenditure
Private lodging	126.95	211.86	28.21	47.08
Public lodging	22.29	29.30	4.95	6.51
Food in restaurants	99.43	137.02	22.09	30.44
Carry out food	27.69	40.02	6.15	8.89
Primary transportation	36.45	61.50	8.10	13.66
Other transportation	1.90	2.53	0.42	0.56
Bike rentals	17.28	18.44	3.84	4.09
Shuttle/guide	19.26	20.95	4.28	4.65
Use fees	0.00	0.00	0.00	0.00
Other expenses	17.56	18.32	3.90	4.07
Total	369.47	539.34	82.10	119.85

Table 4.9 – Expenditure profile for nonlocal nonprimary VCT day users
N = 23, spending party = 4.30, Time share = .24

Expenditure type	w/in 25 miles	entire trip	per person share w/in 25 miles expenditure	per person share per trip expenditure
Private lodging	0.00	165.13	0.00	6.63
Public lodging	0.00	31.18	0.00	1.38
Food in restaurants	51.00	154.18	3.71	7.00
Carry out food	5.90	23.63	0.19	1.09
Primary transportation	59.00	82.18	4.86	5.71
Other transportation	0.00	72.72	0.00	2.73
Bike rentals	47.13	47.13	2.66	2.66
Shuttle/guide	3.90	3.90	0.13	0.13
Use fees	0.00	0.18	0.00	0.00
Other expenses	54.81	100.95	0.76	2.66
Total	162.74	681.18	12.31	30.05

Table 4.10 – Expenditure profile for nonlocal nonprimary VCT overnight users
N = 94, spending party = 3.40, Time share = .09

Expenditure type	w/in 25 miles	entire trip	per person share w/in 25 miles expenditure	per person share per trip expenditure
Private lodging	125.17	175.53	2.50	4.40
Public lodging	46.19	47.89	0.27	0.30
Food in restaurants	97.32	120.51	2.07	2.79
Carry out food	17.23	28.19	0.25	0.62
Primary transportation	44.73	100.51	0.80	1.74
Other transportation	6.80	29.19	0.02	0.15
Bike rentals	17.25	17.59	0.38	0.41
Shuttle/guide	8.50	9.03	0.21	0.22
Use fees	0.00	1.06	0.00	0.00
Other expenses	3.40	3.93	0.45	0.47
Total	366.59	533.43	7.02	11.15

Average per person expenditures per user type were: primary day use $17.16, primary overnight $82.10, nonprimary day use $12.31, and nonprimary overnight $7.02. The per person per trip expenditures from the expenditure profiles were used to estimate total aggregate expenditures. Equation 2.12 from Chapter 2 was applied to determine aggregate recreation expenditures. The number of person trips for each user type was multiplied by the average per person expenditures per user type.

The average recreation expenditure for each user type was summed to determine total aggregate expenditures. Total aggregate expenditures were estimated at $1.28 million dollars. Table 4.11 shows aggregate recreation expenditure per user type and total aggregate recreation expenditures related to VCT use.

Table 4.11 – Total aggregate recreation expenditures for nonlocal VCT trips

Primary Purpose Day Users	30,490 * $17.16	$523,224
Primary Purpose Overnight Users	8,077 * $82.10	$663,165
Nonprimary Purpose Day Users	5,950 * $12.32	$63,194
Nonprimary Purpose Overnight Users	5,130 * $7.02	$36,037
Total Aggregate Expenditures		$1,285,622

The direct effects of nonlocal expenditures were determined by multiplying aggregate expenditures for each user type by the capture rate, as explained in Chapter 2. Equation 2.13 from Chapter 2 was applied to aggregate recreation expenditures to estimate direct effects. Capture rates for each user type were obtained from an IMPLAN model run by John C. Bergstrom, University of Georgia. The direct effects of nonlocal expenditures were $1.16 million dollars. Table 4.12 shows the direct effects from nonlocal expenditures by user type.

Table 4.12 – Direct effects of nonlocal expenditures on VCT trips

Primary Person Day Users	$523,224 * 0.894	$467,919
Primary Person Overnight Users	$663,165 * 0.917	$608,653
Nonprimary Day Users	$63,194 * 0.824	$52,072
Nonprimary Overnight Users	$36,037 * 0.959	$34,581
Direct Effects		$1,163,226

To determine the total economic impact, direct effects are multiplied by regional multipliers. Equation 2.14 from Chapter 2 was applied to direct effects to determine the total economic impact of VCT related expenditures. Regional multipliers for each user type were determined by the IMPLAN model run by John C. Bergstrom, University of Georgia. The total economic impact attributed to nonlocal expenditures for VCT trips was $1.61 million dollars. Table 4.13 shows the total economic impact of VCT related expenditures.

Table 4.13 – Total economic impacts of nonlocal expenditures on VCT trips

Primary Purpose Day Users	$467,919 * 1.39	$650,408
Primary Purpose Overnight Users	$608,653 * 1.38	$839,941
Nonprimary Day Users	$52,072 * 1.39	$72,380
Nonprimary Overnight Users	$34,581 * 1.37	$47,376
Total Economic Impact		$1,610,107

A significance test was performed to determine if there was a significant difference between average expenditures in the winter season and the summer season. The t-test found that only primary purpose day use expenditures differed significantly from the winter to summer season. When the aggregate expenditures for primary day users were estimated accounting for this difference the estimate of aggregate expenditures differed by $1400. Since only one user type showed a significance difference in expenditure patterns from winter to summer, and the difference in estimates was small, user types were not divided by season to calculate total economic impacts. The t-test used to determine if there was a significant difference between winter and summer average expenditures was a two-tailed t-test following the procedure outlined in Chapter 3. This was the same procedure used to test the significance of differences in winter and summer trips by local users. Appendix D shows the significance tests performed on seasonal expenditure patterns.

Summary of Results

This chapter presented the results of use estimation for the VCT and the conversion to person trips, the aggregate net economic value, and the total economic impact of VCT related expenditures. The results of the aggregate consumer surplus estimates are summarized in Table 4.14. The model with zero time costs estimated aggregate consumer surplus at $2.2 million. Based on a 95% confidence interval for annual person trips, aggregate net economic value for the VCT, with zero time costs, is between $2 and $2.5 million.

The travel cost model with time costs valued at ¼ the wage rate estimate aggregate consumer surplus at $3.9 million. Based on a 95% confidence interval for annual person trips the aggregate net economic value for the VCT, with time valued at ¼ the wage rate, is between $3.5 and $4.2 million. These estimates only account for primary purpose trips.

Table 4.14 – Summary Findings of Net Economic Value for Primary Purpose VCT Trips

Visitation in person trips by primary purpose users only	Aggregate consumer surplus @ 13 cents per mile and zero time costs	Aggregate consumer surplus @ 13 cents per mile with time costs valued at ¼ the wage rate
Upper-110,000	$2.5 million	$4.2 million
Mean-100,870	$2.2 million	$3.9 million
Lower-90,000	$2.0 million	$3.5 million

To estimate aggregate net economic value and total economic impact, different methods were used. The employment of different methods leads to difficulty in comparisons. The model used to estimate consumer surplus for VCT trips operates on the assumption that the site in question is the primary purpose for the trip. Those trips not for the primary purpose of visiting the site are excluded. This is because the value that the individual has for the site is tied in with the other activities and sites visited. To my knowledge there has been no research that has found a method to separate the value for each site or activity on a multipurpose trip.

The multiplier analysis performed to estimate total economic impacts included nonprimary purpose trips in the estimate of total economic impacts. This was done through an ad hoc method of apportioning nonprimary expenditures based on total trail time to total time spent in the area. This type of ad hoc procedure has been used previously by the impact literature. Table 4.15 presents the estimated total economic impacts for primary purpose trips. In order to provide a comparison between net economic value and total economic impact, Table 4.15 presents total economic impacts for primary purpose users only. This table presents total economic impacts using two different calculation methods.

The second column shows impact estimates calculated using the mean of ratios method. Using the mean of ratios method, average expenditures were aggregated for each user group and then divided by the average spending party for each user type to estimate per person total expenditures. These expenditures were used in the multiplier analysis described by Stynes (2004) to estimate total economic impact. Using the mean of ratios method, total economic impacts for primary nonlocal users were estimated at $1.49 million.

The third column shows impact estimates using a ratio of means procedure. When using the ratio of means procedure, respondent's trip expenditures are divided by their party size for each survey. This ratio of average expenditure divided by spending party size is aggregated for each user type to estimate total per person expenditures. Using a ratio of means procedure, total economic impacts for primary nonlocal users were estimated at $2.0 million.

Table 4.15 – Summary Findings of Total Economic Impact from Primary Purpose Nonlocal Trips

Primary purpose nonlocal visitation in person trips	Total economic impact by primary nonlocal users calculated by mean of ratios	Total economic impacts by primary nonlocal users calculated by ratio of means
Primary purpose nonlocal dayusers-33,642	$650,408	$811,873
Primary purpose Nonlocal overnight users-5,725	$839,941	$1,226,868
Total primary purpose nonlocal trips-39,367	$1.49 million	$2.0 million

The method of estimating per person expenditures makes a difference in the total economic impact estimates. This thesis reports total economic impacts with per person expenditures estimated using the mean of ratios technique. This technique was chosen over the ratio of means procedure because the data and the variables being used were more appropriate for the means of ratio procedure. Specifically, for the ratio of means procedure to be accurate the ratio of the variables should be constant throughout the sample. In this case, expenditures and spending party size varied for each respondent. Another reason that the ratio of means was not chosen was due to the size of the samples. A ratio of means procedure works best when the sample size is large (Cochran 1963, p.155-157). This was not the case with the four user types used in this thesis. The next chapter presents conclusions and implications of the research performed in this thesis.

Chapter V

SUMMARY AND CONCLUSIONS

The purpose of this chapter is to present a summary and description of the research conducted in this thesis. Conclusions are based on the results of the travel cost models and economic impact model used. The conclusions for the demand models include model specification, signs and significance of explanatory variables, estimates of consumer surplus, and the estimated net economic value. The conclusions for the economic impact model include the estimation of person trips; trail user types, multiplier analysis, and total economic impact. Implications of the research conducted are discussed. The chapter concludes with limitations of the study.

Summary

Background

This thesis sought to determine the net economic value and the total economic impact of the Virginia Creeper Trail. The VCT is a 34-mile rural rail trail in Southwest Virginia. The primary area of interest is Washington and Grayson counties. This area has many types of outdoor recreation opportunities available. The VCT intersects several other trails including the Appalachian Trail.

The research involved is part of a larger initiative to determine the economic impacts and benefits of trails in the state of Virginia. The major contributors to this project include; The Virginia Department of Conservation and Recreation, The Northern Virginia Regional Park Authority, The National Park Service, The Virginia Trails Association, The U.S. Forest Service and The Virginia Department of Forestry and The University of Georgia, Department of Agricultural and Applied Economics.

The data used in this thesis consisted of a stratified random sample and a trail user survey. An expert panel of locals and nonlocals familiar with the trail and trail users identified strata. Surveying occurred over a period of one year and consisted of two sampling seasons. The sampling process obtained 1036 usable surveys. An annual use estimate of 130,172 was found. This use estimate equates to 100,870 primary person trips.

Travel Cost

The Individual Travel Cost Model (ITCM) was chosen as the method for estimating net economic benefits. The choice of ITCM was based on the type of data obtained from the VCT survey, previous trail related literature, and the merits of ITCM. Variable specification for the ITCM was based on economic theory and the previous literature related to recreation trips using similar modeling techniques.

This thesis followed the precedence set in previous trail related literature and employed a count data model. A truncated negative binomial model was employed to estimate the per person consumer surplus of a trip to the VCT. The negative binomial model is a form of the Poisson distribution that accounts for unequal mean and variance. The dependent variable for this model was the number of annual trips to the VCT. Also included in the model were eight independent variables. The independent variables included travel cost, a substitute variable, household income, age, gender, a binary variable for primary activity, and a binary variable describing trip behavior. Two models were run. The first model had zero time costs and the second model valued time at ¼ the wage rate. Six variables were found to be significant in both models, although income was more significant in the model with zero time cost. The travel cost variable was negative and significant, implying a downward sloping demand curve. Both taste and preference variables were found to be significant.

Based on these models per person consumer surplus was estimated. The zero time cost model estimated per person consumer surplus at $22.78. The model with time valued at ¼ the wage rate estimated per person consumer surplus at $38.90. To estimate net economic value, the per person consumer surplus estimates were multiplied by the annual number of primary person trips to the VCT. Net economic value for the VCT was estimated at $2.2 – 3.9 million.

Economic Impact

To estimate the total economic impact of VCT trips, the sample population was separated by the user type. There were four user types defined: primary day user, primary overnight user, nonprimary day user, and nonprimary overnight user. The annual visit estimate was converted to person trips. The annual number of person trips for each category was determined. For each user category the average per person expenditure was estimated. Nonprimary purpose users had their expenditures further apportioned by their ratio of total trail time to total time spent in the local area. The average expenditures were multiplied by the number of person trips taken by the user type to get aggregate recreation expenditures. The aggregate recreation expenditures were multiplied by the capture rate for each user type to estimate total direct effects. The direct effects of VCT related expenditures were multiplied by regional multipliers for each user type to estimate total economic impact. The total economic impact of VCT related expenditures were estimated at $1.6 million.

Policy Implications

The primary policy implication of this research is the economic value and economic impact that the Virginia Creeper Trail provides to users and the surrounding community.

Recreation resources like the Virginia Creeper Trail have properties of nonrivalry and nonexclusiveness that do not allow the marketplace to determine the efficient allocation. Trade of goods like the VCT in the marketplace would invariably lead to externalities. As a result, the public sector typically provides use of these recreation resources.

Estimation of the net economic value of a recreation resource measures the net benefits to users from a national economic development perspective. A national development perspective measures economic gains and losses for the entire nation whereas, a regional or state perspective only measures economic gains and losses occurring in that region or state. A national perspective is appropriate when management actions affect federal lands or when federal funds are used (Loomis 1993, p.124). This is important when determining public funding for outdoor recreation. Net economic value gives policy makers a tool to measure where the allocation of funding will provide the greatest benefit to the greatest number. Put another way net economic value helps policy makers determine the most efficient allocation of public funds.

These national economic development or economic efficiency objectives can be applied at the local level as well. Local and state governments are restricted in the amount of public dollars available. These governments must provide certain goods and services like schooling, public protection, and local roads. Funding for these necessities take up a large portion of county and state funding. Knowing the economic value that people derive from VCT use provides justification for continued and possibly increased resource allocation to maintain the VCT.

The travel cost model used also provides information that may have policy implications. As discussed in Chapter 4, elasticity of demand is a unitless measure of demand response to price changes. This responsiveness measures how people would respond if there were a price increase. In the case of the VCT price elasticity could be defined as relatively inelastic. This means that the percentage change in demand from a price increase would be smaller than the price increase. The two travel cost models used in this thesis estimated price elasticity at, -.605 for the zero opportunity cost model and -.567 for the model with opportunity cost of time valued at ¼ the wage rate. This information is useful as a justification for implementing use or parking fees to supplement public funding for trail maintenance. For example, the average group travel cost for each model is $25.01 and $40.22 respectively. Price would have to rise by approximately $17.56 and $32.41 before unitary elasticity is reached. Based on these findings, implementation of a use fee below $17.56 and $32.41 would increase revenue generated from VCT trips to the agency charging the fee. This is based on the assumption that users would respond to on-site fees like they would an increase in travel cost. Another implication is that an increase in the cost per trip from other sources including changes in gas prices, lodging expenses, and food costs below $17.56 and $32.41 would increase revenues to businesses providing these goods and services.

Net economic value for the VCT was estimated at $2.2 – 3.9 million. This is the use value to users for a fixed period of time. To determine the asset value of the VCT, this value estimated must be valued across time. The asset value of the VCT is an estimate of what the VCT's fair market value would be if it were sold. If net economic value and visitation are assumed to be fix into the future, the asset value of an environmental resource is defined as:

5.1 $$V = \frac{R}{n}$$

where

V = asset value

R = return to asset

n = discount rate.

Using a 7% discount rate, recommended by the Office of Management and Budget, the asset value of the VCT is estimated at $31 million dollars using Net Economic Value estimated from the zero time cost model. Using the Net Economic Value estimated with time costs valued at ¼ the wage rate, the asset value of the VCT is estimated at $55 million dollars.

Economic impact analysis provides a "snapshot" of the local economy and the impact resulting from some action. This impact is measured as changes in visitor spending, regional income, and/or employment. One implication for the public sector is the knowledge of economic impacts that result from this type of recreation resource. Areas with similar demographics and situations may expect to see similar economic impacts if a recreation resource were developed in that area. This could improve public and private support for the development of these types of recreation resources.

Economic impacts measure the impacts of recreation resource use on local economic development, i.e. "What the impacts of VCT use are on the local economy?"

Tourism from a recreation resource like the VCT provides a clean, relatively inexpensive way to provide local economic impact. A visit to a recreation site typically does not create large amounts of air, water, or soil pollution. These users also do not create excessive burdens on the taxpayers either. Tourists typically come to a community to use a resource, spend money and leave. There is not a lot of pressure on the education system, the health care system or public protection. There is a trade off between the economic impacts from recreation resources and the economic impacts from a large factory or industrial complex. The large factory or industrial complex may create more sales, jobs, and secondary effects than a recreation resource.

The model used in this thesis to determine the total economic impacts of VCT trips separated users into four categories. These categories were defined as primary person day users, primary person overnight users, nonprimary person day users, and nonprimary person overnight users. Of the four user types, primary person overnight users have the most impact on the local economy. If increasing economic impacts is a goal policy makers are interested in, increasing the number of trips by primary overnight users would help increase economic impacts without overcrowding becoming a problem. For example, if there were an 10% increase in primary day users, economic impacts for this user type would increase from $650,408 to $715,427. This 10% increase in trips would increase primary purpose day use annual trips to 33,539.

If there were a 10% increase in the number of primary purpose overnight trips, total economic impact for this user type would increase from $839,941 to $923,801. This 10% increase in primary overnight trips would increase primary purpose overnight trips to 3,884 annual trips. Clearly primary purpose users can create more of an impact on the local economy with fewer trips. By marketing to this user type, more "new" money can be brought into the local economy without creating problems of overcrowding.

One thing that should be noted about all of the estimates reported in this thesis. These estimates are based on data collected during the 2003 calendar year. Due to weather conditions in 2003, particularly a rainy summer, Virginia experienced about a 20% decrease in usage across its state park system (Bowker 2004). Based on this information, the net economic value and total economic impacts estimated in this model may be less than estimates using data from a typical year. The estimates used in this thesis may represent a baseline measure of the value and impact of VCT trips.

The estimation of net economic benefits and economic impacts of trips to the VCT is part of a larger project to determine the economic impacts and benefits of trails in the state of Virginia. Four representative trail types were chosen for the study. Based on the estimates of net economic value and economic impact of the VCT, policy makers can estimate the value and impacts of trails with similar characteristics to the VCT. This provides proponents of trail based recreation and communities information on the effects that trail based recreation generate. This information provides a starting point to evaluate whether or not the benefits of trail recreation are worth the costs of development and maintenance.

This thesis also adds to the literature estimating the net value and economic impact of rail trails. This is important because currently there are only a small amount of studies that look specifically at the value and impact of rail trails.

Study Limitations and Future Research

This section presents some of the possible limitations of this thesis. Also included in this section, are suggestions for improvement in future research. An issue that may affect the survey is “trap shyness.” This occurs when a person who has already been sampled avoids filling out the survey in the future. “Trap shyness” is something that could be problematic with frequent visitors. In this case “trap shyness” may have a downward bias on the percentage of local users to nonlocal users. In future studies involving on-site surveying, one thing that may help minimize this problem is to provide some type of incentive to get frequent users to repeat the survey process. This incentive could be a trivial gift or an appeal that their additional information will be useful and benefit future trail use. In providing an incentive the researcher should be careful not to provide an incentive that induces the user to alter their behavior in order to receive additional gifts.

There are also potential problems with the economic modeling. The travel cost method has some inherent methodological concerns. Consistent issues that arise with travel cost modeling include treatment of durable good investment, multi-purpose recreation trips, discretionary expenditures, the treatment of substitutes, choice of travel cost, and accounting for the opportunity cost of time (Randall 1994). The underlying concern set forth by Randall (1994) is whether or not a third party observer can define what an average trip is considering the many choices and decisions and unpredictable factors that go into the household trip production process.

In the travel cost models used in this thesis, the substitute variable could be a potential limitation. It would be ideal to have each user identify a substitute site. The dataset used in this thesis asked nonlocal users to give the name and state of a substitute rail trail. However, the response to this question was less than 40%. A binary variable was created instead. This variable was found to be positive and insignificant in the models used in this thesis. This is counter-intuitive to what economic theory suggests. In using a binary variable it is not clear what the user is substituting activity or site characteristics. In future demand studies it may prove beneficial to find out if the user would substitute activity or site characteristics and create a substitute based on these findings.

Another issue in travel cost modeling that is consistently an issue is how to measure time costs. There is little consensus on how to measure time costs. This thesis chose to follow precedence set in the literature by using a portion of the wage rate as a measure of the time cost associated with a VCT trip. An issue has been raised in the literature regarding the use of a portion of the wage rate to represent time cost. Some individuals cannot trade work for leisure hours due to restrictions of a forty-hour workweek. In this case a portion of the wage rate may not be the appropriate time cost measure. This may potentially be an issue in this study where the local population may have a high percentage of retired individuals. Some studies have asked respondents directly whether or not they could or would trade work for leisure hours. This could prove helpful in determining how to include time costs in the travel cost model.

In this thesis, both locals and nonlocals were included in the travel cost model. It was found that these user populations had distinctly different use patterns. To account for this, a binary variable defining high users was incorporated. This may cause some potential problems. The local users show avidity for the trial that creates problems when trying to model trip behavior. The literature in trail demand studies primarily focus on the nonlocal trail users. It needs to be determined whether or not you can use a modeling technique can be designed to model nonlocal travel behavior to explain the demand by local users. The literature does not mention the use of locals in demand estimation. One option in future studies may be to use different techniques for the two populations. For example, employ a travel cost model for nonlocals and a contingent valuation model for locals.

An issue that may be of concern in estimating the total economic impacts is double counting. Double counting adds in the effect of expenditures on total economic impact, by the same person or user type more than once. For example, in this thesis there were primary and nonprimary user types. The primary user types had all of there expenditures attributed to the VCT, 100%, while nonprimary expenditures were apportioned ad hoc by the ratio of total trail time to total time spent in the area. Assume this is 10% of expenditures for the nonprimary user. If you add up the expenditures associated with VCT trips for primary and nonprimary trips the total is 110%. Now, since the nonprimary VCT user is in the area for another purpose only 90% of his expenditures can be attributed to that primary purpose. As well, if the primary purpose VCT user chose to visit this other place, none of his expenditures would be attributed to this use. In total, 90% of expenditures would be associated with this other place. In this case more expenditures are being associated with VCT use than may be appropriate. While it is beyond the scope of this thesis to determine the correct portioning scheme, this may be something to consider in future research when estimating total economic impacts.

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APPENDIX

Appendix A – Survey Instrument

Virginia Creeper Screener Questionnaire

1. Survey # _____________ 2. Interviewer: ______________ 3. Interview Site:_____________

4. Date: _______________ 5. Activity/Mode: Bike Walk Jog Pet Equestrian Fish
Hike Camp Other _______________

6. Time: ____________ 7. Race: W B O 8. Gender: M F 9. Age <16 >16

10. Group Size: ___________

READ INTRODUCTION – I am a <u>volunteer</u> conducting a survey on behalf of Virginia Trails, the US Forest Service, the Virginia Creeper, and the state of Virginia. I would like to ask you about your trail use. This information will help managers develop better plans for trails throughout Virginia.

9. Do you live or work within Grayson or Washington County? Y N

10. Could we ask you about 5 minutes of questions? Y N

IF 9=Y AND 10=Y → **LOCAL QUESTIONNAIRE**
IF 9=N AND 10=Y → **NONLOCAL QUESTONNAIRE**

11. Is there a <u>reason</u> why you cannot help us?
    A. No time
    B. No interest
    C. Already been surveyed
D. Other _____________________________________

Virginia Creeper On-Site Local Questionnaire

1. Survey # ___________

2. What is your <u>residence</u> Zip Code? _________________

3. Where did you enter the Creeper today? A. Abingdon B. Damascus C. Whitetop D. Watauga
E. Alvarado F. Creek Jct G. Green Cove H. Taylor's Valley I. Straight Branch J. Other ____________

4. How long did it take to get from home/work to where you entered the trail? ___________minutes

6. What is your <u>primary reason</u> for being on the trail today? A. Biking B. Walking C. Jogging
D. Camping E. View Nature F. Horse Riding G. Fishing H. Other ___________

7. How much time did you spend on the trail ___________hours ___________minutes

8. How far did you go (roundtrip)? ____________miles

9. How many, <u>including yourself</u>, were in your group? _______________ people

10.Were you part of an <u>organized group</u>? Yes No Group name ______________________________

11. What <u>seasons</u> do you use the Creeper? A. Spring B. Summer C. Fall D. Winter

12. Counting this visit, how many times have you visited the Creeper in the past 30 days? A. 1 B. 2 - 5
C. 6-10 D. 11- 15 E. 16-25 F. 26-35 G. 36-45 H. More than 45

13. In the past 30 days, what percent of your visits to the CREEPER were on weekends/holidays?
__________percent.

14. In the past 30 days, how many trips have you made to other rail trails like the CREEPER? A. None
B. 1 C. 2 - 5 D. 5 - 10 E. 10 - 20 F. More than 20

15. About how much do you spend each year on goods and services related to your use of the CREEPER?
A. less than $50 B. $50-100 C. $100-250 D. $250-500 E. $500-1000 H. More than $1000

16. About how much of this money is spent Washington or Grayson County? A. more than 75% B. 50-75% C. 25-50% D. less than 25%

Please rate the degree to which you receive the following **benefits** from the Creeper.

1. Health & fitness	High	Med	Low	None
2. Opportunity to view nature	High	Med	Low	None
3. A place to take my pets/animals	High	Med	Low	None
4. Provides a sense of community	High	Med	Low	None
5. Other ___________________________	High	Med	Low	None

Please rate the following **trail issues**: first **importance** to you and then **conditions** you observed **today.**

Trail Issues:	**Importance to you**				**Current conditions**			
1. Safety/security	High	Med	Low	None	Excel	Good	Fair	Poor
2. Amount of crowding	High	Med	Low	None	Excel	Good	Fair	Poor
3. Parking	High	Med	Low	None	Excel	Good	Fair	Poor
4. Natural scenery	High	Med	Low	None	Excel	Good	Fair	Poor
5. Restrooms	High	Med	Low	None	Excel	Good	Fair	Poor
6. No conflicts with others user type:_________________	High	Med	Low	None	Excel	Good	Fair	Poor
7. Trail surfaces	High	Med	Low	None	Excel	Good	Fair	Poor
8. Structures / Bridges	High	Med	Low	None	Excel	Good	Fair	Poor

Please rate these **area features**: first **importance** to you and then **conditions** (only if they apply).

Area Features:	**Importance to you**				**Current conditions**			
1. Lodging	High	Med	Low	None	Excel	Good	Fair	Poor
2. Trail camping	High	Med	Low	None	Excel	Good	Fair	Poor
3. Campgrounds	High	Med	Low	None	Excel	Good	Fair	Poor
4. Eating places	High	Med	Low	None	Excel	Good	Fair	Poor
5. Shopping for gifts	High	Med	Low	None	Excel	Good	Fair	Poor
6. Historical attractions	High	Med	Low	None	Excel	Good	Fair	Poor
7. Outdoor attractions	High	Med	Low	None	Excel	Good	Fair	Poor
8. Shuttle/ bike rentals	High	Med	Low	None	Excel	Good	Fair	Poor
9. Guide services	High	Med	Low	None	Excel	Good	Fair	Poor

Please state whether you **Strongly Agree, Agree, Disagree,** or are **Uncertain** about the following 5 statements:

1. It is important to maintain the Creeper in good condition to continue to **attract visitors** to the region.
   SA A D U

2. A **use fee** for the Creeper would be a good way to provide funds for maintenance/improvements.
   SA A D U

3. **Local tax revenues** should be used to help fund maintenance on the Creeper.
   SA A D U

4. **Volunteer groups** should be the main source of maintenance on the Creeper.
   SA A D U

5. I am concerned that **crowding** will affect the quality of my future visits to the Creeper.
   SA A D U

Please rate **trail surfaces** on the Creeper by stating whether you **Strongly Support, Support,** are **Neutral, Don't Support,** or **Don't Know** for each of the following:

1. Paved surface	SS	S	N	DS	DK
2. Cinder surface	SS	S	N	DS	DK
3. Crushed limestone	SS	S	N	DS	DK

Please give us your opinion about the following **uses** on the Creeper by stating whether you **Support** for **All Users, Support only** for **Disabled Users,** are **Neutral, Don't Support,** or **Don't Know** about the following:

1. Electric golf carts	SA	SDU	N	DS	DK
2. Gas-powered golf carts	SA	SDU	N	DS	DK
3. Motorized bicycles	SA	SDU	N	DS	DK
4. Horse-drawn carts	SA	SDU	N	DS	DK
5. ATV's	SA	SDU	N	DS	DK

DEMOGRAPHIC INFORMATION

1. How many people, including yourself, are in your household? ____________________

2. How many people, including yourself, in your household use the Creeper? ____________________

3. What is the highest level of education in your household? A. High school B. College C. Other ________

4. What is your age? A. 16-25 B. 26-35 C. 36-45 D. 46-55 E. 56-65 F. 65 plus

5. What is your employment status? (circle all)
   A. Student B. Employed C. Retired D. Part-time E. Not currently employed

6. Which interval represents your annual household income? A. Under $40,000 B. $40,000 - $80,000 C. $80,000 - $120,000 D. More than $120,000 E. Prefer not to answer this question

THANK YOU FOR YOUR TIME

Virginia Creeper On-Site Nonlocal Version A Questionnaire

1. Survey # __________

2. What is your residence Zip Code? ________________ or Country of residence __________________

3. Where did you enter the CREEPER today? A. Abingdon B. Damascus C. Whitetop D. Watauga
E. Alvarado F. Creek Junction G. Green Cove H. Taylor's Valley I. Straight Branch J.Other_______

4. What is your primary activity on the trail today? A. Biking B. Walking C. Jogging
D. Camping E. View Nature F. Horse Riding G. Fishing H. Other __________

5. How much time did you spend on the trail today ____________hours ______________minutes

6. How far did you go (roundtrip)? ___________miles

7. How many, including yourself, were in your group? ______________ people

8.Were you part of an organized group? Yes No Group name ___________________________

9. On this trip, how many nights will you be staying away from home within 25 miles of Creeper? __________ nights

10. Are you staying at: A. Cottages B. Motel/Hotel C. Private Home D. Bed &Breakfast
E. Govt Campground F. Private Campground G. Camping along trail H. Other

11. On this trip, how many different times will you use the Creeper? __________ times

12. Is the CREEPER the primary reason for your visit to the area? Yes No

13. Including this visit, how often have you visited this area to use the Creeper in the last 12 months? ________ times

14. Including this visit, how often have you visited any other rail trails in the last 12 months? __________ times

15. Besides the Creeper, what rail trail do you visit most? Name______________________________ State_______

Please rate the degree to which you receive the following **benefits** from the Creeper.

1. Health & fitness	High	Med	Low	None
2. Opportunity to view nature	High	Med	Low	None
3. A place to take my pets/animals	High	Med	Low	None
4. Provides a sense of community	High	Med	Low	None
5. Other _________________________	High	Med	Low	None

Please rate the following **trail issues**: first **importance** to you and then **conditions** you observed **today.**

Trail Issues:	**Importance to you**				**Current conditions**			
1. Safety/security	High	Med	Low	None	Excel	Good	Fair	Poor
2. Amount of crowding	High	Med	Low	None	Excel	Good	Fair	Poor
3. Parking	High	Med	Low	None	Excel	Good	Fair	Poor
4. Natural scenery	High	Med	Low	None	Excel	Good	Fair	Poor
5. Restrooms	High	Med	Low	None	Excel	Good	Fair	Poor
6. No conflicts with others user type:________________	High	Med	Low	None	Excel	Good	Fair	Poor
7. Trail surfaces	High	Med	Low	None	Excel	Good	Fair	Poor
8. Structures / Bridges	High	Med	Low	None	Excel	Good	Fair	Poor

Please rate these **area features**: first **importance** to you and then **conditions** (only if they apply).

Area Features:	**Importance to you**				**Current conditions**			
1. Lodging	High	Med	Low	None	Excel	Good	Fair	Poor
2. Trail camping	High	Med	Low	None	Excel	Good	Fair	Poor
3. Campgrounds	High	Med	Low	None	Excel	Good	Fair	Poor
4. Eating places	High	Med	Low	None	Excel	Good	Fair	Poor
5. Shopping for gifts	High	Med	Low	None	Excel	Good	Fair	Poor
6. Historical attractions	High	Med	Low	None	Excel	Good	Fair	Poor
7. Outdoor attractions	High	Med	Low	None	Excel	Good	Fair	Poor
8. Shuttle/ bike rentals	High	Med	Low	None	Excel	Good	Fair	Poor
9. Guide services	High	Med	Low	None	Excel	Good	Fair	Poor
10. Information	High	Med	Low	None	Excel	Good	Fair	Poor

Please state whether you **Strongly Agree, Agree, Disagree,** or are **Uncertain** about the following 5 statements:

1. It is important to maintain the Creeper in good condition to continue to **attract visitors** to the region. SA A D U

2. A **use fee** for the Creeper would be a good way to provide funds for maintenance/improvements. SA A D U

3. **Local tax revenues** should be used to help fund maintenance on the Creeper. SA A D U

4. **Volunteer groups** should be the main source of maintenance on the Creeper. SA A D U

5. I am concerned that **crowding** will affect the quality of my future visits to the Creeper. SA A D U

Please rate **trail surfaces** on the Creeper by stating whether you **Strongly Support, Support,** are **Neutral, Don't Support,** or **Don't Know** for each of the following:

1. Paved surface	SS	S	N	DS	DK
2. Cinder surface	SS	S	N	DS	DK
3. Crushed limestone	SS	S	N	DS	DK

Please give us your opinion about the following **uses** on the Creeper by stating whether you **Support** for **All Users, Support only** for **Disabled Users,** are **Neutral, Don't Support,** or **Don't Know** about the following:

1. Electric golf carts	SA	SDU	N	DS	DK
2. Gas-powered golf carts	SA	SDU	N	DS	DK
3. Motorized bicycles	SA	SDU	N	DS	DK
4. Horse-drawn carts	SA	SDU	N	DS	DK
5. ATV's	SA	SDU	N	DS	DK

DEMOGRAPHIC INFORMATION

1. How many people, including yourself, are in your household? ____________________

2. How many people, including yourself, in your household use the Creeper? ____________________

3. What is the highest level of education in your household? A. High school B. College C. Other ________

4. What is your age? A. 16-25 B. 26-35 C. 36-45 D. 46-55 E. 56-65 F. 65 plus

5. What is your employment status? (circle all)
A. Student B. Employed C. Retired D. Part-time E. Not currently employed

6. Which interval represents your annual household income? A. Under $40,000 B. $40,000 - $80,000
C. $80,000 - $120,000 D. More than $120,000 E. Prefer not to answer this question

THANK YOU FOR YOUR TIME

Virginia Creeper On-Site Nonlocal Version B Questionnaire

1. Survey # __________

2. What is your residence Zip Code? ________________ or Country of residence __________________

3. Where did you enter the CREEPER today? A. Abingdon B. Damascus C. Whitetop D. Watauga
E. Alvarado F. Creek Jctn. G. Green Cove H. Taylor's Valley I. Straight Branch J. Other____________

4. What is your primary activity on the trail today? A. Biking B. Walking C. Jogging
D. Camping E. View Nature F. Horse Riding G. Fishing H. Other __________

5. How much time did you spend on the trail today ____________hours ______________minutes

6. How far did you go (roundtrip)? ___________miles

7. How many, including yourself, were in your group? ______________ people

8.Were you part of an organized group? Yes No Group name ___________________________

9. On this trip, how many nights will you be staying away from home within 25 miles of Creeper? __________ nights

10. Are you staying at: A. Cottages B. Motel/Hotel C. Private Home D. Bed &Breakfast
E. Govt Campground F. Private Campground G. Camping along trail H. Other

11. On this trip, how many different times will you use the Creeper? __________ times

12. Is the CREEPER the primary reason for your visit to the area? Yes No

13. Including this visit, how often have you visited this area to use the Creeper in the last 12 months? ________ times

14. Including this visit, how often have you visited any other rail trails in the last 12 months? __________ times

15. Besides the Creeper, what rail trail do you visit most? Name______________________________ State_______

Please state whether you **Strongly Agree, Agree, Disagree,** or are **Uncertain** about the following 6 statements:

1. It is important to maintain the Creeper in good condition to continue to **attract visitors** to the region. SA A D U

2. A **use fee** for the Creeper would be a good way to provide funds for maintenance/improvements. SA A D U

3. **Local tax revenues** should be used to help fund maintenance on the Creeper. SA A D U

4. **Volunteer groups** should be the main source of maintenance on the Creeper. SA A D U

5. I am concerned that **crowding** will affect the quality of my future visits to the Creeper. SA A D U

6. **Electric golf carts** should be allowed for **disabled users** of the Creeper. SA A D U

We would like to ask you about your ESTIMATED EXPENSES for this trip to the Creeper. The information will be used to calculate the economic effects of rail trails on state and local economies.

1) How many nights total will you be away from home on this trip? _____________ nights

2) How many, including yourself, are in your spending party? _____________ people

In **Column A** below, estimate spending by your party **within 25 miles of the Creeper Trail**. In **Column B** estimate spending by your party **for your whole trip**.

Note: If your trip is not yet complete, include what you expect to pay where appropriate. For example, if you spent $10 on gas to get here and you need another $10 worth of gas to get home, enter $20 for gas. Remember to report all spending for your party (e.g., family, scout group, friends sharing expenses, or just yourself) and include the correct number of people for your spending party.

	A. Spending by your party within 25 miles of Creeper Trail	B. Spending by your party for the whole trip
Lodging:		
Privately owned (motel, cottage, bed & breakfast)	_______	_______
Publicly owned (state or FS campgrounds)	_______	_______
Food & Beverage:		
Food and drinks consumed at restaurants or bars	_______	_______
Other food and drinks (carry-out, groceries)	_______	_______
Transportation:		
Gasoline, oil, repairs	_______	_______
Other transportation (tolls, airfare, vehicle rental)	_______	_______
Trail Related:		
Bicycle rentals or service	_______	_______
Shuttle or guide service	_______	_______
Trail use, entry, or parking fees	_______	_______
Any other expenses:		
Other services or equipment	_______	_______

DEMOGRAPHIC INFORMATION

1. How many people, including yourself, are in your household? ___________________

2. How many people, including yourself, in your household use the Creeper? ___________________

3. What is the highest level of education in your household? A. High school B. College C. Other ________

4. What is your age? A. 16-25 B. 26-35 C. 36-45 D. 46-55 E. 56-65 F. 65 plus

5. What is your employment status? (circle all)
A. Student B. Employed C. Retired D. Part-time E. Not currently employed

6. Which interval represents your annual household income? A. Under $40,000 B. $40,000 - $80,000
C. $80,000 - $120,000 D. More than $120,000 E. Prefer not to answer this question

Appendix B – Expenditure Profiles

4/12/04

Primary_Dayuse Trimmed n=169

Race and Gender

RACE	99.34% White	MALE	68.87%	FEMALE	31.13%

Site entering VCT

ENTER	Frequency	Percent	Cum. Percent
Whitetop	74	44.05	44.05
Damascus	37	22.02	66.07
Abingdon	25	14.88	80.95
Straight Branch	15	8.93	89.88
Alvarado	5	2.98	92.86
Watauga	4	2.38	95.24
Green Cove	4	2.38	97.62
Creek Jctn	3	1.79	99.40
Taylor's Valley	1	0.60	100.00
Total	168	100.00%	

Primary Activity

ACTIV	Frequency	Percent	Cum. Percent
Biking	143	84.62	84.62
Walking	19	11.24	95.86
Jogging	3	1.78	97.63
Other	2	1.18	98.82
Horse Ride	1	0.59	99.41
Fishing	1	0.59	100.00
Total	169	100.00%	

Time and Distance spent on VCT

	n	Mean	Median	Standard Deviation	Max
TIMESP	168	191.67	180	82.60	480
DIST	165	19.22	17	10.83	61

Time is in minutes and distance in miles

Per Trip VCT Use

CRUSE	Frequency	Percent	Cum. Percent
1	158	95.18	95.18
2	2	1.20	96.39
4	2	1.20	97.59
5	2	1.20	98.80
6	1	0.60	99.40
10	1	0.60	100.00
Total	166	100.00%	

Mean= 1.18, Median= 1, Standard Deviation= 0.96, Max= 10

Number in group and Visits to VCT

	n	Mean	Median	Standard Deviation	Max
NUM	167	3.46	3	2.73	15
CRVISITIS	168	6.80	2.5	14.63	150

Creeper visits represent number of annual trips.

Travel time and Distance to VCT

	n	Mean	Median	Standard Deviation	Max
DISTANCE	165	121.15	91.2	121.94	987
TIMETO	165	142.58	125	125.37	1042

Distance is in miles and time in minutes.

Household Size

HOUSE	Frequency	Percent	Cum. Percent
2	68	41.21	41.21
4	37	22.42	63.64
3	34	20.61	84.24
1	11	6.67	90.91
5	9	5.45	96.36
6	5	3.03	99.39
8	1	0.61	100.00
Total	165	100.00%	

Mean= 2.90, Median= 3, Standard Deviation= 1.24, Max= 8

Number in household using the Creeper

HOUSECR	Frequency	Percent	Cum. Percent
2	80	48.78	48.78
3	29	17.68	66.46
1	24	14.63	81.10
4	21	12.80	93.90
5	6	3.66	97.56
6	4	2.44	100.00
Total	164	100.00%	

Mean= 2.49, Median= 2, Standard Deviation= 1.14, Max= 6

Education Level

EDU	Frequency	Percent	Cum. Percent
College	119	71.26	71.26
Other	35	20.96	92.22
High School	13	7.78	100.00
Total	167		100.00%

Respondents Age

AGE	Frequency	Percent	Cum. Percent
46-55	54	32.73	32.73
36-45	42	25.45	58.18
56-65	29	17.58	75.76
26-35	22	13.33	89.09
16-25	10	6.06	95.15
over 65	8	4.85	100.00
Total	165	100.00%	

Mean= 46.19, Median= 50.5

Employment Status

EMPLOY	Frequency	Percent	Cum. Percent
Employed	131	78.44	78.44
Retired	21	12.57	91.02
Student	8	4.79	95.81
Not working	4	2.40	98.20
Part time	3	1.80	100.00
Total	167	100.00%	

Income Level

INCOME	Frequency	Percent	Cum. Percent
$40,000-80,000	67	40.85	40.85
$80,000-120,000	32	19.51	60.37
> $120,000	19	11.59	90.85
< $40,000	15	9.15	100.00
Total	133	81.10%	

Mean= $75,827 Median= $60,000   Prefer not to answer= 31, 18.90%

Nights away from home

NIGHTS	Frequency	Percent	Cum. Percent
0	145	88.96	88.96
3	8	4.91	93.87
1	2	1.23	95.09
2	2	1.23	96.32
4	2	1.23	97.55
10	2	1.23	98.77
7	1	0.61	99.39
8	1	0.61	100.00
Total	163	100.00%	

Mean= 0.44, Median= 0, Standard Deviation= 1.56, Max= 10

Number in Spending Party

SPEND	Frequency	Percent	Cum. Percent
2	54	33.13	33.13
1	30	18.40	51.53
4	27	16.56	68.10
3	24	14.72	82.82
5	7	4.29	87.12
6	7	4.29	91.41
8	3	1.84	93.25
10	3	1.84	95.09
15	3	1.84	96.93
7	1	0.61	97.55
9	1	0.61	98.16
11	1	0.61	98.77
12	1	0.61	99.39
13	1	0.61	100.00
Total	163	100.00%	

Mean= 3.34, Median= 2, Standard Deviation= 2.74, Max= 15

Spending Party Expenditures n=164

Expenditure type	w/in 25 miles	entire trip	per person w/in 25 miles expenditure	per person per trip expenditure
Private lodging	0.00	14.69	0.00	4.39
Public lodging	0.00	0.09	0.00	0.02
Food in restaurants	21.29	38.13	6.37	11.41
Carry out food	2.65	6.49	0.79	1.94
Primary transportation	11.42	18.68	3.41	5.59
Other transportation	0.06	0.06	0.01	0.01
Bike rentals	11.68	12.98	3.49	3.88
Shuttle/guide	9.17	10.51	2.74	3.14
Use fees	0.14	0.14	0.04	0.04
Other expenses	0.89	1.42	0.26	0.42
Total	57.32	103.22	17.16	30.90

Primary_OvernightTrimmed n=147

Race and Gender

RACE	100.00% White	MALE	59.84%	FEMALE	40.16%

Site entering VCT

ENTER	Frequency	Percent	Cum. Percent
Whitetop	97	65.99	65.99
Damascus	20	13.61	79.59
Abingdon	16	10.88	90.48
Straight Branch	7	4.76	95.24
Creek Jctn	4	2.72	97.96
Watauga	1	0.68	98.64
Green Cove	1	0.68	99.32
Other	1	0.68	100.00
Total	147	100.00%	

Primary Activity

ACTIV	Frequency	Percent	Cum. Percent
Biking	132	89.80	89.80
Walking	9	6.12	95.92
Fishing	2	1.36	97.28
Other	2	1.36	98.64
Jogging	1	0.68	99.32
Camping	1	0.68	100.00
Total	147	100.00%	

Time and Distance spent on VCT

	n	Mean	Median	Standard Deviation	Max
TIMESP	147	197.71	180	95.60	540
DIST	142	20.44	17	11.33	80

Time is in minutes and distance in miles

Per Trip VCT Use

CRUSE	Frequency	Percent	Cum. Percent
1	82	56.16	56.16
2	45	30.82	86.99
3	10	6.85	93.84
4	4	2.74	96.58
14	2	1.37	97.95
5	1	0.68	98.63
6	1	0.68	99.32
8	1	0.68	100.00
Total	146	100.00%	

Mean= 1.81, Median= 1, Standard Deviation= 0.76, Max= 14

Number in group and Visits to VCT

	n	Mean	Median	Standard Deviation	Max
NUM	146	4.67	2	6.50	46
CRVISITIS	146	2.21	1	4.74	50

Creeper visits represent number of annual trips.

Travel time and Distance to VCT

	n	Mean	Median	Standard Deviation	Max
DISTANCE	144	255.32	197.9	162.23	913.8
TIMETO	144	277.42	230.0	153.87	868.0

Distance is in miles and time in minutes.

Nights spent at the VCT

NIGHTC	Frequency	Percent	Cum. Percent
2	68	46.26	46.26
1	36	24.49	70.75
3	27	18.37	89.12
4	9	6.12	95.24
5	3	2.04	97.28
14	2	1.36	98.64
6	1	0.68	99.32
8	1	0.68	100.00
Total	147	100.00%	

Mean= 2.35, Median= 2, Standard Deviation= 1.75, Max= 14

Lodging Type

LODG	Frequency	Percent	Cum. Percent
Motel/Hotel	50	34.72	34.72
Gov. Camp	36	25.00	59.72
B&B	22	15.28	75.00
Cottages	16	11.11	86.11
Private Camp	14	9.72	95.83
Private Home	4	2.78	98.61
Trail Camp	1	0.69	99.31
Other	1	0.69	100.00
Total	144	100.00%	

Nights away from home

NIGHTS	Frequency	Percent	Cum. Percent
2	55	37.67	37.67
1	28	19.18	56.85
3	28	19.18	76.03
4	15	10.27	86.30
5	6	4.11	90.41
8	4	2.74	93.15
0	2	1.37	94.52
7	2	1.37	95.89
14	2	1.37	97.26
6	1	0.68	97.95
10	1	0.68	98.63
13	1	0.68	99.32
15	1	0.68	100.00
Total	146	100.00%	

Mean= 2.94, Median= 2, Standard Deviation= 2.49, Max= 15

Household Size

HOUSE	Frequency	Percent	Cum. Percent
2	56	39.44	39.44
4	35	24.65	64.08
3	23	16.20	80.28
5	13	9.15	89.44
1	11	7.75	97.18
6	4	2.82	100.00
Total	142	100.00%	

Mean= 2.96, Median= 3, Standard Deviation= 1.25, Max= 6

Number in household using the Creeper

HOUSECR	Frequency	Percent	Cum. Percent
2	81	57.04	57.04
4	21	14.79	71.83
1	20	14.08	85.92
3	13	9.15	95.07
5	6	4.23	99.30
6	1	0.70	100.00
Total	142	100.00%	

Mean= 2.40, Median= 2, Standard Deviation= 1.07, Max= 6

Education Level

EDU	Frequency	Percent	Cum Percent
College	98	69.50	69.50
Other	34	24.11	93.62
High School	9	6.38	100.00
Total	141	100.00%	

Respondents Age

AGE	Frequency	Percent	Cum. Percent
46-55	51	35.42	35.42
36-45	47	32.64	68.06
56-65	18	12.50	80.56
26-35	15	10.42	90.97
>65	7	4.86	95.83
16-25	6	4.17	100.00
Total	144	100.00%	

Mean= 46, Median= 46

Employment Status

EMPLOY	Frequency	Percent	Cum. Percent
Employed	121	83.45	83.45
Retired	13	8.97	92.41
Student	7	4.83	97.24
Not Employed	4	2.76	100.00
Total	145	100.00%	

Income Level

INCOME	Frequency	Percent	Cum. Percent
$40,000-80,000	42	30.22	30.22
$80,000-120,000	41	29.50	59.72
>$120,000	30	21.58	81.30
<$40,000	10	7.19	88.49
Total	123	88.49%	

Mean= $88,373 Median= $80,000 Prefer not to answer= 16, 11.51%

Number in Spending Party

SPEND	Frequency	Percent	Cum. Percent
2	73	50.69	50.69
4	24	16.67	67.36
3	12	8.33	75.69
5	7	4.86	80.56
1	6	4.17	84.72
7	4	2.78	87.50
17	3	2.08	89.58
6	2	1.39	90.97
8	2	1.39	92.36
21	2	1.39	93.75
23	2	1.39	95.14
9	1	0.69	95.83
11	1	0.69	96.53
13	1	0.69	97.22
14	1	0.69	97.92
20	1	0.69	98.61
22	1	0.69	99.31
45	1	0.69	100.00
Total	144	100.00%	

Mean= 4.5, Median= 2, Standard Deviation= 5.75, Max= 45

Spending Party Expenditures n=146

Expenditure type	w/in 25 miles	entire trip	per person w/in 25 miles expenditure	per person per trip expenditure
Private lodging	126.95	211.86	28.21	47.08
Public lodging	22.29	29.30	4.95	6.51
Food in restaurants	99.43	137.02	22.09	30.44
Carry out food	27.69	40.02	6.15	8.89
Primary transportation	36.45	61.50	8.10	13.66
Other transportation	1.90	2.53	0.42	0.56
Bike rentals	17.28	18.44	3.84	4.09
Shuttle/guide	19.26	20.95	4.28	4.65
Use fees	0.00	0.00	0.00	0.00
Other expenses	17.56	18.32	3.90	4.07
Total	369.47	539.34	82.10	119.85

NonPrimary_Dayuse n=23

Race and Gender

RACE	100% White	MALE	83.3%	FEMALE	16.67%

Site entering VCT

ENTER	Frequency		Percent	Cum. Percent
Whitetop	10	43.48	10	43.48
Abingdon	6	26.09	16	69.57
Creek Jctn	4	17.39	20	86.96
Damascus	2	8.70	22	95.65
Straight Br	1	4.35	23	100.00
Total	23		100.00%	

Primary Activity

ACTIV	Frequency	Percent	Cum. Percent
Biking	13	59.09	59.09
Walking	7	31.82	90.91
Fishing	2	9.09	100.00
Total	22	100.00%	

Time and Distance spent on VCT

	n	Mean	Median	Standard Deviation	Max
TIMESP	23	139.13	135	87.7	300
DIST	23	11.17	17	9.06	28

Time is in minutes and distance in miles

Per Trip VCT Use

CRUSE	Frequency	Percent	Cum. Percent
1	20	90.91	90.91
2	1	4.55	95.45
3	1	4.55	100.00
Total	22	100.00%	

Mean= 1.13, Median= 1, Standard Deviation= 0.46, Max= 3

Number in group and Visits to VCT

	n	Mean	Median	Standard Deviation	Max
NUM	23	4.52	4	3.92	17
CRVISITIS	23	7.52	1	19.68	85

Creeper visits represent number of annual trips.

Travel time and Distance to VCT

	n	Mean	Median	Standard Deviation	Max
DISTANCE	24	317.65	289	284.61	1125
TIMETO	24	333.82	256	296.58	1237

Distance is in miles and time in minutes.

Household Size

HOUSE	Frequency	Percent	Cum. Percent
2	8	34.78	34.78
3	4	17.39	52.17
4	4	17.39	69.57
7	3	13.04	82.61
5	2	8.70	91.30
1	1	4.35	95.65
6	1	4.35	100.00
Total	23	100.00%	

Mean= 3.56, Median= 3, Standard Deviation= 1.82, Max= 7

Number in household using the Creeper

HOUSECR	Frequency	Percent	Cum. Percent
2	9	39.13	39.13
1	4	17.39	56.52
3	3	13.04	69.57
4	3	13.04	82.61
7	2	8.70	91.30
5	1	4.35	95.65
6	1	4.35	100.00
Total	23	100.00%	

Mean= 2.95, Median= 2, Standard Deviation= 1.82, Max= 7

Education Level

EDU	Frequency	Percent	Cum. Percent
College	15	65.22	65.22
Other	6	26.09	91.30
High School	2	8.70	100.00
Total	23	100.00%	

Respondents Age

AGE	Frequency	Percent	Cum. Percent
36-45	8	34.78	34.78
46-55	7	30.43	65.22
26-35	3	13.04	78.26
16-25	2	8.70	86.96
>65	2	8.70	95.65
56-65	1	4.35	100.00
Total	23	100.00%	

Mean= 43.97, Median= 46

Employment Status

EMPLOY	Frequency	Percent	Cum. Percent
Employed	19	82.61	82.61
Retired	3	13.04	95.65
Student	1	4.35	100.00
Total	23	100.00%	

Income Level

INCOME	Frequency	Percent	Cum.Percent
$80,000-120,000	7	30.43	30.43
>$120,000	7	30.43	60.96
<$40,000	4	17.39	78.25
$40,000-80,000	2	8.70	86.95
Total	20	86.95%	

Mean= $92,250, Median= $100,000   Prefer not to answer= 3, 13.05%

Nights away from home

NIGHTS	Frequency	Percent	Cum. Percent
0	8	34.78	34.78
4	3	13.04	47.83
2	2	8.70	56.52
10	2	8.70	65.22
14	2	8.70	73.91
1	1	4.35	78.26
3	1	4.35	82.61
5	1	4.35	86.96
6	1	4.35	91.30
7	1	4.35	95.65
9	1	4.35	100.00
Total	23	100.00%	

Mean= 4.13, Median= 3, Standard Deviation= 4.55, Max= 14

Number in Spending Party

SPEND	Frequency	Percent	Cum. Percent
2	7	30.43	30.43
1	5	21.74	52.17
4	4	17.39	69.57
3	1	4.35	73.91
5	1	4.35	78.26
6	1	4.35	82.61
9	1	4.35	86.96
11	1	4.35	91.30
13	1	4.35	95.65
17	1	4.35	100.00
Total	23	100.00%	

Mean= 4.30, Median= 2, Standard Deviation= 4.26, Max= 17

Spending Party Expenditures n=23

Expenditure type	w/in 25 miles	entire trip	per person share w/in 25 miles expenditure	per person share per trip expenditure
Private lodging	0.00	165.13	0.00	6.63
Public lodging	0.00	31.18	0.00	1.38
Food in restaurants	51.00	154.18	3.71	7.00
Carry out food	5.90	23.63	0.19	1.09
Primary transportation	59.00	82.18	4.86	5.71
Other transportation	0.00	72.72	0.00	2.73
Bike rentals	47.13	47.13	2.66	2.66
Shuttle/guide	3.90	3.90	0.13	0.13
Use fees	0.00	0.18	0.00	0.00
Other expenses	54.81	100.95	0.76	2.66
Total	162.74	681.18	12.31	30.05

4/14/04

NonPrimary_OvernightTrimmed n=94

Race and Gender

RACE	98.72% White	MALE	63.29%	FEMALE	36.71%

Site entering VCT

ENTER	Frequency	Percent	Cum. Percent
Whitetop	36	38.30	38.30
Abingdon	34	36.17	74.47
Damascus	9	9.57	84.04
Straight Branch	6	6.38	90.43
Watauga	3	3.19	93.62
Creek Jctn	3	3.19	96.81
Alvarado	1	1.06	97.87
Green Cove	1	1.06	98.94
Other	1	1.06	100.00
Total	94	100.00%	

Primary Activity

ACTIV	Frequency	Percent	Cum. Percent
Biking	51	54.26	54.26
Walking	39	41.49	95.74
Jogging	3	3.19	98.94
Other	1	1.06	100.00
Total	94	100.00%	

Time and Distance spent on VCT

	n	Mean	Median	Standard Deviation	Max
TIMESP	94	120.85	120	85.26	480
DIST	94	10.90	9	9.01	36

Time is in minutes and distance in miles

Per Trip VCT Use

CRUSE	Frequency	Percent	Cum. Percent
1	55	58.51	58.51
2	24	25.53	84.04
4	4	4.26	88.30
3	3	3.19	91.49
10	3	3.19	94.68
6	2	2.13	96.81
7	1	1.06	97.87
11	1	1.06	98.94
20	1	1.06	100.00
Total	94	100.00%	

Mean= 2.21, Median= 1, Standard Deviation= 2.78, Max= 20

Number in group and Visits to VCT

	n	Mean	Median	Standard Deviation	Max
NUM	94	3.23	2	3.36	20
CRVISITIS	94	2.08	1	2.69	15

Creeper visits represent number of annual trips.

Travel time and Distance to VCT

	n	Mean	Median	Standard Deviation	Max
DISTANCE	93	484.7	309	542.53	2690.0
TIMETO	93	495.3	325	523.88	3048

Distance is in miles and time in minutes.

Lodging Type

LODG	Frequency	Percent	Cum. Percent
Private Home	29	31.18	31.18
Motel/Hotel	25	26.88	58.06
Gov. Camp	13	13.98	72.04
B&B	7	7.53	79.57
Trail Camp	7	7.53	87.10
Other	5	5.38	92.47
Cottages	4	4.30	96.77
Private Camp	3	3.23	100.00
Total	93	100.00%	

Household Size

HOUSE	Frequency	Percent	Cum. Percent
2	46	49.46	49.46
4	16	17.20	66.67
5	13	13.98	80.65
3	11	11.83	92.47
1	6	6.45	98.92
11	1	1.08	100.00
Total	93	100.00%	

Mean= 2.91, Median= 2, Standard Deviation= 1.47, Max= 11

Number in household using the Creeper

HOUSECR	Frequency	Percent	Cum. Percent
2	41	45.56	45.56
1	31	34.44	80.00
4	9	10.00	90.00
5	5	5.56	95.56
3	4	4.44	100.00
Total	90	100.00%	

Mean= 2.06, Median= 2, Standard Deviation= 1.13, Max= 5

Education Level

EDU	Frequency	Percent	Cum. Percent
College	57	61.29	61.29
Other	30	32.26	93.55
High School	6	6.45	100.00
Total	93	100.00%	

Respondents Age

AGE	Frequency	Percent	Cum. Percent
46-55	29	31.52	31.52
56-65	27	29.35	60.87
36-45	22	23.91	84.78
>65	8	8.70	93.48
16-25	4	4.35	97.83
26-35	2	2.17	100.00
Total	92	100.00%	

Mean= 51, Median= 46

Employment Status

EMPLOY	Frequency	Percent	Cum. Percent
Employed	68	73.12	73.12
Retired	13	13.98	87.10
Part time	6	6.45	93.55
Student	3	3.23	96.77
Not working	3	3.23	100.00
Total	93	100.00%	

Income Level

INCOME	Frequency	Percent	Cum. Percent
$40,000-80,000	30	32.61	32.61
$80,000-120,000	27	29.35	61.96
>$120,000	14	15.22	77.18
<$40,000	6	6.52	83.70
Total	77		83.70%

Mean= $84,545 Median= $80,000 Prefer not to answer= 15, 16.30%

Nights away from home

NIGHTS	Frequency	Percent	Cum. Percent
2	17	18.48	18.48
3	14	15.22	33.70
4	11	11.96	45.65
6	10	10.87	56.52
5	8	8.70	65.22
7	8	8.70	73.91
1	7	7.61	81.52
10	4	4.35	85.87
8	2	2.17	88.04
14	2	2.17	90.22
9	1	1.09	91.30
15	1	1.09	92.39
21	1	1.09	93.48
22	1	1.09	94.57
28	1	1.09	95.65
30	1	1.09	96.74
35	1	1.09	97.83
60	1	1.09	98.91
73	1	1.09	100.00
Total	92	100.00%	

Mean= 7.17, Median= 4, Standard Deviation= 10.78, Max= 73

Nights spent at the VCT

NIGHTC	Frequency	Percent	Cum. Percent
2	25	27.17	27.17
1	15	16.30	43.48
3	14	15.22	58.70
4	10	10.87	69.57
7	9	9.78	79.35
5	8	8.70	88.04
6	5	5.43	93.48
14	3	3.26	96.74
9	2	2.17	98.91
10	1	1.09	100.00
Total	92	100.00%	

Mean= 3.80, Median= 3, Standard Deviation= 2.85, Max= 14

Number in Spending Party

SPEND	Frequency	Percent	Cum. Percent
2	43	47.25	46.25
1	18	19.78	67.03
4	9	9.89	76.92
5	6	6.59	83.52
3	5	5.49	89.01
20	3	3.30	92.31
7	2	2.20	94.51
6	1	1.10	95.60
8	1	1.10	96.70
11	1	1.10	97.80
12	1	1.10	98.90
14	1	1.10	100.00
Total	91	100.00%	

Mean= 3.40 Median= 2, Standard Deviation= 3.84, Max= 20

Spending Party Expenditures n=94

Expenditure type	w/in 25 miles	entire trip	per person share w/in 25 miles expenditure	per person share per trip expenditure
Private lodging	125.17	175.53	2.50	4.40
Public lodging	46.19	47.89	0.27	0.30
Food in restaurants	97.32	120.51	2.07	2.79
Carry out food	17.23	28.19	0.25	0.62
Primary transportation	44.73	100.51	0.80	1.74
Other transportation	6.80	29.19	0.02	0.15
Bike rentals	17.25	17.59	0.38	0.41
Shuttle/guide	8.50	9.03	0.21	0.22
Use fees	0.00	1.06	0.00	0.00
Other expenses	3.40	3.93	0.45	0.47
Total	366.59	533.43	7.02	11.15

* Per person expenditures have the timeshare applied. Where timeshare is total trail time over total time spent in the local area. Time share equals .09

Appendix C – Travel Cost Output

```
--> DSTAT;RHS=TRIPS,tc0,sub,incometc,dtrip,agenu,housecr,activdum,gendum$
Descriptive Statistics
All results based on nonmissing observations.
===============================================================================
Variable        Mean         Std.Dev.        Minimum         Maximum      Cases
===============================================================================
-------------------------------------------------------------------------------
All observations in current sample
-------------------------------------------------------------------------------
TRIPS     60.4781765      99.9999284      1.00000000      365.000000       1031
TC0       40.6398523      74.0016878      .262000000E-01  719.714000       1033
SUB       .405241935      .491186440      .000000000      1.00000000        992
INCOMETC  49619.6524      42993.8985      .000000000      135000.000       1496
DTRIP     .259012016      .438238517      .000000000      1.00000000       1498
AGENU     32.0280374      24.9355458      .000000000      71.0000000       1498
HOUSECR   2.36669970      1.27798868      1.00000000      9.00000000       1009
ACTIVDUM  .688918558      .463090637      .000000000      1.00000000       1498
GENDUM    .578771696      .493920920      .000000000      1.00000000       1498

--> REJECT; INCOMETC<20,000$
--> REJECT; AGENU<21$
--> reject; PRIM<1$
--> SKIP
--> DSTAT;RHS=TRIPS,tc0,sub,incometc,dtrip,agenu,housecr,activdum,gendum$
Descriptive Statistics
All results based on nonmissing observations.
===============================================================================
Variable        Mean         Std.Dev.        Minimum         Maximum      Cases
===============================================================================
-------------------------------------------------------------------------------
All observations in current sample
-------------------------------------------------------------------------------
TRIPS     71.5268817      105.429519      1.00000000      365.000000        837
TC0       25.7565026      39.5308701      .262000000E-01  294.226000        840
SUB       .374074074      .484181870      .000000000      1.00000000        810
INCOMETC  70302.3810      32614.1380      20000.0000      135000.000        840
DTRIP     .446428571      .497417988      .000000000      1.00000000        840
AGENU     47.2142857      13.6516088      21.0000000      71.0000000        840
HOUSECR   2.39109507      1.23107070      1.00000000      9.00000000        831
ACTIVDUM  .563095238      .496298519      .000000000      1.00000000        840
GENDUM    .540476190      .498655892      .000000000      1.00000000        840
Correlation Matrix for Listed Variables

            TRIPS      TC0      SUB INCOMETC    DTRIP    AGENU  HOUSECR ACTIVDUM
   TRIPS  1.00000  -.39855  -.33801  -.27323   .70201   .11939  -.04636  -.43704
     TC0  -.39855  1.00000   .41635   .28271  -.53018   .00303   .01351   .42733
     SUB  -.33801   .41635  1.00000   .24993  -.48209   .01161   .02820   .37679
INCOMETC  -.27323   .28271   .24993  1.00000  -.32261   .01951   .18969   .27767
   DTRIP   .70201  -.53018  -.48209  -.32261  1.00000   .08701  -.03597  -.53947

   AGENU   .11939   .00303   .01161   .01951   .08701  1.00000  -.18953  -.06049
 HOUSECR  -.04636   .01351   .02820   .18969  -.03597  -.18953  1.00000   .06651
ACTIVDUM  -.43704   .42733   .37679   .27767  -.53947  -.06049   .06651  1.00000

            TRIPS      TC0      SUB INCOMETC    DTRIP    AGENU  HOUSECR ACTIVDUM
  GENDUM  -.02760   .02599   .03564  -.01593  -.01438   .04413  -.03150   .06903

           GENDUM
  GENDUM  1.00000
```

```
--> regress; lhs=trips; rhs=ONE,tc0,sub,incometc,dtrip,agenu,housecr,activdum...

 ************************************************************************
 * NOTE: Deleted     39 observations with missing data. N is now    801 *
 ************************************************************************
+-----------------------------------------------------------------------+
| Ordinary    least squares regression    Weighting variable = none     |
| Dep. var. = TRIPS    Mean=   72.63171036    , S.D.=   104.9113456     |
| Model size: Observations =     801, Parameters =   9, Deg.Fr.=    792 |
| Residuals:  Sum of squares= 4370673.014    , Std.Dev.=       74.28679 |
| Fit:        R-squared=  .503621, Adjusted R-squared =          .49861 |
| Model test: F[  8,    792] =  100.44,    Prob value =          .00000 |
| Diagnostic: Log-L =  -4582.6987, Restricted(b=0) Log-L =   -4863.2151 |
|             LogAmemiyaPrCrt.=    8.627, Akaike Info. Crt.=     11.465 |
| Autocorrel: Durbin-Watson Statistic =   1.85080,   Rho =       .07460 |
+-----------------------------------------------------------------------+
+---------+-------------+----------------+--------+---------+----------+
|Variable | Coefficient  | Standard Error |b/St.Er.|P[|Z|>z] | Mean of X|
+---------+-------------+----------------+--------+---------+----------+
 Constant     8.919296092       13.979376      .638   .5235
 TC0      -.6186831858E-01  .82314301E-01    -.752   .4523     25.011972
 SUB          3.978936553       6.4186240      .620   .5353     .37328340
 INCOMETC -.1501045633E-03  .88170755E-04   -1.702   .0887     70340.824
 DTRIP        134.4818695       7.1704980   18.755   .0000     .46192260
 AGENU        .4714179310       .19864900    2.373   .0176     47.317104
 HOUSECR   .9458915199E-01      2.2033309      .043   .9658     2.3995006
 ACTIVDUM    -15.03928771       6.5043895   -2.312   .0208     .55680400
 GENDUM      -3.567485491       5.2975449    -.673   .5007     .54556804
 (Note: E+nn or E-nn means multiply by 10 to + or -nn power.)

--> regress; lhs=log(trips); rhs=ONE,tc0,sub,incometc,dtrip,agenu,housecr,act...

 ************************************************************************
 * NOTE: Deleted     39 observations with missing data. N is now    801 *
 ************************************************************************
+-----------------------------------------------------------------------+
| Ordinary    least squares regression    Weighting variable = none     |
| Dep. var. = LOGTRIPS Mean=   2.679425737    , S.D.=   2.112510333     |
| Model size: Observations =     801, Parameters =   9, Deg.Fr.=    792 |
| Residuals:  Sum of squares= 555.1605771    , Std.Dev.=         .83723 |
| Fit:        R-squared=  .844500, Adjusted R-squared =          .84293 |
| Model test: F[  8,    792] =  537.66,    Prob value =          .00000 |
| Diagnostic: Log-L =   -989.7451, Restricted(b=0) Log-L =   -1735.1189 |
|             LogAmemiyaPrCrt.=    -.344, Akaike Info. Crt.=      2.494 |
| Autocorrel: Durbin-Watson Statistic =   1.95466,   Rho =       .02267 |
+-----------------------------------------------------------------------+
+---------+-------------+----------------+--------+---------+----------+
|Variable | Coefficient  | Standard Error |b/St.Er.|P[|Z|>z] | Mean of X|
+---------+-------------+----------------+--------+---------+----------+
 Constant     1.649883067       .15755164   10.472   .0000
 TC0      -.9258369645E-02  .92770617E-03   -9.980   .0000     25.011972
 SUB       .7532241729E-02  .72339764E-01     .104   .9171     .37328340
 INCOMETC -.2661424339E-05  .99371012E-06   -2.678   .0074     70340.824
 DTRIP        3.162571883   .80813603E-01   39.134   .0000     .46192260
 AGENU     .3051631448E-02  .22388321E-02    1.363   .1729     47.317104
 HOUSECR   .1484756466E-01  .24832182E-01     .598   .5499     2.3995006
 ACTIVDUM    -.3760173796   .73306366E-01   -5.129   .0000     .55680400
 GENDUM    .2564544655E-01  .59704876E-01     .430   .6675     .54556804
 (Note: E+nn or E-nn means multiply by 10 to + or -nn power.)
```

```
Poisson;Lhs=TRIPS;Rhs=ONE,tc0,sub,incometc,dtrip,agenu,housecr,activdum,g...
                        model=n;Limit=0;Truncation; keep=yfit$
************************************************************************
 * NOTE: Deleted     39 observations with missing data. N is now    801 *
 ************************************************************************
+---------------------------------------------+
| Poisson Regression                          |
| Maximum Likelihood Estimates                |
| Model estimated: May 27, 2004 at 07:50:32PM.|
| Dependent variable                TRIPS     |
| Weighting variable                 None     |
| Number of observations              801     |
| Iterations completed                  6     |
| Log likelihood function       -15909.71     |
| Restricted log likelihood     -53498.88     |
| Chi squared                    75178.35     |
| Degrees of freedom                    8     |
| Prob[ChiSqd > value] =        .0000000      |
| LEFT  Truncated data, at Y =  0.            |
| Chi- squared = 29278.62462  RsqP=   .7585   |
| G  - squared = 28213.01893  RsqD=   .7270   |
| Overdispersion tests: g=mu(i)  : 14.361     |
| Overdispersion tests: g=mu(i)^2: 21.744     |
+---------------------------------------------+
+---------+--------------+----------------+--------+---------+----------+
|Variable | Coefficient  | Standard Error |b/St.Er.|P[|Z|>z] | Mean of X|
+---------+--------------+----------------+--------+---------+----------+
 Constant     2.186887046   .34154225E-01   64.030   .0000
 TC0      -.2609656003E-01  .79529788E-03  -32.814   .0000     25.011972
 SUB          .1259236867   .12569985E-01   10.018   .0000     .37328340
 INCOMETC -.2019387507E-05  .14244652E-06  -14.176   .0000     70340.824
 DTRIP        2.815356296   .27898581E-01  100.914   .0000     .46192260
 AGENU     .4658193884E-02  .28307534E-03   16.456   .0000     47.317104
 HOUSECR  -.2337531835E-02  .32472656E-02    -.720   .4716     2.3995006
 ACTIVDUM    -.1324138719   .10212053E-01  -12.966   .0000     .55680400
 GENDUM   -.2823316963E-01  .83745171E-02   -3.371   .0007     .54556804
 (Note: E+nn or E-nn means multiply by 10 to + or -nn power.)

Normal exit from iterations. Exit status=0.
+---------------------------------------------+
| Negative Binomial Regression                |
| Maximum Likelihood Estimates                |
| Model estimated: May 27, 2004 at 07:50:34PM.|
| Dependent variable                TRIPS     |
| Weighting variable                 None     |
| Number of observations              801     |
| Iterations completed                 20     |
| Log likelihood function       -3105.209     |
| Restricted log likelihood     -15909.71     |
| Chi squared                    25609.00     |
| Degrees of freedom                    1     |
| Prob[ChiSqd > value] =        .0000000      |
| LEFT  Truncated data, at Y =  0.            |
```

```
+---------+-------------+---------------+--------+---------+----------+
|Variable | Coefficient  | Standard Error |b/St.Er.|P[|Z|>z] | Mean of X|
+---------+-------------+---------------+--------+---------+----------+
 Constant     2.173146948       .15763121   13.786   .0000
 TC0      -.2350640647E-01  .11296083E-02  -20.809   .0000     25.011972
 SUB       .5462755329E-01  .68414812E-01     .798   .4246     .37328340
 INCOMETC -.2792024466E-05  .11049896E-05   -2.527   .0115     70340.824
 DTRIP        2.961122246   .85578696E-01   34.601   .0000     .46192260
 AGENU     .2285174543E-02  .23111046E-02     .989   .3228     47.317104
 HOUSECR   .1924185396E-02  .26107056E-01     .074   .9412     2.3995006
 ACTIVDUM    -.2909070090   .71666663E-01   -4.059   .0000     .55680400
 GENDUM       .1115589776   .60863027E-01    1.833   .0668     .54556804
          Dispersion parameter for count data model
 Alpha        .6360254348   .56781185E-01   11.201   .0000
 (Note: E+nn or E-nn means multiply by 10 to + or -nn power.)

--> MATRIX; B; VARB;
    BTC=PART(B,2,2);
    VBTC=PART(VARB,2,2,2,2) $
--> CREATE;
    CSBASE= -1/BTC;
    CSHYR= -Trips/BTC;
    CSHYRP= -YFIT/BTC;
    CSBPP=CSBASE/HOUSECR$
--> CALC; LIST;
    ECS=XBR(CSBASE);
    ECSYR=XBR(CShYR);
    ECShYRP = XBR(CShYRP);
    ECSBPP=XBR(CSBPP);
            VARCS=VBTC/(BTC^4);
    CS90L=(-1/BTC) -(1.64*VARCS^.5);
    CS90U=(-1/BTC)+(1.64*VARCS^.5)$
    ECS     =  .42541593972524110D+02
    ECSYR   =  .30428675602713320D+04
    ECSHYRP =  .31225839898230870D+04
    ECSBPP  =  .22783395120087310D+02
    VARCS   =  .41793695822069940D+01
    CS90L   =  .39188858905701400D+02
    CS90U   =  .45894329039347180D+02
Calculator: Computed   7 scalar results
--> CALC; LIST;
    AVTC=XBR(tc0);
    ELAS=BTC*AVTC $
    AVTC    =  .25756502619047700D+02
    ELAS    = -.60544281993012930D+00
Calculator: Computed   2 scalar results
```

```
SAMPLE; ALL$
--> DSTAT;RHS=TRIPS,tc4,sub,incometc,dtrip,agenu,housecr,activdum,gendum$
Descriptive Statistics
All results based on nonmissing observations.
==============================================================================
Variable        Mean         Std.Dev.        Minimum         Maximum      Cases
==============================================================================
------------------------------------------------------------------------------
All observations in current sample
------------------------------------------------------------------------------
TRIPS     60.4781765      99.9999284      1.00000000      365.000000       1031
TC4       64.4713381      122.421709      .158777778      1545.72830       1016
SUB       .405241935      .491186440      .000000000      1.00000000        992
INCOMETC  49619.6524      42993.8985      .000000000      135000.000       1496
DTRIP     .259012016      .438238517      .000000000      1.00000000       1498
AGENU     32.0280374      24.9355458      .000000000      71.0000000       1498
HOUSECR   2.36669970      1.27798868      1.00000000      9.00000000       1009
ACTIVDUM  .688918558      .463090637      .000000000      1.00000000       1498
GENDUM    .578771696      .493920920      .000000000      1.00000000       1498

--> REJECT; INCOMETC<20,000$
--> REJECT; AGENU<21$
--> reject; PRIM<1$
--> SKIP
--> DSTAT;RHS=TRIPS,tc4,sub,incometc,dtrip,agenu,housecr,activdum,gendum$
Descriptive Statistics
All results based on nonmissing observations.
==============================================================================
Variable        Mean         Std.Dev.        Minimum         Maximum      Cases
==============================================================================
------------------------------------------------------------------------------
All observations in current sample
------------------------------------------------------------------------------
TRIPS     71.5268817      105.429519      1.00000000      365.000000        837
TC4       41.2091637      64.8057662      .158777778      597.007500        835
SUB       .374074074      .484181870      .000000000      1.00000000        810
INCOMETC  70302.3810      32614.1380      20000.0000      135000.000        840
DTRIP     .446428571      .497417988      .000000000      1.00000000        840
AGENU     47.2142857      13.6516088      21.0000000      71.0000000        840
HOUSECR   2.39109507      1.23107070      1.00000000      9.00000000        831
ACTIVDUM  .563095238      .496298519      .000000000      1.00000000        840
GENDUM    .540476190      .498655892      .000000000      1.00000000        840

Correlation Matrix for Listed Variables

            TRIPS      TC4      SUB INCOMETC    DTRIP    AGENU  HOUSECR ACTIVDUM
   TRIPS  1.00000  -.38550  -.33767  -.27346   .70195   .12005  -.04530  -.43681
     TC4  -.38550  1.00000   .41935   .33482  -.51430   .02205  -.03365   .41974
     SUB  -.33767   .41935  1.00000   .25072  -.48135   .01000   .02490   .37592
INCOMETC  -.27346   .33482   .25072  1.00000  -.32317   .01992   .19106   .27818
   DTRIP   .70195  -.51430  -.48135  -.32317  1.00000   .08828  -.03365  -.53899
   AGENU   .12005   .02205   .01000   .01992   .08828  1.00000  -.19282  -.06168
 HOUSECR  -.04530  -.03365   .02490   .19106  -.03365  -.19282  1.00000   .06438
ACTIVDUM  -.43681   .41974   .37592   .27818  -.53899  -.06168   .06438  1.00000

            TRIPS      TC4      SUB INCOMETC    DTRIP    AGENU  HOUSECR ACTIVDUM
  GENDUM  -.02710   .01134   .03422  -.01558  -.01334   .04303  -.03400   .06808

           GENDUM
  GENDUM  1.00000
```

```
regress; lhs=trips; rhs=ONE,tc4,sub,incometc,dtrip,agenu,housecr,activdum...
************************************************************************
* NOTE: Deleted     40 observations with missing data. N is now    800 *
************************************************************************
+-----------------------------------------------------------------------+
| Ordinary    least squares regression    Weighting variable = none     |
| Dep. var. = TRIPS    Mean=   72.69125000    , S.D.=   104.9634345     |
| Model size: Observations =     800, Parameters =   9, Deg.Fr.=    791 |
| Residuals:  Sum of squares= 4371670.399    , Std.Dev.=       74.34221 |
| Fit:        R-squared=  .503380, Adjusted R-squared =          .49836 |
| Model test: F[  8,    791] =  100.22,    Prob value =          .00000 |
| Diagnostic: Log-L =  -4577.5684, Restricted(b=0) Log-L =   -4857.5402 |
|             LogAmemiyaPrCrt.=    8.629, Akaike Info. Crt.=     11.466 |
| Autocorrel: Durbin-Watson Statistic =   1.85060,   Rho =       .07470 |
+-----------------------------------------------------------------------+


+---------+-------------+---------------+--------+---------+----------+
|Variable | Coefficient  | Standard Error |b/St.Er.|P[|Z|>z] | Mean of X|
+---------+-------------+---------------+--------+---------+----------+
 Constant     8.695144665       13.987821      .622   .5342
 TC4      -.2997320059E-01  .50677921E-01    -.591   .5542     40.220770
 SUB          3.789525075       6.4363914      .589   .5560     .37250000
 INCOMETC -.1463725522E-03  .89407944E-04   -1.637   .1016     70353.750
 DTRIP        134.9911206       7.1102638   18.985   .0000     .46250000
 AGENU        .4687839600       .19913078    2.354   .0186     47.300000
 HOUSECR  -.2198972855E-01      2.2235556    -.010   .9921     2.3962500
 ACTIVDUM    -15.23478538       6.5052792   -2.342   .0192     .55625000
 GENDUM      -3.654902617       5.3042437    -.689   .4908     .54500000
 (Note: E+nn or E-nn means multiply by 10 to + or -nn power.)

--> regress; lhs=log(trips); rhs=ONE,tc4,sub,incometc,dtrip,agenu,housecr,act...

 ************************************************************************
 * NOTE: Deleted     40 observations with missing data. N is now    800 *
 ************************************************************************
+-----------------------------------------------------------------------+
| Ordinary    least squares regression    Weighting variable = none     |
| Dep. var. = LOGTRIPS Mean=   2.678751425    , S.D.=   2.113745632     |
| Model size: Observations =     800, Parameters =   9, Deg.Fr.=    791 |
| Residuals:  Sum of squares= 560.9588960    , Std.Dev.=         .84213 |
| Fit:        R-squared=  .842863, Adjusted R-squared =          .84127 |
| Model test: F[  8,    791] =  530.35,    Prob value =          .00000 |
| Diagnostic: Log-L =   -993.1652, Restricted(b=0) Log-L =   -1733.4198 |
|             LogAmemiyaPrCrt.=    -.332, Akaike Info. Crt.=      2.505 |
| Autocorrel: Durbin-Watson Statistic =   1.93959,   Rho =       .03020 |
+-----------------------------------------------------------------------+
+---------+-------------+---------------+--------+---------+----------+
|Variable | Coefficient  | Standard Error |b/St.Er.|P[|Z|>z] | Mean of X|
+---------+-------------+---------------+--------+---------+----------+
 Constant     1.631985589       .15844986   10.300   .0000
 TC4      -.5226112957E-02  .57406438E-03   -9.104   .0000     40.220770
 SUB      -.3863307457E-02  .72909524E-01    -.053   .9577     .37250000
 INCOMETC -.1847915732E-05  .10127865E-05   -1.825   .0681     70353.750
 DTRIP        3.210711728   .80542949E-01   39.863   .0000     .46250000
 AGENU     .2752924577E-02  .22556941E-02    1.220   .2223     47.300000
 HOUSECR  -.6440472768E-02  .25187775E-01    -.256   .7982     2.3962500
 ACTIVDUM    -.3906749785   .73689864E-01   -5.302   .0000     .55625000
 GENDUM    .1098979535E-01  .60084892E-01     .183   .8549     .54500000
 (Note: E+nn or E-nn means multiply by 10 to + or -nn power.)
```

```
Poisson;Lhs=TRIPS;Rhs=ONE,tc4,sub,incometc,dtrip,agenu,housecr,activdum,g...
                         model=n;Limit=0;Truncation; keep=yfit$

 ************************************************************************
 * NOTE: Deleted     40 observations with missing data. N is now    800 *
 ************************************************************************
+----------------------------------------------+
| Poisson Regression                           |
| Maximum Likelihood Estimates                 |
| Model estimated: May 27, 2004 at 07:52:56PM.|
| Dependent variable               TRIPS       |
| Weighting variable                None       |
| Number of observations             800       |
| Iterations completed                 7       |
| Log likelihood function       -15971.12      |
| Restricted log likelihood     -53475.36      |
| Chi squared                    75008.49      |
| Degrees of freedom                   8       |
| Prob[ChiSqd > value] =         .0000000      |
| LEFT  Truncated data, at Y =  0.             |
| Chi- squared = 29715.80226  RsqP=   .7546    |
| G  - squared = 28333.68526  RsqD=   .7257    |
| Overdispersion tests: g=mu(i)  : 13.266      |
| Overdispersion tests: g=mu(i)^2: 19.027      |
+----------------------------------------------+
+---------+--------------+----------------+--------+---------+----------+
|Variable | Coefficient  | Standard Error |b/St.Er.|P[|Z|>z] | Mean of X|
+---------+--------------+----------------+--------+---------+----------+
 Constant     2.135878101   .34221746E-01   62.413   .0000
 TC4      -.1564737122E-01  .50695844E-03  -30.865   .0000     40.220770
 SUB          .1281953571   .12608379E-01   10.167   .0000     .37250000
 INCOMETC -.1628686523E-05  .14327879E-06  -11.367   .0000     70353.750
 DTRIP        2.857196374   .28125051E-01  101.589   .0000     .46250000
 AGENU     .4860635484E-02  .28348998E-03   17.146   .0000     47.300000
 HOUSECR  -.8431476066E-02  .32712301E-02   -2.577   .0100     2.3962500
 ACTIVDUM    -.1413171384   .10207575E-01  -13.844   .0000     .55625000
 GENDUM   -.2960283116E-01  .83751915E-02   -3.535   .0004     .54500000
 (Note: E+nn or E-nn means multiply by 10 to + or -nn power.)

Normal exit from iterations. Exit status=0.
+----------------------------------------------+
| Negative Binomial Regression                 |
| Maximum Likelihood Estimates                 |
| Model estimated: May 27, 2004 at 07:52:58PM.|
| Dependent variable               TRIPS       |
| Weighting variable                None       |
| Number of observations             800       |
| Iterations completed                19       |
| Log likelihood function       -3108.317      |
| Restricted log likelihood     -15971.12      |
| Chi squared                    25725.61      |
| Degrees of freedom                   1       |
| Prob[ChiSqd > value] =         .0000000      |
| LEFT  Truncated data, at Y =  0.             |
```

```
+---------+-------------+---------------+--------+---------+----------+
|Variable | Coefficient  | Standard Error |b/St.Er.|P[|Z|>z] | Mean of X|
+---------+-------------+---------------+--------+---------+----------+
 Constant     2.164866409       .15992641   13.537   .0000
 TC4      -.1376742919E-01  .64328504E-03  -21.402   .0000     40.220770
 SUB       .2368818713E-01  .68495354E-01     .346   .7295     .37250000
 INCOMETC -.1814165180E-05  .11210026E-05   -1.618   .1056     70353.750
 DTRIP        3.010820316   .83480736E-01   36.066   .0000     .46250000
 AGENU     .2098143747E-02  .23546206E-02     .891   .3729     47.300000
 HOUSECR  -.2705290695E-01  .27166533E-01    -.996   .3193     2.3962500
 ACTIVDUM    -.3137841576   .71900663E-01   -4.364   .0000     .55625000
 GENDUM    .9990263300E-01  .62100762E-01    1.609   .1077     .54500000
          Dispersion parameter for count data model
 Alpha        .6449648816   .57790312E-01   11.160   .0000
 (Note: E+nn or E-nn means multiply by 10 to + or -nn power.)


--> MATRIX; B; VARB;
    BTC=PART(B,2,2);
    VBTC=PART(VARB,2,2,2,2) $
--> CREATE;
    CSBASE= -1/BTC;
    CSHYR= -Trips/BTC;
    CSHYRP= -YFIT/BTC;
    CSBPP=CSBASE/HOUSECR$
--> CALC; LIST;
    ECS=XBR(CSBASE);
    ECSYR=XBR(CShYR);
    ECShYRP = XBR(CShYRP);
    ECSBPP=XBR(CSBPP);
            VARCS=VBTC/(BTC^4);
    CS90L=(-1/BTC) -(1.64*VARCS^.5);
    CS90U=(-1/BTC)+(1.64*VARCS^.5)$
    ECS      =  .72635201992394390D+02
    ECSYR    =  .51953695016495880D+04
    ECSHYRP =  .53425454295004390D+04
    ECSBPP   =  .38900199830050930D+02
    VARCS    =  .11518488761957780D+02
    CS90L    =  .67069222530147220D+02
    CS90U    =  .78201181454642320D+02
Calculator: Computed   7 scalar results
--> CALC; LIST;
    AVTC=XBR(tc4);
    ELAS=BTC*AVTC $
    AVTC     =  .41209163730000320D+02
    ELAS     = -.56734424355720940D+00
Calculator: Computed   2 scalar results
```

Appendix D – Significance Test

Local- Winter/Summer Trips

$$\text{tstat} = \frac{11.45 - 12.20}{\text{Sqrt}(106.17/854 + 92.22/782)}$$

t-stat = -1.52, t-crit = -1.96
Fail to reject the hypothesis that there is a significant difference between winter and summer trips made by locals.

PPDU-Winter/Summer Expenditures

$$\text{t-stat} = \frac{37.22 - 62.39}{\text{Sqrt}(1763.67/33 + 6844.49/136)}$$

t-stat = -2.47, t-crit = -1.96
Accept the hypothesis that there is a significant difference between winter and summer expenditures.

PPON-Winter/Summer Expenditures

$$\text{t-stat} = \frac{445.96 - 352.90}{\text{Sqrt}(215935.48/26 + 163141.38/121)}$$

t-stat = .947, t-crit = 1.96
No significant difference.

NPDU- Winter/Summer Expenditures

$$\text{t-stat} = \frac{24.39 - 61.36}{\text{Sqrt}(552.87/6 + 21261.65/17)}$$

t-stat = -1.009, t-crit = -2.069
No significant difference

NPON - Winter/Summer Expenditures

$$\text{t-stat} = \frac{27.85 - 22.47}{\text{Sqrt}(2277.02/24 + 668.94/70)}$$

t-stat = .526, t-crit = 1.98
No significant difference