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AN ANALYSIS OF KENTUCKY EQUESTRIAN TRAIL RIDERS: DETERMINING RIDER BEHAVIORS AND VALUING SITE AMENITIES THAT CONTRIBUTE TO REPEAT VISITS

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ABSTRACT OF THESIS

AN ANALYSIS OF KENTUCKY EQUESTRIAN TRAIL RIDERS: DETERMINING
RIDER BEHAVIORS AND VALUING SITE AMENITIES THAT CONTRIBUTE TO
REPEAT VISITS

The purpose of this travel cost study is to determine how rider behaviors and site characteristics influence repeat visits for equestrian trail riding in Kentucky. Primary data was collected via a survey developed and administered to trail riders in person and online. The average surveyed trail rider tends to be female, about 46 years old, with some higher education, and an annual household income of $65,000. She makes 11 trips to a specified site per year, 8 of which are daytrips, usually in the fall, and traveling 132 miles round trip. From other information gathered, an index of trail characteristics was developed to identify positive attributes of trails. To account for overdispersion of the number of visits per year, a negative binomial distribution in the estimation was used. The primary variables significant to explaining repeat visits to a site include distance in miles, the index of characteristics, and gender. Given consumer surplus estimates of $800 per equestrian it is recommended that established trails maximize desired characteristics. For new trail development it is recommended that trail characteristics are maximized and that they are built closer to the urban areas of the state since most riders are coming from these areas.

KEYWORDS: Recreation Demand, Travel Cost, Equestrian Trail Characteristics,
                    Consumer Surplus of Trail Sites, Truncated Negative Binomial Estimation

_____Katharine Auchter_____

_____December 9, 2008_____

An Analysis of Kentucky Equestrian Trail Riders: Determining Rider Behaviors and
Valuing Site Amenities that Contribute to Repeat Visits.

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_____December 9, 2008_____
Date

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THESIS

Katharine Anne Auchter

The Graduate School

University of Kentucky

2008

AN ANALYSIS OF KENTUCKY TRAIL RIDERS: DETERMINING RIDER
BEHAVIORS AND VALUING SITE AMENITIES THAT CONTRIBUTE TO
REPEAT VISITS

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THESIS

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A thesis submitted in partial fulfillment of the
requirements for the degree of Master of Science in the
College of Agriculture at the University of Kentucky

By

Katharine Anne Auchter

Lexington, KY

Director: Dr. Angelos Pagoulatos, Professor of Agricultural Economics

Lexington, KY

2008

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On a personal note, I am grateful for the unending love and support from my family and friends. Finally, I would like to end with a special thank you to my sister, Chef Martha, for her perfectly chewy chocolate chip cookie recipe.

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Chapter I: Introduction

Horses, including ponies, are one of the top agricultural goods in Kentucky. In 2002 Kentucky ranked number one nationwide for value of sales of horses and other related animals, including ponies, donkeys and mules (USDA 2003). Currently, they are Kentucky's number one agricultural outputs as a subset of the agriculture industry that accounts for 30% of Kentucky's economy (KEEP 2008). According to a study requested by the American Horse Council, there are an estimated 320,200 horses in Kentucky (DeLoitte 2005). As such, they significantly impact Kentucky's economy. According to KEEP this economic impact is approximately $4 billion annually. The entire industry provides an estimated 100,000 jobs, over 14,000 of which are involved in the tourism side. Kentucky is famous for the huge thoroughbred farms and is the heart of the racing industry, with the Kentucky Derby each May and thoroughbred sales throughout the year. Keeneland's September yearling sale usually has the most impressive purchase bids, bringing potential buyers in from around the world. The Kentucky Derby brings in about $217 million to the commonwealth. In 2003, horse auctions brought in $650 million (KEEP 2008). Children can begin their interest in horses at a young age through participation in the Pony Clubs and 4-H programs.

Many other horse traditions are localized here as well, with the Saddlebred breed originating in Shelbyville, Lexington hosts the Rolex 4 star 3-Day event every spring and world renowned equine veterinarians Rood and Riddle and Hagyard Davidson and McGee are based in Lexington. Lexington also won the bid to host the 2010 FEI World Equestrian Games, its first time in North America. Throughout the commonwealth, Thoroughbreds, Standardbreds, and Quarter Horses all race. There are horse races nearly every day in Kentucky at various locations such as Churchill Downs, Keeneland, the Red Mile, Turfway Park, and other venues. Horses are celebrated every fall in Georgetown, just 12 miles north of Lexington, at the annual Festival of the Horse. There are many schooling barns and trainers available for riders interested in learning many disciplines.

The Kentucky Horse Park, on the north side of Lexington, hosts horse shows and attracts visitors by providing educational exposure to the equine industry, introducing them to the history, the breeds, and the many uses of horses. The economic impact of the

Kentucky Horse Park is almost $250 million (KEEP 2008). Retired racing champions such as Cigar, Alysheba and Funny Cide call the horse park home. In addition to the tourist attraction, the park also houses many horse related organizations at the National Horse Center. The nearly 30 organizations include the Kentucky Horse Council, the US Equestrian Federations, Inc., the United States Pony Clubs, Inc., the Kentucky Equine Education Project, and several breed organizations such as the American Hanoverian Society, American Saddlebred Horse Association, American Hackney Horse Association, Kentucky Thoroughbred Association/Kentucky Thoroughbred owners and Breeders, and the Friesian Horse Association of North America. Other riding related groups include the U.S. Hunter Jumper association, Central Kentucky Riding for Hope, US Dressage Federation, The Carriage Association of America, and the North American Racing Academy.

Other horse related organizations include the American Association of Equine Practitioners, Kentucky Horse Racing Authority, United Professional Horseman's Association, and the American Farrier's Association. Finally, other groups include the American Academy of Equine Art, inc., American Saddlebred Museum, Communicating for Agricultural Exchange Program, Maker's Mark Secretariat Center, National Horseman's Benevolent and Protective Association, Inc., the Pyramid Society, Race for Education, and the World Games 2010 Foundation, Inc.

Located within the horse park, the Kentucky Equine Education Project (KEEP) aims to promote the equine economy. With over 11,000 members from all aspects of the horse industry, it works with other organizations including the Kentucky Horse Council, the University of Kentucky cooperative extension service, and the University of Kentucky Equine Initiative. Because of the various definitions of what a farm is, many horses in Kentucky have not been counted in the traditional agricultural census. Starting in October 2006, KEEP began the "In Kentucky, Horses Count" survey to determine the numbers and primary uses of horses in Kentucky. The results of that study are not yet available.

Equine organizations are not limited to the horse park. Across town is the central office for the National Thoroughbred Association and the Breeder's Cup Limited. Across the state, Churchill downs in Louisville also has the Kentucky Derby Museum.

The Kentucky Walking Horse Association is in Owingsville, and the Kentucky Mountain Saddle Horse is in Georgetown, among many others.

Kentucky is well known and commonly associated with its deep relationship with horses. The importance of horses is not unique to Kentucky though. Many other states, such as Florida, New York, and California have strong thoroughbred racing circuits and breeding programs. In the Midwest, harness racing is very common, and in the Southwest ranch work still prevails. Pockets of Amish and Mennonite communities use horses for farm work and transportation. These people often purchase retired standardbred racehorses to pull their buggies, giving these animals a new purpose when they can no longer race successfully. There are other communities and states benefiting from the horse industry as well.

These many examples demonstrate why the equine community is such a significant part of the Kentucky economy. Improvements to this industry may benefit other aspects of Kentucky as well, including infrastructure and tourism. As mentioned above, nearly 14% of the jobs in the horse industry are tourism related.

The importance of horses in a state like Kentucky goes beyond the economic benefit that can be directly measured in a typical market (For example feed, veterinary services, horse sales, etc). Horses have an additional value and contribute to the identity of the state as one of the top industries, through tourism, production, and others. This benefit cannot be valued in a traditional market. These services that people value range from spectator events like the Kentucky Derby and the Rolex 3-Day Event to participation events such as showing and trail riding. The beauty of the horse farms add to the aesthetic value specifically in the Bluegrass area, but also across the state. These amenities are enjoyed by both visitors and locals, adding value to their experiences spent in the area.

Equestrian trail riding differs from other users of trails primarily due to the inclusion of the horse. As living beings, horses require additional care including transportation, feeding, watering, and onsite care. Horses must be contained in some manner such as a tie out or trailer. Equipment utilized by other trail users, such as bikes or ATVs, may require periodic maintenance and fuel but they can be left alone for extended periods of time and do not have the daily requirements that horses have. Horse

related activities are important to Kentucky and therefore the popularity of trail riding presents a continuous challenge to trail managers to maintain trails and allocate resources to create new trails with specific amenities. These trail managers will benefit from this study which estimates the value of trails used for equestrian trail riding.

Objectives

This study estimates a participation demand equation for equestrians using Kentucky trails. Since there are no previously existing data, a survey was used to gather primary data. The survey was developed to gather information from trail riders and accounts for distances traveled and site amenities and considers costs associated with the activity. The site amenities were constructed into an index in conjunction with information available from trail site publications. Geographic Information System (GIS) software enabled estimation of distances and times traveled and provided a visual representation of the data (ESRI ArcGIS 2005). Information gathered includes demographic information including gender, age, education level, and income as well as information at the site identified including number of trips, length of stay, seasons of visits, and locations of overnight accommodations when applicable. Chapters 2 and 3 introduce recreational trail riding and the study. Chapter 4 focuses on the travel cost method, development of the pre-test, questionnaire and associated costs while Chapter 5 summarizes some of the descriptive statistics from the questionnaire and identifies the profile of the average trail rider. Chapter 6 identifies the statistical model used to analyze the data and includes the subsequent results. Chapter 7 makes general policy suggestions including welfare statements about recreational trail rider. Chapter 8 sums up the study and offers conclusions.

The objectives for this study are:
1) Collect information to determine general habits of KY equestrian trail riders and their demand characteristics.
2) Estimate trail demand considering the relationships between
   a) miles traveled and visits and
   b) trail amenities and visits.

3) Provide information that can be used by trail managers of current and potential

    trails to manage existing trails and possibly suggest locations of new ones.

Chapter II: Recreational Trail riding activities and locations

Horses in Kentucky serve many uses. Unlike most farm animals such as cattle, chickens, or hogs, they have purposes for humans beyond a food source. They can be work, sport, or livestock animals for people depending on them for livelihood. Horses provide labor and transportation on some farms, particularly the Amish in southern and central Kentucky. Standardbreds, thoroughbreds and quarter horses are race horses. Kentucky boasts large breeding farms with broodmares and stallions. Central Kentucky is renowned for large beautiful thoroughbred breeding and race training facilities. They are also companion animals which people benefit from their enjoyment and lifestyle. Over 50% of horses in Kentucky are used for showing and recreation (DeLoitte 2005). There are show horses such as the Saddlebreds, Morgans, etc. Other horses compete in shows in such disciplines as dressage, fox hunting, hunter/jumper, combined training/eventing, western pleasure, and rodeo, etc. Many of these horses are also companions and/or used for recreational purposes.

In addition to competitive trail riding and endurance riding, recreational trail riding in Kentucky ranges from riding on private property to many available public trails. Recreational trail riding is trail riding for the purpose of enjoyment. There are organized trail rides for fun and fundraising. Many locations provide horse rentals and guided horseback tours, so owning a horse, or even having a lot of riding experience is not necessary to participate in and enjoy the activity.

The market for trail riding, like many recreational activities or environmental amenities, is not readily available. The actual cost of the activity may not be reflected in the cost to the participants. The value of the services from the recreation site can be determined as the sum of the willingness to pay for these services by all people who want to use that site. The willingness to pay and travel cost are methods to determine how people value an activity such as recreational trail riding when typical market information is not available. Thus, the value of the site is the area under the aggregate compensated demand curve for visits to that site. Estimations of the demand for visits are based upon the varying cost of traveling incurred in return to access to the site. The responses of

people to the variation in travel costs to any site can be seen as the implicit price of visits and therefore the basis for estimating the values of recreation sites.

For this study, a survey was designed and administered to collect information from trail site visitors regarding location of origin (distance traveled), socioeconomic information, as well as a set of general questions about site characteristics and frequency of visits. First, the survey was pre-tested on a small group of trail riders. Trail sites to administer the survey were selected. Specific site characteristics at each location were identified for the development of a site index. Then these surveys were administered onsite at selected equine trails. In order to increase the response rate, questionnaires were also administered at horse related functions such as horse shows, organization meetings and trail rides as well as online where horse trail groups were contacted. In this study, the characteristic profile of a representative equine trail user is identified and shows the pattern of use (day trips vs. overnight, camping onsite vs. other, etc). The estimation was done via travel cost model. The demand estimated is a participation demand and focuses on factors contributing to repeat visits.

Participation in a recreational activity such as trail riding requires significant investment. This study focuses on trail riding as an unguided activity. Therefore it does not include riding concessions where horses are available to rent for a guided trail ride as it is considered a separate activity. First and foremost, a horse must be available to the rider, through ownership, leasing, or borrowing. The cost of purchasing a horse can range from nearly nothing to many thousands of dollars. Additionally, in order to get to a riding location, a rider must have access to a trailer to load the horse into, as well as a truck to pull the trailer. These major costs can be shared, however, as many trailers hold multiple horses. Also, the trailer may not be used for trail riding exclusively. Riders may participate in multiple activities with their horses, such as showing, which would also use the trailer getting to and from shows. The horses generally need tack to be ridden in including a saddle pad, saddle, and bridle. Some riders may include accessories such as saddle bags to carry additional gear, food, or water. Additionally horses require a lot of care. A farrier either trims or shoes their feet on a regular basis, often every 4-6 weeks. They need veterinary care. Horses, being living beings, are prone to injuries and illness requiring treatment.

Most states, including KY, require an annual negative Coggins test for Equine Infectious Anemia (EIA) for any change in ownership or exhibition, including trail rides (KY Department of Agriculture 2008). Horses require feed that also must be transported in hay bags or buckets of feed and buckets for water. Being grazing animals, even going out for just a day ride will likely include this investment. Horses must be groomed before riding, removing dirt and debris particularly from their hooves and anywhere that might get rubbed such as under the bridle or saddle. This requires different types of brushes, combs, and a hoof pick. When not being ridden, horses often wear halters to which a lead rope can be attached to walk them around or tie them to a sturdy location. Some horses, particularly in cold weather, may have a blanket. Others may have special boots and protective gear to wear while riding in the trailer. Some horses may wear boots or other special items depending on their individual special needs while being ridden.

The riders incur costs as well. They may pay for riding lessons to learn how to ride and handle horses. Riders prefer special boots and pants to prevent injury and for comfort. Some riders may wear gloves, a vest, a helmet, or other protective gear. Again, many of these costs can be shared across other equestrian activities than just trail riding. Purchase price, farrier, veterinary, and feed costs would be basic costs just for ownership of the horse. Additionally, the horse needs a place to stay when not on the trails. A horse can be boarded at a facility for a monthly fee and can range from access to a field to full service care and a reserved stall space, either at the owner's home or at another location. Barns need shovels, pitch forks, and brooms to keep them clean and bedding to keep the stalls comfortable. Even when located at the owner's home, the horse needs a fenced in area and some sort of shelter such as a run-in shed at minimum. Of all these expenses, however, only the optional saddle bags are specific to trail riding. The other options would be incurred regardless of what type of riding activity the rider chooses to participate with the horse.

In general, any horse can be a trail riding horse. Some breeds, however, are more common on the trails than others. These breeds usually have a gentle disposition, tend not to spook easily, are fairly surefooted and are smooth enough that they are comfortable to ride for extended periods. Common trail riding breeds include stock horses such as the Quarter Horse and Appaloosa and pleasure saddle breeds such as the Tennessee Walking

Horse, Missouri Fox Trotter and various Mountain Saddle Horses (Kentucky, Spotted, Rocky, etc).

There are more than 1000 miles of trails on public land in Kentucky used for trail riding. This includes State and National Parks, the Daniel Boone National Forest, Wildlife Management Areas, and other available lands. Riders also ride on private land as well, often the land including or adjacent to where the horses are kept. There are several horse trail riding organizations established, ranging from those affiliated with equestrians specifically such as the Kentucky Horse Council's Friends of the Trail, Trail Riding Equestrians of Kentucky (TREK), and Kentucky Trail Riders Association (KTRA) to multiuse trail organizations such as Rails to Trails in which members include hikers, bikers, and trail riders, etc. Memberships to many organizations may be individual, family, or even an entire saddle club, and memberships may overlap. Riders of local private property would have fewer costs than those who load up the trailer and go to a trail riding location, as there would be no travel cost incurred. Other trail riders must transport their horses to a location to go trail riding. Many of the trails in Kentucky are part of public land, mostly as federal lands including the Daniel Boone National Forest, which alone has over 700 multiuse trail miles.

Going trail riding involves loading the horse into a trailer and transporting to the desired location. Once there, the horse would then be groomed and tacked for the ride. Trail surfaces can vary from sandy to firm to rocky, and may be hilly or flat. There may be obstacles on the trail such as downed trees or roots or it may be very clear. Trail rides can be brief or last a long time, even multiple days. Upon returning to the parking site from the trail ride, a horse would be untacked and usually fed. The horse would either be reloaded to leave or the riders would prepare for an overnight stay.

Many natural resource systems including lakes, streams, and forests are used for recreational activities which generate valuable services to society. Examples of these activities include hunting, fishing, hiking, biking, climbing, and trail-riding. Equine trails contribute to these recreational services for the community. Access for trail riding, like many recreational activities, is not allocated through markets.   They are typically open to any user at a zero price or nominal fee that bears no relationship to the cost of providing that service. Also, many of these trails are multi-use in which various users must share

the trails, with the most common specified groups as mountain bikers, horse riders, hikers, and All Terrain Vehicle (ATV) riders.

This study focuses on recreational trail riding in Kentucky. It targets people with access to horses to bring to the area, rather than those trails with horse concessions and guided tours. Three of the facilities in the analysis have concessions available in addition to people bringing their own. These include Mammoth Cave National Park in Edmonson County, the Kentucky Horse Park in Lexington and Carter Caves in Carter County. However, due to specific differences in the activities, this survey focused on those riders who hauled horses to the sites. Renting a horse at a concession in each of these locations involves paying for a guided group trail ride, and more closely resembles a guided scenic tour than the type of trail ride where a rider brings their own horse. In that case, the rider is usually in a small group and the riders determine the distance, route taken, difficulty of ride, or gait such as whether to walk, trot, or canter. This would be more similar to going out on a hike rather than taking a guided tour of the area. Determining what these riders want for their trail rides is useful for future planning of additional trails and management of existing trails, including the amenities and characteristics they offer. Therefore the purpose of this study is to determine which characteristics are preferred by the riders. Specific trails and their characteristics are identified. Additional information gathered from the study can be used towards future projects including a travel cost study or cost benefit analysis to identify trail development.

Chapter III: Kentucky Trails and Sample Selection

When many people think of eastern Kentucky, the Appalachian Mountains and coal mining are often the first things that come to mind. However, sprawling across eastern Kentucky lays the commonwealth's only national forest, the Daniel Boone National Forest (DBNF). In the western side of the state, the National Forest Service also manages land at Land Between the Lakes National Recreation Area, but it is not a national forest. The forest has the largest concentration of horse trails in the state. These trails vary in location and characteristics. The Daniel Boone National Forest covers 706,000 acres from the Kentucky/Tennessee border in the south east of Somerset to just north of Morehead, and also spreads east close to Hazard. It is divided into districts including Stearns, London, Cumberland, and Redbird. Over 700 miles of trails throughout the forest offer a variety of uses from ATV, hiking, biking, and horse riding. Horses are allowed on over 250 miles of these trails, including certain sections of the Sheltowee Trace Trail. The Sheltowee Trace trail runs north-south and is over 250 miles long. There are no designated horse trails in the London District, but there is a large multiuse trail in the Redbird District. It is more than just a recreational site for tourists and locals, the local economy benefits as well. In additional to nominal fees to access certain areas, many travelers rely on local stores for food, supplies, and gas. Overnight visitors may also support local hotels, campsites, and lodges.

In order to determine the demand for horse trails, twenty-nine trails were randomly selected. This random sample included four areas that are regularly visited in the DBNF, which are the White Sulphur Horse Camp in Cave Run and Caney Recreation Area in the Cumberland District and Barren Fork and Bell Farm Horse Camps in the Stearns District. Private facilities in the area include Rudy's Ranch and Stampede Run. It is important to note that although the campsites at both locations are private, they use the trails of the DBNF. Groups and online participants of the survey were asked to select from the predetermined trails throughout Kentucky. The characteristics of all the trails evaluated were identified for an index system. The list of selected trails is presented in Table 3.1.

The White Sulphur Horse Camp is just a few miles west of Morehead, easily accessible to interstate 64 running east-west across the state. Morehead has a population of approximately 6000 residents. It is about an hour east of Lexington. There are approximately 100 miles of trails available at the camp. The campsite has room for about 40 trailers, but is considered primitive with no electricity or running water for human consumption. There are no stalls or pens for the horses. Fees charged are $10 per night for campers or $5 per day for day riders. Though open year round, most winter use is from day riders during unseasonably warm weekend days.

The private facility Rudy's Ranch is 3 miles away from White Sulphur Horse Camp, and therefore nearly just as accessible. It connects with the DBNF for trail use and therefore offers over 100 miles of trails.

Interstate 75 runs parallel to both the London and Stearns Districts. Corbin and London are nearby cities, with a combined population of approximately 14,000 people. There are no current fees for the Bell Farm Horse Camp. Though previously open year round, it is currently only open March through November. Barren Fork Horse Camp, also in the Stearns District, does provide campers with running water, parking is available for over 40 trailers, and there is access to a variety of trails, including loops. Fees are $3 for day riders and $8 per night for campers. It is only open March through November.

Stampede Run in Whitley City offers 23 camping sites with water and electric available. The campsites cost $20 per night and stalls are available for $10. Though private camping, it offers access to the trails shared by Barren Fork in the DBNF, in the Stearns District. Whitley City has just over 1000 residents, but Somerset is less than 25 miles away and has over 12,000 inhabitants. There is no major interstate access.

Other public horse trails throughout Kentucky are located in various areas such as state parks, the only national park in the state (Mammoth Cave National Park), community and city parks, some wildlife management areas, national recreation areas (Land Between the Lakes and Big South Fork), and others. Private facilities may utilize nearby public trails but offer private parking and camping, like Stampede Run and Rudy's Ranch, or they may include trails on their own property. Trails are in both urban and rural areas.

Determining sample size

There are 154 members in the Kentucky Trail Riders Association. There are over 500 members in the Kentucky Horse Councils trail rider's division; however a member may be an individual, a family, or an organization such as a saddle club. Members may join more than one organization. Many trail riders are not affiliated with any organization. Trail riding is a common activity among horse riders in KY, however many stay among the fields on local farms and do not travel. This study focuses on those trail riders going to designated trails. Participation is popular in organized trail rides, such as the semi-annual Knott County Trail Ride at the Sutton Memorial Park in Knott County or the Central Kentucky Riding for Hope Harvest Trail Ride held annually at the Kentucky Horse Park where participation exceeds 150 riders.

Based off the membership of two of the largest trail organizations in Kentucky, KTRA and the Friends of the Trails, which is combined at nearly 650 members, the population of trail riders is roughly estimated to be 2500 by multiplying the membership by four. It is difficult to estimate because it is not known how many memberships account for multiple individuals or cross over memberships, nor is the number of trail riders not affiliated with any trail riding organization known. From this estimated population size, the sample size of surveys needed to be filled out is calculated by:

$$n = \frac{Nx}{(N-1)E^2 + x}$$

Where

N= estimated population of KY trail riders, 2500

E= error, in this case 10%, calculated by:

$$E = \sqrt{\frac{(N-n)x}{n(N-1)}}$$

Where:

$$x = Z(\frac{c}{100})r^2(100-r)$$

Where:

The critical value for the confidence is

$$c = Z(\frac{c}{100})^2$$

The confidence level is 95%.

r = response distribution, 50%

This equation assumes a normal distribution and results in a desired sample size of 93 respondents.

Table 3.1. List of trails identified for the study.

Trailhead	County	Number of Observations
Scottsville	Allen	2
White Sulphur	Bath	63
Rudy's Ranch	Bath	8
Middle Creek	Boone	1
Carter Caves	Carter	1
Mammoth Cave	Edmonson	7
KY Horse Park	Fayette	17
Masterson Station	Fayette	1
German Bridge, Dewey Lake	Floyd	1
Irongate	Jefferson	1
AJ Jolly Park	Kenton	3
Sutton Memorial Park	Knott	4
Yatesville Lake	Lawrence	2
Logan Hubble	Lincoln	1
Stampede Run	McCreary	13
Bell Farm	McCreary	11
Barren Fork	McCreary	3
Big South Fork	McCreary	5
Otter Creek	Meade	1
Murder Branch	Menifee	17
Shakertown	Mercer	2
Gambells Campground	Morgan	1
Red Hill Horse Camp	Rockastle	8
Cave Run	Rowan	29
Taylorsville Lake	Spencer	7
Green River	Taylor	1
Wranglers Campground	Trigg	10
DBNF-general	Multiple	1
Red River Gorge	Multiple	1

Chapter IV: Introduction to Travel Cost

The value of recreational sites can often be difficult to measure. However, understanding their value is important for managing the sites. Outdoor recreational sites such as nature preserves, parks, and forests, often have low, if any entrance fees that may not reflect their true value, especially those which may be subsidized through outside funding, whether government or private. Additionally, some of the qualities that attract visitors are not tangible and are not represented in a normal market setting. Some examples of these amenities include air or water quality, lack of congestion, wildlife viewing possibilities, proximity to various facilities, etc. Qualities such as congestion are more difficult to measure and value because it is also based upon personal preferences, and that can be highly variable. Also, there can be differences in perceived values and real values of an amenity, such as with air or water quality. However, their value can still be estimated by using an indirect method such as a travel cost model (Freeman 2003). This method incorporates how much a person pays to get to a site as an indicator of how much they value the site. The Travel Cost (TC) model can be expressed as:

$$q = f(p, p_s, Y, g, c)$$

Where q is the number of trips taken in a period of time (monthly, seasonally, annually, etc), p is the cost to get there each time, the trip cost. As this cost increases, it is expected that the number of visits decreases. Other factors that affect travel to a particular site include the trip cost to available substitute sites (p_s), income (Y), gender (g), and c is the index of characteristics (Boardman et al 2006). The trip cost considers what it cost to get there, any entrance fees, cost of any equipment necessary, as well as the time involved in traveling to the site and time spent once there. Randall (1994) argues that the travel cost is directly related to the distance traveled.

In order to value how changing characteristics affect the use of recreational sites, a contingent valuation (CV) method is often included. This method determines what people would be willing to pay (WTP) to get certain changes in trail characteristics, or be willing to pay to avoid (WTA) other characteristics. This often requires people to

determine value based on a hypothetical situation. Many questionnaires used in gathering information for the TC model also include questions about CV. This can then be added to the TC model in order to determine the effects of changing one or more amenities at the recreational site.

Overview of trail sites and Pre-test for questionnaire

In order to determine the demand for trails, a sample was drawn. Trail sites in Kentucky were randomly selected to conduct interviews over selected weekends. The on site interviews were a sample of individuals from the people found at the selected trail sites. Online surveys will be used if the cost of collecting exclusively on-site data becomes cost prohibitive. From a collection of trail rider clubs in Kentucky, a sample for groups will be randomly contacted until at least 3 clubs agree to participate.

Public and private trails around the Daniel Boone National Forest around the Caney Area in the Cumberland District including White Sulphur, Murder Branch, Stoney Cove, and Rudy's Ranch and those in the Stearns District including Bell Farm, Barren Fork, and Stampede Run were selected. Furthermore the KY Horse Park was selected along with 22 other trails in the state of KY. Participants of the online format had the opportunity to identify one of the previous trails. It is the intent to determine what characteristics these trails possess which encourage repeat visits. Therefore, it was necessary to specify exactly one trail so that characteristics of all the trails evaluated were identified for an index system utilizing the trails' official websites providing information of available amenities and in some cases personal witness.

The DBNF covers over 700,000 acres in eastern Kentucky and is comprised of 4 districts: Redbird, Stearns, London, and Cumberland. The popular trail sites are located in the Stearns and Cumberland districts. There are no designated trails publicized for horseback riding in the London district. The Redbird district also has a lesser known area around the Redbird district trail for horse riding, though it is also used by ATV riders, mountain bikes, hikers, etc. Though horses are permitted on the trail, it is very seldom used for that purpose.

When developing the questionnaire, informal interviews and conversations were held with people at some of the trails in the area to determine what they liked and did not like about the facility, where else they enjoy riding, and what they would be willing to pay for certain characteristics. These informal sessions were done in two parts. The first was done prior to survey development to determine the information that should be included. Some of the survey questions were based on a ranking of characteristics, so it was important to identify what those characteristics should be. Second, after the survey was developed, it was tested on other trail riders to determine whether it was complete, and also to begin getting values to use for the travel cost model.

The first session of questioning took place at the White Sulphur Horse Camp near Morehead, in the Cumberland District. This questioning was performed on a warm weekend in December where over a dozen horse trailers were present and over 10 riders offered information. This was the only one of the 3 commonly used trails in the DBNF open in the winter. The others were closed because of hunter access and insufficient funding to keep them open, as the winter time is much slower for overnight camping and even day riding. Most recorded use of the trails at White Sulphur during the winter is weekend day riding during unseasonably warm weather. In addition, a nearby private facility, Rudy's Ranch, appeared open but had no obvious visitors.

Development of questionnaire

The information gathered from the surveys provides the possibility to evaluate travel cost, ascertain existence of specified characteristics, as well as some questions asked in the interest of the forest service.

The questionnaire (attached as Appendix A) begins with the release and statements regarding participation fulfilling the requirements of the University of Kentucky's Office of Research Integrity, and it is followed by a statement paragraph explaining the purpose of the study. Additionally there is space to document the location the survey was administered and the date. Questions focused on the identified site. For the version given to groups off-site, a site is identified by the respondent and then referenced for the pertinent questions. This is so that the characteristics of the site could

be considered. Valuing the sites for characteristics would not be possible if there were multiple sites included in any given survey. By limiting the survey to one location, the distances, costs, and amenities valued are certain to reflect the specified location. Therefore visiting more than once is a repeat visit to the same location. A rider may or may not make additional trips to other locations. Because this survey does not necessarily consider all trail riding trips made in a year by a surveyed trail rider, demand for trail riding as a whole cannot be calculated. Rather, by focusing on one location for each trail rider, the study attempts to determine what contributes to a rider's decision to return to the same location for multiple trail rides.

The questionnaire is then further divided into two types of information, about the respondent and travel information. The section about the respondent provides demographic information. Using survey type A as a sample, questions 1-4 fell into this category, with questions about gender, age, education, and income. Education was classified as grade school, middle school, high school, associates degree, bachelors degree, graduate degree (MS or PhD), and professional degree (such as MD, law, etc). These categories were also given ranks such that middle school and grade school =0, high school =1, associates degree =2, bachelor's degree =3, graduate degree =4, and professional degree =5. To aid in confidentiality and encourage more responses on topics that some people may feel are too personal, participants chose a range for age and income, and the midpoint was used. This information can be used as control variables in the economic model to be estimated.

The remaining nineteen questions pertained primarily to travel information. First, trail riders were asked to provide their zip code, or city which they traveled from, and approximate mileage. This is used to determine travel distance. Travel distance is an important variable, particularly in a travel cost model for how frequently people visit a location. The 6th question pertains to the number of times the respondent comes to the identified location, which is broken down further. The travel cost model looks at how different factors (such as the aforementioned travel distance) affect the number of visits. Questions 8-11 break down the response in question 6 into daytime and overnight trips as well as identifying the frequency which they visit during each of the 4 seasons. Length of stay is also important for the travel cost model, so in conjunction with the previous 4

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questions, question 12 asks how many nights were stayed for the visit, as well as specifically where the survey participants stayed.

Another important variable for the model is travel cost. Question 7 asks how much it cost for the immediate family to get to the trail location. Question 13 asks a question regarding average cost of lodging per night. Again, this was included because, like actual travel cost, this is an important variable in understanding how frequently a person is likely to visit.

Question 16 was developed as a table, so people could respond about various characteristics at the trail site. The characteristics evaluated were public goods, which were also clearly defined, so that they could be examined in a contingent valuation model. Specifically, for a series of characteristics, people were asked whether they would be interested in paying $2 to have that characteristic added to the trail. If they said yes, there is the opportunity to state how much more they would also be willing to pay for that characteristic. If no, then they could state how little, if any, they would pay.

They were also asked to indicate how many more visits each year they would make to that site, based on the addition of that single characteristic. The $2 starting bid was determined through the pre-test, and average the cost provided. The characteristics analyzed included loop trails, trails free of trash, and lack of congestion. Question 18 asked what a person would be willing to pay for a bundle of goods at a full service campsite facility, such as electricity and water access, and horse facilities. The final question asked respondents to state their least favorite group to share the trails with.

This project was executed in cooperation with the National Forest Service, who permitted the study to be conducted on DBNF land. Because of this, there were a few questions included to provide data on issues of concern for them. These included questions 14, 15, and 17. Specifically these questions were in regard to interest and willingness to pay for on site horse rentals, as well as a question about the Barren Fork trail. They hope to gain insight into why that site is not as popular as they expected, and so question 15 asks whether the rider has ever been to that location, and if so, to provide comment on what was liked and not liked about it. Their final question was to determine if perhaps people would be interested in volunteering work hours to help upkeep the trails, and if so, how many hours per year.

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Survey type A was given onsite at specified trail locations, and therefore the questions were directed specifically to that trail site. Conversely, survey type C was given to groups, whether online or in person at meetings, horse shows, or other gatherings, and the participant selected a location to evaluate. Overall the questions were designed to gather the same information, but for riders in a different setting. The online version included a section to provide comments and a question asking respondents to list their horse related organization memberships. Additionally, each survey type has a "reversed" format changing the order of questioning to avoid any bias.

Cost of collecting data

Faculty and students from the University of Kentucky in Lexington collected data from a variety of sources. The online survey was emailed out to horse groups that had trail riding members. Specified trail sites were targeted to interview people at the trails. Other horse groups were contacted to reach the trail riders there, such as local horse shows and organization meetings including the KY Horse Council and KY Quarter Horse Association. Although ideally, all surveys would be conducted in person onsite at the trails, this was not practical. First, the closest trail sites, White Sulphur and Caney, were an hour and a half away from Lexington. The other sites, Bell farm and Barren Fork, were nearly 3 hours away. It took a lot of time and money to travel to these locations, and once there, there was no guarantee of trail riders' presence. Some trips brought back over a dozen surveys, but some brought back none or just one or two. Data were collected at these trails over several days, often Saturdays and Sundays, but also at least one Friday. Known horse group trail rides and horse events held closer to Lexington often took place on weekends, though a few weekdays were included.

The cost of one trip to the Caney area including the White Sulphur Horse Camp was $160 per day from Lexington. The cost of a trip to the southern trails was $250 and usually covered an overnight stay onsite, in an attempt to reach more riders and not make the trip two days in a row, doubling the cost. Trips to both locations have yielded as few as 0 observations, and as many as 12 in the south, and 16 to the northern location. Four observations were common at the Caney area. Therefore this cost about $40 per

observation. This cost was a limiting factor in ability to travel to get observations frequently, so travel was limited to weekends with comfortable riding weather, to increase the likelihood of multiple observations.

Local events have much cheaper cost of travel, ranging from zero to $25 per day. These events also yielded more surveys. These events included meetings of trail riders in Lexington, several horse shows near Frankfort, and a trail ride at the KY Horse Park. Each of these events provided approximately 10 surveys apiece. At locations with various types of horse activities, participants were first identified as trail riders and selected randomly. To reach the remaining trail riding population, the online survey was emailed out to trail riding groups, including the Kentucky Trail Riders Association, Trail Riding Equestrians in Kentucky, and the Kentucky Rails to Trails group, which includes all users of trails, including the horse trail riders in addition to runners, hikers, bikers, etc. The email included a brief introduction about the project and a link to the website with the survey.

Surveying began in July 2007. Most online surveys came during August and September though they continued to trickle in throughout the fall. The last emailing sent out to recruit participants was sent in late February 2008. Most on-site surveys were completed between September and November. Organization and other location surveys were mostly done November and December. Surveying continued through February 2008.

Chapter V: The data from the survey

Between July 2007 and February 2008 three hundred sixteen trail riders completed the survey. Of these, two hundred twenty one answered all major sections of the survey providing information about the total number of visits, and the explanatory variables including demographic information and frequency of visits. Regarding the rest of the more specific questions, there are varying degrees of responses.

Eighty-eight of the participants filled out the surveys in person onsite at trail locations, at organized trail rides, or at horse related organizations. Interviews, with the total number completed onsite in parenthesis, took place at Caney (17), White Sulphur (28), Bell Farm (8), and Barren Fork (3) locations; organized trail rides at the Kentucky Horse Park (14) and Murder Branch (17). The horse related organizations included the Kentucky Horse Council annual meeting, Kentucky Quarter Horse Association meeting, and Kentucky Rails to Trails meeting where contacts where made resulting in increased participation for the online groups.

The remaining 133 surveys were completed online. The groups contacted via email and directed to the online survey included the Kentucky Horse Council (KHC) where trail riders are a part of "Friends of the Trail", the Kentucky Equine Education Project (KEEP), Rails to Trails (a multiuse trail organization), Kentucky Recreational Trails Authority (KRTA) a multiuse trail organization where trail riders are a subset, Trail Riding Equestrians in KY (TREK), and the Kentucky Trail Riders Association (KTRA). Memberships to KHC and TREK include individuals, family members, or groups such as saddle clubs, and KEEP also has individual and family memberships, making a true estimate of number of people contacted difficult. Additionally, with the close association of many of these organizations, there is potential for a lot of crossover membership where one person or organization may be a member of several groups. Because of this, it is difficult to determine the total number of equestrians who visit trails.

Development of the index of characteristics

Question 16 involved filling out a table which was designed to identify those trail characteristics trail riders valued, and establish how much they were valued and determine a WTP for individual characteristics. The characteristics included were those identified by trail riders during the pre-test period as those of importance. The characteristics identified in the table are existence of loop trails, at least 15 miles of trails, no trash, wildlife viewings, open views, lack of congestion, limited hunter access, trail markers, availability of water on trail, availability of camping along trail, and ecological integrity of the site. Additionally question 18 asked riders to value a full service campground. There were not enough responses that filled out the table completely to have enough information to calculate a WTP for any of the characteristics. Therefore, the information was used to assist in constructing a characteristics index that could be used to help understand the value of these characteristics to the trail riders. Each site was identified whether it had a specific feature (1) or not (0). The features were then summed and given a percentage of the total possibilities to create the index. Because a higher ranking indicated a site with more characteristics, this suggested a positive feature, therefore all characteristics included were determined to be positive, and also had to be measurable. Therefore, some characteristics were excluded. Whether hunting was permitted was excluded because some riders may view a hunter's presence as dangerous and a negative, but others may be interested in hunting in conjunction with trail riding and therefore a positive. Characteristics regarding trash and congestion were excluded because they are very subjective in that some people may be able to tolerate more or less amounts of debris or other trail users than others. Likewise wildlife viewings and ecological integrity could be interpreted in various ways, so they were excluded. The characteristics used for the index were identified as looped trails, trails longer than 15 miles, existence of open views, whether trails were marked, availability of water on trails, opportunity for backcountry camping, and a full service camp facility at the trail head. The information regarding site characteristics was gathered in person, from official internet sites for facilities or phone calls and emails to the facilities if the websites were

not available. Sites varied from rankings of 14.3 to 100 with an average of 72.9. Every trail identified in the study had looped trails.

Profile of Average Trail rider

A trip (or a visit) is defined as a participation event which may last one day in the case of daytrips, or multiple days for overnight trips. The average trail rider has a greater probability of being a woman, about 46 years old, has a little more education than an associate's degree and lives in a household earning $64,939. See Table 5.1. This trail rider takes almost 11 trail riding trips to a specific site a year, traveling an average of sixty-six miles one-way, or 132 miles roundtrip. Eight of these trips are day trips, the rest being overnight camping trips, spending 2.8 nights camping onsite. An average 0.75 of a night was spent at all other overnight options combined; camping onsite was the most common venue for overnight stays. By summing the nights spent on the trips and dividing it by the number of overnight trips taken per year, the average overnight trip at the identified location lasted 1.4 nights. Of 221 responses, 32 trail riders only took overnight trips to their specified location. Eighty one only took daytrips, and the remaining 108 took both daytrips and overnight visits to the identified site.

Fall is the preferred season for both day trips and overnight trips, with an average of 2.8 and 1 trips, respectively. Spring is the second most frequent season, and the fewest trips are in winter.

Even though the total number of visits ranged from 1 to 75, nearly half of the riders made no more than 5 trail riding visits to their identified location in a year (108 of 219). Indeed the median number of visits is 6. This means the number of visits is not normally distributed, and there is a lot of dispersion with the overall number of trips taken in a year. See Figure 5.1.

For the locations chosen, White Sulphur, Caney, Rudy's Ranch, Stampede Run, Barren Fork, and Bell Farm, there were a total of 109 observations. Similarly, 105 came from the Cumberland District locations in the generalized Stoney Cove Recreation Area including the sites White Sulphur, Caney, Rudy's Ranch and Murder Branch. Specifically, twenty eight trail riders evaluated Caney, fifty-six for White Sulphur,

seventeen for Murder Branch, and four for Rudy's Ranch. For the Stearns District, there were twenty-one observations among Stampede Run, Barren Fork, and Bell Farm. Of these, seven equestrian trail riders evaluated Stampede Run, three for Barren Fork, and eleven for Bell Farm.

As expected, there is no significant difference in trips per year between the groups filling out the questionnaire onsite versus the group that filled it out on the internet. This was determined because in order to identify possible differences between the in-person and online surveys, the student's t-Test was run using SAS. However some demographic differences emerged. In general the online participants were more likely to be male, about six years older, have a bachelor's degree, and had a household income $12,510 per year higher. Online participants also traveled twenty one miles further to get to their trail location. See Table 5.2. Two possible explanations for these differences come from inherent characteristics of organizations. First, members pay dues to be associated with the organization and receive certain benefits; therefore there may be a self selection towards those with higher income. Second, many meetings and activities are held near urban areas where they are more accessible to the population, so members may be closer to these areas, specifically around Lexington and Louisville. These reasons may explain why these trail riders traveled further to get to the trails. Also, as is further discussed in Chapter 6, age, education, income and miles traveled are all significantly positively correlated with each other.

Distances traveled

Based off the responses from twenty eight trail riders, the average distance traveled by visitors to Caney was 82.6 miles. At nearby White Sulphur the 56 trail riders traveled an average 71.7 miles. Rudy's Ranch, 3 miles from White Sulphur, had an average travel distance of 91.5 miles. That average came from four trail riders, a relatively small sample. Seventeen riders traveled an average of 49.7 miles to get to Murder Branch, a trail in the DBNF also in the northern Cumberland District.

Further south in the Stearns District of the DBNF, eleven respondents traveled an average of 61.75 miles to get to Bell Farm. Barren Fork, about 30 minutes away, had

three respondents who traveled an average of 34.53 miles. Stampede Run, the private facility sharing the trails with Barren Fork, had seven visitors participating in the survey who traveled an average 50.41 miles. All three of the trails in the Stearns District had a relatively small number of trail riders responding for each location. See Table 5.3 for the average distances to trails with at least 3 visitors.

Day visits versus overnight trips

Of the 221 respondents, nearly half of them, specifically 108 trailriders made both daytrips and overnight visits to the same trailhead. Thirty-two made only overnight trips to the selected location, and eighty-one made only daytrips. Student t-tests were run to compare those who did only daytrips versus those who did only overnight trips, as well as to compare those who made at least one overnight trip and those who made at least one daytrip, and may include those who did both. See Tables 5.4 and 5.5a and b. There were no differences among those surveyed riders who make either just daytrips or just overnight trips to their selected location. However, riders making at least one daytrip to the location in a year had statistically more overall visits, traveled fewer miles, and had visited sites with a lower index ranking. This is intuitive with the travel cost concept that when the cost is lower (or distance closer) riders will opt to participate more frequently. The index value may be forgone to have a place close by to frequent. Those surveyed riders making at least one overnight visit to the selected location in a year made significantly more frequent visits, with a higher index value, and traveled further to get there. Their education level is also slightly lower, but this is thought to be a spurious correlation. Having more frequent visits and traveling further is explained by the higher index value suggesting these riders placed a higher value on the location they went, and that they spent more time there.

Cost of travel

Question 7 asks trail riders, "How much did you pay in travel costs, including trailering costs, for you and your immediate family?" One hundred seventy-five

surveyed trail riders reported an average travel cost of $105 per visit, one-way. Refer back to Table 5.1. This cost of travel is positively correlated to the distance traveled in miles. Calculated using SAS, the correlation coefficient between the two variables is 0.2392 with a p value of 0.0014. Gas is presumably a major portion of this cost, although other factors may include food purchased, gear, wear and tear on the truck and trailer, etc.

Related to the cost of the visit, question 13 asks, "What was your average cost of lodging/camping per night?" Lodging varied from camping onsite, camping nearby, staying in a hotel and to staying in a cabin. The majority of trail riders indicated that they camped onsite and spent an average of $27 per night. Those trail riders who camped nearby, but not at the trailhead, spent an average of $35.50.   To stay in a hotel, surveyed trail riders indicated they spent over $64 per night. Finally, trail riders spending overnights in a cabin spent an average of just over $50 per night. The overall average of overnight stays cost $29 per night.

Additionally, time is another cost to consider. Highly correlated to distances traveled, the average length of time to get to a site is nearly 85 minutes. Additionally, overnight riders were spending an average of 2.8 nights onsite, similar to the length of stay for a long weekend.

Trail riders' interest in onsite horse rentals

Using data gathered from question 14, "Would you be interested in renting horses if available on-site? YES / NO," riders who stated they were willing to rent a horse onsite were compared to riders not interested in renting a horse. According to the student's t-Test run, there was no difference in miles traveled to get to a location between those interested in renting a horse on-site and those not interested. See Table 5.6. There was a significant difference in the number of visits a rider was willing to make. Riders expressing an interest in renting a horse onsite made significantly fewer overall visits to sites, 5.5, compared to 12.2 for those not said they were not interested. Possibilities to explain this include, but are not limited to: 1) lack of availability of reliable access to a horse, trailer, or truck (i.e. borrowing horse or trailer from friend and relying on their schedule, etc.), or 2) difficulties in using their own horse as a trail horse (i.e. if a horse is

difficult to load onto the trailer or frequently spooks during the ride making for an unpleasant experience overall, etc.). It should be reminded that riders who already trailer horses to the sites were targeted for the study. Very few, if any, concessions allow for horses to be rented out for a period of time for unguided use similar to this type of riding. The horse rental question reflects this type of riding. Most current horse rental concessions are geared to beginner or very infrequent riders, and are led by a guide generally "nose to tail" often in rather large groups, resembling more of a guided tour on horseback than recreational trail riding which would be closer to "hiking on horseback" in smaller groups, and therefore in this case are considered a completely separate activity. Of the sites looked at, only three have horse concessions, all in the manner of the latter activity. These locations are the Kentucky Horse Park, Carter Caves, and Mammoth Cave.

Willingness to volunteer to maintain trails

Many respondents indicated a willingness to volunteer an amount of time to maintain the upkeep of the trails, with 102 indicating they would be interested in volunteering. See Table 5.7. Differences among those willing to volunteer and those not interested or unable to as determined by a student's T-test include distance traveled where the average distance traveled was nearly 15 miles further for those willing to volunteer. It is important to note that overall number of visits to a site was not a significant determinant of the willingness to volunteer. Because further distance reflects an increase in travel cost and is associated with fewer trips typically, this suggests the people willing to volunteer value the site more than those unwilling to volunteer. Other differences include those willing to volunteer have higher education, and related to that, higher income. There was no difference between volunteers and non-volunteers regarding the type of trips taken (day trips versus overnight trips). Additionally there were no differences between age and gender. Index of trail characteristics was also not significantly different for those willing to volunteer versus the rest. The 102 respondents indicated they are willing to spend an average of 21 hours per year volunteering. See Table 5.8. They traveled an average of 73 miles to the site, and had an education ranking

of 2.3, where 2.0 would be an associate's degree, and a 3.0 indicates a bachelor's degree (If necessary, refer back to the education ranking descriptions previously mentioned in Chapter 4). On average, those willing to volunteer had a median household income of $70,252.

Other trail users

The last question in the survey asks respondents to identify other trail users which they are least favorable in sharing the trails with. The study did not control these responses against demographic variables or participation rates, so all surveys with that question answered were used, regardless of how completely or accurately the rest of the survey was filled out. Additionally, because participants could list as many groups as they wanted and as such there was some overlap, the percentage sum is greater than 100%. From the 276 respondents who answered that question, 6.5% indicated they had no preference or did not mind sharing the trails. An overwhelming majority, 72%, identified ATVs as their least favorite group, with mountain bikes the next closest group at 43%. Hikers and other motorized vehicles were mentioned by 9% and 8.3%, respectively. Five percent of respondents prefer not to share the trails with hunters, and 3% do not like congestion with other horse riders. Six percent of the respondents indicated another group not previously listed. This information may be valuable to trail managers determining designated use and availability of trails.

Geographic distribution of respondents and land availability for future development

From the data collected, additional information was inferred. Total distance traveled was calculated using the home zip code as the starting point. Zip codes for the trail sites were identified. Then an internet-based GIS system was used to calculate distance traveled and time in minutes. This system used the most direct route and accounts for urban versus rural roadways. Zip code centroids were used to calculate distances. This provided the variables "distance in miles" and "distance in minutes." Using the zip codes also helped determine the trail riders' counties of origin as well as the

counties where trail heads were located. From this, a map was developed using GIS
software showing where the surveyed trailheads were generally located as well as
identifying those counties in which at least 5 respondents participated in the survey. See
Figure 5.2. These counties with several respondents are also close to some of the larger
cities around Kentucky. Specifically, Jefferson and Oldham counties are around
Louisville; Boone, and Campbell are included in the Greater Cincinnati (OH) area; Scott,
Fayette, and Jessamine include Lexington; Somerset is in Pulaski county; and Bath and
Morgan are adjacent to Morehead in Rowan county.

Barren Fork Horse Camp

The U.S. Forest Service expressed interested in finding out trail riders opinions of
the Barren Fork Horse Camp located in the southern portion of the Cumberland District.
Therefore, in the study, a question was included asking if a rider had been there, and then
subsequently what they liked as well what they did not like about the site. Thirty three
respondents indicated they had been to Barren Fork. The most comments that were
mentioned in favor of the site included the scenery (13 respondents) and the trail layout
including loops and length (7). Several riders (6) indicated the site was generally nice,
but some common issues the trail riders suggest were inadequate include lack of good
trail markers (7), debris on the trails including trash and fallen trees, etc. (5), and interest
in seeing improved campground facilities such as electricity and a bath house (3).

Data management

The dependent variable of total trips per year was calculated by summing total
day trips and total overnight trips. A variety of dummy variables were created. The
variable "male" reflects gender in that male respondents were identified with a 1 and
females with a 0. Based on sites specified, locations were identified as part of the DBNF
and whether they are public or private facilities. Using zip code information, Federal
Information Processing Standards (FIPS) codes were identified and locations were

determined to be urban, rural, or suburban. Variables were also created regarding locations of overnight accommodations and survey type administered.

Some potential but not clearly defined biases emerged during data collection. The online respondents first had to have access to the internet, and second be affiliated with one of the trail riding organizations contacted. Then there was self-selection in that people had a choice to go to the website or not, as well as completely and correctly filling out the survey. The selection bias present with the onsite surveys is due to surveying people present on the trails at the time the surveyors traveled to the sites. Because of the previously mentioned cost of administering the surveys, this was usually dry and warm but not hot weekend days in late summer and fall. Demographic information is unavailable for those trail riders who did not fill out the survey. This study targets people actively involved with recreational trail riding. Non trail riders were specifically excluded, and therefore no demographic information was collected for them. However, a study by V. Kerry Smith (1988) shows that particularly for local sites such as these, versus those with a large national attraction, the selection effects are not significant and therefore it is assumed they are not concerns in this study.

Table 5.1 Means of variables describing the "typical trailrider." (n= 221 for all variables except Index of characteristics n=29, Hours willing to volunteer n=154, Travel cost n=175, and Willing to rent horse onsite n=188)

Variable	Mean	Std. Dev.	Min	Max
Total trips per year to location	10.65	13.89	1	75
Male	0.33	0.47	0	1
Age, years	46.50	12.67	18	71
Education (see text for description)	2.21	1.22	0	5
Median Household Income, $	67111	32858.19	6000	120000
Index of characteristics, %	72.9	18.45	14.3	100
Distance, miles (one-way)	68.7	52.76	0	235
Distance, minutes	84.83	54.47	0	260
Nights camping onsite	2.8	6.14	0	60
Nights spent in cabin	0.51	4.22	0	48
Nights spent camping nearby	0.176	1.39	0	20
Night spent in hotel	0.068	0.694	0	10
Day trips per year	8.42	12.5	0	65
Day trips in spring	2.64	4.27	0	23
Day trip in summer	2.457	4.387	0	25
Day trips in fall	2.819	4.35	0	25
Day trips in winter	0.511	1.45	0	10
Overnight trips per year	2.52	4.876	0	40
Overnight trips in spring	0.75	1.57	0	12
Overnight trips in summer	0.683	1.85	0	20
Overnight trips in fall	1.014	2.116	0	15
Overnight trips in winter	0.068	0.33	0	2
Travel cost, $	105.28	246.9	0	2500
Hours willing to volunteer	14.21	25.56	0	200
Willing to rent horse onsite	0.1755	0.3814	0	1

Table 5.2 Student t-test results comparing online surveys with surveys administered onsite. (n= 133 online and 88 onsite)

Variable	Mean difference (online - onsite)	Std. dev.	Std. error	t value	Pr > |t|
Trips per year	-0.499	13.653	1.8762	-0.27	0.7905
Age, years	6.2012	12.293	1.6893	3.51	0.0006
Income, $	12451	32075	4407.5	2.82	0.0052
Education (see text for description)	0.5044	1.2192	0.1675	3.01	0.0029
Male	-0.169	0.4651	0.0639	-2.54	.0089
Distance, miles	20.656	53.717	7.3814	3.0	0.0030

Table 5.3. Average miles traveled for visitors to trails with at least 3 surveyed visitors.

Location	Number of observations	Mean distance traveled, miles	Std. dev	Min	Max
Caney	28	82.6	65.302	0	235
White Sulphur	56	71.17	52.20	0	211
Rudy's Ranch	4	91.54	88.7	13.6	201
Murder Branch	17	49.7	37.56	0	127
Barren Fork	3	34.53	4.39	32	39.6
Bell Farm	11	61.75	68.95	0	225
Stampede Run	7	50.41	52.76	0	125
Mammoth Cave	5	24.66	16.86	0	46.3
Big South Fork	4	32.13	12.56	24	50.6
KY Horse Park	17	52.47	27.59	0	97.8
Wrangler's Campground	10	68.67	43.31	0	138
Taylorsville Lake	3	57.93	20.6	34.4	72.7
RedHill Horse Camp	5	59.92	43.01	13.5	124

Table 5.4. Student's t-test showing differences between those surveyed trailriders who only made daytrips versus those which only made overnight visits. Daytrip n= 72 and Overnight n= 26.

Variable	Mean Difference (overnight – daytrip only)	Std Dev	Std Err	T value	Pr > |t|
Total Visits	6.2393	15.869	3.6309	1.43	0.1617
Age	1.9124	12.52	2.8647	0.67	0.5060
Male	0.0235	0.487	0.1114	0.21	0.8334
Education	-0.351	1.2814	0.2932	-1.20	0.2335
Median Income	-928	31591	7228.1	-.013	0.8981
Distance, miles	-6.51	53.25	12.184	-0.53	0.5943
Index	-1.445	16.462	3.7666	-0.38	0.7022

Table 5.5a. Students t-test showing differences among those surveyed trailriders who made at least one daytrip versus those who did not. Daytrips n= 160, No daytrips n = 28.

Variable	Mean Difference (no daytrips - daytrips)	Std Dev	Std Err	T value	Pr > |t|
Total visits	-7.288	13.671	2.8005	-4.07	0.0001
Male	-0.077	0.4791	0.0981	-0.78	0.4350
Age	3.6304	12.9	2.6426	1.37	0.1712
Education	0.2786	1.2599	0.2581	1.08	0.2818
Median Income	8893.4	32792	6717.6	1.32	0.1872
Distance, miles	59.164	48.488	9.9328	5.96	<.0001
Index	9.667	15.868	3.2506	4.22	<.0001

Table 5.5b. Students t-test showing differences among surveyed trail riders who made at least one overnight trip versus those who did not. Overnight n= 116, No overnights n=72.

Variable	Mean Difference (No overnights – overnights)	Std Dev	Std Err	T value	Pr < |t|
Total visits	-4.297	13.758	2.0642	-2.08	0.0387
Male	-0.074	0.4785	0.0718	-1.03	0.3056
Age	1.3094	14.414	1.9428	0.67	0.5012
Education	0.4325	1.2461	0.1869	2.31	0.0218
Median Income	4028.5	32888	4934.2	0.82	0.4153
Distance, miles	-28.15	51.091	7.6653	-4.00	<.0001
Index	-18.18	14.773	2.2165	-5.31	<.0001

Table 5.6. Student t-test comparing distance traveled and overall trips made for riders not interested in renting a horse onsite and those willing to rent a horse onsite. Those riders not interested in renting a horse onsite made 12.2 trips per year versus those interested in renting a horse onsite making an average of 5.5 visits to a location per year. (n= 155 for not willing to rent and 33 for willing to rent)

Variable	Mean difference (not willing to rent – willing to rent)	Std. dev.	Std. error	t value	Pr > |t|
Distance, miles	6.40	52.85	10.13	0.80	0.4279
Trips per year	6.71	13.69	2.62	4.32	<.0001

Table 5.7. Student t-test comparing those willing to volunteer and those not willing to volunteer to help upkeep trails. (n= 102 for willing to volunteer and n= 86 for those not willing to volunteer.)

Variable	Mean difference, not willing to volunteer- willing to volunteer	Std. dev.	Std. error	T value	Pr > |t|
Total visits	1.9774	13.882	2.0323	0.97	0.3318
Distance, mile	-14.56	52.377	7.6678	-1.95	0.0525
Male	.0388	0.4795	0.0702	0.55	0.5815
Age	-1.802	12.934	1.8934	-0.95	0.3425
Education	-0.417	1.2465	0.1825	-2.35	0.0200
Overnights	0.6961	5.2032	0.7617	0.91	0.3620
Daytrips	0.5264	12.611	1.8462	0.29	0.7758
Income	-11615	32429	4747.4	-2.49	0.0138
Index	2.3266	16.199	2.3715	1.00	0.3203

Table 5.8. Means of significant variables for trail riders willing to volunteer to upkeep trails. (n=102.)

Variable	Mean	Std. Dev.	Minimum	Maximum
Distance, miles	73.203	55.8692	0	235
Education level	2.382	1.4075	0	5
Income	70252.06	35005.45	6000	120000
Hrs to volunteer	21.2376	28.8389	1	200
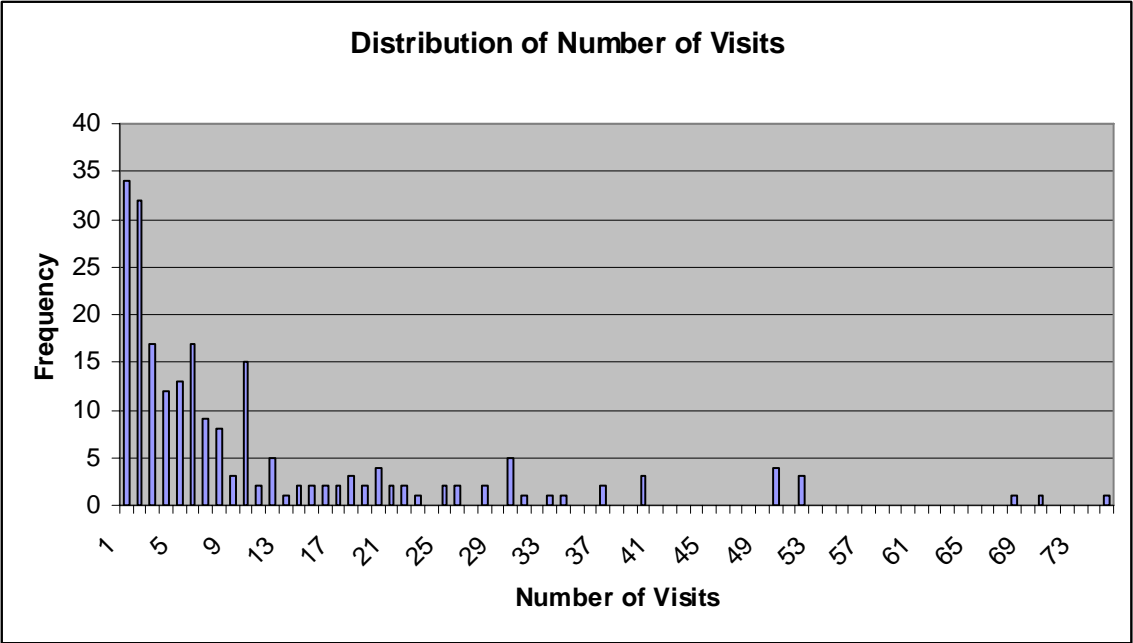
Figure 5.1 Distribution of the total number of annual visits for surveyed KY trail riders. (n= 219)

Figure 5.2 Map of KY counties representing trail heads and those counties with at least 5 surveyed trail riders.

Chapter VI: Estimation of Demand

Demand function estimations for a site typically result from the individual level and site characteristic values are summed from individuals' values. Demand is derived by maximizing an individual's utility, but subject to an income constraint. The utility is a function of all the goods an individual values, in this case, trail riding and everything associated with it, and anything else, for example food, housing, pets, and/or anything else the individual prefers. They also have a limited income, so they try to get as much of the things they like to maximize their utility, but can only do so much as their income permits, hence the constraint. This gives the compensated demand for the site, which is generally not observable. This compensated demand establishes how changes in price and frequency of participation adjust with respect to each other, maintaining all other factors including other prices and even utility constant. However, the ordinary demand is observable and that is estimated by knowing the number of visits a trail rider makes to a particular trail which is a function of the cost to visit that location, including parking or camping fees and travel cost (Freeman 2003). Based on Willig's work (1976), since the income elasticity of demand and expenditure on the activity is a small percentage of income the consumer surplus for the Hicksian (compensated) demand can also be measured from the consumer surplus area under the curve of the Marshallian (ordinary) demand.

After determining consumer surplus, the welfare effects are calculated by multiplying consumer surplus by the cost of travel. This cost of travel times the number of visits can then determine the value of the sites riders visit. The cost of travel considers what it costs to get to a location, including gas, time, wear and tear on the vehicle, etc.

Problems that arise with the TCM include difficulty associated with specification and measurement of quantity, price and substitute site variables. Measurement of quantity varies with using each day as a separate visit, or looking at entire visit of more than one day as one visit (regardless of whether it was 1 day, 2 day, etc). Travel with longer distance would probably have longer visit length, with fewer overall visits. (Brown and Mendelsohn 1984)

None of the participants in the study were trailriding as part of a multidestination trip. Therefore, there is no need to address the implications of how the overall value of the trip must account for each destination. The trailriding is the only destination and therefore the full value of the trip.

Travel Cost Models (TCM) estimate demand for recreation sites. According to Betz, Bergstrom and Bowker (2003) and Freeman (2003) this method relies on several assumptions, but primarily that participants will respond to changes in travel related costs the same as admission price changes. Although never specifically applied to equestrian activities, other research has used this method for recreational activities including fishing, mountain biking, multi-use trails, and rock climbing (Layman, Boyce, and Criddle 1996; Fix and Loomis 1998; Betz, Bergstrom, and Bowker 2003; Shaw and Jakus 1996, respectively) Traditional methods of data collection include mail or on-site surveys of individuals or households (Freeman 2003), but with the prevalence of the internet, it is easy to conclude online surveys are a more recent, growing acceptable method.

In identifying variables to be considered in the analysis, there are some options for travel cost models, depending on which variation is used. It is generally accepted that the minimum variables to be considered are own price, substitute price, and income (Freeman 2003). Interestingly, with respect to other studies of recreation demand, household income is not usually a significant variable, but is often included because it reflects the budget constraint (Betz, Bergstrom and Bowker 2003; Fix and Loomis 1998; and Siderelis and Moore 1995). Other demographic explanatory variables commonly used include most frequently age (Loomis and Walsh 1997; Fix and Loomis 1998; and Betz, Bergstrom and Bowker 2003), and also education, race, gender, and occupation (Loomis and Walsh 1997). The variables included in the KY Trail Riding Study include distance in miles (representing the cost), the index of site characteristics, male and income (representing the budget constraint). Substitutes were excluded because it is nearly impossible to identify every possible substitute and its cost, and as discussed later, is not necessary. Race and occupation were not included in this study's demographic information.

Many variables available for the study were highly correlated resulting in a multicollinearity problem in which the model was significant but no individual variable

was significant. See Table 6.1. Multicollinear variables included age, education, and income, in which income was used as it also reflects the budget constraint. Distance measured in miles and minutes were also highly correlated, thus, distance in miles was used. The final variables used, accounting for the multicollinearity problem, include distance in miles, income, index, and gender.

Actual travel cost is not agreed upon though, as there is debate as to whether to consider food and lodging (Fix and Loomis, 1998) or distance traveled times a cost per mile rate (Siderelis and Moore 1995). However, Bowker, English and Donovan (1996) did not find there to be significance for one over the other. Additionally, significant costs may vary among inputs such as the truck and trailer to transport the horse, the actual cost of the horse, and equipment, all of which may vary by thousands, or even tens of thousands of dollars. Because actual cost is usually unavailable, general costs and distance covered are often used to reflect these costs. Betz, Bergstrom and Bowker (2003) calculated this mileage using an internet based travel direction software. Using zip code centroids of hometown and trail/campsite locations, this study followed their example and used internet based GIS software also.

Opportunity cost of time is addressed in various ways. Some methods include considering a portion of wage rate. However, what this proportion should be is not agreed upon, including whether time should really be considered (McConnell and Strand 1981; Freeman 2003). While Fix and Loomis (1998) used time as a variable, Betz, Bergstrom and Bowker (2003) found it to be highly correlated with distance, therefore they just used distance. As mentioned above, distances and times are indeed related in this study, but distance in miles is chosen.

The household production function implies the items purchased for a household are used as inputs with time to produce a final good or service (Freeman 2003). The final product, however, is valued more than just the cost of the measured inputs. A favorite example is that the toothbrush, toothpaste, mouthwash and floss are of value when it comes to brushing teeth; simply owning the products are not enough to attain clean teeth. Additionally, clean healthy teeth require all of the aforementioned items; without toothpaste, the teeth will not be clean enough. These items are complements in that they work with each other for the outcome. They also require time and technique which

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cannot be easily valued. There may be periodic visits to a dentist for additional care, but this would not be a substitute for the daily care. Just owning the inputs are not enough to identify the value of the product. Individuals value it differently and may brush their teeth more frequently or less frequently than others, or spend a different amount of effort with respect to also using floss, mouthwash, etc. on them.

Relating to the trail study, it is more than just having access to a horse, tack and trailer, but rather putting them all together at a location with a rider's knowledge and interests and valuing the overall experience of trail riding. The true value of trail riding is not realized in just the known prices of each input. Determining the true value of trail riding involves knowing once a person has the basic inputs, and then finding out how much time they spend in that activity, how frequently they participate, and how far they travel for the activity. The characteristics of a specific location can be identified and then the demand of that site determined by number, frequency and time length of visits. This valuation also considers income, as that is a constraint that can limit inputs to the activity.

Substitutes for activities would include more than just going to a different trail. It would also include all other non-trail as well as non-riding activities. These substitutes are highly variable and dependent upon the individuals, therefore, it would be impractical to identify and determine the subsequent cost of all possible substitute activities. Morey and Breffle (2006) identify a solution to this problem by labeling all substitute activities as "other" and would consider that every trail rider is either choosing to ride that trail, or they are not. Specifically, not riding that trail would be the substitute. For this reason there is no set cost to use for this "other" substitute activity, and based on the research by Morey and Breffle, can be excluded from the analysis.

Estimating demand for participation in recreational equestrian trail riding

The dependant variable is a sum of the number of overnight and day trips a trail rider makes to a specific location in a year. Active trail riders that go to the site at least once were targeted for this study, and therefore is always a positive integer. This is considered count data because each number is a quantity representing the total number of trips and is a nonnegative integer. Values ranged from one to seventy-five trips per year.

Related to the dispersion problem mentioned in Chapter 5, even though the total average of visits approached 11 visits annually, nearly half the respondents made no more than 5 visits a year. Visits lasted hours for a day trip up to a total of forty nights out of the year, with an average of just under two nights per visit.

With an average of nearly 11 trips per year per trail rider, participation in the activity is not rare, making the Poisson model recommended by Shaw (1988) unlikely to be appropriate for the analysis. Additionally, the variable "number of trips" is not normally distributed and the mean does not equal the variance, as assumed in the Poisson model, but rather has an overdispersion problem. Refer back to Table 5.2. As mentioned in Chapter 5, nearly half of the respondents made no more than 5 visits per year. Specifically, the median number of visits is 6. This means that equestrians are heterogeneous with respect to number of trips taken to a site. Indeed the variance, calculated as the standard deviation squared, equals 192.93, and it is much larger than the mean total trips per year to a location, 10.65. Because of this, other traditional models assuming normal distribution used in similar works such as the Probit model were also inappropriate. Therefore, a Negative Binomial distribution accounting for the overdispersion of the distribution is most appropriate. Indeed, studies by Grogger and Carson (1991), Englin and Shonkwiler (1995), Greene (2000), and Betz, Bergstrom, and Bowler (2003) all suggest accommodating this problem of overdispersion by specifying a Negative Binomial II (NB) distribution for the number of visits

The Negative Binomial distribution is a variation of the Poisson, but it is more general and accounts for this overdispersion by allowing for the mean and variance to differ. Following the work of Blackwell et al (2008), this model was truncated at zero because one is the minimum value due to the previous mentioned target of surveying active trail riders. Using notation from Grogger and Carson (1991), the equation for the Negative Binomial used is:

$$\Pr(Y_i = y_i \mid Y_i > 0) = \frac{\Gamma\left(y + \frac{1}{\alpha}\right)}{\Gamma(y+1)\Gamma\left(\frac{1}{\alpha}\right)} (\alpha\lambda_i)^y \left[1 + \alpha\lambda_i\right]^{-\left(y+\frac{1}{\alpha}\right)} \left[1 - F_{NB}(0)\right]^{-1},$$

Where Pr is the probability of participation in the event, in this case recreational trail riding at a site, and y is the observed value of Y. This y refers to number of visits made to a site annually. Γ is the gamma function, α is a gamma parameter, λ is the parameter to be estimated as $\exp X_i \beta_i$, and F_{nb} refers to the cumulative distribution of the negative binomial.

The Poisson and Negative Binomial are nonlinear distributions. To obtain efficient estimates the Maximum Likelihood Method is used. This is related to efficiency and the asymptotic distribution. The equation to estimate the Maximum Likelihood for the Negative Binomial is the log linear function as follows:

$$\ln L = \sum_{i=1}^{M} \ln\left(\Gamma\left(y + \frac{1}{\alpha}\right)\right) - \ln\left(\Gamma(y+1)\right) - \ln\left(\Gamma\left(\frac{1}{\alpha}\right)\right) + y\ln(\alpha) + yX_i\beta$$

$$-\left(y + \frac{1}{\alpha}\right)\ln(1 + \alpha\lambda_i) - \ln\left(1 - (1 + \alpha\lambda_i)^{-\frac{1}{\alpha}}\right).$$

Where β is the parameter of the independent variable estimated and estimated alongside α. The subscript i refers to the number of visits, which in the study ranged from one to seventy-five.

The marginal effects were calculated based on the conditional mean. The conditional mean is calculated by

$$E(Y_i|X_i, Y_i > 0) = \lambda_i(1 - F_{NB}(0))^{-1},$$

From there, the marginal effects are calculated by taking the first derivative of the conditional mean:

$$\frac{\partial E(Y_i|X_i, Y_i > 0)}{\partial X_{ih}} = \beta_h \lambda_i \left(\frac{1 - F_{NB}(0)\left(1 - \lambda_i F_{NB}(0)^{\alpha}\right)}{(1 - F_{NB}(0))^2}\right).$$

This shows how a one unit change in each independent variable affects the independent variable, total visits. This study estimates the inverse demand function, and therefore the interpretation of the marginal effects must also be the inverse. Therefore, the true marginal effects for this study are one divided by the marginal effects provided by the equation above.

Results

The variables included in the Negative Binomial model to explain visits to a particular Kentucky trailhead include distance in miles, index, income, and gender. The estimation used LIMDEP (Greene, 2007) and the results are reported in Table 6.2. Of these variables, distance and index are significant at the 1% level. Gender is significant at the 5% level. Income, though not significant, indicates the budget constraint and follows the pattern of other recreational demand studies (Betz, Bergstrom and Bowker, 2003). The marginal effects are included and indicated how each variable must change to increase the likelihood of another visit by one. In this study, riders will visit their identified trail one more time annually for each 7.79 mile decrease in distance. Improving site characteristics by adding one characteristic to the site will increase the average visits by 4. This suggests that trail managers interested in improving current sites should focus on increasing the number of amenities offered. The estimation was conducted by the maximum likelihood estimation method. The McFadden's r-square is used to indicate how well the independent variables explain the dependent variable. In this case, the McFadden r-square is 0.4947.

Table 6.1. Correlation matrix of possible variables where educ refers to education and avg_on refers to average number of nights spent onsite. (n=221) P value underneath the correlation coefficient.

	visits	male	age	educ	income	index	mile	minute	avg_on
visits	1								
male	0.1961 0.0034	1							
age	-0.0062 0.9273	0.0112 0.8688	1						
educ	-0.0989 0.1238	-0.1983 0.0031	0.2013 0.0026	1					
income	-0.0657 0.3304	-0.0607 0.3691	0.3382 <.0001	0.4123 <.0001	1				
index	0.1269 0.0596	0.1414 0.0357	0.0910 0.1778	-0.0925 0.1704	-0.0264 0.6963	1			
mile	-0.3611 <.0001	-0.0757 0.2622	0.2175 0.0011	0.1651 0.0140	0.1998 0.0028	0.2784 <.0001	1		
minute	-0.3403 <.0001	-0.0614 0.3635	0.2033 0.0024	0.1406 0.0367	0.1601 0.0172	0.3236 <.0001	0.9692 <.0001	1	
avg_on	0.0150 0.8245	0.0862 0.2017	0.0731 0.2792	-0.2039 0.0023	0.0712 0.2922	0.2595 <.0001	0.2856 <.0001	0.3004 <.0001	1

Table 6.2. Truncated negative binomial count data model of trips to Kentucky equestrian trails. (n=221, *** is significant at the 1% level, * is significant at the 5% level. McFadden R-sq= 0.4947).

Variable	Parameter Estimate	Asymptotic Std. Error	Marginal Effect	Inverse Marginal Effect
Constant	0.6734	0.4354	6.3740	0.1659
Distance, miles	-0.0136***	0.0016	-0.1284	-7.7870
Index	0.0300***	0.0055	0.2836	3.5260
Income	-0.0066E-4	0.0275E-3	-0.0063E-3	-15.873E4
Male	0.3645*	0.1926	3.4499	0.2899
Alpha (dispersion)	1.2666***	0.2640	---	---

Chapter VII: Welfare Statements and Policy Implications

Calculating consumer surplus

Following Cameron (1992), Randall (1994), Englin and Shonkwiler (1995), and Betz, Bergstrom, and Bowler (2003), distances do not have fixed units representing their cost of travel. Instead, cost is simply measured in "miles." This way, as shown below, the results can be scaled with an arbitrary unit "cost" if the desire is to make welfare statements. The following example considers how changes in the costs affect consumer surplus.

Related to the negative binomial distribution mentioned in Chapter 6, the demand for recreational equestrian trail riders who revisit a site is non-linear. For a linear demand the consumer surplus is typically calculated as the area under the curve. Though the demand is unknown, one point on the demand curve is known. The average trail rider makes 10.7 visits to a specified trail traveling approximately 69 miles (one way) to do so. The quantity demanded in this case is the number of visits, and the price is reflected in the distance traveled. For a linear demand, consumer surplus would be calculated as the area of a triangle under the curve:

$$Area_{triangle} = .5(base * height)$$

According to Boardman et al (2005) consumer surplus (CS) is a measure of welfare and is determined by the equation:

$$CS = .5(Q_1 - Q_0)(P_1 - P_0)$$

At the average point, this is reflected by:

$$CS_{69} = .5(10.7 - 1)(235 - 69)$$

Where $Q_1 = 10.7$ was the average number of trips, $Q_0 = 1$ because all survey participants made at least 1 visit, $P_1 = 235$ is the maximum number of miles traveled by surveyed participants, and $P_0 = 69$ which is the average distance in miles traveled by the surveyed equestrians. Following this, the CS at that point is 805. The marginal effects are also known from the Negative Binomial distribution. At this mean, visits would increase by one for every 7.65 miles decrease in distance. Therefore, the CS at 61.35 miles is:

$$CS_{61.35} = .5(11.7 - 1)(235 - 61.35) = 929$$

The difference in decreasing the mileage by 7.65 miles and increasing visits by 1 is 124. CS is easily understood when interpreted in dollars. Assigning an arbitrary value of $1 per unit, the CS_{69} is now $805, $CS_{61.35}$= $929, and the difference in CS= $124. This CS represents the average trip. Therefore, this would be multiplied by the number of total visitors and total number of trips to estimate total CS. Additionally, the value of $1 can be adjusted to reflect any price for travel cost.

As mentioned above, the demand is non-linear and so this calculation of consumer surplus represents just a segment of the demand curve. See Figure 7.1. The figure also shows a linear and log (non-linear) demand. As seen in the figure, the CS is not the same for both and therefore cannot substitute the linear demand for the non-linear. Continuing to extrapolate out towards either intercept with the same slope, as with a linear demand, will result in an inaccurate estimation of demand and subsequent CS.

CS is useful in determining overall social benefits. Recreational trail riding is not reflected in a normal market setting and as such typical Producer and Consumer Surplus are not easily measured. One point on the demand curve was estimated above, and the marginal effects were used to determine one point below. This CS can be used to estimate the overall social benefits. This study found that the average equestrian is willing to pay up to $805 for a visit to a representative Kentucky horse trail that is approximately 69 miles away from their residence. This calculation assumes a cost of $69 per trip. Dividing the cost of $69 by the 69 miles demonstrates the assumption of a $1 per mile cost. This represents the annual benefit that each equestrian receives from visiting a particular site. At a different cost per mile, the estimate of consumer surplus would also change accordingly. A trail manager, knowing the cost to build a trail, may consider distance and knowing that locating trails closer to the population areas increases consumer surplus because their costs, in this case miles traveled, decrease.

Policy Implications

There are two types of potential implications to policy that can be addressed. These include suggestions for management of existing trails and planning for future trail development. With respect to existing trails, the index of characteristics is significant,

and therefore, maximizing these characteristics improves the annual visits an individual makes to a site. These site characteristics include loop trails, at least 15 miles of trails, full service campsite at trailhead, open views, well marked trails, available water along the trail, and potential for wilderness camping along the trails. For example, a trail manager may opt to improve the site characteristics by adding water and electricity facilities at the trailhead campsite if not already available or trails can by modified so that they loop back to the campsites and parking areas. From the rider preference for multi-use trails, managers may consider keeping some groups, such as ATVs and mountain bikers, on separate trails from horse riders.

Trail managers interested in creating new trails for riders should seriously consider the distance and locate trails near where the populations are focused, as well as include as many attributes as possible. This study identified population centers near the urban areas of Northern KY (across from Cincinnati, OH), Lexington, and Louisville, so future considerations for trails may consider proximity to any or all of these cities. Figure 7.2 shows where the trail riders originate from, and there is a large number coming from these populated areas. There lies a region between this triangle, in proximity to interstates 75, 71 and 64 where potential land may be available for future trail development. Figure 7.3 shows all protected public and private lands in Kentucky. Figure 7.4 narrows down the protected land areas to potential areas in this region of KY to consider equestrian trail development and/or further management. Additionally, information gathered on preferences of riders sharing the trails may provide insight to trail managers regarding what groups to allow access to which trails.

The identification of potential trail development is not absolute. Figure 7.3 only identifies protected land areas in Kentucky. Other public and private land that may or may not be available is not considered. However, there are many other factors affecting a potential trail site. Two of the largest tracts of land in the vicinity are not likely because they are federally owned military areas that would be impractical due to restricted access. Additionally some parcels of land are very small, and therefore not able to handle the capacity of the campsites, parking areas, and trails. Figure 7.4 focuses on the northwestern area of the state, and identifies the cities of Louisville, Lexington, and Cincinnati (OH). Additionally protected areas greater than 200 acres are identified as

being the absolute minimum size to accommodate a campsite and enough trails to meet the characteristics of the index, with larger areas being preferred. Of course land characteristics specific to locations may alter that size and require more land. Some of the parcels are adjacent to each other and potentially could be combined. Sites within 65 miles of at least one of the urban areas are identified. Because GIS software was used to develop the maps, and it identifies straight distances instead of road distances, as estimate of 1 straight mile equals approximately 1.5 road miles. In addition to federally controlled land, the remaining parcels of land were identified as private, locally governed (by the county in these instances), or state governed land. Again, this map just identifies potential trail sites; final suitability of land for trail development would still depend upon other factors such as physical characteristics of the land and possible conflict with current usage, etc. which policy makers and trail managers would need to consider.

Comparing the identified trails in the Louisville, Lexington, and Cincinnati triangle with those trails included in the survey elsewhere, the trails were significantly lower in characteristic attributes. This is certainly an area which can be improved. Of the characteristics identified in the index, specifically the length of trails, water availability, and campsites along the trails were identified as lower than the other sites, lowering the overall index. Although all trail combined averaged an index rating of 73%, the sites not within 65 miles of at least one of the cities, averaged 79% yet the closer trails averaged only 57%. See Table 7.1.

Some of the protected areas in Figure 7.4 identified as potential trailsites already allow trail riding on at least some parts of the land. From our survey, these include Taylorsville Lake between Louisville and Lexington, Shaker Village, Clay Wildlife Management Area (WMA). Although not identified among surveyed respondents, the John A Kleber WMA in Owen County also has a trailhead. This trail is approximately 3 miles long, one way. There are no camping facilities (camping is not allowed in this WMA). Water is available along the trail in the form of creeks and streams, and changes in elevation at least suggest the potential for scenic overlooks. This area is less than 80 miles from Cincinnati, 70 miles from Louisville, and 28 miles from Lexington. Current uses of the area include hunting and fishing at a sustainable level and restoration of wildlife habitats. With over 2300 acres included in the land, there is plenty of space to

extend the trail length while still offering safety from the shooting range. Because camping is not currently allowed, that rule would either need to change to increase attributes, or it would have to be exclusively for day use only. Currently the index would be a minimum of 28.6 for having water accessibility and open views, or 42.9 if the trail is well marked. With adjustments of extending trail length, looping the trails, the trail can potentially achieve an index rating of 71.4, even without making any changes in the "no camping" regulation. This location is used as an example only and is not an attempt to suggest that this particular tract of land would be best suited for trail development. Other factors would need to be considered including a benefit-cost analysis of all potential uses, legal issues, etc before a final decision could be made.

Table 7.1. Students T-test showing differences between the trail identified by surveyed trail riders from the Cin/Lex/Lou urban triangle and the other areas. (n= 21 for other trailheads, and n=9 for trails included in the urban region.)

Variable	Mean Difference (Other areas - Cin/Lex/Lou)	Std Dev	Std Error	T value	Pr > |t|
Looped Trails	0	0	0	n/a	n/a
Length > 15 miles	0.3492	0.3795	0.1512	1.86	0.0913
Open Views	0.2857	0.3247	0.1294	1.65	0.1325
Trail Markers	0.2222	0.2357	0.0939	1.51	0.1690
Water Availability	0.4444	0.2817	0.1122	2.53	0.0353
Camping	0.1905	0.3401	0.1355	2.17	0.0423
Full Service Campsites	-0.016	0.5129	0.2043	-0.08	0.9386
Index	21.088	16.475	6.5637	2.30	0.0470
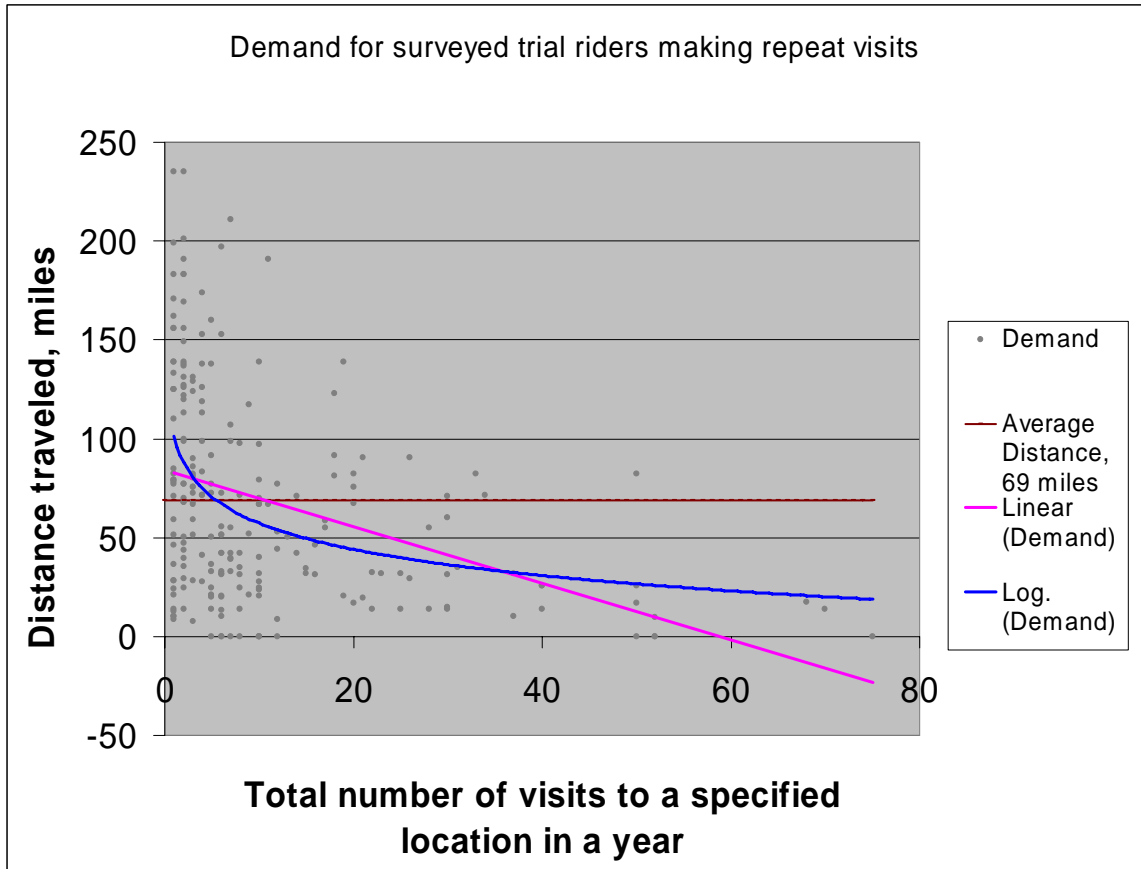
Figure 7.1. Linear and Non-linear Demand for Visitors making a Repeat Visit to a Specified Site.
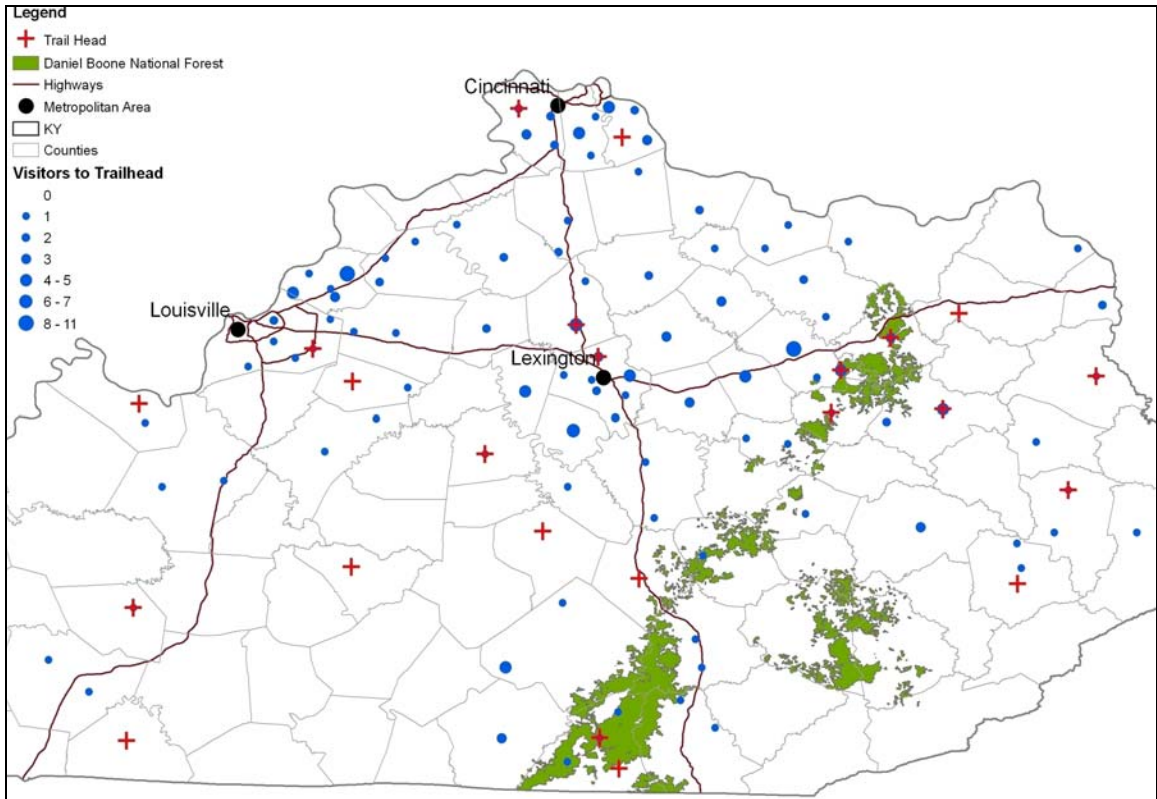
Figure 7.2 Where the trail riders are coming from by zip code, showing a concentration around the 3 metropolitan areas of Greater Cincinnati, Louisville, and Lexington.

Figure 7.3. Map of Kentucky counties representing protected areas with potential to be considered for future trail development and management and proximity to urban areas.

Figure 7.4 Potential lands for future trail development within 65 road miles of at least one of the metropolitan areas of Northern KY (Cincinnati, OH) Lexington, and Louisville, KY. Potential land is a minimum of 200 acres.

Chapter VIII: Conclusions

With over 320,000 horses in the state, the horse industry as a whole contributes nearly $4 billion to Kentucky annually (DeLoitte 2005). Based off the membership of multiple trail riding organizations, hundreds of Kentuckians are estimated to participate in recreational trail riding, with even more not affiliated with any organization. The average surveyed trail rider surveyed in Kentucky has a greater probability 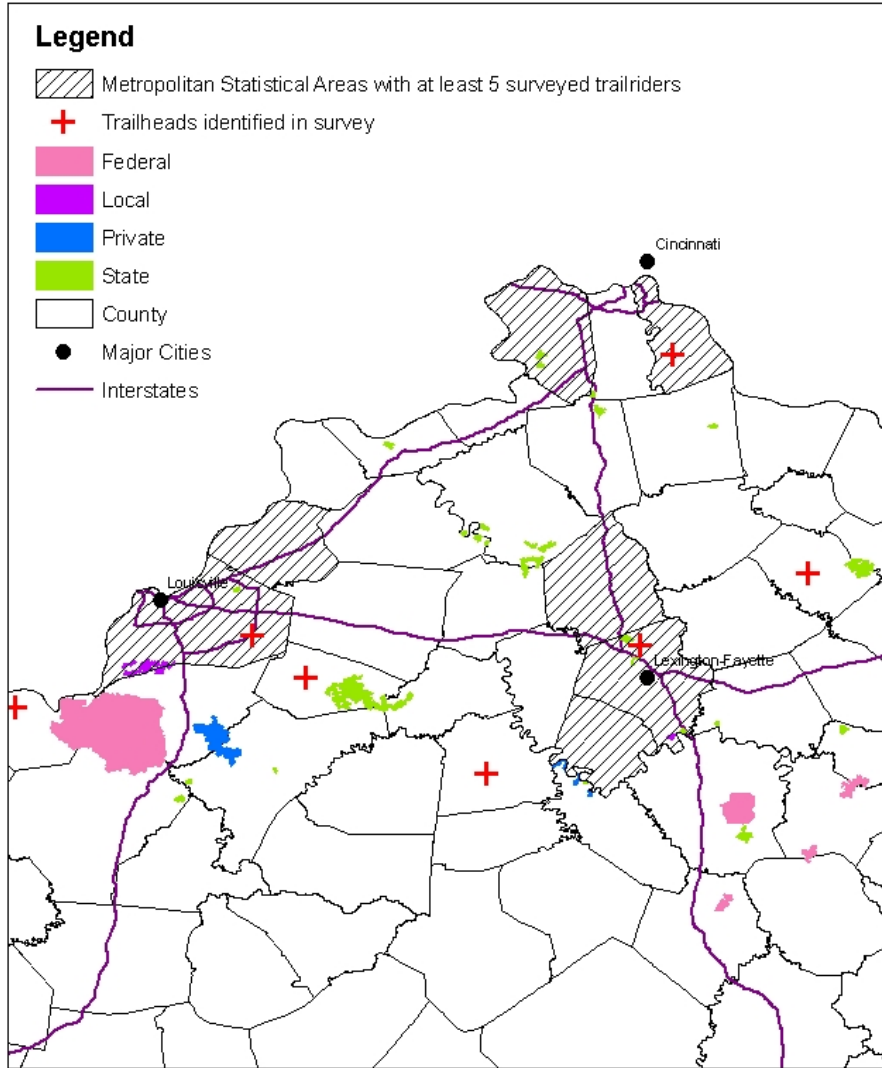of being a woman, approximately 46 years old, has a little more education than an associate's degree and lives in a household earning just over $67,000. This trail rider takes 10.7 trail riding trips to the same specific site a year, traveling an average of sixty-nine miles one-way. Some times these trips last a day, and sometimes they last longer, as about eighty percent of these trips are day trips, the rest being overnight trips. Nearly half of the surveyed trail riders took both day trips and overnight trips to the same location. Fourteen percent took only overnight trips and almost 47% took only daytrips. Surveyed trail riders make most of their trips, nearly 38%, during the fall season. These trail riders spent an average of $105 to get to the trails, and another $27 when they stayed overnight. Trail riders willing to volunteer hours to maintain the trails averaged a willingness to volunteer of 21 hours per year.

In general, trail riders making at least one daytrip to the identified location, made more overall visits, traveled fewer miles, and the sites had a lower index rating. This supports the travel cost concept that travel cost, in this study measured in miles, is inversely related to visits. Although the riders offering to volunteer took the same number of trips to a site each year and did not spend more time there, they did travel an average of nearly 15 miles to get there. Because this does not initially support the inverse travel cost concept of inverse price and number of visits, those trail riders willing to help with the trails value the trails more.

The variables used to explain a trail rider's likelihood to make a repeat visit to a site include distance in miles, median household income, index, and gender. Of these, the most important variable associated with locations identified by the surveyed trail riders is distance in miles. This variable explains the total number of visits to a trail location. From this, welfare implications were calculated, showing an average of $845

per trail rider to a specified location. This welfare is a benefit to society. With distance as the largest variable, by decreasing miles traveled, this welfare benefit can increase. Trail riders will increase their overall number of visits to a site by one with a 7.35 mile decrease in distance. This increases consumer surplus by 125 to $970. Because of this, the primary policy recommendation for the creation of new trails involves locating them closer to where the most trail riders are originating, in this case, the urban areas around Lexington, KY, Louisville, KY, and Cincinnati, OH. Trail riders increase their repeat visits to a location for a decrease of nearly 8 miles of distance traveled.

For current trails, the index of trail amenities is a major indicator of the number of visits trail riders make. The index is comprised of seven positive and measurable amenities including: 1) looped trails, 2) trail length at least 15 miles, 3) availability of water along the trails, 4) trails marked, 5) existence of open views, 6) opportunities to camp along the trail, and 7) a full service camp facility at the trail head. A full service campsite includes water facilities and electricity access. The average value of the index from each trail identified in the survey is 72.9%. Each increase in index amenity increases the index by almost 15 points and increases the likelihood of more than 4 repeat visits. Therefore, the main policy recommendation for existing trails is to maximize amenities for trail riders, enhancing their experience with such characteristics as long well marked looped trails with access to water and open views. Camping areas should be full service with electricity, water and facilities, which day users may also appreciate.

No other published work addresses the recreational use equestrian riding trails. While horse related activities are part of the identity of the commonwealth of Kentucky, it is by no means exclusive to the state. Therefore the management suggestions stated above in the Policy Implications may be extrapolated to other trails in other states. Further, this type of analysis can be expanded to incorporate all the users of multi use trails or broadened to include other types of recreational activities. A benefit/cost analysis of potential trail developments can be conducted to identify suitability of a land area for trail development. Finally, there is other information included in the study that can be separated into other studies, such as the information regarding volunteer habits and interests of current Kentucky trail riders, WTP for specific site or characteristic improvements.

KENTUCKY EQUINE TRAILS SURVEY 2007   (Type A)

Introduction:

This survey is being administered by the University of Kentucky Department of
Agricultural Economics. The survey about what people like and don't like about the
horse trails in eastern Kentucky around the Daniel Boone National Forest. The
information collected will be used to study for management of horse trails in Kentucky.
The information you provide is confidential.   Location: _____
Date: _____

About the Respondent:

1.   Sex: Male / Female   *(circle one)*

2.   Age *(years, select one):*   18-25   _____
                                               26-35   _____
                                               36-45   _____
                                               46-55   _____
                                               56-65   _____
                                               Over 65   _____

3.   Highest level of education completed: 3A   Grade School   _____
                                            3B   Middle School   _____
            (Select one.)   3C   High School   _____
                                            3D   Associate Degree   _____
                                            3E   Bachelor Degree   _____
                                            3F   Graduate Degree   _____ (MS, PhD,
     etc.)
                                            3G   Professional Degree   _____ (MD, lawyer,
4.   etc)

     Household Annual Income: 4A $0-12,000   _____   4D $40,001-60,000_____
                               4B $12,001-25,000_____   4E $60,001-80,000_____
            (Select one.)   4C $25,001-40,000_____   4F $80,001-100,000_____
                                                             4G Over $100,000_____

     Travel Information:

5.   From what city or ZIP code did you travel to get to this trail riding facility?
          _____

5A How many miles? _____

6.   How many times a year do you come to this location? _____

7.   How much did you pay in travel costs, including trailering costs, for you and your immediate family?
      $ _____

8.   How many day trail riding trips do you usually take per year to this location?
      _____

9.   Based on your answer to question 8 above, how many of these trips are in
      9A. Spring _____   9B. Summer _____
      9C. Fall _____   9D. Winter _____

10.   How many overnight trail riding trips do you usually take per year to this location?
      _____

11.   Based on your answer to question 10 above, how many of these trips are in
      11A. Spring _____   11B. Summer _____
      11C. Fall _____   11D. Winter _____

12.   In the last year, when you visited this trail riding facility, how many nights did you stay at:
      12A. Camping at the site _____   12B. Camping nearby _____
      12C. Nearby hotel/motel _____   12D. House/cabin _____
                                           12E. (Is the cabin yours? Yes / No)

13.   What was your average cost of lodging/camping per night? _____

14.   Would you be interested in renting horses if available on-site?   YES / NO
           14A. How much would you pay to rent a horse? $_____/Day

15.   Have you ever ridden on the Barren Fork trail?   YES / NO
           15A. If you have ridden that trail, what did you like about it?

15B. If you have ridden that trail, what did you not like about it?

Thinking of this horse trail site, please indicate if you would be willing to pay an extra $2 to have one of the following characteristics (if this trail does not already have this characteristic)

16.

Characteristic	Yes	No	If No, then how much?	If Yes, then how much more?	How many more times per year would you visit sites with that characteristic?
Loop Trails					
Double the Length of Trails at least 15 miles					
Trails free of trash					
Wildlife					
Open views (double overlooks)					
Lack of other people (riders, hikers, ATVs, mountain bikes, etc.)					
Limited hunter access					
Trail markers					
Availability of water on trail					
Availability of picnic or camping sites on the trail					
Ecological integrity of the site					
Other: _____					

17. How many hours per year would you be willing to volunteer for upkeep of this horse
trail? _____

18. If a camping (or day parking) facility (not necessarily this one) would have electricity, water access (drinking & shower), horse facilities such as stalls, paddocks or tie-outs, etc., would you be willing to pay $25 per day?
YES / NO

        18A. if yes, how much more would you be willing to pay? _____

        18B. if no, then how much would you be willing to pay? _____

19. What are your least favorites groups to share the trails with? (For example, congested   with other riders; presence of hikers; ATVs; mountain bikes)
_____
___

_____
___

Interviewer _____

References

Betz, C. J., J. C. Bergstrom, and J. M. Bowker. 2003. "A Contingent Trip Model for Estimating Rail-trail Demand." *Journal of Environmental Planning and Management.* 46(1): 79-96.

Blackwell, M., A. Pagoulatos, and W. Hu. "Recreational Demand for Equestrian Trail-Riding" paper presented to the Department of Agricultural Economics. University of Kentucky. May 14, 2008. pp 1-21

Boardman, A. D. Greenberg, A. Vining, and D. Weimer. 2005. *Cost Benefit Analysis: Concepts and Practice*, 3rd ed. Prentice Hall.

Bowker, J. M., D. B. K. English and H. K. Cordell. 1996. "Toward a Value for Guided Rafting on Southern Rivers." *Journal of Agriculture and Applied Economics*. 28(2): 423-432.

Brown, G. M., Jr. and R. Mendelsohn. 1984. "The Hedonic Travel Cost Method." *Review of Economics and Statistics.* 66(3): 427-433

Cameron, T. A. 1992. "Combining Contingent Valuation and Travel Cost Data for the Valuation of Non-market Goods." *Land Economics*. 68(3): 302-317.

DeLoitte Consulting LLP. 2005 American Horse Council Foundation, http://horsecouncil.org.

Englin, J. and J. S. Shonkwiler. 1995. "Estimating Social Welfare using Count Data Models: An Application to Long Run Recreation Demand under Conditions of Endogenous Stratification and Truncation." *The Review of Economics and Statistics*. 77(1): 104-112.

ESRI ArcGIS. 2005. Version 9.1 (Redlands, CA: Environmental Systems Research Institute.)

Fix, P. and J. Loomis. 1998. "Comparing the Economic Value of Mountain Biking Estimated using Revealed and Stated Preference." *Journal of Environment Planning and Management*. 41(2): 227-236.

Freeman, A. Myrick III. 2003. *The Measurement of Environmental and Resource Values: Theory and Methods,* 2nd edition. Washington DC: Resources for the Future.

Greene, W.H. 2000. *Econometric Analysis,* 4th Ed., Prentice Hall, New Jersey.

Greene, William H. 2007. LIMDEP version 9.0. (Plainview, NY, Economics Software, Inc)

Grogger, J.T. and R. T. Carson. 1991. "Models for Truncated Counts." *Journal of Applied Econometrics*. 6(3): 225-238.

Kentucky Department of Agriculture. 2008. "Equine Infectious Anemia" http://www.kyagr.com/statevet/equine/anemia.htm

Kentucky Equine Education Project (KEEP). 2008. www.horseswork.com

Layman, R. C., J. R. Boyce, and K. R. Criddle. 1996. "Economic Valuation of the Chinook Salmon Sport Fishery of the Gulkana River, Alaska, under current and Alternate Management Plans." *Land Economics*. 72(1): 113-28.

Loomis, J. B. and R.G. Walsh. 1997. *Recreation economic decisions: Comparing benefits and costs,* 2nd edition (State College, PA: Venture Publishing)

McConnell, K.E. and I. Strand. 1981. "Measuring the Cost of Time and Recreation Demand Analysis: Applications to Sport Fishing." *American Journal of Agricultural Economics.* 61: 153-156.

Morey, E. and W. Breffle. 2006. "Valuing a Change in a Fishing Site Without Collecting Characteristics Data on all Fishing Sites: A Complete but Minimal Model." *American Journal of Agricultural Economics*. 88(1): 150-161.

Parsons, G. R. 2003. "The Travel Cost Model" in K. Boyle and G. Peterson, eds., *A Primer on Non-Market Valuation.* Dor drecht: Kluwer Academic Publishers. Chapter 9.

Randall, A. 1994. "A Difficulty with the Travel Cost Model." *Land Economics*. 70(2): 88-96.

SAS. 2005. *SAS version 9.1*. (Cary, NC: SAS Institute Inc.)

Shaw, D. 1988. "On Site Samples' Regression: Problems of Non-negative Integers, Truncation, and Endogenous Stratification." *Journal of Econometrics*. 37(2): 211-223.

Shaw, W. D. and P. Jakus. 1996. "Travel cost models of the demand of rock climbing." *Agricultural and Resource Economics Review*. 25:133-142.

Siderelis, C. and R. L. Moore. 1995. "Outdoor Recreation Net Benefits of Rail-trails." *Journal of Leisure Research*. 27(4): 344-359.

Smith, V. Kerry. 1988. "Selection and Recreation Demand." *American Journal of Agricultural Economics*. 70(1): 29-36.

US Department of Agriculture. 2003. *Statistical Highlights of United States Agriculture, 2002/2003.* National Agricultural Statistics Service (NASS) Washington, DC

Willig, Robert D. 1976. "Consumer's Surplus without Apology." *American Economic Review.* 66(44): 589-597

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