MULTIPLE DESTINATION TRIPS AND THE ECONOMIC VALUATION OF OUTDOOR RECREATION SITES

by

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(ABSTRACT)

This study examines multiple destination recreation trips and the economic valuation of recreation sites using the travel cost method. One common assumption of the travel cost method is that all travel costs incurred by a visitor are exclusively for a trip to a single site. However, this assumption is often invalid, particularly in the eastern United States where there are numerous recreation areas close to large urban populations.

Few researchers have attempted to overcome the difficulty of incorporating multiple destination trips into the travel cost method. Those researchers that have proposed methods have not provided a definitive guideline for how to account for multiple destination trips in the travel cost method, and have not compared their methods. This study proposes a simple model to assist in understanding the varying suggestions by researchers who have attempted to incorporate multiple destination trips into travel cost analyses. The difficulty of defining a recreation good or service, the identification of recreation substitutes, and possible decision processes used by individuals to identify recreation trip destinations are also discussed.

Data collected at Shenandoah National Park, Virginia, are used in a zonal travel cost model to estimate the consumers' surplus associated with on-site recreation use at the Park, and to compare proposed methods for handling multiple destination trips. The results of this

study show that the travel cost method is sensitive to assumptions about multiple destination visitors, as well as which visitors are included in travel cost analyses. Consumers' surplus estimates ranged from $38 to $8249 per visitor, depending on the assumptions about multiple destination trips, and which visitors were included in the analyses.

The results of this study suggest that the travel cost method can be used as an information system, rather than as a method to determine a single estimate of recreation value in monetary terms. The travel cost method is capable of providing a manager with information about relative magnitudes of willingness to pay for a resource by a variety of visitor groups. By varying the assumptions about visitors to the site, a manager can determine a range of consumers' surplus estimates, which may be more useful than a single estimate, to better assist in management decisions regarding the mixture of resources desired by individuals.

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Finally, I wish to dedicate this work to my parents and to Lisa Comly. Without your constant, unconditional, love and support, I would never have even dreamed this achievement was possible.

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Chapter I. INTRODUCTION

Management of the nation's forests and wildlands for the multitude of resources contained therein has been characterized as a "wicked" problem for public land management agencies, due to complex biological and social systems, and that solutions are unique in time and space (Allen and Gould 1986). Research has advanced our understanding of biological and social systems, yet information about the mixture of forest resources desired by individuals is always needed by public land management agencies. This need for information arises because these agencies manage the public lands for a variety of resources and if the various publics' concerns about the resources of these lands are not addressed in some satisfactory manner, citizens may challenge the management actions.

Because there is a limited land base and because agencies cannot provide all desired forest resources to everyone at the same time and place, information is needed about the value to the public for these forest resources, so that trade-offs between resources can be made. However, information about the value of resources such as preservation of wilderness areas or historic sites is difficult to obtain because these values are not directly observed in market transactions. Recreation is an example of such a non-market resource, although recreation markets do exist in some cases. Information about recreation values is important to many land management agencies and tourist boards, because participation in recreation activities affects both the participants and the communities where recreation opportunities exist.

Outdoor recreation activities occur at hundreds of natural, historical, and cultural sites across the country. Visitation at national recreation sites managed by numerous federal agencies, including the Forest Service, National Park Service, Tennessee Valley Authority, and the Bureau of Land Management, has increased from approximately 566 million visitor days in 1977 to approximately 677 million visitor days in 1992 (United States Department of the Interior, In Press). This upward trend of recreation participation by Americans is expected to continue, following the trend begun immediately after World War II. Although the total number of visitor days has increased, the rate of increase in the percentage of people who participate in recreation activities has slowed, matching the decreased rate of population growth in the United States. Additionally, recreation participation in recent years has tended toward more frequent trips that are taken closer to home, and of shorter duration than in the past (Cordell *et al.* 1990). While developed recreation sites are relatively evenly distributed in the United States, a greater burden is placed on sites in the eastern United States than in the western United States, due to greater population densities in the East. The expected increase in levels of visitation and the limited availability of resources for recreation opportunities present a challenge for recreation managers who provide for these opportunities and protect the resource base from degradation.

To provide for recreation opportunities in an efficient manner, managers seek information about various aspects of recreation, including preferences and demand for recreation activities, and recreation values. This dissertation focuses specifically on the value for on-site recreational use at outdoor recreation sites. There are numerous definitions of value. For example, Brown (1984, 232) defines value as "an enduring conception of the preferable which influences choice and action." The neoclassical economic definition of value depends on the relation between the object and an individual (Woo 1992), and "in the aggregate neoclassical sense, value generally signifies economic surplus (the sum of producers' and consumers' surplus)" (Brown 1984, 239). Economic value may be considered the amount of money an individual is willing to pay for a good, service, or experience; or, if the good, service, or experience is being taken away, the amount of money an individual is willing to accept as compensation. When determining the value of resources, economists are interested in the total economic value, which consists of value for the use of the resource (both on-site and off-site use) and for its preservation (for the options which preservation provides for future use and for the continued existence of the resource) (Randall 1987).

The importance of quantifying the value of recreation and other non-market resources was perhaps first recognized by the National Park Service (NPS) after Congress passed an act in 1936 to authorize a study of the park, parkway, and recreational area programs in the United States (16 U.S.C., 1988 ed., Chap. 1, Sec. 17k). As a result of the act, NPS Director Roy Prewitt requested ideas from scientists about how to determine the economic value of national parks. Responding to this request, Hotelling (1949) presented the idea for what became known as the travel cost method (TCM). Other methods for valuing non-market resources that have been developed since that time include contingent valuation, hedonic pricing, and hedonic travel cost method. The valuation of non-market resources was officially recognized as an important component of land management by the Water Resources Council in 1962 and the Outdoor Recreation Resources Review Commission in 1963, which called for the measurement of all benefits and costs relating to activities affecting land and water resources. Each of the methods developed for valuing non-market resources relies upon traditional economic paradigms to determine an individual's willingness-to-pay for the non-market resource.

Non-market valuation methods have been questioned due to controversies over certain underlying economic assumptions and the reason the methods are used (Harris *et al.* 1988; Schulze and Howe 1985; Batie and Shabman 1979; Beardsley 1971). Schulze and Howe state (1985, 1037): "The neoclassical agenda became the complete monetization of all benefits and costs based on a naive optimism that this is in fact possible." Questioning also comes from government agencies that use value estimates in management decisions:

> Generally, forest planners regard the mixing of current prices for some resources, such as timber, with hypothetical willingness-to-pay prices with other resources, such as wildlife recreation, as inappropriate...difficult to justify and thus lack credibility (USDA Forest Service 1990, 44).

One question about non-market valuation methods as applied to recreation resources is whether individuals can express their value for recreation at a site as a monetary estimate of willingness-to-pay, especially when the site is one stop[1] on a multiple destination trip (Mendelsohn *et al.* 1992; Haspel and Johnson 1982; Beardsley 1971). This is a specific problem for TCM, which assumes that the visitor holds a value for the recreation site as though it was a single destination and that all travel costs are incurred exclusively for visiting that site. However, this assumption may not always be valid, as in the case of ecotourism or heritage tourism. The occurrence of multiple destination trips is causing managers of different sites in a region and governing authorities to work together to promote tourism within the *region*. For example, in the Williamsburg, Virginia area, agencies at all levels of government and managers of attractions in the cities of Williamsburg, Jamestown, and

[1] The words "stop", "site", and "destination" will be used synonymously in this dissertation to refer to the cities, parks, monuments, attractions, etc. that an individual visits on a multiple destination trip, as opposed to all stops for gas, food, or at rest areas.

Yorktown have combined efforts to market "Virginia's Historic Triangle"; a region with many historic sites, theme parks, and natural areas (Ashworth and Tunbridge 1990).

Study Objective

The objective of this research is to determine how the estimation of economic value for outdoor recreation at a site is affected by multiple destination visitors to that site, using the travel cost method. To accomplish this overall objective of understanding multiple destination trips in recreation valuation, the following items are addressed:

1) The historical development of non-market valuation is reviewed. This development is important for understanding the methods currently used and criticisms of these methods. This review briefly discusses the development of utility theory, consumers' surplus, welfare economics, and public goods -- several foundations of non-market valuation methods.

2) Alternative travel cost methodologies for calculating the recreational value of a site, when multiple destination trips are made which include that site as one stop, are compared. A theoretical model is presented which is then used to help explain differences in value estimates resulting from the various proposed methodologies.

3) Data were collected at Shenandoah National Park on visitor expenditures, trip itineraries, visitor motivations, and demographic characteristics. These data are used with TCM to estimate the economic value individuals have for on-site recreational use of the Park as one site on a multiple destination trip. The sensitivity of TCM to various

assumptions about the role of the Park in an individual's itinerary, as proposed by other researchers, is examined. These assumptions are:

a) visitors are assumed to travel to the Park as a primary destination, but multiple destination visitors are eliminated from the analyses;

b) visitors are assumed to travel to the Park as a primary destination and <u>all</u> visitors are included in the analyses, regardless of whether or not this assumption is true;

c) the decision to visit the Park is marginal and independent of the decision to visit other places on a trip; and

d) the decision to visit the Park is based on the combined costs of travelling to the Park and combinations of all other visited sites in the area.

Each of these assumptions has been proposed by researchers, yet a complete examination and comparison of the estimates derived under these various assumptions has not been conducted. The purpose of this study is not to determine the value for recreation at Shenandoah National Park. The purpose is to examine the sensitivity of TCM to assumptions about multiple destination visitors, using Shenandoah National Park as an example.

This study is important given the interest of government officials and conservation organizations in determining trade-offs from the allocation of forest resources. Because the consumers' surplus estimates of non-market forest resources derived from methods such as TCM continue to be used in policy analysis, it is important to test the validity of the assumptions underlying these methods, so that the best possible information is available for decision-makers.

Chapter II. LITERATURE REVIEW

A. Introduction

Decision-makers often seek information about the economic values associated with recreation so they may effectively manage the resources under their purview to provide for the demand for recreation opportunities. Because certain recreation experiences are not normally traded in the market (although it is possible for some recreation markets to exist), methodologies have been advanced to determine recreation values which are comparable to values of other goods and services; i.e., dollar estimates of willingness to pay. There exist a large number of topics which are relevant to a discussion of recreation valuation and multiple destination trips, including the current status of valuation methodologies, the foundations of these methodologies (utility theory, consumers' surplus, public goods allocations, etc.), and criticisms of these methodologies.

This review is divided into two primary sections. The first presents a brief discussion of the evolution of ideas relating to current valuation methodologies, specifically, value and utility theory developments. The second section deals primarily with developments of the travel cost method (TCM), upon which this dissertation focuses.

B. Value and Utility Theory

To understand the developments and criticisms of non-market valuation methods, it is helpful to understand the foundations of these methods, and in particular what is meant by the term *value*. An understanding of the foundations of non-market valuation methods is important because, as Blaug states (1985, 711): "it is better to know one's intellectual heritage than to merely suspect it is deposited somewhere in an unknown place and in a foreign tongue." The basic foundations of current non-market valuation methods can be found within the marginalist revolution in the late nineteenth century, with advances of marginal utility theory by Jevons, Marshall, Walras, and Clark. Prior to the marginalist revolution, many classical economists believed that the value of a commodity was derived from the amount of labor required to produce the commodity. Smith states (1776, Vol. I, 35): "Labour alone, therefore, never varying in its own value, is alone the ultimate and real standard by which the value of all commodities can at all times and places be estimated and compared."

Many authors after Smith, including Ricardo, Malthus, Mill, and Marx refined this labor theory of value. Each of these authors focused on the production of goods, the costs of production, and how the costs of production (i.e., labor value) were distributed to the three classes of citizens: labor, capitalist, and landlord classes (Rima 1991). In fact, Mill believed his treatment of value closed the book on value, and that there was nothing further to discuss regarding the topic (Mill 1848).

In the nineteenth century, many individuals voiced their criticisms of the classical economic theory of value, where the value of labor to produce a commodity was believed to be an unchanging standard of value. Samuel Bailey states (1825, 4-5): "Value denotes... nothing positive or intrinsic, but merely the relation in which two objects stand to each other as exchangeable commodities." Rauner (1961) suggests that Bailey was the first to steer economic thought away from the classical theories of value. Jevons was the first to formally propose that, instead of focusing on the costs of production, the emphasis of economic inquiry should be placed on what emerges from the production line (Dobb 1973). Jevons states (1871, 2): "Repeated reflection and inquiry have led me to the somewhat novel opinion, that value depends entirely upon utility." Another important shift in economic thought was Jevons' focus on marginal analysis. Through the application of differential calculus, Jevons said (1880, 98) that what was of primary concern was the ratio of marginal utilities: "The word value only means that so much of one thing is given for so much of the other, and it is the proportion of these quantities which measures the value of a thing." From these first tenets, Marshall expanded the economic theories of consumer behavior through his derivation of demand curves from underlying utility curves, and defining consumers' surplus: that amount which the individual is willing to pay in excess of the actual prices paid.

Pareto further developed the field of welfare economics which focuses on optimal exchanges, intrapersonal comparisons of utility, and the use of consumers' surplus to measure the effect on individual's welfare from price/quantity changes. From the work of Pareto, the field of welfare economics has expanded and its concepts are used as a basis for public policy analysis. By looking at optimal exchanges between parties, welfare economics seeks "to formulate propositions by which we may rank, on the scale of better or worse, alternative economic situations open to society" (Mishan 1967, 156). As a guide for state activities, welfare economics often looks at situations where government intervention may be needed; i.e., situations where the market mechanism is prevented from behaving efficiently (Vining and Weimer 1992). For example, Mazzola (1890) noted there are some goods of which the consumption by one does not reduce the amount available for others to consume - called public goods. Wicksell (1896) proposed that individuals will not reveal their preferences for these goods through ordinary market mechanisms, and that only political decisions can allocate public goods. To help make these decisions, politicians and bureaucrats may use benefit-cost analysis, which may compare all benefits and costs of an activity, including those associated with non-market goods and services.

Because some types of outdoor recreation are considered non-market goods[2], various methodologies for determining the economic value of recreation have been developed, including the travel cost method. The next section presents the travel cost method, and subsequent refinements of the method. This method for valuing recreation at a site is one of the three methods formally approved for valuing recreation by the U.S. Water Resources Council (1983); the other two methods are contingent valuation and unit day value approach. A primary advantage of the TCM is that it is based on actual observed behavior: travel to a recreation site. Contingent valuation is based on hypothetical markets and the unit day value approach relies on expert opinion to develop approximations of the willingness to pay for recreation activities. Bowes and Loomis (1980) suggest that, due to agency budget constraints, and the ease of obtaining information directly from visitor registers, the travel cost method will be one of the most widely used techniques in the future.

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[2] There remains confusion over the exact definition of a *public good* (Randall 1987). The confusion stems from the debate over whether a public good has the characteristics of both nonrivalry and nonexclusiveness. Nonrivalry occurs when the consumption of a good by one person does not reduce the availability of the good to others; nonexclusiveness occurs when the good is offered to everyone, regardless of whether or not they want it. Because of the confusion, outdoor recreation will be called a non-market good in this dissertation, as it is a good not normally traded in the market.

C. Travel Cost Method

1. History of TCM

The U.S. Congress passed in 1936 an act which required the National Park Service to develop, for recreational lands other than those administered by the U.S. Department of Agriculture, a comprehensive study to assist in planning for the recreational needs of the country (16 U.S.C., 1988 ed., Chap. 1, Sec. 17k). One area of research which developed as a result of the study was that of evaluating the benefits associated with recreational use of public lands. The National Park Service was instrumental in the first research on recreation valuation (Carlton, 1957). For assistance in the comprehensive study, NPS Director Roy Prewitt solicited ideas from scientists about how to determine the economic value associated with recreation at the nation's parks. Responding to the request, Hotelling (1949) suggested the idea which has since developed into the travel cost method (TCM). He stated that since visitors travel a certain distance from their homes to a recreation site, thus incurring travel costs, recreation at the site must be worth at least the cost of travel to the site. From the relationship between the quantity of trips taken and the distance travelled, a demand curve could be determined and a measure of consumers' surplus for the site could be derived. Travel costs are based on the distance between a recreation site and concentric origin zones around the site, and the cost of travel from each zone is assumed to be constant. Hotelling said that travel costs for individuals in the most distant zone are the basis from which the consumers' surplus is determined for recreationists from all origin zones.

For example, suppose individuals in the most distant zone from which individuals are observed to arrive incur a $5 travel cost, and individuals in the zone adjacent to the site incur a $1 travel cost. If 100,000 individuals from the closest zone visited the site, then the consumers' surplus for this zone is calculated as 100,000 * (5-1) = $400,000. This procedure is repeated for all origin zones; if 10,000 visitors come from the next farthest away zone, incurring a $2 travel cost, consumers' surplus for this zone is: 10,000 * (5-2) = $30,000, and so on. These zonal consumers' surplus values are then summed to determine an overall measure of the economic value of recreation at the site. The idea was first implemented by Trice and Wood (1958), to determine the economic value of a recreational day in the Upper Feather River area of the Sierra Mountains in California. They estimated the consumers' surplus to be between $1.61 and $2.41 (1958 dollars) for a recreation day in this area.

Clawson (1959), Knetsch (1963), Scott (1965) and Clawson and Knetsch (1966) extended the original work of Hotelling, by suggesting that travel costs of individuals in the most distant zone cannot be used as the basis to determine the consumers' surplus associated with use of a recreation site. Instead, they argue that the manner in which individuals react to changes in travel costs, vis-a-vis changes in travel distances, should be used to determine consumers' surplus. The travel cost method presented by Clawson, Knetsch, and others has its roots in the marginalist ideas discussed previously. The point at which the travel cost becomes so high that the individual does not visit the site is of primary interest. This is the basic notion embodied in the subsequent work on the travel cost method.

Since the introduction of this travel cost method, many refinements have been made and hundreds of site-specific studies conducted. Walsh *et al.* (1988), Sorg and Loomis (1984), and Bittner (1991) review many applied TCM studies and present many of the resultant estimates of the economic value of recreational services. Although TCM has been applied numerous times, several issues have arisen in the development of the travel cost method, specifically concerning the measurement of the critical variables of recreation demand functions -- the quantity and price of recreation opportunities.

2. TCM Issues

a. Quantity

The method suggested by the early work of primarily Clawson and Knetsch (1966) used visitation per capita of a zone as the measure of the quantity of use demanded for a recreation site; referred to as the zonal travel cost method. This method assumes that tastes and preferences of individuals within a zone are similar (Clawson and Knetsch 1966; Ward and Loomis 1986). Corrections can be made for observed differences between individuals by also considering socioeconomic variables, such as age and income (Mendelsohn and Markstrom 1988; Clawson and Knetsch 1966; Durden and Shogren 1988).

The zonal travel cost method proceeds in two stages. First, the number of visits to a recreation site from each zone is estimated as a function of distance (i.e., travel costs) from the origin zone to the recreation site. Differences in the population of the zones are accounted for by using visits per capita of the origin zone as the dependent variable. This is referred to as the first-stage demand curve, though 'demand curve' is a misnomer because the equation actually describes recreation participation at the site (Menz and Wilton 1983). This first-stage equation can be specified as:

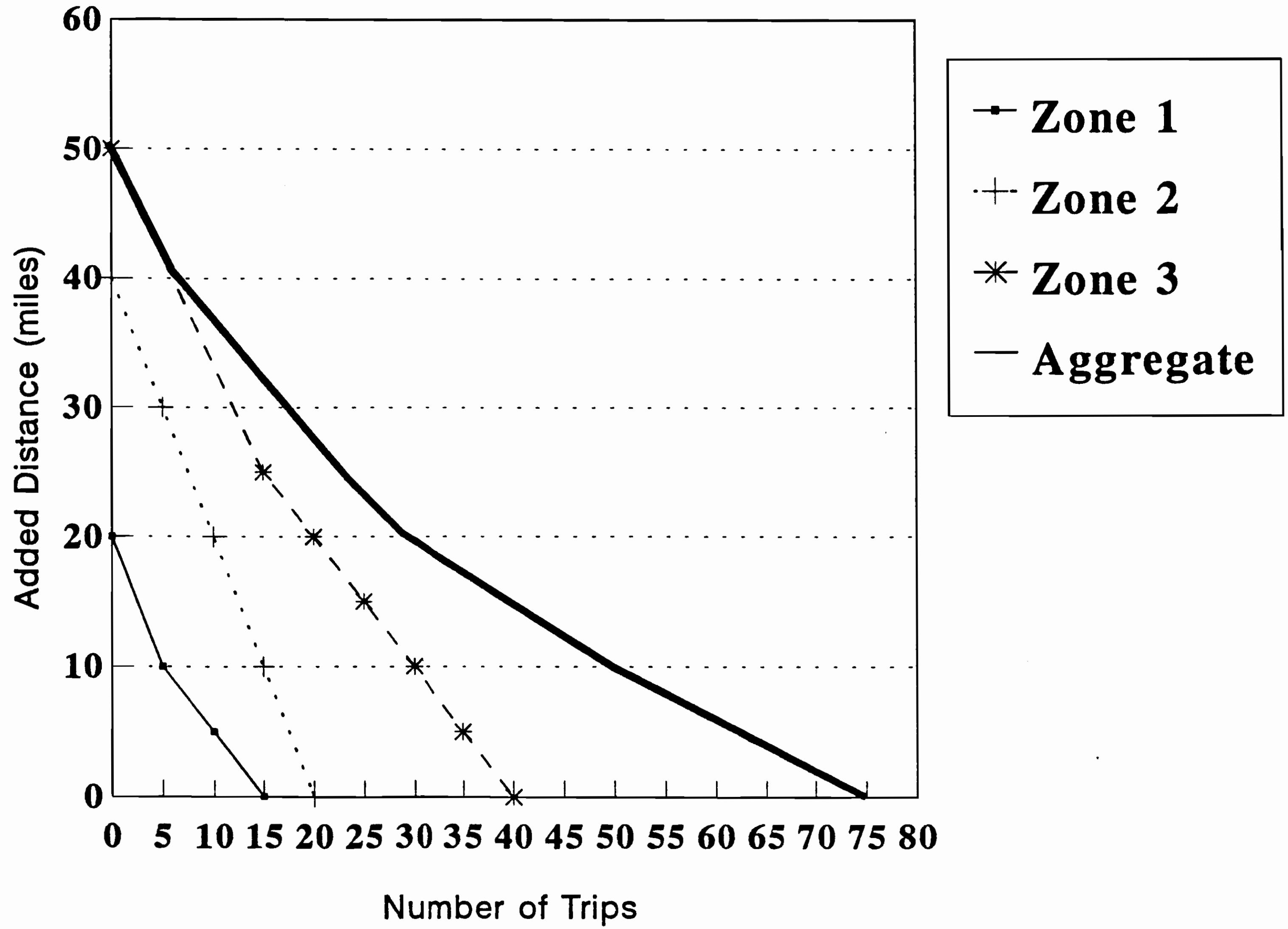
$$V = a + bT + c\mathbf{W} \qquad (1)$$

where: V = vector of visitation (participation) rates, per capita, from all zones
T = vector of travel costs from all zones
W = matrix of socioeconomic variables for all zones
a, b, c = vectors of regression coefficients

The second step in the zonal travel cost method requires estimating, using the parameters of the first-stage demand curve, the demand individuals within each zone would have if travel cost rose incrementally, representing an increase in the cost of recreation at the site. That is, for each zone, incremental distances are added to the current distance travelled by individuals within that zone. The number of trips from each zone for each increment is estimated using the first-stage demand parameter estimates, resulting in a second-stage demand curve for each zone. Then, to determine the aggregate second-stage demand curve, the number of trips from each zone, at each incremental distance, is summed; i.e., the individual second-stage demand curves are summed horizontally. Figure 1 shows a hypothetical example of this horizontal summation. Thus, the parameters of the second-stage demand curve are not directly estimated; instead, the points on the demand curve are estimated from the parameters of the first-stage equation and incremental changes in travel distance or travel cost. From this second-stage demand curve, Clawson (1959) and Knetsch (1963) derive the user benefits of recreation areas, measured as consumers' surplus.

One of the first issues addressed in TCM research was the determination of the components of travel costs. Monetary travel costs are only one part of the total cost a recreationist incurs. Individuals who travel to a recreation site also incur a time cost (Knetsch 1963; Clawson and Knetsch 1966; Cesario and Knetsch (1970), and Cesario 1976). That is, individuals from different origin zones require different amounts of time to travel to the site. The assumption that the "disutility of overcoming distance is a function only of money cost... is not correct" (Cesario and Knetsch 1970, 702). Thus, if travel time is not accounted for, the demand functions are poorly specified (Brown and Nawas 1973). However, travel distance and travel time are highly correlated, resulting in multicollinearity problems in the

Figure 1. Hypothetical Second-Stage Demand Curve Derivation



specification of the demand function (Cesario and Knetsch 1970; Brown and Nawas 1973; Gum and Martin 1975; Brown *et al.* 1983).

Brown and Nawas (1973) noted that the problem of multicollinearity stems from the aggregation of data required in the zonal TCM, and developed the individual travel cost method as an alternative to the zonal method. They suggested that the quantity of recreation visits demanded should be expressed not as average number of trips per person in a zone, but simply as the number of trips per person. Thus, in this alternative formulation, instead of using zonal averages of the variables (average zonal travel cost and average socioeconomic variables for each zone) in the first-stage demand specification, the travel cost and socioeconomic variables are used as individual observations.

b. Price

1) Time Since the TCM is used to estimate the amount that individuals are willing to pay for recreation at a site using travel costs as a proxy for the price of recreation, it is important that the reactions to changes in travel costs to a site are similar to reactions to changes in the unobserved price of recreation at that site (Ward 1984; Ward 1986). For this reason, only the variable costs of transportation were considered in the early applications of TCM (Ward and Loomis 1986). However, as mentioned previously, individuals also incur a time cost when travelling to a site. Cesario and Knetsch (1970) and Cesario (1976) suggest that the money cost of travel time should be added to the transportation costs. Even though individuals may encounter changes in travel cost, the time required for travel to the site will remain constant for a given zone. The estimated changes in visitation due to incremental increases in travel cost (second stage of the TCM) for those adjacent to the site will not be the

same as for those of individuals from more distant zones, due to the greater amount of time required to travel to the site from more distant zones. Cesario (1976) suggests that, unless travel time is accounted for, the original TCM would underestimate the value of the recreation site.

Determining the cost of travel time proved difficult. Cesario and Knetsch (1970) suggest that the effects of travel costs and time can be accounted for in a single variable that describes how individuals trade time for money costs, which replaces the travel cost variable in the first-stage equation of the TCM. Although this solution overcomes the original problem of how to determine cost of travel time, a new problem of the specification of the variable describing trade-offs between travel cost and time is added to the estimation process. Alternatively, Cesario (1976) suggests, based on a review of transportation studies, that the monetary value of time, valued at one-fourth to one-half of the individual's wage rate should be added to the transportation costs. This alternative approach has been used most frequently in TCM studies.

Leuschner *et al.* (1987) added 20% of the respondents' hourly wage to the travel costs in a study of the effects of implementing a fee policy in wilderness areas. Weithman and Haas (1982) used 35% of the hourly wage rate to approximate the value of travel time in a study of trout fishing in Missouri. Mullen and Menz (1985) also used 35% of the respondents' hourly wage rate in a study of the losses of recreational fishing in the Adirondacks due to acid deposition damage.

<u>2) Substitute Sites</u> The demand for recreation at a site will be influenced by the price and availability of recreation at substitute sites (Ward and Loomis 1986; Rosenthal 1987). The

incorporation of substitute sites into the travel cost method is another difficulty addressed by researchers. Burt and Brewer (1971) incorporated substitute sites into their analyses by estimating recreation participation (first-stage demand curve) using systems of demand equations. Recreation sites in an area are grouped according to the type of recreation offered. Individuals are assumed to travel to the closest site for the type of recreation desired, and changes in the prices (travel costs) associated with any single site may alter which site the individual chooses for recreation. They argue that, when prices of substitute sites are omitted, resultant value estimates will be biased upwards.

Caulkins *et al.* (1985) use the geographic distribution of recreationists relative to the recreation sites to suggest that estimates which do not consider prices of substitutes are biased upwards only when, as travel costs to the primary site increase, travel costs to the substitute sites also increase. Ciccetti *et al.* (1976) use a method similar to Burt and Brewer to estimate the benefits of a new ski facility at the Mineral King area in California. They report that estimates of consumers' surplus are overestimated if only a single site is considered versus a more general system of demand equations. Estimates of consumers' surplus have also been shown by Rosenthal (1987) to be higher when substitute sites are not included in the analysis. Rosenthal, however, used single equations to model the demand for recreation at a single site and an index of substitute site availability, created using principle components analysis and the prices of substitute sites.

In spite of the apparent importance of the inclusion of substitute sites into travel cost models, prices of substitute sites are often omitted due to data limitations, difficulties in determining which sites are substitutes, and possible multicollinearity between own price and substitute sites (Rosenthal, 1987). In a comprehensive review by Walsh *et al.* (1988) of non-market benefit studies conducted after 1968, approximately 50% of the TCM studies were found to have not accounted for substitute sites.

A popular method for accounting for substitute sites is to define an index based on the distance from the origin to the substitute site. For example, Knetsch *et al.* (1976) used an index of the availability of substitute sites for a TCM study of U.S. Army Corps of Engineers reservoirs in Sacramento, California. The index, K, was defined as:

$$K = \sum \frac{\log L}{D} \tag{2}$$

where: L = size (surface acres) of the alternative site
D = mileage to that site from the population zone

The index is then summed over all possible alternative sites for a zone. Bittner (1991), using TCM to derive the benefits of spring turkey hunting in Virginia, also used a substitution index. Bittner's index was based on the number of opportunities hunters from each zone had to shoot at turkeys at substitute sites. This number was divided by the distance from the origin zone to the substitute site. The site with the highest value of this index was chosen as the substitute site. Menz and Wilton (1983) used an index based on the miles from the origin to substitute bass fisheries when estimating the benefits of a Lake Ontario bass fishery.

c. Estimation Procedures and Functional Form

Much research has been conducted on the choice of estimation procedures and the functional form of equations used in travel cost models. Bowes and Loomis (1980) use the zonal TCM and suggest that when the populations from the origin zones are different and the samples of individuals from these zones are of uneven sizes, heteroskedasticity will be present. They present a comparison of consumers' surplus estimates derived from ordinary least squares (OLS) and generalized least squares regressions (GLS). They conclude that generalized least squares is the appropriate regression type, as it weights the trips per capita and travel costs for each zone to correct for unequal zonal populations. Additionally, they show that when OLS is used, negative visits can arise as estimates, further supporting the use of GLS.

Vaughan *et al.* (1982) criticize Bowes and Loomis, suggesting instead that heteroskedasticity arises from choice of functional form. Bowes and Loomis maintain a linear relationship between trips per capita and the independent variables, while Vaughan *et al.* suggest *a priori* specification of linearity is inappropriate for TCM. If a non-linear relationship is hypothesized they show that heteroskedasticity vanishes when using a semi-log functional form. Strong (1983) also shows that the semi-log form is appropriate, and that this form also overcomes the negative visits problem observed by Bowes and Loomis.

Linear models have been used by Burt and Brewer (1971), Ciccetti *et al.* (1976), and Clawson and Knetsch (1966). Batie *et al.* (1976) used a semi-log form, while Gum and Martin (1975) used a quadratic form. Ziemer *et al.* (1980) suggest that economic theory does not provide guidance in determining the choice of functional form for recreation demand estimations. They compared the linear, semi-log, and quadratic forms, and found that the chosen form can produce widely divergent estimates of consumers' surplus.

d. Other Assumptions

Other assumptions made in the early development of TCM which have since been addressed include the following:

1) there is no shortage of the good in question; i.e., there is no congestion at the site;

2) travel expenditures are made solely for obtaining an experience at the destination; i.e., there is no pleasure from travel itself;

3) site characteristics do not affect behavior of individuals from a given origin; and

4) travel is made to only one destination on a trip.

Wetzel (1977) argues that TCM estimates will always be underestimated when congestion is present. He states that, given a change in price, the presence of congestion will cause the demand curve to shift, becoming more inelastic. Smith (1981), however, argues that the direction of bias cannot be determined *a priori*. Smith states that, to account for congestion in TCM models, the researcher should observe the timing of recreational use at the site. The simple TCM is used to provide estimates of an average season of use at the site. However, in some cases, use varies dramatically within the season. He concludes that the direction of bias depends on the timing of use. Loomis (1982) examined the use of TCM in the presence of congestion; specifically in the case of big game hunting in Utah. Instead of using trips per capita as the dependent variable, applications for hunting permits, per capita, is used because there were more hunting applications received than permits actually issued in Utah. He reports that the estimation of the per capita demand curve is improved when applications per capita is used as the dependent variable than when trips per capita is used as the dependent variable.

Harris *et al.* (1988) and Tinsley and Tinsley (1986) report that the validity of the assumption that the individual does not derive pleasure from travel may depend on the nature of the trip. Concern about the validity of this assumption is important for places such as Shenandoah National Park or the Blue Ridge Parkway which can be used as a scenic route to another destination. Walsh *et al.* (1988) state that, although mechanical travel and viewing scenery is the most popular recreation activity in the United States, very few studies of this activity have been conducted. They report an average value of $21 per day of mechanical travel and sightseeing.

Several authors have studied the effects of site characteristics on TCM estimates (Sorg *et al.* 1985; Cesario and Knetsch 1976; Vaughan and Russel 1982). These authors have shown that inclusion of site characteristics, or some measure of site quality, has a significant effect on benefit estimation. For example, in a study on the value of a fishing day, Vaughan and Russell report that, if the trout catch per angler per day were to increase by one fish more than the mean catch, the estimated average willingness to pay per angler increased by $0.45. Over all anglers, this amount may result in rather large estimates of willingness to pay.

The assumption that visitors travel to only one destination on a trip is made because it is difficult to allocate travel costs between destinations on a multiple destination trip. For example, if an individual travels from Virginia to Yosemite National Park in California, and visits other places along the way, apportioning the total travel cost (and therefore apportioning the assigned value) between all stops is difficult because there is a certain fixed cost of travelling to California regardless of how many stops are made along the way. Allocating travel costs among multiple destinations is arbitrary and using an arbitrary apportionment in TCM may affect resulting consumers' surplus estimates. This issue is discussed in greater detail in the next chapter.

Chapter III. MULTIPLE DESTINATION TRIPS

A. Theoretical Foundations

One assumption of the travel cost method is that costs incurred by recreationists are made exclusively for travel to the study site; i.e., there are no other destinations on the trip (Clawson and Knetsch 1966; Beardsley 1968; Harris *et al.* 1988; Haspel and Johnson 1982). However, recreationists often travel to more than one destination on a trip, especially if an individual is travelling a long distance from their home (Mendelsohn and Markstrom 1988; Smith and Kopp 1980). Smith and Kopp observe, however, that the validity of the assumption about the relationship between travel distance and the number of destinations may vary depending on the resource, noting that TCM does not seem to perform well for urban parks. This issue is particularly relevant for determining the economic value for outdoor recreation at sites in the East, given the large number and close proximity of recreation attractions to each other and to urban population centers.

The incorporation of multiple destination trips into the TCM relies upon an understanding of the perceived relationship between attractions -- whether it is a complementary or a substitute relationship. The role of recreation sites as complements is an issue which has not been addressed in the TCM literature (Harris *et al.* 1988). Even if this relationship is known, the researcher using TCM is faced with a further challenge of determining how other sites affect the valuation of any single site. To fully understand the role of multiple destination trips in TCM, the economic foundations underlying recreation demand will first be presented. From these foundations, the issue of multiple destination trips will be discussed, followed by a review of the empirical studies examining multiple destination trips and TCM.

The demand for a good or service can be derived by assuming that individual j maximizes utility, U_j, subject to a budget constraint:

$$\max \quad U_j = f(x_1, x_2, \ldots, x_n)$$
$$s.t. \quad \sum_{a=1}^{n} p_a * x_a \leq y_j \tag{3}$$

where: x_a = quantity consumed of good a
p_a = price of good a
y_j = income of individual j
n = number of goods or services

This maximization problem can be solved by setting up the Lagrangian function, V_j, as follows:

$$V_j = f(x_1, x_2, \ldots, x_n) + \lambda (y_j - \sum_{a=1}^{n} p_a * x_a) \tag{4}$$

The first-order conditions are then solved to determine the demand for good a, by individual j:

$$x_a = g_a(p_1, p_2, \ldots, p_n, y_j) \quad \forall \; a=1 \ldots n \tag{5}$$

where: g_a = demand for good or service a

Thus, an individual's demand for a good or service is a function of the price of that good or service, the prices of other goods or services, and the individual's income. From the demand function for a single good or service, the relationship between that good and other goods can be determined; i.e., whether or not those goods and services are substitutes or complements. If utility is assumed to be constant, substitute goods exist when:

$$\frac{\partial x_a}{\partial p_b} > 0 \qquad \forall \quad a,b = 1 \ldots n;\ a \neq b \tag{6}$$

or complements when:

$$\frac{\partial x_a}{\partial p_b} < 0 \qquad \forall \quad a,b = 1 \ldots n;\ a \neq b \tag{7}$$

That is, if the demand for a good or service increases when the price of another good or service increases, and utility remains constant, the two goods or services are substitutes. If the demand for a good or service increases when the price of another good or service decreases, and utility remains constant, the two goods or services are complements.

These economic foundations can be applied to recreation demand. Assume individual j maximizes utility received from all goods or services, q, including recreation opportunities, q_R, subject to a budget constraint:

$$\begin{aligned} \max \quad & U_j = \boldsymbol{f}(q_1, q_2, \ldots, q_n, q_R) \\ s.t. \quad & \sum_{a=1}^{n} p_a * q_a + p_R * q_R \leq y_j \end{aligned} \tag{8}$$

where: q_a = quantity of good or service a
p_a = price of good or service a
q_R = recreation opportunity
p_R = price of recreation opportunity

Again, solving this maximization problem, the demand for recreation opportunities can be determined. One can also determine which recreation opportunities are substitutes and which are complements, by calculating $\partial q_a/\partial p_b$, where a and b are any good or service, including any recreation opportunities, and a does not equal b.

The fundamental question which arises in recreation demand, particularly when multiple destination trips occur is: "What is the recreation good which is being demanded?" Is an individual's demand for a certain type of activity that could occur at any of several sites? Alternatively, is the demand for a certain activity that may occur only at one point in time and place, thereby precluding substitute or complement sites? These questions are not as important when using TCM to determine the economic value of a single destination trip as compared to the case of multiple destination trips. If an individual takes a single destination trip, all travel costs are associated with only visiting that one site, regardless of what the individual does at the site, or exactly why the individual chose to visit that site.

However, to apply TCM in the case of multiple destination trips, it is important to understand whether the individual receives utility from the entire trip experience or separable utilities from visits to each stop on the trip. This understanding is important because in the case of multiple destination trips, not all travel costs are associated with visiting any one site. To determine the economic value associated with any single site on a multiple destination trip, using TCM, the researcher may wish to understand how individuals perceive the allocation of travel costs among destinations, and why those destinations were chosen for the multiple destination trip. By understanding what an individual on a multiple destination trip receives utility from, the researcher may also be able to address the relationship between sites; i.e., whether sites visited on a multiple destination trip are all complements, and/or whether some of the sites are substitutes for other sites, which for some reason (e.g., a full campground) the individual was unable to visit.

Recreation substitutability has been characterized as "an elusive research topic" (Brunson and Shelby 1993, 67). Questions have been raised in recreation research about exactly what an individual may perceive as a recreation substitute. Early research suggested that an individual chooses among recreation *activities* such as camping or fishing (Brunson and Shelby 1993; Iso-Ahola 1986). However, other recreation researchers have suggested that this is not necessarily the case. Brunson and Shelby (1993, 69) suggest that recreation substitutability is:

> the interchangability of recreation experiences such that acceptably equivalent outcomes can be achieved by varying one or more of the following: the timing of the experience, the means of gaining access, the setting, and the activity.

Williams *et al.* (1992) suggest that thinking of recreation settings as commodities which are theoretically interchangeable has limitations. Instead, recreation settings "are very often one-of-a-kind places that cannot be designed or engineered like so many makes of automobiles" (Williams *et al.* 1992, 30).

These ideas suggest that substitutes may not exist for a multiple destination trip. For example a trip to Florida which includes a stop at Disney World may not necessarily be considered a substitute for a trip to California which includes a stop at Disneyland. A multiple destination trip may be a one-of-a-kind experience whose utility arises from the *combination* of activities at various sites and feelings from the entire trip. An individual may have a utility for the synergy between the sites of a multiple destination trip, and not for each site separately. Further research will be needed to answer the questions about what an individual values on a multiple destination trip, and how to incorporate this knowledge into the TCM. A review of the few studies which have attempted to address multiple destination trips is presented in the next section.

B. Empirical Studies

Because of the difficulty surrounding multiple destination trips, few researchers have attempted to address how to incorporate multiple destination trips into TCM. Common methods for handling multiple destination trips in applied TCM studies have included simply eliminating from the analysis the survey responses of individuals who travelled to more than one destination, or excluding those individuals whose homes are more than a certain distance from the study site (Rosenthal *et al.* 1986; Mendelsohn and Markstrom 1988). However, these methods may introduce a significant bias into the estimates, given the possible existence of a large number of multiple destination trips taken by vacationers (Harris *et al.* 1988).

There have been several other methods proposed to incorporate multiple destination trips into the TCM. These include: 1) allocating a proportion of travel costs to the study site depending on an individual's length of stay at the site, 2) redefining the individual's destination by grouping several often visited sites into a single destination and using the distance of an average leg of the trip as the basis for travel cost, 3) using the marginal distance (i.e., how far out of the way the individual travelled to visit the study site while on a multiple destination trip) as the basis for travel cost, and 4) redefining the underlying utility function to explicitly account for combinations of destination packages. Studies which have addressed multiple destination trips in recreation valuation will be discussed below.

Beardsley (1968) was perhaps the first to explicitly address multiple destination trips in the TCM. He surveyed 665 recreationists at a 7-mile section of the Cache La Poudre

River canyon in Colorado. He observed that, since many of the recreationists travelled to several destinations on their trip, simply using the reported gross trip expenditures would bias the estimated recreation value of the river upwards. To adjust respondents' reported travel costs, he apportioned all costs that were not specifically incurred for recreation at the study site according to the proportion of the total trip time spent at the study site relative to the total time spent on the trip. This assumes the recreationists will allocate the trip time to several destinations based on the relative value the individual holds for recreation at each destination.

Using TCM, Beardsley estimated the economic value for recreation on the 7-mile section of the river to be $0.93 per visitor-day for the 1966 season. No comparison was made to address how the adjustments for multiple destination trips changed the estimated value from the case where all recreationists visit the site as the only destination on their trip, as is commonly assumed in TCM. Thus, there is no check of the sensitivity of the model to the assumption about how visitors allocate total trip time among various destinations.

Another study which examined the economic value of recreation at sites on multiple destination trips was conducted by Haspel and Johnson (1982). They surveyed visitors to Bryce Canyon National Park (BCNP), collecting information on travel costs, socioeconomic characteristics, and trip itineraries. They suggest that, in the presence of multiple destination trips, the appropriate travel cost to use in TCM is the cost of an average leg of a trip with given destinations; i.e., the average cost of travelling to all destinations. They also suggest that, if several destinations are close to each other, these sites could be grouped into a single destination. They hypothesize that, since many of the respondents visited Zion National Park and Grand Canyon National Park during their trip to BCNP (all a few hours drive apart), visitors may perceive the southern Utah-northern Arizona parks as a single destination.

If the three National Parks are grouped into a single destination, Haspel and Johnson estimate the economic value of recreation at the southern Utah-northern Arizona parks to be $69 per vehicle. If multiple destinations are not grouped and average cost of travel to legs of the trip is used, they estimate the economic value of recreation at BCNP to be $91 per vehicle. They compared these estimates to the case where respondents' reported total travel cost is used in the TCM, assuming all respondents visited BCNP as the only trip destination. This estimated economic value of recreation was $1988 per vehicle. They did not estimate the economic value of BCNP using only those visitors' responses who indicated BCNP was their only trip destination. They conclude that consumers' surplus estimates are overstated if multiple destinations are not accounted for in the TCM.

Mendelsohn *et al.* (1992) criticized this approach by suggesting that the assignment of fixed costs to travel destinations is arbitrary and that average cost is not an appropriate proxy for travel cost. For example, if a visitor incurred $2000 in round trip travel cost to 3 equally spaced destinations (thus, there are 4 legs of the visitor's trip: home to destination A, A to B, B to C, and C to home), Haspel and Johnson's approach would suggest $500 is an appropriate proxy for travel cost to any given destination. If the trip would have required $2000 in travel cost to go to only one destination, (e.g., the farthest destination from the visitor's home), then Mendelsohn *et al.'s* criticism is valid; all costs should have been attributed to the single destination, not just 1/4 of the costs.

Brown and Plummer (1990) suggest that the marginal travel distance is the appropriate measure for travel cost in TCM; i.e., how far out of the way individuals travel to visit any single site on a multiple destination trip. Brown and Plummer also observe that consumers' surplus estimates will be biased upwards when travel to multiple destinations is not accounted for in the TCM, although they do not use the marginal distance measure in an applied TCM. Haspel and Johnson also suggest a marginal travel distance measure, but do not use the measure in an estimation of the consumers' surplus for recreation at BCNP. The marginal travel distance measure is a more appropriate measure for travel cost than the average distance measure, if one assumes the decision to travel to one destination is independent of the decision to travel to other destinations on the same trip. In this case, an individual will choose to visit a certain destination if the additional benefit from the visit is greater than or equal to the additional cost of the visit; i.e., the individual bases the destination decision on the marginal costs, not the average costs.

Mendelsohn *et al.* (1992) present an alternative formulation to account for multiple destination trips in TCM. They suggest that each possible combination of destinations visited can be treated as a different "site," with individuals choosing from all combinations in a single decision process. The demand for recreation at each combination of sites is estimated with its own demand function in a demand system, where the costs of all alternative trips are included in each demand function. That is, utility is derived from single destination trips to sites Q_1 to Q_n and all combinations of those *n* sites, Q_{n+1} to Q_m:

$$U = f(Q_1, \ldots, Q_n, Q_{n+1}, \ldots, Q_m; \mathbf{X}, \mathbf{W}) \quad (9)$$

where:
Q_i = trips per capita to single site i, if i=1...n
Q_i = trips per capita to combinations of sites, if i=n+1...m
X = all other commodities which can be purchased
W = demand shifters
n = number of single destinations
m = number of destinations, including combinations of sites

Thus, single destination trips are a subset of all possible trips. The individual maximizes this utility function subject to a budget constraint, resulting in a system of m inverse demand equations:

$$\begin{aligned}
P_1 &= G_1(Q_1, \ldots, Q_m; \mathbf{P_x}, \mathbf{W}) \\
&\vdots \\
P_n &= G_n(Q_1, \ldots, Q_m; \mathbf{P_x}, \mathbf{W}) \\
P_{n+1} &= G_{n+1}(Q_1, \ldots, Q_m; \mathbf{P_x}, \mathbf{W}) \\
&\vdots \\
P_m &= G_m(Q_1, \ldots, Q_m; \mathbf{P_x}, \mathbf{W})
\end{aligned} \tag{10}$$

where: P_i = travel cost to site i, if i=1...n
P_i = travel cost to combination of sites, if i=n+1...m
G_i = inverse demand for trip i
P_x = vector of prices for other commodities, x

This model extends the model presented by Burt and Brewer (1971). This approach allows for the consideration of all possible combinations of destinations within each demand equation, whereas Burt and Brewer only allowed for a system of demand equations in which other sites were treated as alternative single destinations. Mendelsohn *et al.* allow for combinations of sites as an alternative in each demand equation.

Continuing the presentation of Mendelsohn *et al.*, the consumer surplus for any site i is:

$$CS_i = \int_{Q_i}^{0} G_i\,(Q_1, Q_2, \ldots, Q_i, \ldots, Q_m, \mathbf{P_x}, \mathbf{W})\, dq_i - P_i Q_i \tag{11}$$

By including all combinations of trip packages in this calculation, the relationship between a single site and alternative sites or trip packages is incorporated into the analysis. Mendelsohn *et al.* state that the economic value of any single site arises from the value for single destination trips and multiple destination trips. They estimate the demand system twice -- once with the existence of site i and again without that site -- and then take the difference between the consumers' surplus estimates from the two demand systems. Mendelsohn *et al.* then show, by expanding this difference, that the total use value for site i can be calculated as:

$$
\begin{aligned}
CS_i = & \int_{Q_i}^{0} G_i(q_i, Q_2, \ldots, Q_m, \mathbf{P_x}, \mathbf{W})\, dq_i - P_i Q_i \\
& + \int_{Q_{n+1}}^{0} G_{n+1}(0, Q_2, \ldots, Q_n, Q_{n+1}, Q_{n+2}, \ldots, Q_m, \mathbf{P_x}, \mathbf{W})\, dq_{n+1} - P_{n+1} Q_{n+1} \\
& + \int_{Q_{n+2}}^{0} G_{n+2}(0, Q_2, \ldots, Q_n, 0, Q_{n+2}, Q_{n+3}, \ldots, Q_m, \mathbf{P_x}, \mathbf{W})\, dq_{n+2} - P_{n+2} Q_{n+2} \qquad (12) \\
& + \ldots \\
& + \int_{q_{n+k}}^{0} G_{n+k}(0, Q_2, \ldots, Q_n, 0, \ldots, 0, Q_{n+k}, Q_m, \mathbf{P_x}, \mathbf{W})\, dq_{n+k} - P_{n+k} Q_{n+k}
\end{aligned}
$$

where: k = number of combinations which include the site

Equation (12) is an estimate of the economic value of trips to site *i* given incremental changes in price until the number of trips equals 0. The first term is the economic value of single destination trips to site *i*. The subsequent terms arise from the multiple price changes which occur when the price change of an individual site subsequently changes the price for all other trips which include that site as a destination. For example, the second term defines the consumers' surplus of a multiple destination trip, Q_{n+1}, which includes site *i* as one stop, when a trip to site i, Q_i, is no longer available (i.e., Q_i is set equal to zero). The third term is evaluated where trips Q_i and Q_{n+1} are set equal to zero, and so on for all trip combinations which include site i.

Mendelsohn *et al.* used the BCNP data collected by Haspel and Johnson (1982) to estimate the use value of BCNP, using the demand system framework presented above. Since there were over 40 different sites visited by respondents, all possible combinations (over 1.1 trillion) were not examined. They instead examined all possible combinations of BCNP and the three most visited sites: Grand Canyon National Park, Arches National Park, and Las Vegas. They note that this sample is not a complete representation of visitors to southwestern national parks, because the sample only included visitors who stopped at BCNP. Mendelsohn *et al.* also dropped from the sample all individuals that travelled farther than 850 miles, assuming visitors from greater distances have different travel behaviors. This approach seems to exclude from the analysis many of the individuals which they wish to use to analyze the effects on TCM estimates. Additionally, they apparently assume that the visitors to each combination of destinations did not visit any other destination along the way, although this is not clear. They did not include a measure of the prices of other goods consumed, as suggested in the theoretical model.

The total travel cost for these trip packages was derived from the minimum total distance required to visit all sites in the package. To compute estimates of the economic value for recreation at any single site, the system was estimated by imposing symmetry on the cross-quantity coefficients. They used equation (12) to calculate the consumers' surplus associated with recreation at BCNP. They report that, if multiple destinations are not accounted for in the TCM, the economic value for recreation at BCNP is $10 per single destination visitor. This estimate results from a TCM estimation where respondents who travelled to multiple destinations were eliminated from the sample. If multiple destinations are accounted for in the TCM, and the entire system of demand equations is estimated, they report an estimated economic value of $16.80 per person, and they suggest that the additional $6.80 comes from the value of BCNP when multiple destination trips are taken. Recall that Haspel and Johnson estimated the consumers' surplus associated with recreation at BCNP, when accounting for multiple destination trips, to be $91 per visitor and, if multiple destination visitors are not accounted for, they report an estimate of $1988 per visitor.

C. Further Considerations

Although Mendelsohn *et al.* (1992) do not compare their results with those of Haspel and Johnson (1982), the estimates vary due to the different theoretical structure of the demand equations. Haspel and Johnson show that the estimates of consumers' surplus decrease if multiple destination trips are accounted for in the TCM, while Mendelsohn *et al.* show that the estimates of consumers' surplus increase if multiple destination trips are accounted for. The first obvious difference is that Haspel and Johnson used a single equation to represent the demand for recreation at BCNP, while Mendelsohn *et al.* used a demand system. Another more crucial difference is that, for the single destination estimate, Haspel and Johnson assume all survey respondents travelled to BCNP as a single destination while Mendelsohn *et al.* only use those responses where this is indeed true, and when the origin was less than 850 miles, in their consumers' surplus estimate for BCNP as a single destination.

Mendelsohn *et al.* do, however, present a framework which can be used to begin to understand multiple destination trips in the TCM. This framework extends the work of previous researchers, yet a complete empirical examination of the effects of multiple destination trips in the context of all previous ideas about multiple destination trips has not been conducted. For example, although Mendelsohn *et al.* compare their estimates using equation (12) with estimates from a traditional TCM, they do not compare their results with Haspel and Johnson, using marginal or average cost for the proxy for price. This type of sensitivity analysis is important due to the increased use of non-market value estimates in benefit cost analysis.

Randall (1987, 191) argues that sensitivity analysis is crucial "to determine whether final conclusions are sensitive to assumptions about technical and economic magnitudes, [and]... special attention should be addressed to sensitivity analysis where the uncertainty is the greatest." Caution is recommended when the ranges of non-market value estimates under varying assumptions result in different benefit-cost outcomes (Randall 1987). An understanding of the effects of different assumptions about multiple destination trips, and an empirical examination of these effects, is important for the continued use of TCM in policy analysis.

Due to the uncertainty of consumers' surplus estimates when multiple destination trips are present, managers may gain useful insights from determining ranges of estimates under varying assumptions, to facilitate sensitivity analysis. The lower bound of estimated consumers' surplus, for an individual site, would occur when the marginal travel distance is used. This minimum estimate is the result of assuming a visitor only holds a value for a shorter trip (i.e., the assigned value arises from a marginal distance) as opposed to the trip that was actually taken (i.e., the assigned value arises from total distance).

To summarize, the economic value which all individuals hold for recreation at an individual site comes from the value held by individuals who visit the site as a single destination trip and those who visit the site as a stop on a multiple destination trip. Given this, the total consumers' surplus, CS, for recreation at a site could be expressed, simply, as:

$$CS_i = \{\int_{Q_i}^{0} G_i dq_i - P_i Q_i\} + \{\int_{Q_i}^{0} H_i dq_i - P_i Q_i\} \tag{13}$$

where: G_i = demand for visits to site i from single destination visitors
H_i = demand for visits to site i from visitors which include the site as one stop on a multiple destination trip.

The first term is the consumers' surplus from all single destination visits to the site, while the second term is the consumers' surplus from all visits to the site as a part of multiple destination trips. If an average consumers' surplus is needed, and there are a disproportionate number of single or multiple destination visitors, each term could be weighted by the proportion of single and multiple destination visitors. This weighted average would more accurately represent the economic value a visitor holds for recreation at the site than if the unweighted consumers' surplus estimates were just divided by the number of visitors to the site.

Although equation (13) presents a simple model for consumers' surplus when multiple destination trips exist, many questions remain about how it should be empirically estimated. The traditional TCM focuses solely on the first term, and questions remain as to how consumers' surplus for a site is to be evaluated when the second term is positive (as opposed to being equal to 0), which indicates multiple destination trips were made which included the site as a stop. The researchers mentioned previously in this chapter have focused on how to determine consumers' surplus when a primary destination visitor is a special case of the multiple destination visitor. That is, consumers' surplus is determined in a single step, either as a demand system or a single equation. They have not tried to determine the economic value for each type of visitor separately. However, recall that Mendelsohn *et al.* state that of the estimated $16.80 consumers' surplus for Bryce Canyon, multiple destination visitors accounted for $6.80 of the value. This suggests that, while they estimated total consumers' surplus in equation (13) in a single step, they thought of the *value* as arising from two distinct types of individuals. Thus, the incorporation of the value multiple destination visitors hold for a single site into TCM to determine a single value estimate for the site, is still not fully resolved.

The fundamental question to ask at this point in understanding multiple destination trips is: "Exactly <u>what</u> is being valued by the visitor to a site on a multiple destination trip?" If each site is said to be separate input into the production of a trip from which utility is received, then possibly only the marginal costs of the inputs need to be considered. However, if a visitor makes destination choice decisions based on an evaluation of the whole trip experience, comprised of the synergistic effects of all destinations, then the total costs of that trip experience might be appropriate, as in the case presented by Mendelsohn *et al.*

Although Mendelsohn *et al.* suggest that an individual chooses among all possible combinations of destinations in a single choice process, this may not necessarily imply that combinations of sites are the only substitutes an individual considers. Instead, an individual may choose between trips to different regions, in addition to choosing between different attractions -- a two-tiered decision process where the tiers may not be separable. Thus, regions may be substitutes on one level and specific attractions may be substitutes on another level.

The study presented by Mendelsohn *et al.* presumes that the only choice visitors had to make was which attractions in the area of Bryce Canyon to visit. However, a visitor may have made several other possible choices. A visitor may have first decided to visit the Utah region, and then chosen to visit Bryce Canyon as an attraction within the region. Or, the individual may have chosen to visit the Bryce Canyon region (where this region is defined as a smaller area than the state of Utah region). Or, the visitor may have decided to visit another region, and the individual decided en route to stop at Bryce Canyon; i.e., trip experiences are dynamic in nature and can change during the course of the trip. The sentiment that visitors change itineraries en route has been stated by several NPS personnel at sites in Virginia. For example, both the Superintendent at Richmond National Battlefield and the Director of the Richmond Community Development Office, a local tourism official for the Richmond area, suggest that many visitors stop while en route to Williamsburg simply because they see the NPS shield on the side of the road and expect good experiences at an NPS site (MacLeod 1992, pers. commun.; Peters 1992, pers. commun.). This change of trip itinerary may have a positive effect on the value that individuals have for their vacations.

This two-tiered approach has been suggested in the results of a study of visitors to Virginia, conducted by Alan Newman Associates for the Virginia Division of Tourism (1989). In that study, most visitors were found to choose which state to visit before choosing specific attractions to visit. In discussing how visitors choose their destinations, the report states (Alan Newman Associates 1989, 15): "[Visitors] want general information to help them decide which state to visit and detailed information once they have selected the state." Visitors preferred travel brochures from a state to be organized by region, because they usually only choose to visit certain parts of a state. One study respondent, discussing event calendars in travel brochures states (Alan Newman Associates 1989, 21): "You don't go there because it's the event. You're in the state because you want to visit the state. The event is just something that's going on at the time that you're there. It's something extra."

The study by Alan Newman Associates also found that most visitors first decide to visit a particular state, and then may choose to visit relatives in that state. In another study of National Park Service units in Virginia (Grow 1993), many visitors to NPS sites in Virginia were found to be local residents who take out-of-town relatives and guests to the site. This was found to be the case especially for Appomattox Court House, Assateague Island, Blue Ridge Parkway, Manassas Battlefield, and Petersburg National Battlefield (Grow 1993). This suggests the out-of-town guests made two choices: first to visit the area where their relatives lived, and second, to go to a park in that same area. Of course, these choices may not have been separable decisions.

Our understanding of how individuals value trips is not yet complete. Current approaches have not fully answered the questions about destination choice processes and the perceived substitutability of destinations. This research extends the current understanding of multiple destination trips in the TCM by providing an empirical examination, using the same data set, of ideas presented by previous researchers on how to incorporate multiple destination trips into the TCM. From these cases a range of estimates can be derived, which can be helpful in sensitivity analysis. Although this research does not explicitly examine the possible two-tiered destination choice approach, the determination of the sensitivity of the TCM to various assumptions about the visitors of a site will further our understanding of TCM estimations. From this understanding, future research can focus on the actual destination choice process.

Chapter IV. METHODS

A. Introduction

An analysis of the effects of multiple destination trip assumptions on TCM estimates of the economic value for on-site recreation use was conducted by varying the assumptions about multiple destination visitors, and the use of these visitors in TCM analyses. The four basic assumptions addressed in this research, as discussed in the previous chapter are:

Assumption #1. Only visitors who use the site as a primary destination are used in the TCM estimation of the economic value of on-site recreation, the traditional approach (Harris *et al.* 1988);

Assumption #2. All visitors are used in the analysis, and it is assumed all visitors travel to the site as their only destination (Clawson and Knetsch 1966);

Assumption #3. All visitors are used in the analysis, and the decision to visit a site is marginal, and independent of the decision to visit any other site, as suggested by Haspel and Johnson (1982) and Brown and Plummer (1990);

Assumption #4. All visitors are used in the analysis, and the decision to visit a site is made by assessing the costs of visiting all combinations of destinations to make on the trip, as suggested by Mendelsohn *et al.* (1992).

The following section describes the data collection and analysis methods for this examination of multiple destination trips.

B. Data Collection

The data used in this analysis were collected as part of a larger study at Shenandoah National Park, Virginia. A survey of visitors to Shenandoah National Park (SNP) was conducted from January, 1992 to November, 1992. The survey focused on trip characteristics of visitors to the Park, visitor characteristics, trip expenditures, and visitor satisfaction with their experiences at the Park. A random sample of 2986 visitors was asked by Park Service entrance station employees to participate in the study as each visitor passed through one of four entrance stations. Approximately once per hour during the sampling period, the driver of a car was asked to participate in the study, if it was the visitor's first entrance into the Park on that trip (many visitors exit and then re-enter the Park several times each trip). If the visitor was unwilling to participate in the study, the driver of the next car was asked to participate, until someone willing to participate was found.

After obtaining the participant's address, the participant was given a packet at the entrance station which contained a cover letter describing the study and assuring the respondent of confidentiality, the survey instrument, and a postage-paid return envelope. Approximately 10 days after the initial contact, a postcard reminder was mailed. Two weeks later, if the respondent still had not returned a survey, another survey packet was mailed, followed by another postcard reminder one week later (see Appendix A for all survey materials). To increase participation in the survey, an incentive (a chance to win a $50 U.S. savings bond in a random drawing) was offered to all respondents. This incentive was offered for each season during the survey (winter, spring, summer, fall). The survey implementation approximated the total design method, as outlined by Dillman (1978).

Survey questions related to the individual's reason for visiting Shenandoah National Park, experiences at the Park, socioeconomic characteristics, trip expenditures in the local area, and total trip expenditures. Questions of particular importance for this study included whether or not the stop at SNP was the visitor's primary trip destination, location of the visitor's home, other attractions and recreation sites visited on the trip, and questions pertaining to how dependent on SNP the visitor is for doing their chosen recreation activities.

C. TCM Analysis

1. Data Screening

The survey responses were screened to ensure that answers were given to the questions of most importance to this study: whether or not SNP was a primary destination, the visitor's origin, and the question relating to dependence upon the Park for the recreation activity. Additionally, respondents who indicated that SNP was a secondary destination, but who indicated that no other stops were made (i.e., the travel itinerary question was blank), were removed from the sample. These responses were deemed illogical: the visitor perceived the visit to SNP as a secondary destination on their trip, but did not indicate that other stops were made. Responses to the reverse case (SNP was a primary destination and other stops were made on the trip) were not removed. One should note that if a respondent indicated that SNP was a primary destination, the visitor could still have made a multiple destination trip. That is, there is a difference between a single destination visitor, who only stopped at SNP, and a visitor who indicated SNP was a primary destination. Each attraction visited on all respondents' trips was assigned a code, and all data were entered into computer files.

2. Sub-sample

Since the sample of SNP visitors was quite large, a smaller sub-sample of responses was chosen for this study, so that data analysis would be manageable given the limited availability of resources and extensive time to run the computer program which calculated TCM estimates (detailed later in this section). Because the objective of this study was to analyze the effects of multiple destination visitors, it was important to obtain a sub-sample which was representative of different types of visitors. The visitors were classified into three visitor origin categories, and within each category visitors were divided into those who indicated that SNP was a primary destination and those who indicated that SNP was a secondary destination. Thus, there were six visitor groups:

1. Visitors to SNP whose homes were greater than 350 miles away and who came to the Park as a primary destination ("National/Primary");
2. Visitors to SNP whose homes were greater than 350 miles away and who came to the Park as a secondary destination ("National/Secondary");
3. Visitors to SNP whose homes were greater than 100 miles but less than 350 miles away and who came to the Park as a primary destination ("Regional/Primary");
4. Visitors to SNP whose homes were greater than 100 miles but less than 350 miles away and who came to the Park as a secondary destination ("Regional/Secondary");
5. Visitors to SNP whose homes were less than 100 miles away and who came to the Park as a primary destination ("Local/Primary");

6. Visitors to SNP whose homes were less than 100 miles away and who came to the Park as a secondary destination ("Local/Secondary").

Foreign visitors were excluded from the sub-sample. Appendix B provides a list of all visitor category definitions used throughout this discussion, for the reader's reference.

The distinction was made between visitors who indicated that the stop at SNP was a primary destination and those who indicated that the stop was a secondary destination in order to analyze the effects of including multiple destination visitors to the Park in a TCM analysis. The additional distinction between distance from the visitor origin to the Park was made to analyze the effects of excluding visitors from the analysis whose home was a great distance away. Using these six groups of visitors, a complete empirical examination of various assumptions can be made. For example, many researchers eliminate individuals from the analysis if the visitor's home is a great distance away (Mendelsohn and Markstrom, 1988). It is often believed that these long-distance visitors violate the assumption that all costs incurred are for travel to only that particular site. Because this study obtained information about visitors' travel itineraries, a comparison can be made between cases where those long-distance visitors are included in the TCM analysis and cases where those visitors are excluded, and hence, whether or not the single destination assumption is valid.

A random, stratified sample of the respondents, by each of the six visitor categories, was selected. There were proportionately fewer respondents whose homes were greater than 350 miles from SNP, and who went to SNP as a primary destination ("National/Primary"). Thus, all responses from the "National/Primary" group were used in the analysis. The random sample was taken of the five remaining groups of visitors, essentially oversampling the "National/Primary" visitors. This stratified sample was chosen to ensure there were enough respondents in each visitor group to allow for TCM estimation and for assessing how that type of visitor affects the TCM consumers' surplus estimates. This sub-sample is not, therefore, representative of all visitors to SNP, and as such the consumers' surplus estimates cannot be generalized to the entire population of visitors. Recall that the objective of this study was not to determine the economic value of SNP to all visitors, but to assess how the inclusion of, and assumptions made about, certain types of visitors affects the TCM estimates.

3. Other Data Collected

This analysis used a zonal TCM model where visitor origins were determined by county. Origins were determined by matching the visitor's home zip code to the county of origin using *Rand McNally Zip Code Atlas and Market Planner* (Rand McNally and Company 1988). Data from other sources were also collected on the population, median age, and median per capita income of each origin county. Two indicators of the education level of each origin county were obtained: the percent of individuals older than 25 years in each county with a college degree, and the median number of years of education for each person older than 25 years. All socioeconomic data for each origin county were collected from *USA Counties - Computer Laser Optical Disks* (U.S. Department of Commerce, 1992). The average number of sites visited by individuals from a zone was determined using the SNP survey data.

The demand for any good is often influenced by the price and availability of substitute recreation sites and experiences (Rosenthal, 1987). However, the survey instrument did not address substitute sites using traditional approaches, nor did this study address possible substitute regions for Virginia, as suggested in the two-tiered approach presented in Chapter three. To account for the substitutability of SNP, a variable measuring "place-dependence" was developed. The concept of place-dependence has been developed to help describe "sense of place." Place-dependence emphasizes "the overall necessity attached to a specific place for enjoying a leisure pursuit" (Williams *et al.* 1992, 31). Individuals are believed to compare places for meeting their needs and have an attachment to the place that could potentially best meet their needs. Thus, a measure of this dependence on a site for the fulfillment of certain goals and needs can be used to measure individuals' reactions to pursuing their activities at other sites. The substitutability of sites would be inversely related to how dependent the individual is on the current site for their chosen activities (Williams *et al.* 1992). To determine the place-dependence measure (a latent variable), the ratings on a 5-point Likert scale to five questions (see Appendix A, questions 12.3, 12.5, 12.7, 12.10, and 12.14) about place-dependence were analyzed with internal consistency reliability analysis. This analysis is used to determine the degree to which all the questions measure the same thing, i.e., the latent variable -- place-dependence in this case (DeVellis 1991). For the questions found to be the most reliable measures of place-dependence, according to Cronbach's alpha[3], an average rating was calculated, to be used as a single measure of place-dependence in the first-stage demand estimation. This measure of substitutability is not a traditional measure in economics studies, however it does capture the willingness of individuals to substitute other sites for the experience at SNP.

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[3] Cronbach's alpha measures "the proportion of a scale's total variance that is attributable to a common source, presumably the true score of the latent variable underlying the items" (DeVellis 1991, 27).

Although information about the visitor's trip expenditure was requested on the survey, it became apparent after further analysis that the trip expenditure question may have been misinterpreted. Many individuals did not seem to have reported all travel costs, but instead reported only the portion spent in the local area, or even left the question blank. Because of these possible problems, an alternative measure of travel costs was calculated. Road distance travelled by the respondents was estimated and used as a proxy for travel cost, as is common in traditional TCM applications. The distance had to be estimated because the survey instrument did not address distance travelled. To determine the approximate road distance travelled, the latitude and longitude of the city where the visitor was from, of all stops made on the visitor's trip, and of the four entrances to SNP were determined using *Geographic Names Information System* (United States Geological Survey, 1983). To convert the latitude and longitude of two points into the distance of the great circle between those two points, the following formula was used (Maling 1992):

$$s = R*(\arccos(\sin\xi_a \sin\xi_b + \cos\xi_a \cos\xi_b \cos\lambda)) \qquad (14)$$

where: s = distance (miles) between two points
R = radius of the Earth
ξ_a, ξ_b = latitude of points a,b
λ = | longitude of point a - longitude of point b |

To calculate approximate road distance between the two points, the great circle distance was multiplied by a road circuity factor (U.S. Department of Commerce 1978). The approximate road distance between all points on a visitor's itinerary was calculated. Distances were calculated only to the Park entrance where the visitor was first contacted. This method has been used previously by Haspel and Johnson (1982). The average road distance for all visitors from each zone was then determined, and used as the road distance from the zone to the Park. This distance calculation is based on an assumption that a representative individual from that zone would travel, on average, that distance while taking a trip which included SNP as a destination.

The incremental road distances used to determine the second-stage demand curve were converted into travel costs using the average variable cost (gas, maintenance) of operating an automobile in the U.S., \$0.127 per mile (U.S. Department of Transportation 1989) plus an approximate cost per person per mile for travel time. Travel time cost was calculated as:

$$time\ cost = \frac{\left(\frac{1}{3} * \frac{I}{earners} * \frac{1}{2080\ workhours/yr}\right)}{speed} \quad (15)$$

where: I = average yearly household income of respondents in each zone (from visitor survey)
earners = average number of wage earners per household = 1.4 (U.S. Department of Commerce 1991)
speed = average automobile speed on interstates and rural freeways in U.S. = 56.6 (U.S. Department of Transportation 1990)

The numerator is a standard approximation of the cost of travel time -- 1/3 of an individual's wage rate (Cesario, 1976).

4. First-Stage Demand Estimation

The first-stage demand curve is used to estimate the number of trips per capita from each origin. A correlation analysis was first conducted to provide an indication of the relationship between the independent variables and the dependent variable, trips per capita. The independent variables considered were the travel distance, zonal population, per capita income, age, both measures of education level, number of stops made on the trip, and the measure of place-dependence. Trips per capita was determined by summing the number of trips in the sub-sample taken per county, and then dividing by the population of that county. The first-stage demand curve was estimated for all 5 assumptions, outlined previously. Recall that the general form of the first-stage estimation is:

$$V = a + bT + c\mathbf{W}$$

where: V = vector of visitation (participation) rates, per capita, from all zones
T = vector of travel costs from all zones
W = matrix of socioeconomic variables for all zones
a, b, c = vectors of regression coefficients

The regression analysis was conducted using the following visitor origin categories from the sub-sample, to analyze the effects of the common practice of excluding long-distance visitors:

- *all visitors*;
- *local/regional visitors* (origins < 350 miles from SNP);
- *local visitors* (origins < 100 miles from SNP).

To summarize the assumptions, Assumption #1 is that only the primary destination visitors in each category are used in the TCM estimation. Assumption #2 is that all visitors in each category are used in the TCM estimation, and these visitors are assumed to be primary destination visitors. Assumptions #3 is that all visitors in each category are used and marginal travel distance is used as independent variables in the first-stage demand estimation (suggested by Haspel and Johnson 1982; Brown and Plummer 1990). Assumption #4 is that all visitors in each category are used and a demand system is estimated (the Mendelsohn *et al.* approach).

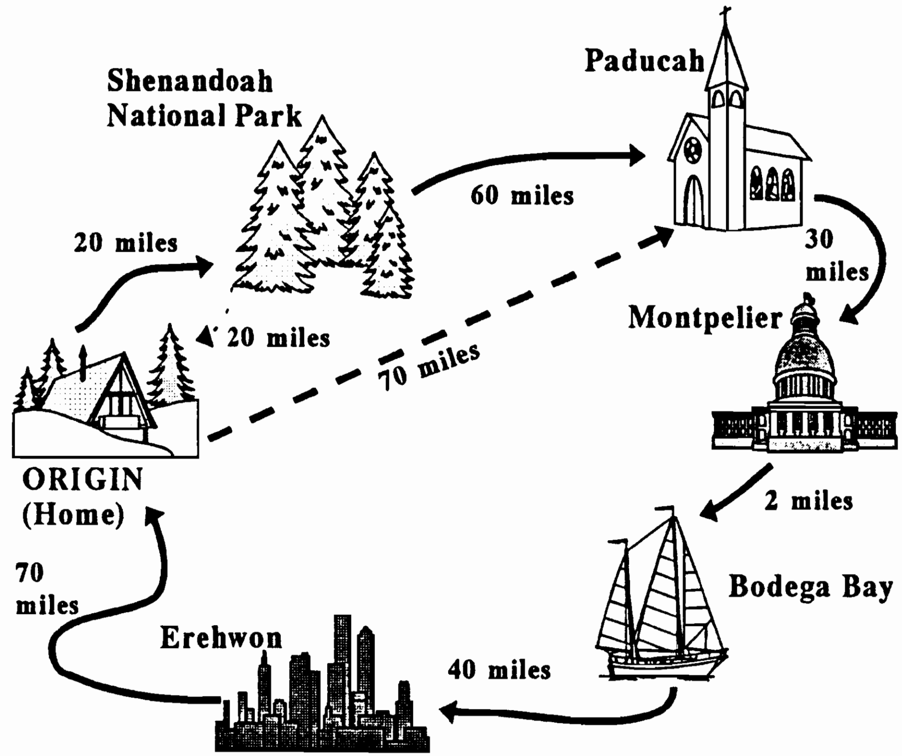
Many TCM surveys ask whether the visit to the site was a primary destination, and if a positive response is received, the visitor is assumed to have made no other stops on the trip. However, a visitor may have indicated that the trip to SNP was their primary destination, and may have also made other stops on the trip, Therefore, in the TCM estimations using both Assumptions #1 and #2, two measures of distance were determined -- total round trip distance, which includes distance between all stops on a visitor's trip, and direct round trip distance from the visitor's home to the Park. An additional distinction was made between visitors for whom the visit to SNP was their only destination ("single destination"), and those ("multiple destination") who made other stops on their trip (whether they indicated the Park was a primary or secondary destination).

For Assumption #3, marginal travel distance was calculated as the difference between: a) the travel distance from the stop immediately before SNP to the Park to the stop immediately after SNP and b) the shortest distance between the stops immediately before and after SNP (i.e., how far out of the way the individual went to visit SNP).

Figure 2 illustrates the determination of these four measures of travel distance. In this example the visitor travels to Shenandoah National Park and 4 other destinations. The total round trip distance is the sum of all distances between the destinations (222 miles). The direct round trip distance is the distance from the visitor's home to SNP, then back home (40 miles). The marginal distance is how far out of the way the visitor travelled to visit SNP, instead of going directly to Paducah (10 miles).

Various functional forms were analyzed: linear, semilog, and double log. Regression equations were judged according to the significance of the variables, the adjusted R^2,

Figure 2. Example of Calculation of Distance Measures



Total Round Trip Distance = 20 + 60 + 30 + 2 + 40 + 70 = 222 miles
Direct Round Trip Distance = 20 + 20 = 40 miles
Marginal Distance from Origin to Shenandoah = (20 + 60) - 70 = 10 miles

goodness of fit, and lack of collinearity between variables. Collinearity was judged by condition numbers. A condition number less than 1000 roughly indicates that there is no problem with collinearity (Myers 1990). Plots of squared residuals against fitted values were used to detect heteroskedasticity.

5. Second-Stage Demand Estimation

The second-stage demand curve uses the first-stage demand parameter estimates to determine the number of trips per capita, given incremental increases in the travel cost above the current travel cost. To estimate this demand curve, 5-mile incremental distances were added to the actual distance the visitor travelled. With each incremental change, the number of trips was calculated using the estimated parameters from the first-stage demand equation. Increments were added until the maximum observed travel distance was reached, or the number of predicted trips became less than one (since in the case of the semilog and double log functional form, the first-stage demand curve approaches but never crosses either axis; Rosenthal *et al.* 1986).

The area under this second-stage demand curve was estimated using the trapezoidal rule of integration (Swokowski 1988), as the actual parameters of the second-stage demand curve are not estimated. This rule of integration is:

$$\int_a^b f(x)\,dx \approx \frac{b-a}{2n}\left[f(x_0) + 2f(x_1) + \ldots + 2f(x_{n-1}) + f(x_n)\right] \tag{16}$$

where (b-a) is the maximum incremental distance and n is the number of 5-mile increments.

The area under the second-stage demand curve represents consumers' surplus because the "price" is the added costs above the travel costs currently paid by the visitors. Appendix

C presents the SAS program used to calculate the TCM estimates for Assumptions #1 through Assumption #3 in this analysis. The program is based on Bittner (1991), although some modifications were made to meet the specific data requirements of this study.

6. Demand System Approach

The approach presented above is the method used to analyze Assumptions #1 to #3. Assumption #4, the demand system approach suggested by Mendelsohn *et al.* (1992), was also analyzed. Recall that the general form of this demand system is:

$$
\begin{aligned}
P_1 &= G_1(Q_1, \ldots, Q_m; \mathbf{P_x}, \mathbf{W}) \\
&\vdots \\
P_n &= G_n(Q_1, \ldots, Q_m; \mathbf{P_x}, \mathbf{W}) \\
P_{n+1} &= G_{n+1}(Q_1, \ldots, Q_m; \mathbf{P_x}, \mathbf{W}) \\
&\vdots \\
P_m &= G_m(Q_1, \ldots, Q_m; \mathbf{P_x}, \mathbf{W})
\end{aligned}
$$

where:
- P_i = travel cost to site i, if i=1...n
- P_i = travel cost to combination of sites, if i=n+1...m
- G_i = inverse demand for trip i
- Q_i = trips per capita to site i, if i=1...n
- Q_i = trips per capita to combination of sites, if i=n+1...m
- P_x = vector of prices for other commodities, x
- W = vector of demand shifters
- n = number of single destinations
- m = number of destinations, including combinations of sites

Mendelsohn *et al.* (1992) estimated the demand system for visits to combinations of Bryce Canyon National Park and the three most visited sites by BCNP visitors on multiple destination trips. Similarly, in this study, the three most visited attractions, other than SNP, were determined from the SNP visitor survey. There were eight possible combinations of sites, and each equation in the demand system is the demand for a particular trip combination. The dependent variable in each equation is the minimum round trip travel distance required for each trip combination from each zone. The independent variables included relevant socioeconomic variables (per capita income, zonal population, etc.) and the number of trips per capita from each zone for each destination combination. The coefficients on each of the cross-quantity terms were set equal to each other to ensure symmetry. That is, $\partial P_j/\partial x_i = \partial P_i/\partial x_j$, where P is the travel distance (price) required for each trip combination and x is the observed number of trips per capita for each combination, and i is not equal to j. In this case, similar to Mendelsohn *et al.*, no measure of the prices of other consumed goods is included as an independent variable.

For example, if sites A, B, and C were the most visited sites in addition to Shenandoah National Park, there would be eight possible trip combinations (all visitors must go to SNP to be in the sample):

1. SNP only	5. SNP, A, and B
2. SNP and A	6. SNP, A, and C
3. SNP and B	7. SNP, B, and C
4. SNP and C	8. SNP, A, B, and C

Using these combinations, the estimated system would be:

$$P_{SNP} = \alpha + \beta_{1a}X_{SNP} + \beta_{2a}X_{SNP,A} + \beta_{3a}X_{SNP,B} + \beta_{4a}X_{SNP,C} + \beta_{5a}X_{SNP,A,B} + \beta_{6a}X_{SNP,A,C} + \beta_{7a}X_{SNP,B,C} + \beta_{8a}X_{SNP,A,B,C} + \lambda W + \epsilon$$

$$P_{SNP,A} = \alpha + \beta_{1b}X_{SNP} + \beta_{2b}X_{SNP,A} + \beta_{3b}X_{SNP,B} + \beta_{4b}X_{SNP,C} + \beta_{5b}X_{SNP,A,B} + \beta_{6b}X_{SNP,A,C} + \beta_{7b}X_{SNP,B,C} + \beta_{8b}X_{SNP,A,B,C} + \lambda W + \epsilon$$

$$P_{SNP,B} = \alpha + \beta_{1c}X_{SNP} + \beta_{2c}X_{SNP,A} + \beta_{3c}X_{SNP,B} + \beta_{4c}X_{SNP,C} + \beta_{5c}X_{SNP,A,B} + \beta_{6c}X_{SNP,A,C} + \beta_{7c}X_{SNP,B,C} + \beta_{8c}X_{SNP,A,B,C} + \lambda W + \epsilon$$

$$P_{SNP,C} = \alpha + \beta_{1d}X_{SNP} + \beta_{2d}X_{SNP,A} + \beta_{3d}X_{SNP,B} + \beta_{4d}X_{SNP,C} + \beta_{5d}X_{SNP,A,B} + \beta_{6d}X_{SNP,A,C} + \beta_{7d}X_{SNP,B,C} + \beta_{8d}X_{SNP,A,B,C} + \lambda W + \epsilon$$

$$P_{SNP,A,B} = \alpha + \beta_{1e}X_{SNP} + \beta_{2e}X_{SNP,A} + \beta_{3e}X_{SNP,B} + \beta_{4e}X_{SNP,C} + \beta_{5e}X_{SNP,A,B} + \beta_{6e}X_{SNP,A,C} + \beta_{7e}X_{SNP,B,C} + \beta_{8e}X_{SNP,A,B,C} + \lambda W + \epsilon$$

$$P_{SNP,A,C} = \alpha + \beta_{1f}X_{SNP} + \beta_{2f}X_{SNP,A} + \beta_{3f}X_{SNP,B} + \beta_{4f}X_{SNP,C} + \beta_{5f}X_{SNP,A,B} + \beta_{6f}X_{SNP,A,C} + \beta_{7f}X_{SNP,B,C} + \beta_{8f}X_{SNP,A,B,C} + \lambda W + \epsilon$$

$$P_{SNP,B,C} = \alpha + \beta_{1g}X_{SNP} + \beta_{2g}X_{SNP,A} + \beta_{3g}X_{SNP,B} + \beta_{4g}X_{SNP,C} + \beta_{5g}X_{SNP,A,B} + \beta_{6g}X_{SNP,A,C} + \beta_{7g}X_{SNP,B,C} + \beta_{8g}X_{SNP,A,B,C} + \lambda W + \epsilon$$

$$P_{SNP,A,B,C} = \alpha + \beta_{1h}X_{SNP} + \beta_{2h}X_{SNP,A} + \beta_{3h}X_{SNP,B} + \beta_{4h}X_{SNP,C} + \beta_{5h}X_{SNP,A,B} + \beta_{6h}X_{SNP,A,C} + \beta_{7h}X_{SNP,B,C} + \beta_{8h}X_{SNP,A,B,C} + \lambda W + \epsilon$$

where: P_i = minimum travel distance for trip combination i
X_i = trips per capita for trip combination i
W = socioeconomic variables
α, β, λ = regression coefficients
ϵ = error term

The cross-quantity coefficients are restricted to be equal:

$\beta_{2a}=\beta_{1b}$	$\beta_{3b}=\beta_{2c}$	$\beta_{5c}=\beta_{3e}$	$\beta_{8d}=\beta_{4h}$
$\beta_{3a}=\beta_{1c}$	$\beta_{4b}=\beta_{2d}$	$\beta_{6c}=\beta_{3f}$	$\beta_{6e}=\beta_{5f}$
$\beta_{4a}=\beta_{1d}$	$\beta_{5b}=\beta_{2e}$	$\beta_{7c}=\beta_{3g}$	$\beta_{7e}=\beta_{5g}$
$\beta_{5a}=\beta_{1e}$	$\beta_{6b}=\beta_{2f}$	$\beta_{8c}=\beta_{3h}$	$\beta_{8e}=\beta_{5h}$
$\beta_{6a}=\beta_{1f}$	$\beta_{7b}=\beta_{2g}$	$\beta_{5d}=\beta_{4e}$	$\beta_{7f}=\beta_{6g}$
$\beta_{7a}=\beta_{1g}$	$\beta_{8b}=\beta_{2h}$	$\beta_{6d}=\beta_{4f}$	$\beta_{8f}=\beta_{6h}$
$\beta_{8a}=\beta_{1h}$	$\beta_{4c}=\beta_{3d}$	$\beta_{7d}=\beta_{4g}$	$\beta_{8g}=\beta_{7h}$

The demand system was estimated for the following visitor categories:

- *all visitors*;
- *local/regional visitors* (origins < 350 miles from SNP).

Local visitors were not analyzed as a separate category because there were few from the local area who visited any combination of the three most visited sites, in addition to SNP. An estimate of consumers' surplus was calculated using equation (12) from the previous chapter.

Chapter V. RESULTS AND DISCUSSION

A. Survey Response

During the sampling period from January 1992 to November 1992, 2986 visitor contacts were made. Of these contacts, 2261 surveys were returned (76% response rate), and 1807 (80% of returned surveys, 61% of all contacts) of these surveys were useable according to the criteria mentioned in Chapter IV (see p. 43): responses to zip code, primary/secondary destination, place-dependence questions, and a trip itinerary was provided if secondary destination was indicated. Of these surveys, 82 visitors were classified as "National/Primary," visitors whose home was greater than 350 miles from Shenandoah National Park (SNP) and who indicated their visit to the Park was a primary destination (Table 1). The largest group of visitors was "Local/Primary," visitors whose home was less than 100 miles from SNP and who indicated their visit to the Park was a primary destination. There were 699 of these "Local/Primary" visitors. For the sub-sample, all 82 "National/Primary" visitors were used, and 100 visitors from each of the remaining groups were randomly selected. Thus, each group was represented by approximately an equal number of respondents, for a total sub-sample size of 582 respondents.

Table 1. Total Responses by Origin and Destination for Shenandoah National Park Survey

Origin Category	Destination		
	Primary Destination Visitors	Secondary Destination Visitors	Total
National[1]	82	270	352
Regional	298	334	632
Local	699	124	823
Total	1,079	728	1,807

[1] National: visitor origins > 350 from Park
Regional: visitor origins > 100 miles but < 350 miles from Park
Local: visitor origins < 100 miles from Park

B. Travel Cost Variables

1. Travel Costs

The range of estimated travel distances for each visitor origin category, used for Assumptions #1 to #3[4], are presented in Table 2. The farthest total round trip distance (the distance between all stops and the origin) that an average individual from a zone travelled, for the sub-sample, was 6247 miles, while the shortest total round trip distance travelled was 15 miles. The range of travel distances according to primary and secondary destination visitors is presented in Table 3. Of the individuals who indicated the stop at SNP was a primary destination, the farthest total round trip distance travelled was 5841 miles, while the shortest total round trip distance travelled was 15 miles. Of the visitors for whom SNP was the only destination on their trip, the farthest total round trip distance travelled was 5387 miles, while the shortest total round trip distance was 15 miles. The estimated travel costs based on distance travelled for each of these groups are shown in Table 4. The travel cost ranged from $0.217 per mile per person to $0.237 per mile per person.

2. Place-Dependence

The reliability analysis of all 1807 study participants' responses to the 5 survey questions which measure "place-dependence," indicative of substitutability of other sites for a visitor's chosen activities at SNP, resulted in a Cronbach's alpha of .871. This indicates that 87% of the variability in the place-dependence questions is due to the true score of the latent

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[4] Because Assumption #4, the demand system approach suggested by Mendelsohn *et al.*, is fundamentally different from Assumptions #1 to #3, it is discussed separately.

Table 2. Ranges of Estimated Travel Distances by Visitor Category[1]

Visitor Origin Category		Travel Distance Measure: Total Round Trip Distance[2] (miles)	Direct Round Trip Distance (miles)	Marginal Distance (miles)
All Visitors[3]	min.	15	15	6
	max.	6247	6107	2066
Local/Regional Visitors	min.	15	15	6
	max.	3977	1045	1024
Local Visitors	min.	15	15	6
	max.	795	238	161

1 Travel distances were determined using approximate road distance. The distances used to determine visitor origin categories were based on air miles; i.e., straight line distance.

2 Total round trip distance = total distance between origin and all stops on trip and back to the origin;
Direct round trip distance = distance from origin to Park and back to the origin;
Marginal distance = difference between: a) the travel distance from the stop immediately before SNP, to the Park entrance, to the stop immediately after SNP and b) the shortest distance between the stops immediately before and after SNP.

3 *All Visitors:* All visitors regardless of distance from origin to Park
Local/Regional Visitors: Visitors whose origin is < 350 miles from Park
Local Visitors: Visitors whose origin is < 100 miles from Park

Table 3. Range of Estimated Travel Distances by Primary/Single/Multiple Destination Visitors to Shenandoah National Park[1]

Visitor Origin/Destination Category		Travel Distance Measure: Total Round Trip Distance[2] (miles)	Direct Round Trip Distance (miles)	Marginal Distance (miles)
All Primary Destination Visitors[3]	min.	15	15	6
	max.	5841	6107	2066
All Single Destination Visitors[4]	min.	---	15	---
	max.	---	5387	---
All Multiple Destination Visitors[5]	min.	101	---	5
	max.	6247	---	979
Local/ Regional Primary Destination Visitors[6]	min.	15	15	6
	max.	5658	1045	1024
Local/ Regional Single Destination Visitors[7]	min.	---	15	---
	max.	---	1023	---
Local/ Regional Multiple Destination Visitors[8]	min.	101	---	5
	max.	3977	---	979
Local Primary Destination Visitors[9]	min.	15	15	6
	max.	599	223	174
Local Single Destination Visitors[10]	min.	---	15	---
	max.	---	213	---
Local Multiple Destination Visitors[11]	min.	101	---	5
	max.	795	---	65

[1] Travel distances were determined using approximate road distance. The distances used to determine visitor origin categories were based on air miles; i.e., straight line distance.

[2] Total round trip distance = total distance between origin and all stops on trip and back to the origin;
Direct round trip distance = distance from origin to Park and back to the origin;
Marginal distance = difference between: a) the travel distance from the stop immediately before SNP, to the Park entrance, to the stop immediately after SNP and b) the shortest distance between the stops immediately before and after SNP.

[3] All visitors who indicated SNP was the primary destination.

[4] All visitors whose only stop was SNP.

[5] All visitors who stopped at several sites including SNP.

[6] Visitors whose origin was < 350 miles from SNP and who indicated SNP was a primary destination.

[7] Visitors whose origin was < 350 miles from SNP and who only stopped at SNP.

[8] Visitors whose origin was < 350 miles from SNP and stopped at several sites including SNP.

[9] Visitors whose origin was < 100 miles from SNP and who indicated SNP was a primary destination.

[10] Visitors whose origin was < 100 from SNP and only stopped at SNP.

[11] Visitors whose origin was < 100 miles from SNP and who stopped at several sites including SNP.

Table 4. Estimated Travel Costs by Visitor Category

Visitor Category	Avg. Income ($/household/yr)	Time Cost[1] ($/person/mile travelled)	Travel Cost[2] ($/person/mile travelled)
All[3] Visitors	50522.44	.10	.227
All Primary Destination Visitors	46723.65	.09	.217
All Single Destination Visitors	45813.52	.09	.217
All Multiple Destination Visitors	51895.24	.10	.227
Local/Regional[4] Visitors	50388.25	.10	.227
Local/Regional Primary Destination Visitors	46881.23	.09	.217
Local/Regional Single Destination Visitors	46573.59	.09	.217
Local/Regional Multiple Destination Visitors	51942.90	.11	.237
Local[5] Visitors	52325.72	.11	.237
Local Primary Destination Visitors	46683.73	.09	.217
Local Single Destination Visitors	47878.31	.10	.227
Local Multiple Destination Visitors	54751.58	.11	.237

[1]

$$Time\ Cost = \frac{\left(\frac{1}{3} * \frac{I}{earners} * \frac{1}{2080\ workhours/yr}\right)}{speed}$$

where: I = avg. household income per year
earners = avg. no. of wage earners per household = 1.4
speed = avg. automobile speed = 56.6 mph

[2] Travel cost = Time cost + $.127 (cost of operating a vehicle)

[3] All visitors regardless of distance from origin to SNP.

[4] Visitor origin < 350 miles from SNP.

[5] Visitor origin < 100 miles from SNP.

variable "place-dependence." That is, the questions about an individual's dependence on SNP for doing their chosen activities were relatively good measures of the latent variable, place-dependence (the higher the Cronbach's alpha, the better the items are as measures of a latent variable). Question 12.10 ("The things I do here I would enjoy just as much at another site") was not used in the dependence measure, as the Cronbach's alpha with that question was .843, but would increase to .871 without that question. As such, the four questions used to measure place-dependence were:

- I enjoy doing the type of things I do here more than in any other area;
- I wouldn't substitute any other area for doing the type of things I do here;
- Doing what I do here is more important to me than doing it in any other place; and
- This area is the best place for what I like to do.

Results from the reliability analysis using the 582 sub-sample responses to the 5 place-dependence questions yield similar results to the reliability analysis using all 1807 respondents. The highest Cronbach's alpha for the 582 sub-sample responses was .856 without question 12.10, and .831 with that question. Thus, an average of the respondent's answers to the four question listed above was calculated and used as a single measure of substitutability.

C. Travel Cost Model Estimation

1. Correlation Analyses

Correlation matrices of variables for the three visitor categories -- *all visitors, local/regional visitors, local visitors* -- are presented in Tables 5, 6, and 7, respectively. The underlying theory of the Travel Cost Method suggests that measures of travel distance (or

Table 5. Correlation Analysis - *All Visitors* Category

	TPCAP[1]	RDIST	MDIST	TDIST	POP	PCI	AGE	EDUC1	EDUC2	DEPEND	# STOPS
TPCAP	1.0000 (0.0000)[2]										
RDIST	-.21449 (.0003)	1.0000 (0.0000)									
MDIST	-.05496 (.3648)	.04631 (.4452)	1.0000 (0.0000)								
TDIST	-.24125 (.0001)	.92902 (.0001)	.03909 (.5194)	1.0000 (0.0000)							
POP	-.20975 (.0005)	.27856 (.0001)	-.05949 (.3265)	.27983 (.0001)	1.0000 (0.0000)						
PCI	-.01548 (.7986)	.05602 (.3556)	-.05581 (.3574)	.08493 (.1609)	.10841 (.0732)	1.0000 (0.0000)					
AGE	.07752 (.2008)	-.08827 (.1450)	.11738 (.0523)	-.10187 (.0924)	-.02704 (.6558)	-.02319 (.7023)	1.0000 (0.0000)				
EDUC1	-.12929 (.0324)	.12013 (.0470)	-.07504 (.2157)	.14080 (.0197)	.18157 (.0026)	.31656 (.0001)	-.08229 (.1744)	1.0000 (0.0000)			
EDUC2	-.00603 (.9209)	-.00027 (.9965)	-.03774 (.5339)	-.00316 (.9585)	.00971 (.8729)	-.02960 (.6257)	.39326 (.0001)	.41183 (.0001)	1.0000 (0.0000)		
DEPEND	.06049 (.3185)	-.10033 (.0974)	.00138 (.9819)	-.10995 (.0692)	-.04949 (.4145)	-.10592 (.0801)	.43219 (.0001)	.19476 (.0012)	.93023 (.0001)	1.0000 (0.0000)	
# STOPS	-.14196 (.0187)	.35714 (.0001)	-.27052 (.0001)	.43360 (.0001)	.14448 (.0167)	.10662 (.0781)	-.09893 (.1022)	.07834 (.1961)	-.00105 (.9861)	-.10398 (.0858)	1.0000 (0.0000)

[1] TPCAP = trips per capita of zone, RDIST = distance from home to origin to home, MDIST = marginal trip distance, TDIST = total actual trip distance, POP = population of zone, PCI = median per capita income of zone, AGE = median age of zone, EDUC1 = % of individuals over 25 years of age in zone with college degree, EDUC2 = median # of years of school for individuals over 25 years of age in zone, DEPEND = measure of place dependency, # STOPS = average # of destinations by individuals in zone.

[2] Numbers in parentheses are the probability level at which the correlation coefficients are significant.

Table 6. Correlation Analysis - *Local/Regional Visitor* Category

	TPCAP[1]	RDIST	MDIST	TDIST	POP	PCI	AGE	EDUC1	EDUC2	DEPEND	# STOPS
TPCAP	1.0000 (0.0000)[2]										
RDIST	-.42816 (.0001)	1.0000 (0.0000)									
MDIST	-.06160 (.4649)	.26675 (.0013)	1.0000 (0.0000)								
TDIST	-.31448 (.0001)	.67793 (.0001)	.24173 (.0036)	1.0000 (0.0000)							
POP	-.28837 (.0005)	.28566 (.0005)	-.04666 (.5800)	.27887 (.0007)	1.0000 (0.0000)						
PCI	-.08603 (.3069)	.00315 (.9703)	-.08637 (.3050)	.11926 (.1560)	.37269 (.0001)	1.0000 (0.0000)					
AGE	.07381 (.3810)	-.09449 (.2616)	-.02628 (.7554)	-.06825 (.4179)	.05232 (.5348)	.05156 (.5408)	1.0000 (0.0000)				
EDUC1	-.04323 (.6082)	-.02916 (.7296)	-.05667 (.5007)	.04794 (.5696)	.27128 (.0010)	.62936 (.0001)	.12643 (.1324)	1.0000 (0.0000)			
EDUC2	-.00755 (.9287)	-.07874 (.3499)	-.06253 (.4581)	-.04182 (.6200)	-.00718 (.9322)	-.09277 (.2705)	.63982 (.0001)	.45685 (.0001)	1.0000 (0.0000)		
DEPEND	.05857 (.4871)	-.13363 (.1116)	-.02017 (.8110)	-.08995 (.2854)	-.05758 (.4946)	-.21377 (.0104)	.63696 (.0001)	.28798 (.0005)	.95868 (.0001)	1.0000 (0.0000)	
# STOPS	-.20536 (.0139)	.46269 (.0001)	-.15078 (.0722)	.47957 (.0001)	.17049 (.0419)	.10253 (.2230)	.05316 (.5283)	.00627 (.9408)	-.00302 (.9714)	-.06532 (.4383)	1.0000 (0.0000)

[1] TPCAP = trips per capita of zone, RDIST = distance from home to origin to home, MDIST = marginal trip distance, TDIST = total actual trip distance, POP = population of zone, PCI = median per capita income of zone, AGE = median age of zone, EDUC1 = % of individuals over 25 years of age in zone with college degree, EDUC2 = median # of years of school for individuals over 25 years of age in zone, DEPEND = measure of place dependence, # STOPS = average # of destinations by individuals in zone.

[2] Numbers in parentheses are the probability level at which the correlation coefficients are significant.

Table 7. Correlation Analysis - *Local Visitor* Category

	TPCAP[1]	RDIST	MDIST	TDIST	POP	PCI	AGE	EDUC1	EDUC2	DEPEND	# STOPS
TPCAP	1.0000 (0.0000)[2]										
RDIST	-.38073 (.0184)	1.0000 (0.0000)									
MDIST	-.10189 (.5427)	.09778 (.5592)	1.0000 (0.0000)								
TDIST	-.22671 (.1711)	.75118 (.0001)	-.05944 (.7230)	1.0000 (0.0000)							
POP	-.28477 (.0831)	.38009 (.0186)	.00484 (.9770)	.44559 (.0051)	1.0000 (0.0000)						
PCI	-.15521 (.3521)	.37276 (.0212)	.21410 (.1968)	.48352 (.0021)	.49624 (.0015)	1.0000 (0.0000)					
AGE	.02441 (.8843)	-.09720 (.5616)	-.23763 (.1508)	-.04276 (.7988)	-.11014 (.5103)	-.32401 (.0472)	1.0000 (0.0000)				
EDUC1	-.08911 (.5497)	.30758 (.0603)	-.0358 (.8310)	.48841 (.0019)	.54256 (.0004)	.53363 (.0006)	.34938 (.0316)	1.0000 (0.0000)			
EDUC2	-.04593 (.7842)	.04365 (.7947)	-.15747 (.3451)	.04742 (.7774)	-.00282 (.9866)	-.29487 (.0723)	.89416 (.0001)	.53462 (.0005)	1.0000 (0.0000)		
DEPEND	-.00989 (.9530)	-.04267 (.7992)	-.14450 (.3867)	-.06173 (.7128)	-.10513 (.5299)	-.41832 (.0090)	.89691 (.0001)	.40615 (.0114)	.98226 (.0001)	1.0000 (0.0000)	
# STOPS	-.10644 (.5248)	.53352 (.0006)	-.37236 (.0213)	.59594 (.0001)	.13413 (.4221)	.07001 (.6762)	.11630 (.4868)	.11075 (.5080)	.06326 (.7059)	.02445 (.8842)	1.0000 (0.0000)

[1] TPCAP = trips per capita of zone, RDIST = distance from home to origin to home, MDIST = marginal trip distance, TDIST = total actual trip distance, POP = population of zone, PCI = median per capita income of zone, AGE = median age of zone, EDUC1 = % of individuals over 25 years of age in zone with college degree, EDUC2 = median # of years of school for individuals over 25 years of age in zone, DEPEND = measure of place dependence, # STOPS = average # of destinations by individuals in zone.

[2] Numbers in parentheses are the probability level at which the correlation coefficients are significant.

travel cost) should be significantly related, in a negative direction, to the observed number of trips to the site. That is, as distance increases, the number of trips to the site decreases. For the *all visitor and the local/regional visitor* categories, direct round trip distance (RDIST; distance from the origin to the Park and back to the origin) is significantly related at α = .05 level, with a negative coefficient, to trips per capita (TPCAP). For the *all visitor* and the *local/regional* visitor categories, the total round trip miles (TDIST) travelled is also significantly related, negatively, to trips per capita.

Other variables which have been shown by previous researchers to be significantly related to trips per capita in the zonal travel cost model include zonal population, per capita income, education level, and other demographic variables (Walsh *et al.* 1988). In this analysis, population (POP) and the percent of persons age 25 and older with a college degree (EDUC1) were significantly related (α = .05) to trips per capita in the *all visitor* category. In the *local/regional* visitor category, population (POP) was significantly related (α = .05) to trips per capita. In the *local* visitor category, only population (POP) was significantly related (α = .10) to trips per capita.

The results of the TCM analyses for each of the four assumptions are discussed separately below, followed by a summary comparison of consumers' surplus estimates. Under each assumption, several cases are presented, using different measures of travel distance, or using different visitor categories. Because the visitor origin categories and other visitor definitions are used often throughout the discussion, all definitions are listed in Appendix B, and stated throughout the discussion for the reader's reference. The consumers' surplus estimates are not representative of the economic value for recreation at SNP by all

SNP visitors, but instead provide an indication of the sensitivity of TCM to assumptions about a purposefully chosen sample of visitors.

2. Assumption #1

Assumption #1 is that only those visitors who indicated that SNP was a primary destination are used in the TCM estimation. Three cases are analyzed under this assumption:

1. Direct round trip distance is used as the measure of travel distance;
2. Total round trip distance is used as the measure of travel distance;
3. Only single destination visitors are used in the analysis, and direct round trip distance is used as the measure of travel distance.

a) Case #1 Case #1 uses the direct round trip distance (distance from origin to SNP and back to the origin) as a measure of travel distance. Parameter estimates for the Case #1 first-stage demand curve are presented in Table 8 for the three visitor categories -- *all visitors, local/regional visitors (origins < 350 miles from SNP), and local visitors (origins < 100 miles from SNP).* A semi-log functional form was found to have the best fit. Also, the use of the natural log of the dependent variable, trips per capita, has been shown by Rosenthal *et al.* (1986) and others to reduce heteroskedasticity. The log of direct round trip distance (distance from origin to SNP and back to the origin) was used as an independent variable, along with population, per capita income, and the measure of place-dependence (substitutability). Additionally, the square of population and the square of per capita income were used in the model to reduce the effects of non-linearity (Myers 1990), detected in an initial observation of

Table 8. Travel Cost Model Estimates: Assumption #1 (Case #1)
(Only visitors that indicated Shenandoah National Park (SNP) was a primary destination are used in the analyses)[a]

First-Stage Parameter Estimates

Visitor Category	Intercept	LRDIST[b]	POP	$(POP)^2$	PCI	$(PCI)^2$	DEPEND	Adj. R^2	F-value	Predicted no. of trips (actual)
	Dependent Variable: Log(trips per capita)									
All Visitors[c]	-7.2982 (.0001)[d]	-.4363 (.0001)	-2.232×10^{-6} (.0001)	2.194×10^{-13} (.0001)	-7.1141×10^{-5} (.0022)	7.34×10^{-10} (.0002)	.0033 (.8590)	.74	77.67	270 (282)
Local/Regional Visitors	-4.8094 (.0008)	-.5898 (.0001)	-3.755×10^{-6} (.0001)	1.114×10^{-12} (.0003)	-2.72×10^{-4} (.0327)	7.3×10^{-9} (.0219)	-.0131 (.5406)	.77	50.44	177 (200)
Local Visitors	-4.7019 (.1369)	-.4955 (.0674)	-9.8×10^{-6} (.0025)	9.01×10^{-12} (.0175)	-3.07×10^{-4} (.3449)	8.64×10^{-9} (.2559)	-.0173 (.7039)	.60	8.33	86 (100)

Second-Stage Consumers' Surplus Estimates ($/person/trip)

All: $5021
Local/Regional: $382
Local: $68

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[a] Travel cost based on direct round trip distance between origin and SNP
[b] LRDIST = Log(direct round trip distance)
POP = population
PCI = per capita income
DEPEND = measure of place-dependence
[c] *All*: All visitors
Local/Regional: origins < 350 miles from SNP
Local: origins < 100 miles from SNP
[d] Probability level at which coefficient is significant

the residuals from a model without these quadratic terms. This also improved the fit of the estimated equation.

The log of direct round trip distance (LRDIST) was significant (α = .05), with a negative coefficient, for the *all visitor* and *local/regional* visitor categories. Other significant variables (α = .05) for these two visitor categories included population (POP), square of population (POP^2), per capita income (PCI), and square of per capita income(PCI^2). For the *local visitor* category, population (POP) and square of population (POP^2) were significant (α = .05). The log of direct round trip distance (LRDIST) was significant (α = .10), with a negative coefficient for this category. The measure of place-dependence was not significant in any of the equations. The adjusted R^2 ranged from .60 to .77. From the second-stage demand curve, the estimates of consumers' surplus ranged from $68 per person to $5021 per person per trip (Table 8). The minimum estimate was for the *local visitor* category (origins < 100 miles from SNP), while the maximum was for the *all visitor* category.

b) Case #2 Because a visitor may have indicated that SNP was a primary destination, yet also could have stopped at other sites on the trip, Assumption #1 was analyzed using the total round trip miles (includes distance between all stops made on the visitor's trip). The parameter estimates for the Case #2 first-stage demand curve are presented in Table 9 for the three visitor categories. The log of total round trip distance (LDIST) was significant (α = .05), with a negative coefficient, for the *all visitor* and *local/regional* visitor categories. Other significant variables (α = .05) for these two categories were population (POP), square of population (POP^2), per capita income (PCI), and square of per capita income (PCI^2). For the *local* visitor category, population (POP) was significant (α = .05). Adjusted R^2 ranged

Table 9. Travel Cost Model Estimates: Assumption #1 (Case #2)
(Only visitors that indicated Shenandoah National Park (SNP) was a primary destination are used in the analyses)[a]

First-Stage Parameter Estimates

Visitor Category	Dependent Variable: Log(trips per capita) Intercept	LDIST[b]	POP	$(POP)^2$	PCI	$(PCI)^2$	DEPEND	Adj. R^2	F-value	Predicted no. of trips (actual)
All Visitors[c]	-7.2773 (.0001)[d]	-.4362 (.0001)	$-2.22*10^{-6}$ (.0001)	$2.18*10^{-13}$ (.0001)	$-6.84*10^{-5}$ (.0022)	$7.13*10^{-10}$ (.0004)	.0068 (.7200)	.73	73.72	269 (282)
Local/Regional Visitors	-5.2834 (.0005)	-.5351 (.0001)	$-4.06*10^{-6}$ (.0001)	$1.294*10^{-12}$ (.0003)	$-2.44*10^{-4}$ (.0670)	$6.75*10^{-9}$ (.0431)	-.0056 (.8031)	.74	45.07	173 (200)
Local Visitors	-3.5236 (.2672)	-.3868 (.1039)	$-1.02*10^{-5}$ (.0018)	$9.45*10^{-12}$ (.0136)	$-4.41*10^{-4}$ (.1625)	$1.15*10^{-8}$ (.1249)	-.0362 (.4006)	.59	7.96	85 (100)

Second-Stage Consumers' Surplus Estimates ($/person/trip)

All: $4937
Local/Regional: $3426
Local: $275

[a] Travel cost based on total round trip distance, includes distance between all stops made on trip
[b] LDIST = Log(total round trip distance)
POP = population
PCI = per capita income
DEPEND = measure of place-dependence
[c] *All*: All visitors
Local/Regional: origins < 350 miles from SNP
Local: origins < 100 miles from SNP
[d] Probability level at which coefficient is significant

from .59 to .74. The estimates of consumers' surplus from the second-stage ranged from $275 to $4937 per person per trip (Table 9). In Case #2, the consumers' surplus estimates are much higher for the *local/regional* and *local* visitor categories, than in Case #1 (where travel distance is based on direct round trip distance for primary destination visitors). These higher estimates suggest that, even though visitors indicated on the survey that SNP was a primary destination, other stops were made by some of the visitors, especially those visitors from areas close to the Park. The consumers' surplus estimates varied depending on whether visitors were assumed to have stopped only at SNP, because they indicated on the survey that SNP was the primary destination, or whether they actually stopped at other sites on their trips.

<u>c) Case #3</u> Because of the divergent consumers' surplus estimates in Cases #1 and #2, Assumption #1 was analyzed using just those visitors who stopped only at SNP (i.e., a single destination trip was made). The parameter estimates for the Case #3 first-stage demand curve are presented in Table 10 for the three visitor categories. Similar results for the first-stage estimation were found in this case as when primary destination visitors (Case #1) were used. The log of round trip direct distance (LRDIST) was significant ($\alpha = .05$), with a negative coefficient, for the *all visitor* and *local/regional* visitor categories. Adjusted R^2 ranged from .69 to .76. The estimates of consumer surplus from the second-stage ranged from $81 to $3687 per person per trip (Table 10).

For the *local/regional* and *local* visitor categories, the consumers' surplus estimates when single destination visitors were used are higher than when those who indicated that SNP was a primary destination were used (Assumption #1, Case #1: $68-$382). A wide range of

Table 10. Travel Cost Model Estimates: Assumption #1 (Case #3)
(Only visitors that stopped at Shenandoah National Park (SNP) are used in the analyses)[a]

First-Stage Demand Parameter Estimates

Visitor Category	Intercept	LRDIST[b]	POP	$(POP)^2$	PCI	$(PCI)^2$	DEPEND	Adj. R^2	F-value	Predicted no. of trips (actual)
	Dependent Variable: Log(trips per capita)									
All Visitors[c]	-5.723 (.0011)[d]	-.473 (.0001)	$-2.926*10^{-6}$ (.0001)	$2.845*10^{-13}$ (.0001)	$-2.71*10^{-4}$ (.0871)	$6.774*10^{-9}$ (.0862)	.0698 (.5656)	.75	37.72	126 (134)
Local/Regional Visitors	-6.034 (.0012)	-.441 (.0001)	$-7.062*10^{-6}$ (.0001)	$4.042*10^{-12}$ (.0001)	$-2.21*10^{-4}$ (.1875)	$6.81*10^{-9}$ (.1031)	-.026 (.8357)	.76	32.30	109 (118)
Local Visitors	-4.064 (.2726)	.273 (.4053)	$-1.024*10^{-5}$ (.0101)	$8.627*10^{-12}$ (.0558)	$-5.14*10^{-4}$ (.2795)	$1.291*10^{-8}$ (.2271)	.1834 (.6550)	.69	9.78	59 (69)

Second-Stage Consumers' Surplus Estimates ($/person/trip)

All: $3687
Local/Regional: $905
Local: $81

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[a] Travel cost based on direct round trip distance between origin and SNP
[b] LRDIST = Log(direct round trip distance)
POP = population
PCI = per capita income
DEPEND = measure of place-dependence
[c] *All*: All visitors
Local/Regional: origins < 350 miles from SNP
Local: origins < 100 miles from SNP
[d] Probability level at which coefficient is significant

consumers' surplus estimates resulted from eliminating visitors with origins of varying distances from the site. However, when visitors who indicated that SNP was a primary destination, yet made multiple destination trips, were eliminated from the analyses (Case #3), the direction of change in the estimates was not consistent in each visitor origin category. The estimate when *all* single destination visitors were included ($3687) is less than when *all* primary destination visitors were included (Assumption #1, Case #1: $5021); but the reverse was true for the other two visitor categories, *local/regional* and *local* visitors (Assumption #1, Case #1: $68-$382). Thus the practice of eliminating from the analysis visitors whose origin is a great distance from the site, because those visitors are assumed to make multiple destination trips, may lower the estimates of consumer surplus. However, the researcher should question whether or not visitors stopped at only one site just because they indicated on a survey that the site was a primary destination. In fact, different consumers' surplus estimates may result when the following factors are varied: 1) distance between visitor origin to site and 2) assumptions about primary/secondary destination visitors. That is, eliminating visitors whose origin is greater than a certain distance from the site does not necessarily imply that the remaining visitors made single destination trips. Even if the visitors indicated that the site was their primary destination, other stops could still have been made. The effects of these factors will cause estimates of consumers' surplus to vary.

3. Assumption #2

Assumption #2 is that all visitors in each visitor origin category are used in the TCM estimation, and these visitors are assumed to be primary destination visitors. Two cases are analyzed under this assumption:

1. Direct round trip distance is used as the measure of travel distance;

2. Total round trip distance is used as the measure of travel distance.

a) Case #1 Case #1 uses the direct round trip distance (distance from origin to SNP and back to the origin) as a measure of travel distance. The parameter estimates for the Case #1 first-stage demand curve are presented in Table 11 for the three visitor categories -- *all visitors, local/regional visitors (origins < 350 miles from SNP), and local visitors (origins < 100 miles from SNP).* Again, a semi-log functional form was used, where the log of trips per capita is the dependent variable. Independent variables included: natural log of direct round trip distance (distance from origin to SNP and back to the origin), population, square of population, per capita income, square of per capita income, and measure of place-dependence. The results for the first-stage estimation were similar to those in Assumption #1. The log of direct round trip distance (LRDIST) was significant (α = .05), with a negative coefficient, for the *all visitor* and *local/regional* visitor categories. Other significant variables (α = .05) for these two visitor categories included population (POP), square of the population (POP^2), and square of per capita income (PCI^2). Per capita income (PCI) was significant (α = .05) in the *all visitor* category. The log of direct round trip distance (LRDIST) was also significant (α = .05), with a negative coefficient, for the *local* visitor category. Adjusted R^2 ranged from .34 to .69, the lowest being for the *local* visitor category. From the second-stage demand curve, the estimates of consumers' surplus ranged from $74 per person to $5059 per person per trip (Table 11). The minimum estimate was for the *local visitor* category (origins < 100 miles from SNP), while the maximum was for the *all visitor* category. These estimates are not very different from Assumption #1, where only visitors who indicated that SNP was a primary destination were included in the analysis (estimates from Assumption #1, Case #1 ranged from

Table 11. Travel Cost Model Estimates: Assumption #2 (Case #1)
(All visitors included in each category, assumed to be primary destination visitors)[a]

First-Stage Parameter Estimates

Dependent Variable: Log(trips per capita)

	Intercept	LRDIST[b]	POP	(POP)^2	PCI	(PCI)^2	DEPEND	Adj. R^2	F-value	Predicted no. trips (actual)
All Visitors[c]	-7.2761 (.0001)[d]	-.4670 (.0001)	$-2.047*10^{-6}$ (.0001)	$2.121*10^{-13}$ (.0001)	$-4.6541*10^{-5}$ (.0113)	$5.398*10^{-10}$ (.0012)	$3.21*10^{-4}$ (.9867)	.67	93.39	535 (582)
Local/Regional Visitors	-5.1452 (.0001)	-.7015 (.0001)	$-3.062*10^{-6}$ (.0001)	$8.639*10^{-13}$ (.0015)	$-1.63*10^{-4}$ (.0941)	4.71610^{-9} (.0458)	-.0065 (.7514)	.69	53.74	329 (400)
Local Visitors	-4.0886 (.1372)	-.4742 (.0268)	$-5.367*10^{-6}$ (.0592)	$4.888*10^{-12}$ (.1598)	$-4.05*10^{-4}$ (.1319)	$1.169*10^{-8}$ (.0748)	-.0254 (.4889)	.34	4.22	189 (200)

Second-Stage Consumers' Surplus Estimates ($/person/trip)

All: $5059
Local/Regional: $340
Local: $74

[a] Travel cost based on direct round trip distance between origin and SNP
[b] LRDIST = Log(direct round trip distance)
POP = population
PCI = per capita income
DEPEND = measure of place-dependence
[c] *All*: All visitors
Local/Regional: origins < 350 miles from SNP
Local: origins < 100 miles from SNP
[d] Probability level at which coefficient is significant

$68 to $5021 per person). Eliminating from the Assumption #2 analysis those visitors whose origin was a great distance away resulted in lower estimates of consumers' surplus.

b) Case #2 For comparison, the log of visitors' total round trip distance (including the distance between all stops on the trip) was used as an independent variable in another first-stage demand estimation, as opposed to using log of direct round trip distance. The parameter estimates are presented in Table 12. The results are similar to previous cases: the distance variable (LDIST) is significant (α = .05), with a negative coefficient, for the *all visitor* and *local/regional* visitor categories. Population (POP) and square of population (POP^2) are also significant (α = .05) in these two categories. For the *local* visitor category, only population (POP) is significant (α = .05). Adjusted R^2 ranged from .25 to .65, the lowest being for the *local* visitor category.

From the second-stage demand curve, the estimates of consumers' surplus ranged from $485 per person to $8249 per person per trip (Table 12). The minimum estimate was for the *local visitor* category, while the maximum was for the *all visitor* category. These estimates are much higher than when visitors are assumed to travel only to SNP (Assumption #2, Case #1: $74-$5059 per person). The estimates are also higher than when only those visitors that stopped at SNP (single destination visitors) are included in the analysis, presented above in Assumption #1, Case #3 ($81-$3687 per person). The effect of eliminating visitors whose origin is a great distance from SNP is similar to previous cases. If a researcher includes all respondents in the TCM analysis, the assumption that all respondents are primary destination visitors (i.e., distance from origin to the site and back to the origin is used for all

Table 12. Travel Cost Model Estimates: Assumption #2 (Case #2)
(All visitors included in each category, assumed to be primary destination visitors)[a]

First-Stage Parameter Estimates

Visitor Category	Dependent Variable: Log(trips per capita) Intercept	LDIST[b]	POP	$(POP)^2$	PCI	$(PCI)^2$	DEPEND	Adj. R^2	F-value	Predicted # trips (actual)
All Visitors[c]	-7.466 (.0001)[d]	-0.448 (.0001)	$-2.07*10^{-6}$ (.0001)	$2.13*10^{-13}$ (.0001)	$-3.34*10^{-5}$ (.0751)	$4.31*10^{-10}$ (.0114)	0.005 (.8081)	.65	84.13	529 (9%)
Local/Regional Visitors	-6.465 (.0001)	-0.539 (.0001)	$-3.32*10^{-6}$ (.0001)	$9.78*10^{-13}$ (.0011)	$-1.10*10^{-4}$ (.2989)	$3.76*10^{-9}$ (.1450)	0.006 (.8079)	.63	40.87	317 (21%)
Local Visitors	-4.561 (.1358)	-0.187 (.3989)	$-6.48*10^{-6}$ (.0388)	$6.15*10^{-12}$ (.1051)	$-4.62*10^{-4}$ (.1080)	$1.28*10^{-8}$ (.0699)	-0.036 (.3529)	.25	3.02	187 (7%)

Second-Stage Consumers' Surplus Estimates ($/person/trip)

All: $8249
Local/Regional: $2827
Local: $485

[a] Travel cost based on total round trip distance, includes distance between all stops made on trip
[b] LDIST = Log(total round trip distance)
POP = population
PCI = per capita income
DEPEND = measure of place-dependence
[c] *All*: All visitors
Local/Regional: origins < 350 miles from SNP
Local: origins < 100 miles from SNP
[d] Probability level at which coefficient is significant

visitors) may be invalid, and may result in very different consumers' surplus estimates than if the total mileage travelled by the visitors is used.

4. Assumption #3

Assumption #3 is that all visitors in each visitor origin category are used and travel decisions are assumed to be based on the marginal travel distance between the stop preceding SNP and the stop following SNP, the difference between the travel distance from the stop immediately before SNP to the Park to the stop immediately after SNP and the shortest distance between the stops immediately before and after SNP (one approach suggested by Haspel and Johnson). Two cases are analyzed under this assumption:

1. All visitors are used in the analysis, and the distance measure is the marginal travel distance;
2. Only multiple destination visitors are used in the analysis, and the distance measure is the marginal travel distance.

<u>a) Case #1</u> In Case #1 all visitors are used in the analysis. The parameter estimates for the Case #1 first-stage demand curve are presented in Table 13 for the three visitor categories -- *all visitors, local/regional visitors (origins < 350 miles from SNP), and local visitors (origins < 100 miles from SNP).* Again, a semi-log functional form was used, where the log of trips per capita is the dependent variable. Independent variables included: log of marginal trip distance, population, square of population, measure of place-dependence, and the average number of stops on trips made from each origin zone. The log of marginal trip distance (LMDIST) was significant (α = .05), with a negative coefficient, for the *all* visitor category, but not the other two categories. This indicates that, for many of the local or regional

Table 13. Travel Cost Model Estimates: Assumption #3 (Case #1)
(All visitors in each category included in the analysis)[a]

First-Stage Parameter Estimates

	Dependent Variable: Log(trips per capita)								
	Intercept	LMDIST[b]	POP	$(POP)^2$	DEPEND	# Stops	Adj. R^2	F-value	Predicted no. of trips (actual)
All Visitors[c]	-10.037 (.0001)[d]	-.1224 (.0188)	$-2.414*10^{-6}$ (.0001)	$2.463*10^{-13}$ (.0001)	.0237 (.2803)	-.1105 (.0005)	.55	68.92	525 (582)
Local/Regional Visitors	-9.5853 (.0001)	-.1163 (.1319)	$-3.492*10^{-6}$ (.0001)	$9.830*10^{-13}$ (.0014)	.0167 (.4552)	-.1572 (.0019)	.51	30.98	307 (400)
Local Visitors	-9.975 (.0001)	.1122 (.6071)	$-7.941*10^{-6}$ (.0091)	$8.288*10^{-12}$ (.0292)	.0042 (.8682)	.0372 (.8392)	.15	2.27	165 (200)

Second-Stage Consumers' Surplus Estimates ($/person/trip)

All:	$1422
Local/Regional:	$633
Local:	$127

[a] Travel cost based on marginal trip distance
[b] LMDIST = Log(direct round trip distance)
POP = population
DEPEND = measure of place-dependence
# Stops = Average number of stops on trip
[c] *All*: All visitors
Local/Regional: origins < 350 miles from SNP
Local: origins < 100 miles from SNP
[d] Probability level at which coefficient is significant

visitors, the distance to SNP may not be a major factor in their decision to visit the Park. Population (POP) and square of population (POP^2) were significant (α = .05) for all three visitor categories. The average number of stops (# STOPS) made on an individual's trip was significant (α = .05), with a negative coefficient, for the *all visitor* and *local/regional* visitor categories. This suggests that there were fewer trips to SNP which included a large number of stops. Adjusted R^2 ranged from .15 to .55, the lowest being for the *local* visitor category.

From the second-stage demand curve, the estimates of consumers' surplus ranged from $127 per person to $1422 per person per trip (Table 13). The minimum estimate was for the *local visitor* category, while the maximum was for the *all visitor* category. Again, the elimination of visitors whose origin was a great distance from the site resulted in lower estimates of consumers' surplus.

b) Case #2 For comparison, the effects of the marginal travel distance measure was analyzed for only multiple destination visitors. The multiple destination visitors may have based their decision to visit SNP on how far out of the way they had to go on their trip in order to stop at SNP, while single destination visitors only had to choose to either visit SNP or not to visit SNP. The parameter estimates for the Case #2 first-stage demand curve are presented in Table 14 for the three visitor categories. Again, a semi-log functional form was used, where the log of trips per capita is the dependent variable. Independent variables included: log of marginal trip distance, population, square of population, measure of place-dependence, and the average number of stops on trips made from each origin zone. The log of marginal trip distance (LMDIST) was significant (α = .05), with a negative coefficient, for

Table 14. Travel Cost Model Estimates: Assumption #3 (Case #2)
(Only Multiple Destination visitors in each category included in the analyses)[a]

First-Stage Parameter Estimates

	Dependent Variable: Log(trips per capita)								
	Intercept	LMDIST[b]	POP	$(POP)^2$	DEPEND	# Stops	Adj. R^2	F-value	Predicted no. of trips (actual)
All Visitors[c]	-10.4265 (.0001)[d]	-.1360 (.0212)	$-2.33*10^{-6}$ (.0001)	$2.33*10^{-13}$ (.0001)	.0260 (.2137)	-.0352 (.2843)	.57	65.75	525 (448)
Local/Regional Visitors	-9.7049 (.0001)	-.2541 (.0063)	$-3.16*10^{-6}$ (.0001)	$8.40*10^{-13}$ (.0042)	.0189 (.3616)	-.0518 (.3082)	.54	28.43	307 (282)
Local Visitors	-11.398 (.0001)	.3562 (.1625)	$-7.72*10^{-6}$ (.0089)	$8.14*10^{-12}$ (.0240)	.0188 (.4060)	.1544 (.3166)	.23	2.76	165 (129)

Second-Stage Consumers' Surplus Estimates ($/person/trip)

All: $648
Local/Regional: $469
Local: $50

[a] Travel cost based on marginal trip distance
[b] LMDIST = Log(direct round trip distance)
POP = population
DEPEND = measure of place-dependence
# Stops = Average number of stops on trip
[c] *All*: All visitors
Local/Regional: origins < 350 miles from SNP
Local: origins < 100 miles from SNP
[d] Probability level at which coefficient is significant

the *all visitor* and the *local/regional* visitor categories. Adjusted R^2 ranged from .23 to .57, the lowest being for the *local* visitor category.

From the second-stage demand curve, the estimates of consumers' surplus ranged from $50 per person to $648 per person per trip (Table 14). The minimum estimate was for the *local visitor* category, while the maximum was for the *all visitor* category.

Again, the elimination of visitors whose origin was a great distance from the site resulted in lower estimates of consumers' surplus. These estimates of consumers' surplus are lower than when all visitors are included in the analysis and assumed to make decisions based on marginal distance (Assumption #3, Case #1: $127-$1422 per person). This suggests that multiple destination visitors may hold a lower value for the stop at SNP than single destination visitors, <u>if</u> it is assumed that visitors make their travel destination decisions as purely marginal, independent, decisions. That is, the decision to visit SNP is assumed to be independent of the decision to stop at another site on the trip. This will be discussed further in the summary of this chapter.

5. Assumption #4

Assumption #4 is that all visitors in each visitor origin category are used, but the TCM estimation is based on a system of demand equations (the approach suggested by Mendelsohn *et al.*). Under this assumption, two cases are analyzed: 1) *all* visitors are used in the analysis and 2) *local/regional* visitors are used in the analysis. Of all 1807 visitors who responded completely to the survey, 124 cities and attractions were visited in the 10 counties surrounding Shenandoah National Park (Albemarle, Augusta, Greene, Madison, Nelson, Page, Rappahannock, Rockingham, Shenandoah, and Warren counties) in addition to SNP. A total of 543 cities and attractions were visited outside these 10 counties. Destinations included various wineries, Civil War battlefields, Presidents' homes, other national parks, and Disney World. Of the 582 visitors in the sub-sample, there were 82 other sites and attractions visited in the 10 counties near SNP, and 281 sites visited outside these counties (Appendix D). The sites visited by most of the individuals in the sub-sample were in Virginia (Table 15). The locations of several of the most visited sites in relation to Shenandoah National Park are shown in Figure 3. The three most visited sites by visitors to Shenandoah National Park were Luray Caverns, Monticello, and Washington, DC, resulting in eight possible combinations of sites an individual could visit; i.e., eight equations are estimated in the demand system.

a) Case #1 In Case #1, the demand system is estimated using the *all visitor* category. The demand system parameter estimates and the resultant estimate of consumers' surplus for the *all visitor* category are presented in Table 16. For the *all visitor* category, almost all variables in the system were significant at the $\alpha = .10$ level. All cross-quantity coefficients were negative, indicating the combinations of trip destinations had a substitute relationship. That is, as the marginal willingness to pay for other combinations increases, the quantity of the trip type j decreases.

b) Case #2 In Case #2, the demand system is estimated using the *local/regional* visitor category (origins $<$ 350 miles from SNP). In this category no trips were observed which included SNP, Luray Caverns, Monticello, and Washington, DC, in the same trip. Thus, in this case only seven equations were estimated in the demand system (Table 17). For the *local/regional* visitor category, almost all variables in the system were significant at the

Table 15. Sites Most Often Visited by Shenandoah National Park Visitors

Destinations Outside the Counties Surrounding SNP

City/Attraction, State	# of Trips
Washington, DC	70
Williamsburg, VA	42
Natural Bridge, VA	30
Great Smokey Mountains	18
Harpers Ferry, WV	17
Gettysburg, PA	16
Fredericksburg, VA	15
Virginia Beach, VA	14
Blue Ridge Parkway, (VA and NC)	13
Richmond, VA	13
Lancaster, PA	12
Lexington, VA	12
Roanoke, VA	12
Jamestown, VA	11
Winchester, VA	11
Baltimore, MD	10
Manassas, VA	10
Busch Gardens, VA	9

Destinations in Counties Surrounding SNP

City/Attraction	# of Trips
Luray Caverns	121
Monticello	71
Charlottesville	30
New Market Battlefield	19
University of Virginia	18
Harrisonburg	17
Massanutten Mountain	17
Luray	13
Skyline Caverns	13
Staunton	13
Front Royal	12
Blue Ridge Parkway, Waynesboro	11
George Washington National Forest	7
Shenandoah Caverns	7
Ash Lawn/Highland	6
Endless Caverns	6
Mitchie Taverns	6
Waynesboro	6
Woodrow Wilson Birthplace	6
Museum of Frontier Culture, Staunton	5

Figure 3. Shenandoah National Park and Other Attractions in Viriginia

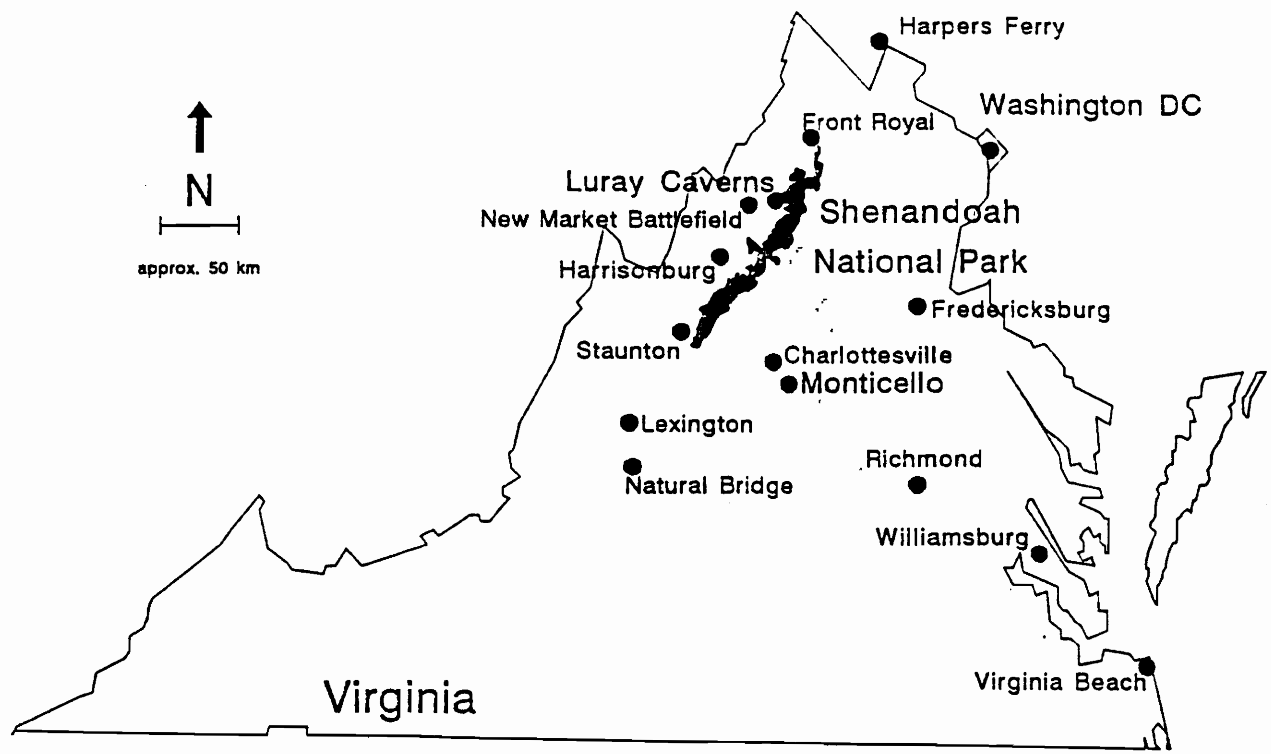


Table 16. Travel Cost Model Estimates: Assumption #4 (Case #1) (Demand system: *All* Visitor data pool)

Independent Variable	Dependent Variable -- Minimum trip distance to:							
	SNP[1]	SNP,LC	SNP,M	SNP,WDC	SNP,LC,M	SNP,LC,WDC	SNP,M,WDC	SNP,LC,M,WDC
Intercept	52.6379 (.0018)[2]	112.3267 (.0009)	117.0272 (.0005)	128.5926 (.0001)	111.4336 (.0002)	132.4320 (.0001)	139.0580 (.0001)	148.2045 (.0001)
SNP (trips per capita)	-5.0096 (.0013)	-9.8844 (.0015)	-10.1026 (.0011)	-10.1418 (.0011)	-8.9096 (.0012)	-10.0748 (.0010)	-10.0990 (.0009)	-10.0053 (.0011)
SNP,LC	-9.8844 (.0015)	-19.6209 (.0016)	-20.2241 (.0011)	-19.1138 (.0018)	-18.1122 (.0010)	-19.2212 (.0017)	-19.3579 (.0015)	-19.3563 (.0016)
SNP,M	-10.1026 (.0011)	-20.2241 (.0011)	-19.0087 (.0022)	-18.8930 (.0021)	-18.8617 (.0007)	-18.8356 (.0021)	-17.9863 (.0033)	-16.3452 (.0091)
SNP,WDC	-10.0418 (.0011)	-19.1138 (.0018)	-18.8930 (.0021)	-17.4702 (.0045)	-16.6564 (.0029)	-17.0163 (.0055)	-16.2668 (.0076)	-18.1735 (.0038)
SNP,LC,M	-8.9096 (.0012)	-18.1122 (.0010)	-18.8617 (.0007)	-16.6564 (.0029)	-16.0528 (.1537)	-16.7260 (.0026)	-17.4649 (.0016)	-16.6317 (.0038)
SNP,LC,WDC	-10.0748 (.0010)	-19.2212 (.0017)	-18.8356 (.0021)	-17.0163 (.0055)	-16.7260 (.0026)	-16.9160 (.0060)	-15.3870 (.0119)	-10.7661 (.1818)
SNP,M,WDC	-10.0990 (.0009)	-19.3579 (.0015)	-17.9863 (.0033)	-16.2668 (.0076)	-17.4649 (.0016)	-15.3870 (.0119)	-14.4712 (.0214)	-20.3143 (.0082)
SNP,LC,M,WDC	-10.0053 (.0011)	-19.3563 (.0016)	-16.3452 (.0091)	-18.1735 (.0038)	-16.6317 (.0038)	-10.7661 (.1818)	-20.3143 (.0082)	-7.2176 (.9864)
# Stops	25.4091 (.0001)	50.7308 (.0001)	51.0537 (.0001)	49.2819 (.0001)	42.4858 (.0001)	49.1243 (.0001)	49.1449 (.0001)	49.3887 (.0001)

Estimated Consumers' Surplus for Shenandoah National Park from Demand System = $77/person/trip

1 SNP = Shenandoah National Park
LC = Luray Caverns
M = Monticello
WDC = Washington DC

2 Probability level at which coefficient is significant

Table 17. Travel Cost Model Estimates: Assumption #4 (Case #2) (Demand system: *Local/Regional* Visitor data pool)

Independent Variable	Dependent Variable -- Minimum trip distance to:						
	SNP[1]	SNP,LC	SNP,M	SNP,WDC	SNP,LC,M	SNP,LC,WDC	SNP,M,WDC
Intercept	30.9957 (.0001)[2]	70.2532 (.0001)	74.3438 (.0001)	85.3560 (.0001)	71.6034 (.0001)	89.9757 (.0001)	96.3560 (.0001)
SNP (trips per capita)	-1.6588 (.0001)	-3.2385 (.0001)	-3.5001 (.0001)	-3.3163 (.0001)	-2.8271 (.0001)	-3.3967 (.0001)	-3.4542 (.0001)
SNP,LC	-3.2385 (.0001)	-6.6799 (.0001)	-7.2492 (.0001)	-6.2594 (.0001)	-5.6828 (.0001)	-6.5240 (.0001)	-6.5917 (.0001)
SNP,M	-3.5001 (.0001)	-7.2492 (.0001)	-5.4431 (.0075)	-5.2886 (.0006)	-6.6162 (.0002)	-5.4692 (.0009)	-4.6108 (.0222)
SNP,WDC	-3.3163 (.0001)	-6.2592 (.0001)	-5.2886 (.0006)	-6.5071 (.0001)	-5.0645 (.0012)	-6.1101 (.0003)	-4.9330 (.0057)
SNP,LC,M	-2.8271 (.0001)	-5.6828 (.0001)	-6.6162 (.0002)	-5.0645 (.0012)	-6.2484 (.1091)	-5.0893 (.0008)	-5.9313 (.0003)
SNP,LC,WDC	-3.3967 (.0001)	-6.5240 (.0001)	-5.4692 (.0009)	-6.1101 (.0003)	-5.0893 (.0008)	-3.8684 (.2942)	-3.4280 (.4138)
SNP,M,WDC	-3.4542 (.0001)	-6.5917 (.0001)	-4.6108 (.0222)	-4.9330 (.0057)	-5.9313 (.0003)	-3.4280 (.4138)	-0.3547 (.9659)
# Stops	6.9575 (.0001)	13.4698 (.0001)	14.4725 (.0001)	12.8962 (.0001)	12.5769 (.0001)	12.7775 (.0001)	13.2640 (.0001)

Estimated Consumers' Surplus for Shenandoah National Park from Demand System = $38/person/trip

[1] SNP = Shenandoah National Park
LC = Luray Caverns
M = Monticello
WDC = Washington DC

[2] Probability level at which coefficient is significant

α = .10 level. All significant cross-quantity coefficients were negative. For each visitor category, the number of stops actually visited on the trip was significant at the α = .05 level.

The estimated consumers' surplus for on site recreation use at SNP for the *all visitor* category was $77 per person per trip. The estimated consumers' surplus for on site recreation use at SNP for the *local/regional* visitor category was $38 per person per trip. Again, the elimination of visitors whose origin was a great distance away from SNP resulted in a lower estimate of consumers' surplus. Further discussion of the estimates of consumers' surplus for this case and a comparison between all cases follows in the next section.

D. Summary of All Cases

Estimates of consumers' surplus for all cases discussed previously are presented in Table 18. As predicted, the marginal distance measure (Assumption #3) produced lower estimates of consumers' surplus than estimates based on the total miles travelled (Assumption #1, Case #2 and Assumption #2, Case #2). In the case of marginal travel distance the economic value of recreation at the site is not based on all costs incurred; the consumers' surplus for the shorter trip should be less than the consumers' surplus for the total trip.

For all visitor categories, the economic value held by multiple destination visitors based on marginal distance ($50-$648 per person) was less than the economic value held by those single destination visitors who only stopped at SNP ($81-$3687 per person), as predicted. Recall from equation 13 of chapter III that consumers' surplus per person arises from the consumers' surplus from single destination and multiple destination visitors, and could possibly be estimated as two distinct terms. As such, a minimum estimate of the

Table 18. Consumers' Surplus Estimates for Assumptions #1 - #4 ($ per person/per trip)

Visitor Origin Category	Assumption #1: Primary destination visitors used in analysis		Assumption #2: All visitors used in analysis		Assumption #3: Marginal distance used in analyses		Assumption #4: Demand system used in analysis	
All visitors: all visitors regardless of distance between origin and the Park	Case #1: distance based on direct round trip mileage[1]	$5021	Case #1: distance based on direct round trip mileage	$5059	Case #1: all visitors used	$1422	Case #1: demand system estimated for all visitors	$77
	Case #2: distance based on total trip mileage	$4937	Case #2: distance based on total trip mileage	$8249	Case #2: only multiple destination visitors used	$648		
	Case #3: distance based on direct round trip mileage, single destination visitors used	$3687						
Local/Regional visitors: visitors whose origins are < 350 miles from the Park	Case #1: distance based on direct round trip mileage	$382	Case #1: distance based on direct round trip mileage	$340	Case #1: all visitors used	$633	Case #2: demand system estimated for local/regional visitors	$38
	Case #2: distance based on total trip mileage	$3426	Case #2: distance based on total trip mileage	$2827	Case #2: only multiple destination visitors used	$469		
	Case #3: distance based on direct round trip mileage, single destination visitors used	$905						
Local visitors: visitors whose origins are < 100 miles from the Park	Case #1: distance based on direct round trip mileage	$68	Case #1: distance based on direct round trip mileage	$74	Case #1: all visitors used	$127		
	Case #2: distance based on total trip mileage	$275	Case #2: distance based on total trip mileage	$485	Case #2: only multiple destination visitors used	$50		
	Case #3: distance based on direct round trip mileage, single destination visitors used	$81						

[1] Direct round trip distance = distance from origin to Park and back to the origin;
Total round trip distance = total distance between origin and all stops on trip and back to the origin;
Marginal distance = difference between: a) the travel distance from the stop immediately before SNP, to the Park entrance, to the stop immediately after SNP and b) the shortest distance between the stops immediately before and after SNP.[1] Direct round trip distance = distance from origin to Park and back to the origin.

average consumers' surplus for recreation use at SNP based on marginal travel distance, weighted by the proportion of visitors who were single destination and multiple destination visitors, could be computed as:

Average consumers' surplus per person = $(SD/TOT*CS_{Single}) + MD/TOT*CS_{Multiple})$

where:
- SD = number of single destination visitors
- MD = number of multiple destination visitors
- TOT = total number of visitors
- CS_{single} = consumers' surplus ($ per person) for single destination visitors, travel distance measure is direct round trip distance
- $CS_{multiple}$ = consumers' surplus ($ per person) for multiple destination visitors, travel distance measure is marginal trip distance

For the three visitor origin categories, the consumers' surplus estimates are:

all visitors: (.23*$3687)+(.77*648) = $1347 per person

local/regional: (.30*$905)+(.70*469) = $600 per person

local: (.35*$81)+(.65*$50) = $61 per person

The equations based on marginal distance did not, however, always produce the minimum consumers' surplus estimates in Assumption #2, where all visitors in each category were assumed to be primary destination visitors. For the *local/regional* and *local visitor* categories, consumers' surplus estimates using direct round trip distance between the origin and the Park ($74-$340 per person) were lower than when marginal distance was used ($127-$633 per person). This occurred because the marginal trip distance could have been greater than the direct round trip distance. For example, several individuals visited several national parks on their trip, including Shenandoah, Grand Canyon, Zion, Bryce, and Yosemite. Their marginal trip was from their origin in the eastern United States to Shenandoah National Park, then to other national parks in the western United States, minus the distance to the next park without going to SNP. For these individuals, the value held for the stop at Shenandoah may have arisen by its inclusion on a trip to several of the national park crown jewels. The marginal trip may have had greater value than a visit to only Shenandoah National Park. This is an example of the possible value of ecotourism on a national scale. That is, the individual may have a greater economic value for the synergy of visiting many national parks on the same trip than the economic value for visiting each park as a single destination trip. It was because individuals may make travel decisions based on choices between packages of all destinations that Mendelsohn *et al.* presented the demand systems approach.

Duplicating the Mendelsohn *et al.* approach in the case of Shenandoah National Park resulted in consumers' surplus estimates ($38-$77) which were much less than for Assumptions #1 through #3. Contrary to the Mendelsohn *et al.* example of Bryce Canyon, consumers' surplus estimates for SNP were lower when multiple destination visitors were included in the analysis than when only primary destination visitors were included in the analysis. It is unclear whether Mendelsohn *et al.* assumed that visitors did not travel to any sites other than the four sites they selected for analysis. For example, if visitors in their study travelled to Bryce Canyon and the Grand Canyon, as well as other sites such as Phoenix, the visitor may have been assumed to only have travelled to Bryce Canyon and Grand Canyon. By doing this, the travel decision is not based on the distance actually travelled by the visitor.

In the demand system estimation used in this study, visitors were classified as taking one of eight destination combinations if their trip included any of the sites of the combination. Recall that the three sites in addition to Shenandoah National Park used in this study were Luray Caverns, Monticello, and Washington, DC. If the visitor travelled to SNP and Disney

World, for example, the visitor was classified as having taken a trip to SNP only. If the visitor travelled to SNP, Monticello, Washington, DC, and Endless Caverns, the visitor was classified as having taken a trip to SNP, Monticello, and Washington, DC. This limitation causes the researcher to assume a visitor had a certain trip experience, with a certain value associated with that experience, when in actuality a different trip experience may have occurred.

For Mendelsohn *et al.*, the situation where visitors stopped at destinations other than the four they chose to examine may have been less common than in Virginia. The great distance between attractions in the western United States may limit the number of destinations individuals visit. However, for this study in the eastern United States, this situation occurred most of the time. There were no identical trips taken by any of the study participants. Thus, if a visitor was classified as having taken one of the eight trip combinations for the demand system estimation, much of their actual trip distance was not accounted for. This limitation also shows the difficulty in defining a substitute for a trip experience. All combinations of certain destinations may not be all that an individual considers when choosing to go on a trip. As previously argued, the individual may have chosen an entirely different region, with different attractions, as a substitute trip. Alternatively, the individual may not have even perceived substitutes to exist for a certain trip experience, and might have stayed home if the desired trip was not available.

Another issue of concern in applied TCM studies is whether visitors whose origin is a great distance from the site should be eliminated from the analysis. This study shows that, regardless of how the distance variable is measured, or whether a single or multiple equation approach is used, consumers' surplus estimates will vary greatly depending on the visitor origin category. In this study, estimates of consumers' surplus were always the smallest for the *local visitor* category, and increased as individuals from further distances away were added. This is true even for the case where only single destination visitors to Shenandoah National Park were used in the analysis, assuming those single destination visitors did not consider any other stops made on their trip as a "destination." For example, if visitors from greater than 350 miles away stopped at other cities (e.g., for lodging), but considered SNP as their only destination, this was indicated on their survey response by leaving the trip itinerary question blank and indicating SNP as their primary destination.

The use of visitors from a great distance away in a TCM analysis is an important issue for attractions which have a national significance. For instance, Shenandoah National Park is a major national park attraction in the East. Of visitors to the Park, 65% are from a state other than Virginia. The states where most visitors reside include, California, Texas, Florida, New York, Pennsylvania, Maryland, and Ohio (Patterson *et al.* 1993). When a site is not of national significance, it may be appropriate to only consider local or regional visitors when determining consumers' surplus. However, for sites with national appeal, there may be a significant number of visitors from a great distance away who do not have other destinations on their trips. Eliminating these visitors from an estimate of value may bias the consumers' surplus estimate.

The estimates in this study ranged from $38 to $8249 per person, a difference of over 200%. This suggests that TCM is extremely sensitive to assumptions about multiple destination visitors. The range of estimates determined in this research provides useful insights for the continued use of TCM, based on previous researchers' suggestions about multiple destination trips. An estimated lower bound of consumers' surplus can be determined using the marginal trip distance. The lower bound based on marginal distance results from the use of only the separable cost of travel, assuming there is no synergy between destinations. The consumers' surplus estimate based on marginal travel distance provides an indication of the *minimum contribution* to the value of an individual's entire trip that can be attributed to a single site on that trip. The manager could then determine if conclusions of a benefit-cost analysis are sensitive to the use of a minimum estimate of consumers' surplus versus using a greater estimate, such as that where actual total distance travelled is used.

The demand system estimation suggested by Mendelsohn *et al.* may be appropriate to use if the manager of a site believes visitors to that site stop at only a few other possible sites on their trips. However, as in the case of sites in the eastern United States, this assumption may be frequently violated.

Chapter VI. CONCLUSIONS

Smith and Kaoru (1990) state that the travel cost method is regarded as a robust methodology for determining an individual's willingness to pay for a non-market recreation resource. In a review of non-market studies, Sorg and Loomis (1984) show a consistency between estimates of consumers' surplus for recreation use. They state (1984, 20), "differences in value that exist can be largely explained by differences in resource quality and relative location from user populations." Smith and Kaoru (1990) suggest that, although TCM is regarded as a robust methodology, the perception should be interpreted cautiously, as TCM estimates are sensitive to several assumptions. They did not, however, address assumptions made about multiple destination visitors. Generalizing TCM values to an entire population, when the population consists of individuals who are different from the visitors used in the analysis, may be inappropriate. That is, generalizing a TCM estimate based on the assumption that all visitors are primary destination visitors may be inappropriate when that assumption is invalid.

Given that TCM consumers' surplus estimates will continue to be used by many managers, this research points out the need to fully consider the different ways to determine the economic value of a recreation site. This study examined multiple destination trips and the economic valuation of recreation sites using TCM. Most researchers currently choose to eliminate from the analysis those visitors that stopped at multiple destinations on their trip, or travelled from greater than a certain distance from the site. Few researchers have attempted to solve the problem of how these multiple destination visitors affect the resultant estimates of consumers' surplus. However, the few that have proposed solutions have drawn varying conclusions about the effects of multiple destination visitors, although each researcher claims that their solution is better than previous solutions.

A basic model is presented in this study to help explain why consumers' surplus estimates may vary, depending on what is assumed about multiple destination visitors. A complete empirical examination of proposed methods for handling multiple destination visitors in TCM was conducted for recreation at Shenandoah National Park. Visitors to this park often come from great distances away and may stop at numerous sites within the area while en route to other destinations.

Results of this study indicate that estimates of consumers' surplus using TCM are very sensitive to assumptions about multiple destination visitors. When visitors who made other stops on their trip were eliminated from the analysis, consumers' surplus estimates ranged from $81 to $3687 per person per trip, depending on whether or not long-distance visitors were included in the analyses. Minimum estimates of consumers' surplus were achieved when the marginal travel distance to the site was used as the basis for determining travel costs, as opposed to using total trip distance as the basis for determining travel costs. These consumers' surplus estimates, based on marginal distance, ranged from $127 to $1422 per person per trip, depending on whether or not long-distance visitors were included in the analyses; and $485 to $8249 per person per trip when total round trip distance was used.

While the demand system approach suggested by Mendelsohn *et al.* may seem more robust, it may not be practical for all sites, especially those recreation sites in the eastern United States where there are many sites in close proximity to each other. The results of this study using a demand system show wide divergence from traditional TCM consumers' surplus estimates. The reason for the differences may be that, for visitors to Shenandoah National Park, hundreds of other sites were visited, and much of the actual travel distance was not accounted for by only choosing a few of these sites to be substitutes in the system. For sites in the western United States, the demand system approach may be appropriate if the manager knows that visitors stop at the same sites on their trips, and there are only a few of these other sites.

This research also illustrates the difficulty of defining a substitute for a multiple destination trip, if in fact any substitutes exist. An issue which deserves attention in the next phase of TCM research is that of determining exactly how visitors choose which sites to visit on their trips and how to integrate a visitor's travel decision making process into TCM. That is, do visitors choose among all sites or combinations of sites in a single process as Mendelsohn *et al.* suggest, or is the decision process more dynamic in nature? Experimental economists and psychologists have shown that learning has an impact on behavior (Schulze and Howe 1985). This may explain why some visitors to NPS sites decide, en route, to visit a particular park or historic monument. Previous experiences at other NPS sites may be remembered with fondness while travelling and trip itineraries may be altered unexpectedly to include a visit to a new NPS site. Or, visitors may face two, possibly inter-related, travel decisions: 1) which region to visit and 2) which destinations in the region, or along the way, to visit. How these decisions affect the individual's value for recreation at a given area needs to be explored. Until these behaviors are better understood and incorporated into non-market valuation methodologies, managers may wish to determine the sensitivity of consumers' surplus estimates for recreation at their sites to assumptions about multiple destination visitors.

This study suggests that TCM may be viewed as an information system, rather than a method to determine a single estimate of value in monetary terms. The travel cost method is capable of providing a manager with information about relative magnitudes of willingness to pay for a resource by a variety of visitor groups. By varying the assumptions about visitors to the site, a manager can determine a range of consumers' surplus estimates to guide in the decision process. If a dollar estimate of value is warranted, then a minimum estimate of consumers' surplus can be determined with TCM by using the marginal distance travelled in the analysis. If a benefit-cost ratio greater than one is achieved using this minimum estimate, then the project could be implemented. However, until more research is conducted on how individuals perceive the role of a single site on a multiple destination trip, and this role can be represented in TCM, the sensitivity of TCM estimates to varying assumptions should be determined. The resultant range of estimates may provide more information to a manager than a single estimate of consumers' surplus. This is because managers may recognize that economic value is only one definition of *value*, and decisions are often based on different types of information about visitors and the *value* they hold for recreation at that site.

Appendix A. Survey Materials

Virginia Tech
VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

Department of Forestry
School of Forestry and Wildlife Resources
Blacksburg, Virginia 24061-0324 USA
(703) 231-5482 FAX (703) 231-3330

Dear Shenandoah National Park Visitor:

Thank you for agreeing to participate in this study. As you know, Shenandoah National Park/Skyline Drive is a precious resource. It protects a natural landscape and is the home of deer, bear, bobcat, turkey and other wild animals. It also preserves remnants of our pioneer heritage and provides visitors with a wide variety of recreational experiences. Management of this park is a complex task. To assist managers in this process, more information is needed about you, the visitor to the park.

Enclosed is a questionnaire that deals with your use of Shenandoah National Park and the surrounding area, your trip expenses, and the features of the park that are important to you. Because some of the questions explore what you did and saw at the park, please wait until after your visit to complete the survey. However, we request that you respond to the survey as soon after the visit as possible, while the experience is still fresh in your mind.

Because only a sample of park visitors have been selected to participate in the survey, it is important that you take the time to complete the questionnaire if the results are to be representative of all park visitors. When you have finished, please place the questionnaire in the self-addressed, stamped envelope and drop it in the mail. Individuals who complete and return the questionnaire will be entered in a random lottery drawing for a $50.00 US Savings Bond. The winner will be notified by mail in July 1992.

The questionnaire has an identification number for lottery and mailing purposes only. Your response will be held in the strictest confidence. All results will be analyzed in such a way that your answers on any single question cannot be identified with you.

We greatly appreciate your help with this study.

Sincerely,

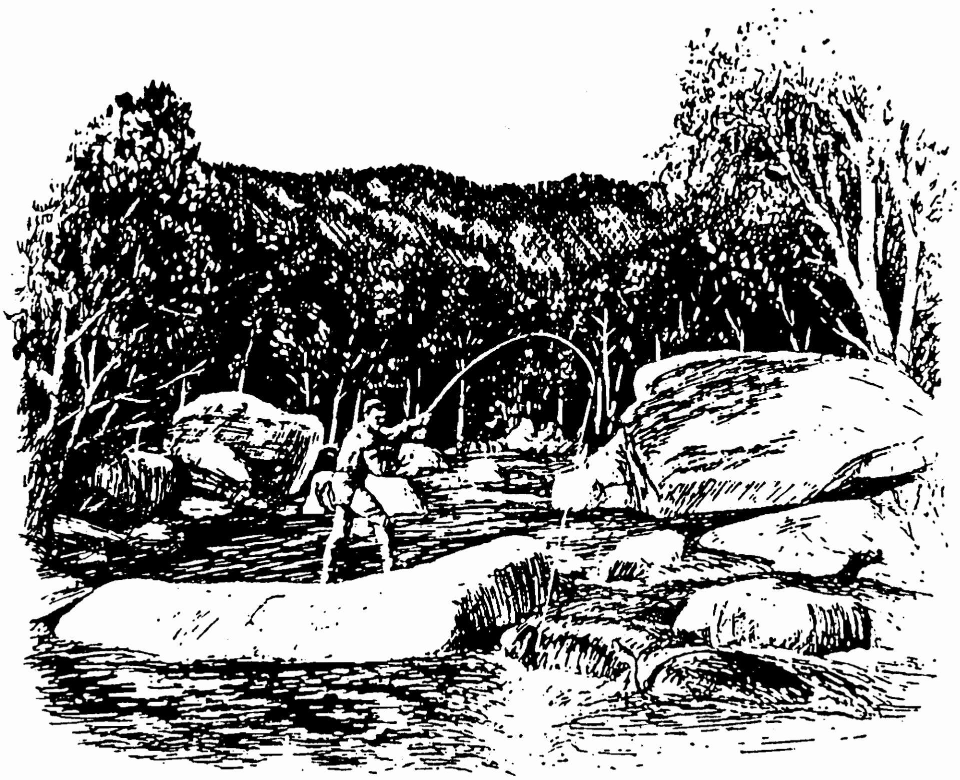
Daniel R. Williams

Daniel R. Williams
Assistant Professor of
Forest Recreation

A Land-Grant University—The Commonwealth Is Our Campus
An Equal Opportunity / Affirmative Action Institution

SHENANDOAH NATIONAL PARK

VISITOR SURVEY 1992



Department of Forestry
Virginia Polytechnic Institute and State University
Blacksburg, Virginia 24061

OMB #10240091 EXP. 2/01/93

Thank you for agreeing to participate in this mail survey. While your participation is voluntary and you are not required to respond, your cooperation is needed to make the survey results comprehensive, accurate, and timely. You may be assured that all responses are confidential, and your answers will not be connected with you.

1. How would you describe the group you were with when you visited Shenandoah National Park/Skyline Drive?

_____ 1. Family
_____ 2. Family and friends
_____ 3. Friends
_____ 4. Organized group (e.g. Boy Scouts, guided tours, etc.)
_____ 5. Alone
_____ 6. Other, please describe:______________________________

2. People come to this park for many different reasons and experiences. In the space below, please state the primary reason for your visit to Shenandoah National Park/Skyline Drive.

____

3. During your stay at the park, about how many times did you exit then return to the park?

_____ Times

4. When did you leave Shenandoah National Park/Skyline Drive for the final time? (Please indicate date, time, and AM or PM.)

__________ Date

__________ Time _____ AM _____ PM

5. Which exit did you use when leaving Shenandoah National Park/Skyline Drive for the final time?

_____ 1. Front Royal (US 340)
_____ 2. Thornton Gap (US 211)
_____ 3. Swift Run Gap (US 33)
_____ 4. Rockfish Gap (I 64)

6. Was Shenandoah National Park/Skyline Drive your primary destination on this trip?

_____ Yes

_____ No

7. How many times per year do you typically visit Shenandoah National Park/ Skyline Drive?

_____ Visits per year

8. How many times per year do you typically visit other areas like Shenandoah National Park/Skyline Drive (e.g. other natural parks, forests, historical areas, etc.)?

_____ Visits per year

9. Which of the following was the most important reason for visiting Shenandoah National Park/Skyline Drive? (Check only one category.)

_____ I went there because I enjoy the place itself

_____ I went there because it is a good place to do the outdoor activities I enjoy

_____ I went there because I wanted to spend more time with my companions

10. Please check the activities you participated in while at Shenandoah National Park/Skyline Drive, and estimate the amount of time you spent participating in each activity. (Please check all that apply.)

	Activity	Time (Hours)
_____	Wildlife Observation/Nature Study	_____
_____	Photography	_____
_____	Spending time in camp (relaxing, camp chores, etc.)	_____
_____	Sightseeing along Skyline Drive	_____
_____	Walking for pleasure	_____
_____	Day hiking	_____
_____	Horseback riding	_____
_____	Exploring visitor centers/displays	_____
_____	Campfire programs/guided walks	_____
_____	Picnicking	_____
_____	Fishing	_____
_____	Bicycling	_____
_____	Other, please describe: ______________________	_____

11. Please indicate whether you agree or disagree with each of the following statements about your recent visit to Shenandoah National Park/Skyline Drive.

	Agree	Disagree
My thoughts focused more on the features of the natural environment than on my companions.	[ ]	[ ]
I found myself thinking more about my activity than the surrounding environment.	[ ]	[ ]
I thought more about my companions than the activity.	[ ]	[ ]
I spent more time talking to my companions than exploring my surroundings.	[ ]	[ ]
More of my time was spent engaged in my activities than interacting with members of my group.	[ ]	[ ]
I spent more time studying the natural environment than participating in any one activity.	[ ]	[ ]
Frequently stopping to examine the environment in detail would have interfered with my activities.	[ ]	[ ]
I learned more about my companions than the surrounding environment.	[ ]	[ ]
Being with my companions was more important to me than the outdoor activities.	[ ]	[ ]
My attention was focused more on the surroundings than on my companions.	[ ]	[ ]
My attention was drawn more to my companions than to the activities I participated in.	[ ]	[ ]
My attention was held more by my outdoor activities and skills than by the surrounding environment.	[ ]	[ ]
Sharing the experience with my companions was more enjoyable than the actual activities I participated in.	[ ]	[ ]
Being in a natural environment was more pleasing than the actual activities I was engaged in.	[ ]	[ ]
Being with my companions was more enjoyable than being in the natural setting.	[ ]	[ ]

12. Please indicate the extent to which each statement below describes your general feelings about Shenandoah National Park/Skyline Drive. (Circle the number that best describes your general feeling about each statement.)

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
This place says a lot about who I am	1	2	3	4	5
I would prefer to spend more time here if I could	1	2	3	4	5
I enjoy doing the type of things I do here more than in any other area	1	2	3	4	5
This place plays a central role in my lifestyle	1	2	3	4	5
I wouldn't substitute any other area for doing the type of things I do here	1	2	3	4	5
I am very attached to this park	1	2	3	4	5
Doing what I do here is more important to me than doing it in any other place	1	2	3	4	5
No other park can compare to this one	1	2	3	4	5
I identify strongly with this park	1	2	3	4	5
The things I do here I would enjoy just as much at another site	1	2	3	4	5
I feel like this park is a part of me	1	2	3	4	5
I think a lot about coming here	1	2	3	4	5
I get more satisfaction out of visiting this park than from visiting any other	1	2	3	4	5
This area is the best place for what I like to do	1	2	3	4	5
I use this park to help define and express who I am inside	1	2	3	4	5

13A. Which of the following best describes how you handled your expenses for your trip to Shenandoah National Park/Skyline Drive?

_____ I paid all my expenses and the expenses of _____ other people (please indicate number of people). (In part B. below, please report all of these expenses.)

_____ I paid all my own expenses. (Please report your expenses in part B. below.)

_____ I shared expenses. (In part B. below, please indicate your personal expenses and your portion of the shared expenses.)

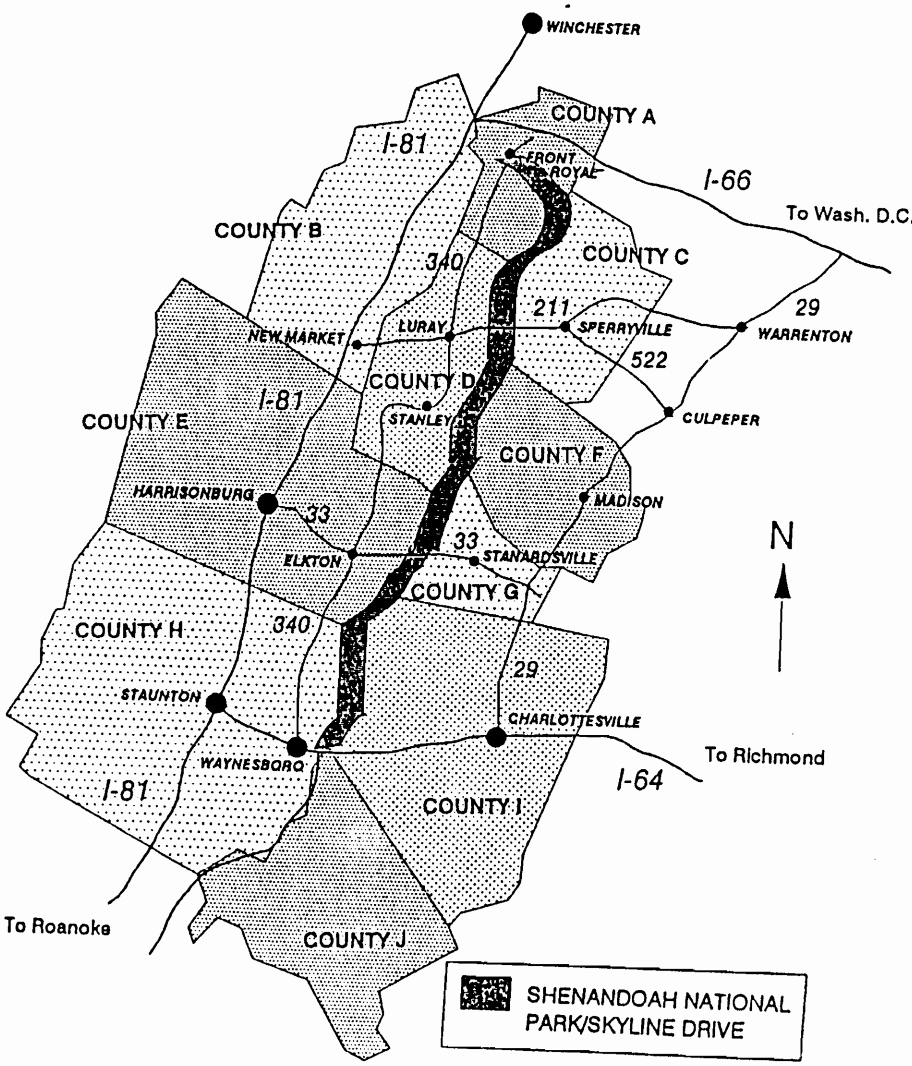
_____ Someone else paid expenses. (Please go to question 15 on the next page).

B. In the spaces below, please list your estimated expenses while on your trip to Shenandoah National Park/Skyline Drive. For each type of expense, please indicate the amount you spent inside the park and the amount you spent in each county surrounding the park. (See the enclosed map for the appropriate county codes.)

	Inside Park	Counties Surrounding the Park (See Enclosed Map)					
TYPE OF EXPENSE	$	$	County Code	$	County Code	$	County Code
Restaurant	____	____	____	____	____	____	____
Food and Beverage in Retail Stores	____	____	____	____	____	____	____
Personal Items, Film and Developing, Souvenirs	____	____	____	____	____	____	____
Lodging Expenses							
Hotel/Motel/Cabin	____	____	____	____	____	____	____
Bed and Breakfast	____	____	____	____	____	____	____
Camping	____	____	____	____	____	____	____
Auto Expenses							
Gas and Oil	____	____	____	____	____	____	____
Repairs and Service	____	____	____	____	____	____	____
Car Rental and Parking	____	____	____	____	____	____	____
Other Transportation (e.g. Taxis, Local Tours, etc.)	____	____	____	____	____	____	____
Entrance Fees	____	____	____	____	____	____	____
Fees for Other Attractions and Entertainment	____	____	____	____	____	____	____
Rental Fees for Horses, Bikes, etc.	____	____	____	____	____	____	____
Other Expenses. Please Specify.							
____________	____	____	____	____	____	____	____
____________	____	____	____	____	____	____	____

COUNTY CODES

County A	= Warren	County F	= Madison
County B	= Shenandoah	County G	= Greene
County C	= Rappahannock	County H	= Augusta
County D	= Page	County I	= Albemarle
County E	= Rockingham	County J	= Nelson



14. Please estimate the total amount spent on restaurants, food, lodging, travel (airfare, busfare, gas, etc.), gifts/souvenirs, and fees for the entire trip from the time you left home until the time you returned home. (If you shared expenses, please report your personal expenses and your portion of the shared expenses.)

$ ________

15A. Please list other attractions (e.g Luray Caverns, other parks, relatives, etc.) *within* the counties surrounding Shenandoah National Park (see enclosed map) that you visited during *this* trip to Shenandoah National Park.

Attraction	City/County	Date
________________	____________	______
________________	____________	______
________________	____________	______
________________	____________	______
________________	____________	______

B. Please list destinations *outside* of the surrounding counties (e.g. cities, other parks, relatives, etc.) that you visited during *this* trip to Shenandoah National Park. If you visited more than 5 other destinations, list only the 5 *closest* to Shenandoah National Park.

Destination	City/State	Date
________________	____________	______
________________	____________	______
________________	____________	______
________________	____________	______
________________	____________	______

16. Shenandoah National Park spends over $100,000 a year picking up trash and transporting it to local landfills. The park could reduce this cost if visitors were to take more of their trash home. One way to encourage visitors to take out more trash is to reduce the number of trash receptacles at overlooks and other areas. Would you favor or oppose this action?

_____ Favor

_____ Oppose

17. To what extent do each of the following statements describe the way you experienced Shenandoah National Park/Skyline Drive? (Circle the number that best describes how you feel about each statement.)

	A lot like me	Somewhat like me	A little like me	Not like me	Not at all like me
I spent much of my time studying the details of nature (e.g. behavior of animals, geologic features).	1	2	3	4	5
When viewing scenery at the park I found that I often became lost in my imagination.	1	2	3	4	5
I had a fairly specific idea about the things I wanted to see and do at the park.	1	2	3	4	5
I was deeply moved by the scenic landscapes in the park.	1	2	3	4	5
I tried to learn more about the cultural/ natural history of Shenandoah during my visit.	1	2	3	4	5
I was primarily interested in the park as a place to participate in a specific activity.	1	2	3	4	5
When I saw wild animals, I felt a sense of mystery and excitement.	1	2	3	4	5
I enjoyed carefully exploring the details of the park.	1	2	3	4	5
During my visit to the park, I tried to follow a carefully laid out plan.	1	2	3	4	5
During my visit to the park, I really felt like a part of nature.	1	2	3	4	5
An important part of the visit was getting caught up in the atmosphere of the park.	1	2	3	4	5
As I visited sites in the park, I tended to rate them with respect to how good they were for my favorite activities.	1	2	3	4	5
The vistas/views in the park looked a lot alike.	1	2	3	4	5
I frequently concentrated on specific features of the setting.	1	2	3	4	5
If it had not been possible to participate in my primary activity, I would not have visited the park on this trip.	1	2	3	4	5

18. Below is a list of items that may affect the quality of your recreational experience at Shenandoah National Park/Skyline Drive. *On the left* please circle the number that indicates the extent to which each item would add to or detract from your experience. *On the right*, please circle the number that indicates the extent to which you felt each characteristic was evident during your visit to the park.

Effect on Experience: Detracts Greatly	Detracts Somewhat	Neither Adds Nor Detracts	Adds Somewhat	Adds Greatly		Level of Characteristic During Visit: Not at all Noticeable	Somewhat Noticeable	Moderately Noticeable	Very Noticeable	Extremely Noticeable
1	2	3	4	5	Presence of air pollution	1	2	3	4	5
1	2	3	4	5	Residential development visible from the park	1	2	3	4	5
1	2	3	4	5	Presence of wildlife	1	2	3	4	5
1	2	3	4	5	Dead/defoliated trees	1	2	3	4	5
1	2	3	4	5	Noise originating inside the park (from cars, other visitors, etc.)	1	2	3	4	5
1	2	3	4	5	Presence of litter	1	2	3	4	5
1	2	3	4	5	Erosion and vegetation loss along trails	1	2	3	4	5
1	2	3	4	5	Traffic congestion on Skyline Drive	1	2	3	4	5
1	2	3	4	5	Presence of haze	1	2	3	4	5
1	2	3	4	5	Crowding along hiking trails	1	2	3	4	5
1	2	3	4	5	Clear directional signs	1	2	3	4	5
1	2	3	4	5	Trees damaged by visitors (e.g. initials or names carved in bark)	1	2	3	4	5
1	2	3	4	5	Conflicts with other visitors	1	2	3	4	5
1	2	3	4	5	Poor visibility	1	2	3	4	5
1	2	3	4	5	Crowding at visitor centers	1	2	3	4	5
1	2	3	4	5	Presence of birds	1	2	3	4	5
1	2	3	4	5	A wide variety of wild animals	1	2	3	4	5
1	2	3	4	5	Noise originating outside the park	1	2	3	4	5
1	2	3	4	5	Interpretive signs at overlooks and historic sites	1	2	3	4	5
1	2	3	4	5	Mowing along roadsides	1	2	3	4	5

19. What year were you born?

19_____

20. What is your gender?

_____ Male

_____ Female

21. What is the highest educational level you have attained? (Please circle the highest grade you completed.)

1 2 3 4 5 6 7 8	9 10 11 12	13 14 15 16	17+
Primary School	High School	College	Graduate Work

22. Which of the following describes your present employment status? (Please check only one.)

_____ 1. Employed, full time

_____ 2. Employed, part time

_____ 3. Unemployed

_____ 4. Homemaker

_____ 5. Student

_____ 6. Retired

23. Which of the following income levels describes your total household income before taxes?

[ ] Less than $10,000

[ ] $10,000 to $19,999

[ ] $20,000 to $29,999

[ ] $30,000 to $39,999

[ ] $40,000 to $49,999

[ ] $50,000 to $59,999

[ ] $60,000 to $69,999

[ ] $70,000 to $79,999

[ ] $80,000 to $89,999

[ ] $90,000 to $99,999

[ ] $100,000 or more

Thank you for your time and effort. We appreciate your willingness to respond to our questionnaire and welcome any comments you wish to make. We have provided the space below for your convenience.

16 U.S.C. la-7 authorizes collection of this information. This information will be used by park managers to better serve the public. Response to this request is voluntary. No action may be taken against you for refusing to supply the information requested. Your name is requested for follow-up mailing purposes only. When analysis of the questionnaire is completed, all name and address files will be destroyed. Thus, the permanent data will be anonymous. Please do not put your name or that of any member of your group on the questionnaire. Data collected through visitor surveys may be disclosed to the Department of Justice when relevant to litigation or anticipated litigation, or to appropriate Federal, State, local, or foreign agencies responsible for investigating or prosecuting a violation of law.

Public reporting burden for this form is estimated to average 20 minutes per response. Direct comments regarding the burden estimate or any other aspect of this form to the Information Collection Clearance Officer, National Park Service, P.O. Box 37127, Washington, DC 20014-7127; and to the Office of Management and Budget, Paperwork Reduction Project 1024-0091, Washington, DC 20503.

Virginia Tech
VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

Department of Forestry
School of Forestry and Wildlife Resources
Blacksburg, Virginia 24061-0324 USA
(703) 231-5482 FAX (703) 231-3330

Dear Shenandoah National Park Visitor:

During a recent visit to Shenandoah National Park, you were given a questionnaire about your visit to the park. You are one of a few randomly selected visitors to receive the survey. If the results of this survey are to be useful in guiding future decisions about management of the park, your participation is essential.

As a visitor to the park, you may be affected by management actions taken by the National Park Service. The Park Service needs to know the preferences and concerns of the people who will be most directly influenced by management decisions. This study is an opportunity for you to express your personal thoughts and feelings about Shenandoah National Park.

As of today, we have not received your completed questionnaire. If you have not already done so, we encourage you to take a few minutes to complete the questionnaire. We have enclosed another copy of the questionnaire and a self-addressed, stamped envelope in case you have misplaced the survey you received at the park. Remember that individuals who complete and return the questionnaire will be entered in a random lottery drawing for a $50.00 US Savings Bond. The winner will be notified by mail in July 1992.

We greatly appreciate your help with this study.

Sincerely,

Daniel R. Williams
Assistant Professor of
Forest Recreation

Dear Shenandoah National Park Visitor:

It has been over three weeks since you received the "Shenandoah National Park Visitor Survey." As of yet, we have not received your survey. Your help in the study is needed very much.

Because we have contacted only a small number of visitors, it is very important that we get your views. If you have not already done so, please take a few minutes to complete and return the survey. Also, to be eligible for the drawing of the $50.00 US Savings Bond, your completed questionnaire must be received.

I thank you for your cooperation in this study.

Sincerely,

Daniel R. Williams
Assistant Professor, Forest Recreation

Appendix B. Visitor Category Definitions

All visitors:	All visitors, regardless of distance between origin and the Park;
Local/Regional visitors:	Visitors whose origins are < 350 miles from Park
Local visitors:	Visitors whose origins are < 100 miles from Park
Primary Destination visitors:	Visitors who indicated the stop at Park was a primary destination
Secondary Destination visitors:	Visitors who indicated the stop at Park was a secondary destination
Single Destination visitors:	Visitors who stopped only at the Park
Multiple Destination visitors:	Visitors who stopped at several destinations on their trip

Appendix C. SAS Code for Travel Cost Method

```
/*SAS PROGRAM FOR ASSUMPTIONS #1-#3
ADAPTED FROM BITTNER (1991) */

/***                    DATA INPUT                    ******
*                                                          /

OPTIONS LINESIZE=70;
 CMS FILEDEF INPUTS DISK TCM1 ASC A;
 DATA ONE; INFILE INPUTS;
 INPUT PRIM GROUP QNUM STATE $  COUNTY $ & RDIST
 MDIST TOTDIST STOP;
 PROC PRINT DATA=ONE;
 CMS FILEDEF INPUTS DISK TCM2 ASC A;
 DATA TWO;  INFILE INPUTS;
 INPUT QNUM AVGDIST POP PCI EDUC1 EDUC2 AGE DEPEND;

PROC SORT DATA=ONE; BY QNUM;
PROC SORT DATA=TWO; BY QNUM;

DATA TCM;
MERGE ONE TWO; BY QNUM;

TITLE 'ALL DESTINATIONS';

/****          SORTING BY COUNTY                       ******
*              DETERMINES OBSERVATIONS BY ZONES               *
*                                                             /

 DATA TPC; SET TCM;
 RDDIST=RDIST*2;
  PROC SORT; BY STATE COUNTY;
  PROC MEANS NOPRINT;
    VAR RDDIST MDIST TOTDIST STOP AVGDIST POP PCI EDUC1 EDUC2 AGE
    DEPEND;
    BY STATE COUNTY; ID STATE COUNTY;
    OUTPUT OUT=TPC N=TRPCOUNT MEAN= MRDIST MMDIST MTOTDIST
MSTOP
    MAVGDIST MPOP MPCI MEDUC1 MEDUC2 MAGE MDEPEND;
 PROC PRINT DATA=TPC;

/****          DATA TRANSFORMATIONS ****/

 DATA TWO; SET TPC;
      SQPOP=MPOP**2;
      SQPCI= MPCI**2;
```

```
      TPCAP=TRPCOUNT/MPOP;
      LTPCAP = LOG(TPCAP);
      LRDIST = LOG(MTOTDIST);
      OBS=_N_;

/***          CORRELATION ANALYSIS          ******
****                                        ******
****                                        ******/

DATA THREE; SET TWO;

  PROC CORR; VAR TPCAP MRDIST MMDIST MAVGDIST MTOTDIST MPOP MAGE
MDEPEND MPCI MSTOP MEDUC1 MEDUC2;

/****  FIRST-STAGE DEMAND ESTIMATION ******
****                                        ******
****                                        ******/

 DATA THREE; SET TWO;
   PROC REG;
      MODEL LTPCAP = LRDIST MPOP SQPOP MDEPEND MPCI SQPCI
      /COLLIN
    PARTIAL INFLUENCE VIF R;
   OUTPUT OUT=C R=RESID P=PREDICT;

 DATA A; SET C; TPCAP=EXP(PREDICT); TRIP=TPCAP*MPOP;
   PROC MEANS; VAR TRIP; OUTPUT OUT=D SUM=TRIPS;
   PROC PRINT DATA=D; VAR TRIPS;
   PROC PLOT DATA=C;
   PLOT RESID*PREDICT;

/****  SECOND-STAGE DEMAND ESTIMATION ******
****                                        ******
****                                        ******/

/* STEP 1. DETERMINE MAX DISTANCE */

 DATA THREE; SET TWO;
   PROC MEANS; VAR MTOTDIST;OUTPUT OUT=MAX MAX=MAXTDIST;

/* STEP 2. ESTIMATE WITH INCREMENTAL CHANGES IN DISTANCE
          PLUG IN MAX DISTANCE FOR ALPHA
          PLUG IN ESTIMATES FROM FIRST-STAGE DEMAND EQUATION FOR
          ELTPC  */
```

```
DATA TCM1; SET TWO;

  DO I = 0 TO (ALPHA-MTOTDIST) BY 5 UNTIL (TRIPS<.05);
    DIST=MTOTDIST+I;
    LRDIST= LOG(DIST);

    ELTPC = CONSTANT + BETA0*LRDIST + BETA1*MPOP + BETA2*SQPOP
    + BETA3*MDEPEND + BETA4*MPCI + BETA5*SQPCI;
    TRIPS = EXP(ELTPC)*MPOP;
    OUTPUT;
 END;

DATA TCM2; SET TCM1;
PROC SORT; BY I;
   PROC MEANS NOPRINT;
      VAR TRIPS;
      BY I;
      OUTPUT OUT=B SUM=SITRIPS;
   PROC PRINT DATA=B;
       PROC MEANS NOPRINT;
      VAR I SITRIPS;
      OUTPUT OUT=C MAX=MAXI MAXTRIPS MIN=MINI MINTRIPS;
    PROC PRINT DATA=C;

/* CONVERT DISTANCE INCREMENTS TO $
      PLUG IN TRAVEL COST FOR 'COST' */

DATA TCM4; SET B;
  BENI= COST*SITRIPS;

/* STEP 3.  DETERMINE CONSUMERS' SURPLUS **/
      PLUG IN MAXIMUM INCREMENT FOR 'MAXI'**/

DATA TCM5; SET TCM4;
 IF I=0 OR I=MAXI THEN M=1; ELSE M=2;
    MBENI=M*BENI;
PROC MEANS; VAR MBENI; OUTPUT OUT=D SUM=TOTBENS;

DATA TCM6; SET D;
 TOTAL=((MAXI)/(2*((MAXI/5)+1)))*TOTBENS;

/***   PRINT CONSUMERS' SURPLUS ESTIMATE ***/

PROC PRINT; DATA TCM6;
DATA TCM6;
```

Appendix D. Other Sites Visited by Shenandoah National Park Visitors

Destinations Shenandoah National Park visitors in the sub-sample (n=582). Total number of trips to all destinations is greater than 582, as several destinations could be indicated on a visitor's itinerary.

Destinations Outside the Counties Surrounding Shenandoah National Park

City/Attraction, State	# of Trips	City/Attraction, State	# of Trips
Washington, DC	70	Alexandria, VA	3
Williamsburg, VA	42	Atlanta, GA	3
Natural Bridge, VA	30	Blacksburg, VA	3
Great Smokey Mountains, NC	18	Boone, NC	3
Harpers Ferry, WV	17	Charles City, VA	3
Gettysburg, PA	16	Charlotte, NC	3
Fredericksburg, VA	15	Durham, NC,	3
Virginia Beach, VA	14	Grand Canyon NP, AZ	3
Blue Ridge Parkway (entire)	13	Lynchburg, VA	3
Richmond, VA	13	Martinsburg, WV	3
Lancaster, PA	12	Mountain Lake, VA	3
Lexington, VA	12	Nashville, TN	3
Roanoke, VA	12	Seneca Rocks, WV	3
Jamestown, VA	11	Woodbridge, VA	3
Winchester, VA	11	Asheville, NC	2
Baltimore, MD	10	Assateague, VA	2
Manassas, VA	10	Atlantic City, NJ	2
Busch Gardens, VA	9	Beckley, WV	2
Mount Vernon, VA	8	Berkeley Springs, WV	2
Appomattox, VA	7	Biltmore, NC	2
Norfolk, VA	6	Bluegrass, VA	2
Warrenton, VA	6	Brunswick, GA	2
Annapolis, MD	5	Cape Hattaras, NC	2
Antietam, MD	5	Cass, WV	2
Blue Ridge Parkway, NC	5	Chancellorsville, VA	2
Blue Ridge Parkway, VA	5	Cherokee, NC	2
Culpeper, VA	5	Chesapeake Bay-Bridge Tunnel	2
Hershey, PA	5	Chincoteague, VA	2
Montpelier, VA	5	Columbia, SC	2
Arlington National Cemetery, VA	4	Davis, WV	2
Boston, MA	4	Galax, VA	2
Chapel Hill, NC	4	Great Falls, VA	2
Charleston, WV	4	Greensboro, NC	2
Disney World - Orlando, FL	4	Harrisburg, PA	2
Pittsburgh, PA	4	Herndon, VA	2
Yorktown, VA	4	Hot Springs, VA	2

City/Attraction, State	# of Trips
Hungry Mother State Park, VA	2
Longwood, PA	2
Mammoth Caves, KY	2
Memphis, TN	2
Mount Airy, NC	2
New River Gorge, WV	2
Newport News, VA	2
Petersburg, VA	2
Philadelphia, PA	2
Pigeon Forge, TN	2
Reston, VA	2
Saint Augustine, FL	2
Smith Mountain Lake, VA	2
Spruce Knob NRA, WV	2
Stratford Hall, VA	2
Whitepost, VA	2
Wilderness, VA	2
Winston-Salem, NC	2
York, PA	2
Zion NP, UT	2
Acadia, ME	1
Albany, GA	1
Alexandria, KY	1
Allendale, NY	1
Allentown, PA	1
Altavista, VA	1
Anniston, AL	1
Ansted, WV	1
Arches NM, UT	1
Arkadelphia, AR	1
Arlington, VA	1
Ashland, VA	1
Ashville, VA	1
Aurora, WV	1
Backbone Mountain, WV	1
Badlands NP, SD	1
Banner Elk, NC	1
Barboursville, VA	1
Bartow, WV	1
Bath, ME	1
Berlin, OH	1
Bethany Beach, DE	1
Bethesda, MD	1

City/Attraction, State	# of Trips
Beuna Vista, VA	1
Blackwater State Park, WV	1
Bloomsburg, PA	1
Blue Ridge Mountains, NC	1
Blue Ridge Summit, PA	1
Bluefield, WV	1
Booker T. Washington NM, VA	1
Boone, VA	1
Bristol, TN	1
Brooksville, FL	1
Bryans Road, MD	1
Bryce Canyon NP, UT	1
C & O NHP, MD	1
Cambridge, MA	1
Canaan Valley State Park, WV	1
Cape Canaveral, FL	1
Cape Girardeau, MO	1
Cape May, NJ	1
Catskill, NY	1
Chancellorsville, VA	1
Charleston, SC	1
Chattanooga, TN	1
Cherokkee, NC	1
Chester, VA	1
Chicago, IL	1
Chimney Rock, NC	1
Cimarron, CO	1
Cincinnatti, OH	1
Clearwater, FL	1
Clifton Forge, VA	1
Columbia, MD	1
Columbus, OH	1
Conyers, GA	1
Coral Springs, FL	1
Cortez, CO	1
Cumberland Falls, KY	1
Cumberland Gap, VA	1
Danville, VA	1
Dayton, OH	1
Deep Creek Lake State Park, MD	1
Delaware Gap, PA	1
Duck, NC	1
Dunbar Caves, WV	1

City/Attraction, State	# of Trips	City/Attraction, State	# of Trips
Elkins, WV	1	Lake George, NY	1
Eureka Springs, AR	1	Laurinburg, NC	1
Everglades NP, FL	1	Lawton, OK	1
Fairfax, VA	1	Leesburg, VA	1
Fairy Stone State Park, VA	1	Linville, NC	1
Fayetteville, NC	1	Little Rock, AR	1
Fort Belvoir, VA	1	Long Island, NY	1
Fort Lauderdale, FL	1	Lost Run Creek, WV	1
Fort Necessity, PA	1	Loudon, NH	1
Fort Pierce, FL	1	Louisville, KY	1
Fort Pulaski, SC	1	Markham, VA	1
Fort Sumter, SC	1	Marlinton, WV	1
Fort Walton Beach, FL	1	Mathias, WV	1
Fort Worth, TX	1	Media, PA	1
Franklin, VT	1	Middletown, VA	1
Frederick, MD	1	Mobile, AL	1
Fundy NP, New Brunswick Canada	1	Montgomery, AL	1
Gatlinburg, TN	1	Morehead City, NC	1
George Washington Birthplace, VA	1	Morehead, WV	1
Gordonsville, VA	1	Myrtle Beach, SC	1
Gore, VA	1	Natchez Trace Parkway, MS	1
Goshen Pass, VA	1	Nauvoo, IL	1
Great Falls, MT	1	New Orleans, LA	1
Greenville, NC	1	New Smyrna Beach, FL	1
Hadley, PA	1	New York, NY	1
Harrisville, WV	1	Newark, DE	1
Hartford, CT	1	Niagara Falls, NY	1
Haymarket, VA	1	Norfolk, NY	1
Headwaters, VA	1	Oglethorpe, GA	1
Hertford, NC	1	Ohiopyle, PA	1
High Point, NC	1	Orbisonia, PA	1
Hopewell, VA	1	Orlean, VA	1
Huntington Valley, PA	1	Palmyra, NY	1
Hyannis, MA	1	Pasadena, MD	1
Hyde Park, NY	1	Peaks of Otter, VA	1
Indianapolis, IN	1	Petersburg, WV	1
Jacksonville, NC	1	Pipestem, WV	1
Johnson City, TN	1	Portsmouth, VA	1
Joplin, MO	1	Potomac - Outlet Mall, VA	1
Kernersville, NC	1	Potomac,WV	1
King's Dominion - Doswell, VA	1	Poughkeepsie, NY	1
Kissimmee, FL	1	Prince Edward Island, Canada	1
Knoxville, TN	1	Purcellville, VA	1

City/Attraction, State	# of Trips
Puxico, MO	1
Quantico, VA	1
Raleigh, NC	1
Rockbridge Baths, VA	1
Rocky Mount, VA	1
Romney, WV	1
Rush, AR	1
Salisbury, NC	1
San Antonio, TX	1
Sandy Point State Park, MD	1
Savannah, GA	1
Seaside Park, NJ	1
Silver Spring, MD	1
Slade, KY	1
Snow Shoe Ski Area, WV	2
South of the Border, SC	1
Spotsylvania, VA	1
Springfield, IL	1
Springfield, MA	1
Springfiled, MO	1
Statesville, NC	1
Stephens City, VA	1
Stone Mountain, GA	1
Stonewall Jackson's House, VA	1
Sweetwater, TN	1
Troya, PA	1
Tupelo, MS	1
Valley Forge, PA	1
Vienna, VA	1
Water Country - Williamsburg, VA	1
White Mountains, NH	1
White Sulpher Springs, WV	1
Wilmington, DE	1
Wilmington, NC	1
Wintergreen, VA	1
Wytheville, VA	1
Yosemite NP, CA	1

Total trips = 741

Destinations Within the Counties Surrounding Shenandoah National Park

City/Attraction	# of Trips
Luray Caverns	121
Monticello	71
Charlottesville	30
New Market Battlefield	19
University of Virginia	18
Harrisonburg	17
Massanutten Mountain	17
Luray	13
Skyline Caverns	13
Staunton	13
Front Royal	12
Blue Ridge Parkway - Waynesboro	11
George Washington Nat'l Forest	7
Shenandoah Caverns	7
Ash Lawn/Highland	6
Endless Caverns	6
Mitchie Taverns	6
Waynesboro	6
Woodrow Wilson Birthplace	6
Museum of Frontier Culture	5
Sperryville	5
Bryce	4
James Madison University	4
Waynesboro - Outlet Mall	4
Wintergreen	4
Prince Michel Winery	3
Shenandoah Vineyards	3
Sperryville - Emporium	3
Afton	2
Bridgewater College	2
Charlottesville - Wineries	2
Elkton	2
Grand Caverns	2
Natural Chimneys	2
New Market	2
P.B. Moss Museum - Waynesboro	2
Reptileland	2
Strasburg	2
Washington	2
Woodstock	2
Barboursville Winery	1
Catherine Furnace	1

City/Attraction	# of Trips
Caverns Country Club	1
Crab Tree Falls	1
Cross Keys	1
Dayton	1
Deer Meadow Vineyards	1
Dyke	1
Edinburg	1
Elizabeth Furnace	1
Fishersville	1
Ft. Valley Fisheries	1
Grave's Mountain Orchards	1
Graves Mountain Lodge	1
Jordon Hollow Farm Inn	1
Lake Arrowhead	1
Lewis and Clark Memorial	1
Madison	1
Mauertown	1
Meem's Bottom - Covered Bridge	1
Mills Store - Charlottesville	1
Mimlyn Hotel	1
Montdomaine Winery	1
Mount Jackson	1
Mountaintop Ranch	1
Oakencroft Winery	1
Pen Park	1
Port Republic	1
Rappahannock County Flea Market	1
Scenic Rt. 340 - Front Royal	1
Shenandoah Golf Course	1
Shenandoah River, Page Co	1
Shenandoah River, Rockingham	1
Simeon Winery	1
Sperryville - Antique shops	1
Stanardsville	1
Stanley	1
Stuart's Draft	1
Timberville	1
Viking Farms	1
Weyer's Cave	1
Wineries - Albemarle County	1

Total trips = 486

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