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Estimating the Recreational Value of Portland's Forest Park

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Abstract

Using the travel cost method, this study estimates the per-trip value and total annual value of recreational visits to Portland's Forest Park. Based on the opportunity cost of visitors' time and the estimated costs of travel, we derive a demand function for visits to Forest Park on the assumption that visitors value their trips to Forest Park at least as highly as the alternative uses of their time and money. The Portland Parks and Recreation Department supplied survey data for 2277 Forest Park visitors, of which we use 1626 observations.

We find that a truncated negative binomial regression best fits the data. This regression indicates an average value per visit of $240 and an annual value of $31 million, though we note some limitations that may have biased this figure upwards. Additional results include a summary of visitor activities, durations and a profile of the socioeconomic statuses of Forest Park visitors. Finally, we recommend that future research implement a contingent valuation method to corroborate and improve the validity of our estimates.

JEL Classifications: Q20, Q23, Q26, R00
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I. Introduction

Forest Park, which was established in 1948, is a 5,200-acre natural area located in the heart of the Portland-Vancouver metro region. The mostly secondary growth forest provides a variety of valuable ecosystem services, including carbon sequestration, flood control, clean air and water, and a stable habitat for more than 100 species of birds and 50 species of native mammals (Forest Park Conservancy website). In addition, Forest Park provides recreational opportunities for thousands of visitors each year. Tourists and Portland residents visit Forest Park to exercise on its 79 miles of trails, socialize with friends and family, reduce stress and enjoy solitude in a natural setting.

Although cost-benefit analysis has been increasingly applied to natural resources, little research has been done to value the ecosystem services specifically in Forest Park. To help close this gap, Portland State University was asked by the Forest Park Conservancy to estimate the value of recreational activities enjoyed by visitors to Forest Park. Based on survey data collected and provided by the Portland Parks and Recreation[1], this report presents preliminary estimates of the per-trip and annual value of recreational visits to Forest Park using the Travel Cost Method (TCM). TCM estimates the opportunity cost of time and travel a visitor sacrifices when she visits Forest Park. The assumption underlying TCM is that a visitor must value a visit to Forest Park at least as highly as she values the forgone alternative uses of her time and the cost of transportation. The primary alternative methods for valuing non-market goods and services, such as those from natural resources, are stated preference. An example of such a method is the contingent valuation method (CVM), which asks visitors to estimate how much they would pay to engage in or receive services in question.

The data provided by the Portland Parks and Recreation do not lend themselves to a CVM analysis, but as discussed below, we believe such a study would provide a powerful complement to our results. The data, furthermore, were not collected specifically for the purpose of the TCM. In particular, the granularity of data collected on visitors' incomes is not ideal for TCM. Despite

[1] For additional details on the data and how they were previously used, please see Portland Parks and Recreation (2012)

these limitations, there is sufficient data to draw provisional conclusions about the recreational value of Forest Park.

Foremost among those conclusions is that the average Forest Park visit is valued at $240 and scaling this up to an annual value yields an estimated $31 million in consumer surplus[2] for visitors in the sample. Additionally, this study finds that, compared to the average Portland resident, visitors to Forest Park are wealthier and better educated. The most popular recreational activities in Forest Park are exercising and fitness. The typical visit lasts 60-89 minutes and those who visit very rarely stay longer. The next section presents a literature review of the travel cost method, including its limitations and advantages as a tool for valuing non-market resources and the unique challenges of the travel cost method. Following the literature review, we describe our methodology for determining consumer surplus, present our findings and discuss key conclusions.

II. Travel Cost Method Literature Review

Valuing services such as recreation opportunities in Forest Park can be quite problematic, because markets and prices for such ecosystem services do not exist. Instead of relying on market information, economists must use other means to estimate the value of recreation experiences.[3] Economists have devoted substantial efforts to creating non-market valuation methodologies to estimate the marginal benefit function (i.e. the demand curve) for non-marketed natural resource goods and services. This notion is of particular importance when conducting cost-benefit analysis, because the demand function is used to measure total benefit.

The travel cost method is one such valuation approach. The basic steps in the method include:

1. Defining the setup: Who and what are we interested in?
2. Data collection, either from secondary or primary sources

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[2] Consumer surplus is a measure of total economic value, which allows for the possibility that different users place different values on ecosystem services, such as a Forest Park recreation experience.

[3] "Value" and "benefit" are subjective measures that need not only be measured in monetary units. Because money is our market measure of value, however, including for costs to maintain and improve Forest Park, willingness to pay is an appropriate measure of value. As users' recreation experience values are likely to differ, we analyze the marginal (i.e. additional) benefit of recreation. The functional relationship between these marginal benefits and number of visits is often referred to as a "demand" function.

3. Calculating the visitation rates and distances traveled
4. Converting travel times to monetary values
5. Computing the travel cost (i.e. including both direct and times costs) for each user
6. Estimating the functional relationship between travel cost and number of recreational visits.

An example of a function that may be used to estimate the demand for visits to a recreation area is given in Equation 1.

(1) Q (trips) = f(travel cost, travel time, prices of substitutes, tastes, income, total time budget)

As a general matter, most economists agree that the distribution of park visits and their frequency do not follow a normal distribution, the most commonly used distribution in statistics, but rather follows a Poisson distribution. The literature reviewed did not present any cases in which a normal distribution was used.

One of the challenges with travel cost analysis is how to measure distance and convert travel times to monetary values. To estimate travel cost, researchers often employ a function in which travel cost is a function of computed distance (from zip code to site, multiplied by an adjustment variable) and the wage rate. In the literature, wage rates are estimated using income divided by 2000 hours (40hours/week for 50 weeks/year).

To estimate the value of Civil War battle sites in Tennessee, for example, Melstrom (2013) used the following equation to compute travel costs:

(2) Round Trip distance x DC + Round trip distance x VT/(Average mph), where

DC = per mile cost of driving

VT = the value of visitors' time.

The per-mile cost of driving includes average fuel prices in the state at the time of the trip. In addition, depreciation and maintenance costs from the American Automobile Association (AAA) were used. The value of visitor time is estimated at one-half the reported wage rate (Melstrom, 2013).

A more complex method is to use the stated cost of travel time, based on visitors' willingness to pay (WTP) to reduce travel time in a CVM experiment. CVM takes into account recreationists' individual perceptions of whether travel time is a cost or part of the experience rather than assigning a standardized or imputed hourly cost. Second, if based on a properly designed WTP question, the stated cost of time accounts for individual factors and constraints—e.g. employment and work-time status, discretionary time available, income and alternative uses of time—as built-in features.

Third, a monetized cost of time can be used to construct a combined full-cost travel cost variable for a comprehensive consumer surplus measure. As multicollinearity, or very high correlation, between driving cost and time cost (whether monetized or physical time) usually hampers their use as separate variables, the combined travel cost variable may be the only practicable way to account for the time cost. The solutions with flexible choice between work-time and leisure justify a combined travel cost variable. Otherwise, the model leads to a demand function with separate variables for money cost and physical travel time (Ovaskainen et al., 2012).

Researchers use two methods to calculate travel times—the individual trip method and the zonal method. The individual trip method asks for self-reported data on the trip distance, while the zonal method groups respondents into distance zones. The drawback of the individual method is that it relies on self-reporting, which is subject to error. While the zonal method is less prone to error, it is also less accurate.

One study used a two-stage hedonic travel cost method to value commercial fishing area visits. In the first stage, the implicit prices of characteristics are estimated for each location. In the second stage, the number of trips and the level of characteristics are simultaneously estimated for each fisherman with two-stage least squares regression. Independent regressions are performed for 1 day, 2-3 day, and 4 or more day trips. Two different sets of prices are estimated in the first stage: a time price and a distance price. The distance prices are computed by regressing distance on the characteristics of fishing sites (scenery, crowdedness, and fish density). Travel time is regressed on the same characteristics in order to compute the time prices (Brown and Mendelsohn, 1984).

Benson et al. (2013) used a zero-truncated negative binomial (ZTNB) regression, which adjusted for endogenous stratification in which recreationists that participate frequently are more likely to be surveyed. To determine consumer surplus for national parks in Spain, Juarez and

Canete (2013) used the individual travel cost method. This study found that individual demand (i.e. marginal benefit) depends on number of visits, cost to reach locations, income, socio-demographic characteristics, quality of locations and the cost of visiting competing locations. To estimate the coefficients in the regression equation, the authors used a maximum likelihood Poisson regression (Juarez and Canete, 2013).

Travel cost methods are widely used and generally accepted by most economists and policy analysts. However, recreational uses and populations may have characteristics that require nuanced approaches. One issue that concerns analysts is how to correct for park users whose visits are part of multiple-destination trips. If such corrections are not made, it is possible to overstate travel costs or, if WTP is significantly higher than travel costs, to underestimate consumer surplus (Tuffour, 2012). Sometimes researchers will avoid the issue of multiple trips altogether by removing respondents who indicate that their trip was one stop in a series of trips. Removing multiple-trip respondents is justified when researchers are examining a single recreation use and want to determine only the value enjoyed by those who engage in the recreational activity under investigation (Melstrom, 2013). At a minimum, it's considered best practice to acknowledge the selective deletion of problematic data or to provide sound reasoning for why the sample was consciously manipulated in such a way.

III. Methods

In this report we use the individual travel cost method and estimate the "demand" for visits using an equation akin to Equation 1. The total cost to travel to Forest Park, the time actually spent in Forest Park and the direct costs (e.g. fuel) to reach the park make up travel costs, with time valued as foregone wages. Estimating the relationship between reported trips and travel cost then allows estimation of the consumer surplus derived by those who visit Forest Park. Travel cost is a simple sum of all the opportunity costs. Time is valued based on the income levels from the individual data collected at Forest Park in 2010 and direct costs are based on reported mileage distance (Portland Parks and Recreation, 2012). We then use the Internal Revenue Service reimbursement rate of $0.50 per mile for year 2010 to value the per-mile direct cost (IRS, 2010).

The sum of shadow wages and the cost of travel yield the estimated travel cost of a trip to Forest Park.

Using the data to estimate recreation value requires several assumptions. In order to obtain trips per year for each respondent, we annualized reported visits using reported values (for example, respondents who answered that they visited daily were assumed to make 360 trips per year) or best estimates based on responses (e.g. respondents who made visits "several times a week" were assumed to make 150 trips per year). Respondents who said they visited Forest Park "once a week" were assumed to make 50 trips per year. Data for people who visited less than once a year were discarded, because we can reasonably assume that this group came from far away and were likely making multi-purpose trips. This decision was made to avoid over-estimating consumer surplus.

Median wages for each group were used to determine the opportunity cost of time (i.e. shadow wages). We note that about 30% of respondents earned more than $100,000, but we do not know how much more. In order to better approximate the shadow wages for this higher-income group, we used proportions based on 2010 U.S. Census data from the Bureau of Labor Statistics for Portland, Oregon. Above incomes of $200,000 per year, we assumed the constant distribution shown in Table 1.

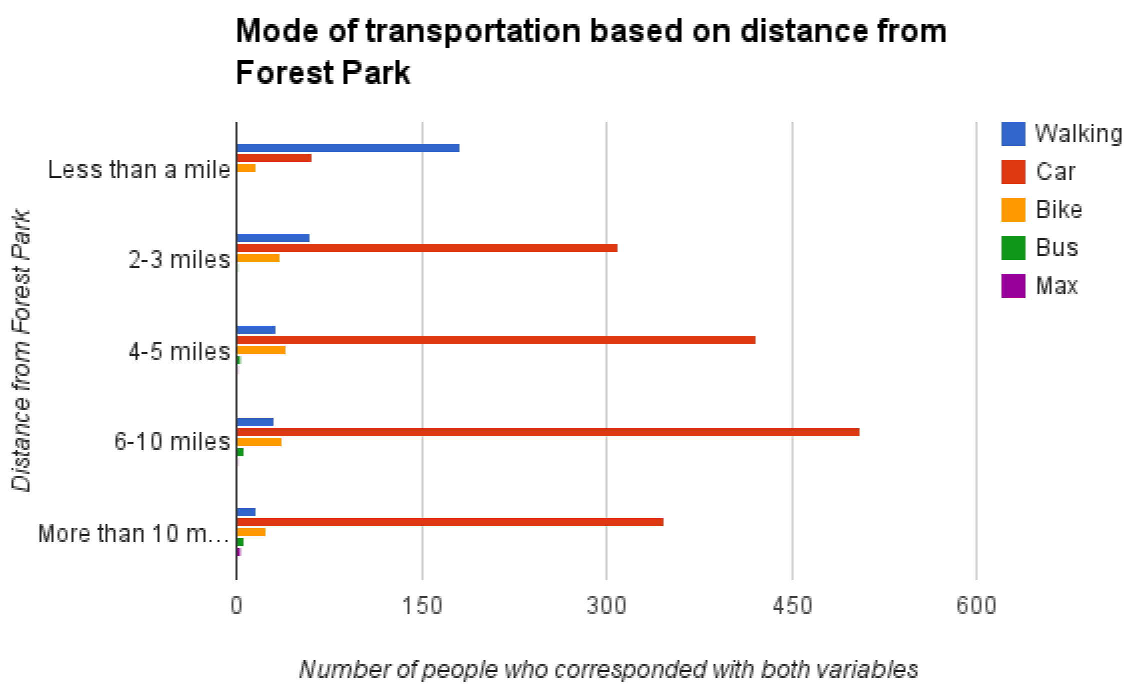
Table 1. Distribution of Reported and Assumed Income Categories

Income Group	Percent
Categories from Survey	
Less than $10,000	5%
10,000-14,999	3%
15,000-24,999	5%
25,000-34,999	6%
35,000-49,999	12%
50,000-74,999	17%
75,000-99,999	16%
≥ 100,000	30%
Refused to Answer	6%
Assumed Distribution of Incomes above $100,000	
150,000-199,999	8%
200,000-299,999	1%
300,000-399,999	1%
400,000-499,999	1%

500,000-749,999	1%
≥ 750,000	1%

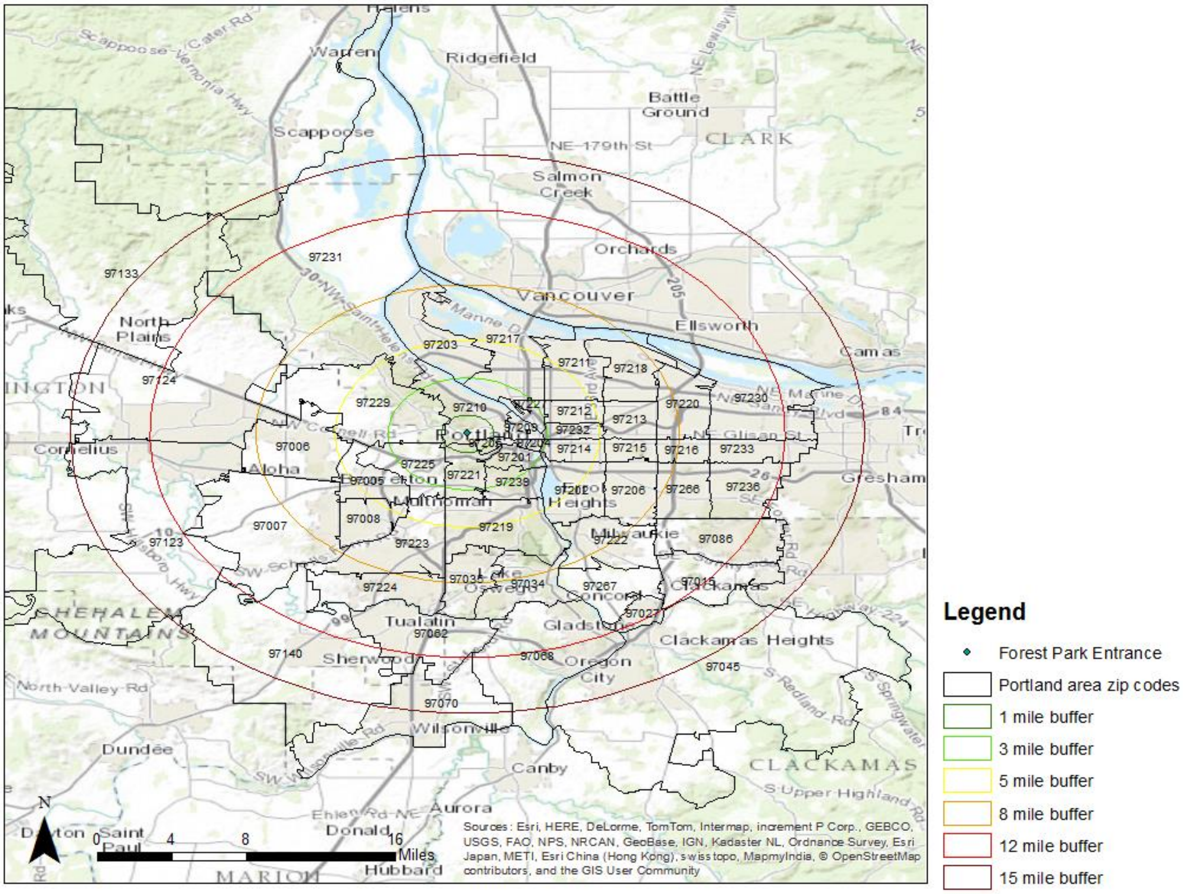
To determine travel cost, several additional assumptions were needed. Those who traveled to Forest Park via public transportation were dropped from the data set, because as shown in Figure 1, this group is very small and we did not feel we had sufficient information to estimate travel time. Most respondents traveled by car unless they were less than a mile away, in which case most walked (70.2%). When visitors were more than 3 miles away, walking was the 2nd highest option, but still only very few (less than 10%) walked. At less than 3% each, biking, taking the bus/MAX were uncommon travel mode choices.

Figure 1. Travel Mode Used to Go to Forest Park



Visitors traveling from zip codes outside of the Portland metro area were omitted, because those people were likely making multi-purpose trips. To include groups that came from outside the Portland, Oregon area, additional data would be required to properly allocate the travel cost specifically for Forest Park. Figure 2 shows the zip code areas in the analysis.

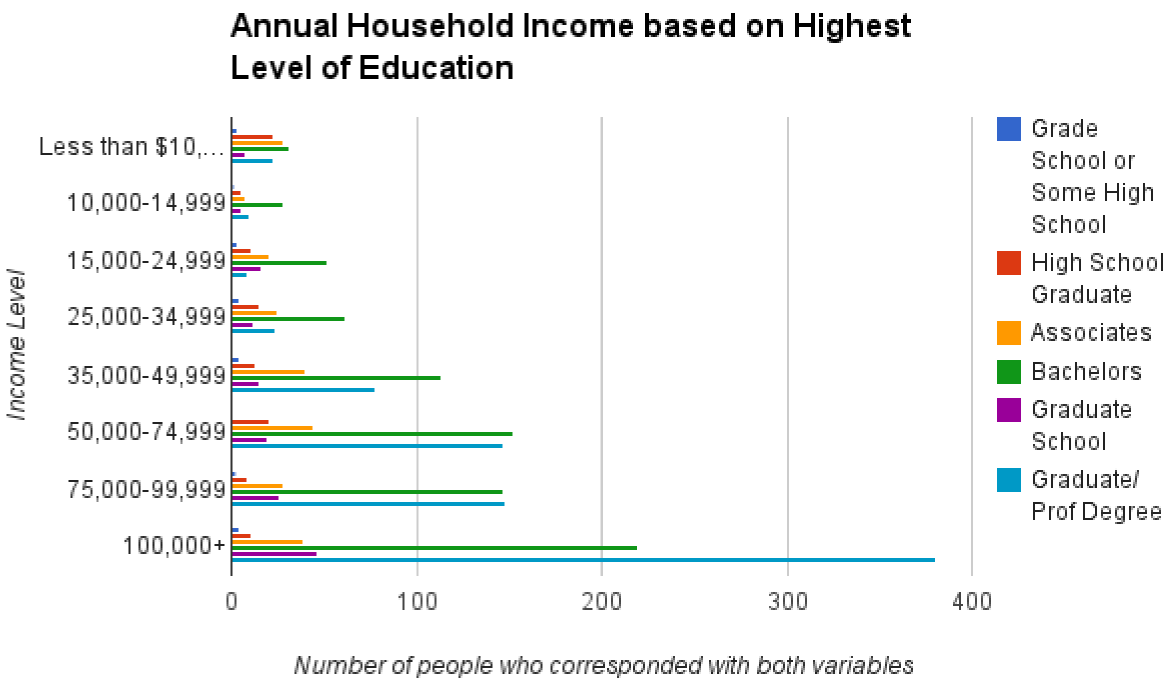
Figure 2. Map of Respondent Areas



Surveys with incomplete answer(s) with respect to any dependent or independent variable that had the potential to affect travel cost or annual visitation were not used. Of the original 2277 observations, 1626 were therefore used in the final estimations. The best-fit regression was a truncated negative binomial regression. Because the dependent variable is a countable variable (number of trips per year), negative binomial and Poisson regressions were obvious estimation choices, but the Poisson was rejected based on statistical testing. The regression was truncated such that it would not predict a zero count for the number of trips. This method is appropriate for the data, because there is no information from people who were not in the park on the days the survey occurred.

IV. Results

Figure 3. Household Income and Education in the Sample



As shown in Figure 3, the highest number of visitors earned more than 100,000, of which 54% have graduate or professional degrees. For visitors with annual household incomes between $75,000 and $99,000, a majority hold bachelor's (40.7%) and graduate/professional (40.9%) degrees. Below that income range, most respondents hold a bachelor's degree and those earning less than $10,000 had a higher proportion of associate's degrees and high school diplomas.

Most people who primarily exercise in Forest Park spend 60 - 89 minutes (28.9%), 120 - 239 minutes (26%) and 90 - 119 minutes (22.8%). Exercise is the most popular reason to visit Forest Park. The second most favored activity is enjoying nature and the outdoors (28.5%). Most of these visitors spend 120 - 239 minutes (31%) or 60 - 89 minutes (26.8%) in Forest Park. Socializing with family, reducing stress and enjoying solitude were the third, fourth and fifth most common reasons for visiting Forest Park. Figure 4 shows the primary activities in Forest Park by length of time spent.

Figure 4. Activities and Length of Time in Forest Park

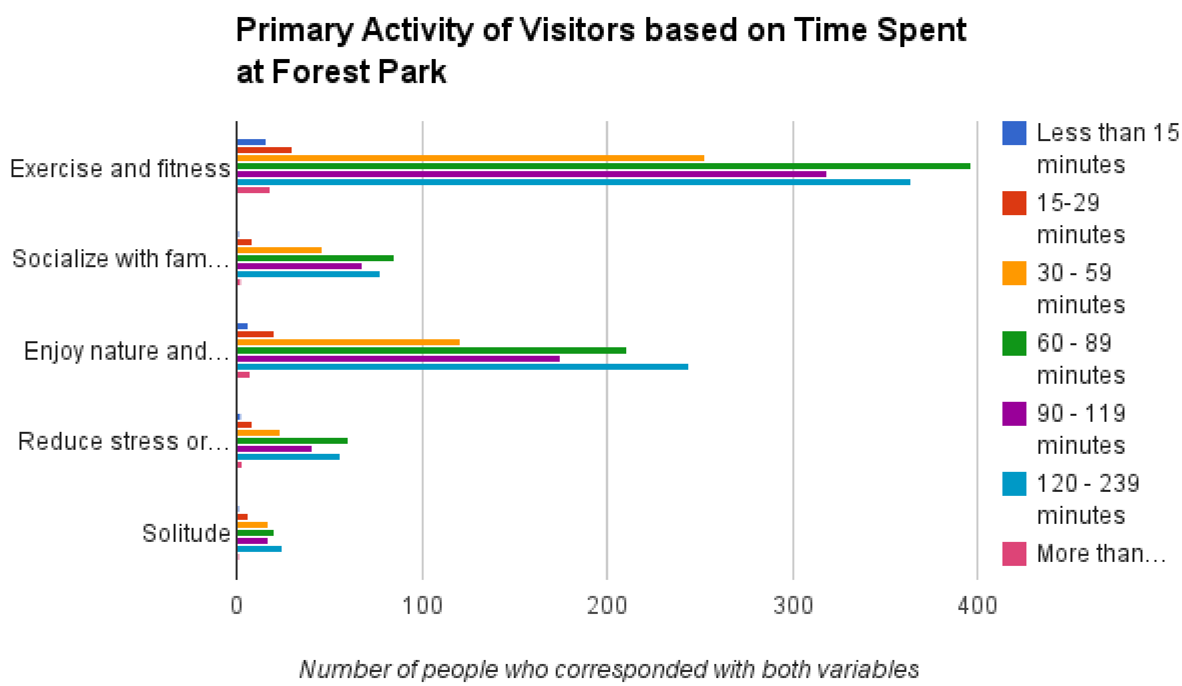
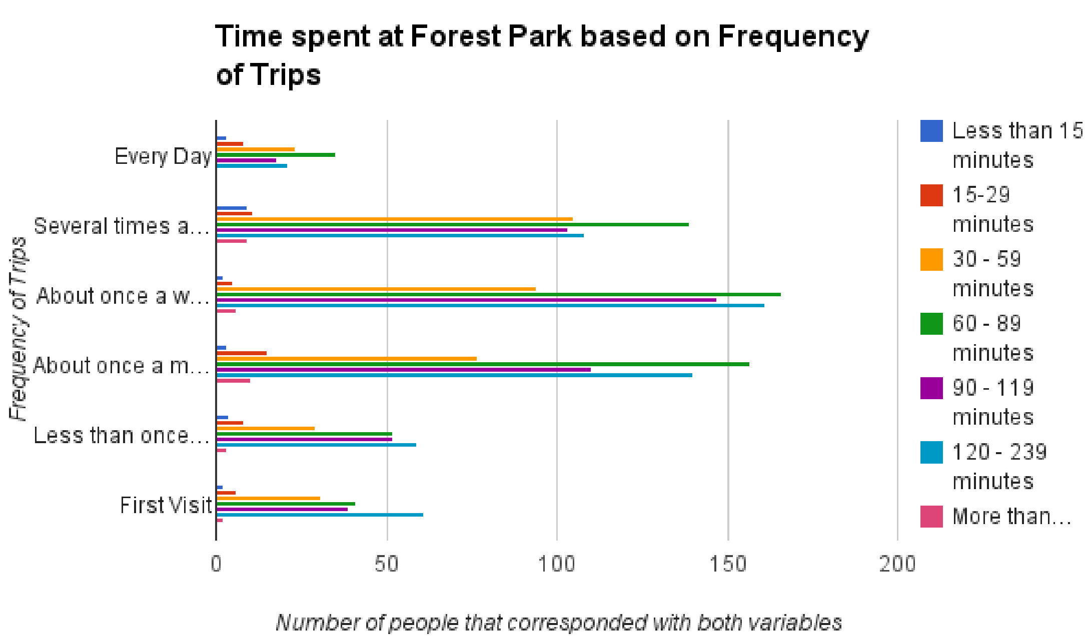


Figure 5. Time Spent each Trip and Trip Frequency



Most people spend 60 - 89 minutes in Forest Park (28.2%) unless it is their first visit or they visit Forest Park less than once a month, in which case most stay in Forest Park between 120 and 239 minutes (28.2% and 32.1%). Figure 5 shows time spent versus frequency of visits.

Two regression models were used to estimate the impacts of independent variables on annual trips to Forest Park in 2010. All the regression analyses were performed using STATA, Version 13. The table of estimated regression coefficients, standard errors, and significance can be found in Figure 6. We hypothesized that the number of trips per year is given in Equation 3, which is very similar to Equation 1, but includes personal characteristics that could affect visitation.

(3) Number of visits = f(primary activity, primary motivation, gender, age, education, opportunity costs)

Travel cost is found to be an important determinant of visitation as is primary activity, primary motivation and age. Gender, education and income are found to be insignificant. We particularly expected income to play a bigger role than is actually the case, because high levels of income might have translated into a higher preference for the environment or leisure. The final model chosen for calculating per trip and annual value is on the right hand side of Figure 6. This model includes only primary activity, primary motivation, age, and opportunity costs as explanatory variables.

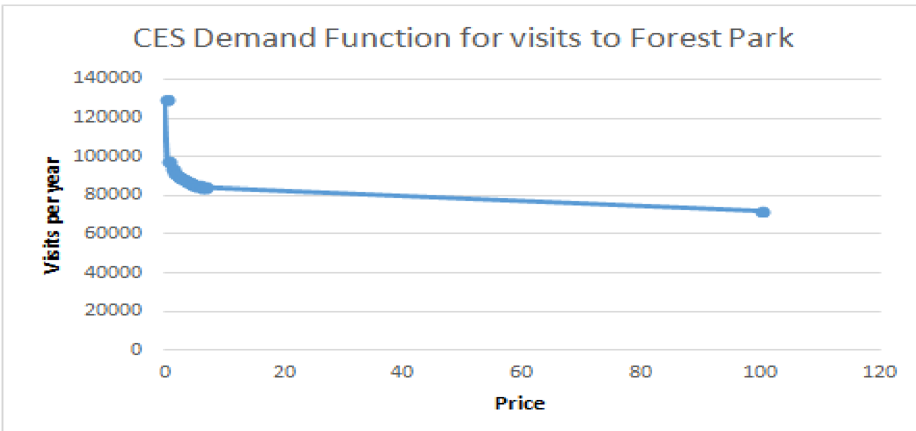
Figure 6. Negative Binomial Regression Model (Dependent Variable is Trips/Year)

VARIABLES	Number of trips	ln(alpha)	Number of trips	ln(alpha)
Primary Activity				
Plant or wildlife viewing	0.108		0.0903	
	(0.0964)		(0.0962)	
Cycling	0.172**		0.161**	
	(0.0732)		(0.0725)	
Hiking/walking	-0.149**		-0.144**	
	(0.0632)		(0.0666)	
Walking the dog	0.326***		0.330***	
	(0.0694)		(0.0704)	
Jogging/running	0.394***		0.401***	
	(0.0673)		(0.0662)	
Scientific Research	-0.361		-0.337	
	(0.277)		(0.283)	
Education	-0.607**		-0.615**	
	(0.249)		(0.251)	
Primary Motivation				
Exercise and Fitness	0.159**		0.157**	
	(0.0766)		(0.0766)	
Socializing with family	-0.431***		-0.407***	
	(0.104)		(0.110)	
Enjoy nature and be outdoors	-0.258***		-0.241***	
	(0.0836)		(0.0830)	
Reduce stress or unwind	0.298**		0.280**	
	(0.122)		(0.120)	
Solitude	0.370**		0.339**	
	(0.152)		(0.151)	
Gender				
Gender	-0.00602			
	(0.0622)			
Age Group				
25-34	-0.0144		0.0643	
	(0.164)		(0.160)	
35-44	0.0806		0.151	
	(0.168)		(0.159)	
45-54	0.346*		0.418**	
	(0.177)		(0.167)	
55-64	0.592***		0.668***	
	(0.179)		(0.170)	
65-74	0.843***		0.945***	
	(0.229)		(0.212)	
75-84	1.271***		1.342***	
	(0.485)		(0.466)	
85+	-0.520		-0.497**	
	(0.341)		(0.227)	
Income group				
$10,000-14,999	0.189			
	(0.252)			
$15,000-24,999	-0.0472			
	(0.213)			
$25,000-34,999	0.263			
	(0.210)			
$35,000-49,999	0.0451			
	(0.196)			
$50,000-74,999	0.168			
	(0.193)			
$75,000-99,999	0.153			
	(0.193)			
$100,000+	0.0463			
	(0.191)			
Education				
High School Graduate	-0.287			
	(0.631)			
Associates	-0.249			
	(0.616)			
Bachelors	-0.268			
	(0.610)			
Some Graduate	-0.156			
	(0.616)			
Graduate/Professional	-0.168			
	(0.610)			
Cost				
Opportunity Cost	-0.00105**		-0.00121***	
	(0.000472)		(0.000421)	
Constant	3.988***	0.454***	3.797***	0.461***
	(0.648)	(0.0472)	(0.175)	(0.0475)
Observations	1,626	1,626	1,626	1,626

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

From the estimated coefficient of opportunity cost, we calculate the elasticity of visitation with respect to opportunity cost. Given the non-linear form assumed by the regression model, we derive a non-linear demand function with a constant elasticity, which is shown in Figure 7. At around 70,000 visits the function becomes asymptotic, and while we have no doubt that some people receive large consumer surplus from visiting Forest Park, the choke price (the price at which visitation would go to zero) is infinite.

Figure 7. Non-Linear Demand for Annual Visits to Forest Park



To calculate consumer surplus using the log-linear form assumed in the negative binomial model, we divide 1 by the coefficient of opportunity cost. Calculated this way, the average consumer surplus per trip equals $240. Summing over the calculated annual visits from the survey data, this equals $240 times 129,375, or $31 million per year. This figure represents the estimated total value of recreational visits by sample visitors in 2010.

V.Discussion and Conclusion

The results suggest that the average value of recreational visits to Forest Park by sampled visitors is $240 per visit or a total of $31 million dollars. Shadow wages were incomes that respondents were assumed to have foregone during their time spent going to and visiting the park — the opportunity costs of time. We are concerned that, while perhaps reasonable for our relatively high-income sample, the $240 value per trip may not representative of Portland as a whole. Indeed, compared to similar studies, our finding that the average visit provides $240 in total value is quite high. Two main factors may account for this finding. First, visitors to Forest Park tend to be high income. The largest income group in our data is those earning more than $100,000 per year and about 30% of the 2277 respondents reported annual incomes greater than $100,000. In Portland the actual proportion of higher-income residents is lower at about 19.1%[4].

As our opportunity cost of time estimates are based on wage rates, high incomes lead to high estimates of recreational value. We also had to make assumptions for incomes above $100,000, which could have further biased upward per-trip values. Second, visits to Forest Park tend to be quite long. This fact will, for similar reasons, lead to high estimates of value per trip. Together, these facts provide a valid basis for our especially high per trip value estimate.

Scaling up this per-trip value to annual visits may have introduced over-estimation issues, because annual visits were scaled up to a total of 139,000 visits from reported visits based on much shorter durations. It is possible that respondents over-estimated their short-term visitation rate or if they were asked about annual visitation they would have offered lower values. For example, respondents may have taken into account time away from Portland that we are unable to consider.

Despite the caveats we have noted, our findings strongly suggest that Forest Park provides, for the individual visitor and for the City of Portland, an extremely valuable recreational resource. The travel cost method is commonly used to value recreation, but it is recommended that other studies should be coupled with this method to arrive at a more comprehensive understanding of the value of the ecosystem services provided by Forest Park. In addition to its recreational opportunities, Forest Park also offers a host of ecosystem services—including water and air purification, carbon sequestration, flood and stormwater control, and microclimate stability—that are not valued here. While $31 million per year in consumer surplus may be a high estimate of Forest Park's recreational value, the true value of Forest Park to Portlanders is certainly much higher.

Contingent valuation is a commonly used method to value natural resources like Forest Park that offer many use and non-use ecosystem services. CVM is a powerful way to estimate values that people place on services that do not have traditional markets and may not even be used.

[4] http://www.city-data.com/income/income-Portland-Oregon.html

The method uses a survey with the primary objective to understand what respondents are willing to pay for access to ecosystem services. We recommend that future research on the value of Forest Park use stated preference methods, such as the contingent valuation method, to corroborate and further develop our findings.

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Appendix

Note on the Use of a Linear Model

In addition to the negative binomial regression to model the demand curve for recreating in Forest Park, we also tried a linear ordinary least squares model. Since our non-linear model does not yield an estimate of a maximum price, a linear demand function was estimated using the coefficient of opportunity cost and elasticity from an OLS version of the model. Re-estimated this way, we found a choke price of approximately $110,000. With this demand function, it is possible to derive another estimate of consumer surplus for all visitors to Forest Park per year.

Consumer surplus is the integration of the demand function over price, and for the linear model, we used the triangle formula, in which the consumer surplus is the number of annual visit times choke price less average opportunity cost divided by two. In this case: (129,375 * ($110,000-$17))/2 = $7 billion. With this method, the annual consumer surplus received from Forest Park is estimated to be $7 billion. This estimate corresponds to an average value per visit of about $54,000—higher than the median household income in Portland. Given the patent implausibility of this figure, we abandoned the linear model in favor of the negative binomial regression.