Effects of Per-Vehicle Entrance Fees on U.S. National Park Visitation Rates

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Abstract

This study tested the hypothesis that increases in per-vehicle entrance fees at United States National Parks between the years 1996 and 2006 resulted in reduced numbers of park visitors. Analysis proceeded in three stages: (1) annual visitor numbers and entrance fees were plotted together over the 11 year period; (2) a difference-in-difference analysis was performed, comparing visitor trends for clusters of similar parks from the year before to the year after that in which fees were increased; and (3) the natural log of yearly visitor count was regressed on the natural log of fees in an attempt to quantify the elasticity relationship between the two variables. The analysis did not find a clear relationship between per-vehicle entrance fees and visitation rates. However, the possibility remains that such a relationship exists, at least for some parks.

I. Introduction

National parks around the country have been steadily raising entrance fees since Congress expanded their authority to do so in 1996. Predictably, the increased cost to the public has sparked some controversy; opponents of the fee increases are concerned that higher prices will exclude lower income citizens from national parks, and discourage use by other citizens with marginal preferences for visiting national parks. To assess the validity of these claims, I analyzed the question: *Do per-vehicle entrance fees affect yearly visitation rates of U.S. National Parks?* Analysis proceeded in three stages; (1) visitor number and fee data were plotted over time and examined visually; (2) a difference-in-difference analysis was conducted comparing visitor trends of clusters of similar parks from the year before until the year after fees were increased; and (3) the natural log of yearly visitor count was regressed on the natural log of fees in an attempt to quantify the elasticity relationship between the two variables.

II. Background

In 1996, Congress authorized the Recreation Fee Demonstration Program. Under this program, four government agencies – the National Park Service, the Fish and Wildlife Service, the Bureau of Land Management, and the Forest Service – were authorized to establish, charge, and collect fees, and required to spend 80 percent of the revenue at the site at which it was collected. Originally scheduled to expire in December 2005, Congress extended this authority for an additional ten years as part of the 2005 Omnibus Appropriations Bill, under the new Federal Lands Recreation Act.

Each year from 1997 to 2006, the Department of the Interior (DOI) submitted reports to congress detailing the status of the program.[1] From 1996 to 2001, the number of National Park Service (NPS) sites in the fee demonstration program was set to 100 (there are currently 391 sites in the NPS system), allowing a consistent comparison of visitation rates for sites included and those not included in the program (Figure 1).

[1] Department of Interior, *The Recreation Fee Program*, http://www.doi.gov/initiatives/recreation_feeprogram.html, (July, 2007).

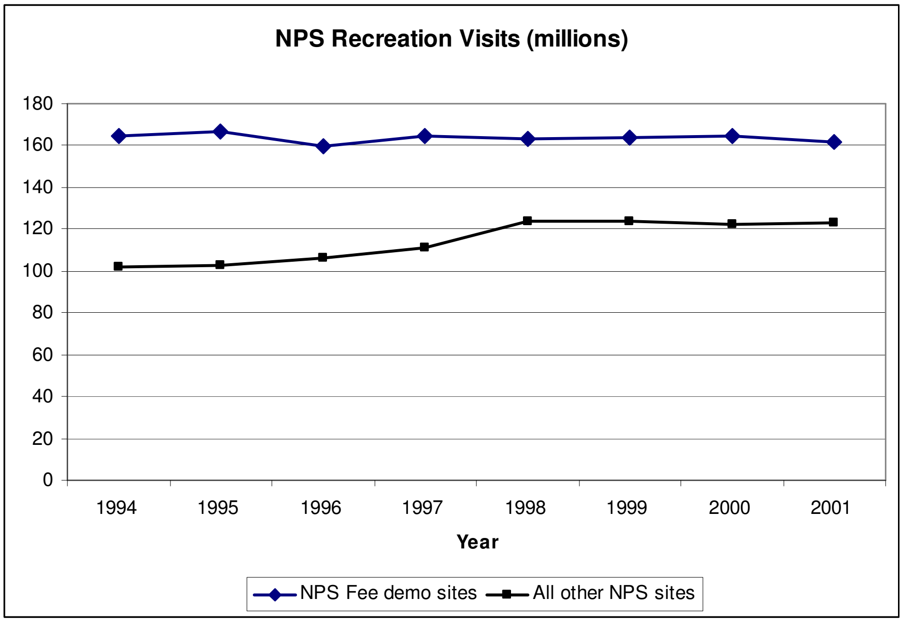

Figure 1. Comparison of visitation rates at demo and non-demo NPS sites.

In 2002, the number of sites in the program increase to 236, preventing further simple year-to-year comparisons. At that point, DOI reports began limiting their discussion to the general overall trends in visitation at fee sites, foregoing a comparison with non-fee sites. In the final report for the program, discussion of visitation rates is limited to one section in the executive summary. That section reads:

> *Aggregate visitation to recreation sites participating in the Fee Demo Program continues to be unaffected in any significant way by fees (see Table 1). Total visitation to fee and non-fee sites has remained relatively constant over the last five years, averaging approximately 370 million visitors per year.* [2]

However, the data referenced in Table 1 (reproduced here in Appendix A) are insufficient to allow DOI to make such a determination of no-effect. One limitation is that NPS sites

[2] Department of the Interior, FY 2004 Recreation Fee Demonstration Program Summary: Visitation, Revenue, Cost, and Obligation Information, 2004. (p. 2). http://www.doi.gov/initiatives/FY_2004_Accomplishments_financial_information.pdf. (July, 2007).

were not randomly selected for inclusion in the program. As a result, sites included in the program were systematically different from those that were not; almost all of the sites included in the original 100 were already charging fees before the program went into effect, whereas none of the non-demonstration sites was.

Furthermore, by aggregating all recreation sites, the DOI analysis obscures any differences in trends that might exist between the visitation rates of demonstration and non-demonstration sites. It allows for the possibility that visitor increases at non-demonstration sites could be obscuring visitor decreases at demonstration sites.

Finally, the sites lumped together by DOI as "fee demonstration sites" vary fundamentally by type. DOI's reports disaggregate sites only to the level of the managing agency, leaving grouped, for example, national parks, national historic sites and national recreation areas. However, it seems reasonable to think that these types of sites might be affected by fee changes differently.

Several other studies have searched for a relationship between visitor numbers and entrance fees for U.S. recreation areas. Using a chi square test for statistical significance, Becker, *et al*, concluded that the reduction in visitation at South Carolina State Parks between 1980 and 1982 was not associated with the introduction of entrance fees in 1982.[3] Analyzing a mail survey of New Hampshire and Vermont households, More and Stevens concluded that user fees may reduce participation in resource-based recreation by

[3] R.H. Becker, Deborah Berrier, and G.D. Barker, "Entrance Fees and Visitation Levels," Journal of Park and Recreation Adminstration. 3, no 1 (1985).

those earning less than $30,000 per year.[4] Through factor analysis of data collected from a national phone survey of 3.515 people, Ostergen, *et al*, concluded that entrance fees do not represent a barrier to visitation of National Park Service units.[5] Finally, Ngure and Chapman applied ordinary least squares regression to National Park visitation and fee data for the years 1993, 1994 and 1996.[6] While they were unable to demonstrate an effect of fee levels during those periods, these authors speculated that "much higher fees would significantly affect park visitation levels."

III. Data

This analysis was performed with geospatial and tabular data obtained from a variety of sources, as described below. Summary statistics for the tabular data appear in Appendix B.

Parks

In order to analyze a more homogeneous sample than that which the Department of Interior analyzed, the data set was limited to include only National Parks, and only those that were part of the fee demonstration program.

Sequoia and Kings Canyon National Parks were excluded because at some point after 1996 the Park Service began tabulating visitor numbers for the two parks together. Dry Tortugas, Carlsbad Canyon, and Guadalupe Mountains National Parks were excluded

[4] Thomas More and Thomas Stevens,"Do User Fees Exclude Low-income People from Resource-based Recreation?" Journal of Leisure Research 32, no. 3 (2000).
[5] David Ostergren, Frederic I. Solop, and Kristi K. Hagen, "National Park Service Fees: Value for the Money or a Barrier to Visitation?" Journal of Park and Recreation Administration 23, no 1 (2005).
[6] Njorge Ngure and Duane Chapman, "Demand for Visitation to U.S. National Park Areas: Entrance Fees and Individual Area Attributes," Working Paper of the Dept. of Agricultural, Resource, and Managerial Economics, Cornell University (1999).

from the analysis because they do not charge per-vehicle entrance fees. Table 1 lists the remaining 29 national parks that were included in this analysis, and the fees they charged during the period under investigation.

National Park	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Acadia	6.42	6.28	12.37	12.1	11.71	11.38	11.21	10.96	21.34	20.65	20.00
Arches	0	0	0	0	11.71	11.38	11.21	10.96	10.67	10.32	10.00
Badlands	6.42	6.28	12.37	12.1	11.71	11.38	11.21	10.96	10.67	15.48	15.00
Big Bend	6.42	6.28	12.37	12.1	11.71	11.38	11.21	16.43	16.01	15.48	15.00
Black Canyon of the Gunnison	5.14	5.02	8.66	8.47	8.2	7.97	7.84	7.67	8.54	8.26	8.00
Bryce Canyon	6.42	6.28	12.37	12.1	23.41	22.77	22.41	21.91	21.34	20.65	20.00
Canyonlands	5.14	5.02	12.37	12.1	11.71	11.38	11.21	10.96	10.67	10.32	10.00
Capitol Reef	0	0	0	0	4.68	5.69	5.6	5.48	5.34	5.16	5.00
Crater Lake	6.42	6.28	12.37	12.1	11.71	11.38	11.21	10.96	10.67	10.32	10.00
Death Valley	6.42	6.28	12.37	12.1	11.71	11.38	11.21	10.96	10.67	10.32	20.00
Denali	6.42	6.28	12.37	12.1	11.71	11.38	11.21	10.96	21.34	20.65	20.00
Everglades	6.42	6.28	12.37	12.1	11.71	11.38	11.21	10.96	10.67	10.32	10.00
Glacier	0	0	0	0	11.71	11.38	11.21	10.96	21.34	20.65	25.00
Grand Canyon	12.85	12.56	24.74	24.2	23.41	22.77	22.41	21.91	21.34	20.65	25.00
Grand Teton	12.85	12.56	24.74	24.2	23.41	22.77	22.41	21.91	21.34	20.65	25.00
Haleakala	5.14	5.02	12.37	12.1	11.71	11.38	11.21	10.96	10.67	10.32	10.00
Hawaii Volcanoes	6.42	6.28	12.37	12.1	11.71	11.38	11.21	10.96	10.67	10.32	10.00
Joshua Tree	6.42	6.28	12.37	12.1	11.71	11.38	11.21	10.96	10.67	10.32	15.00
Lassen Volcanic	6.42	6.28	12.37	12.1	11.71	11.38	11.21	10.96	10.67	10.32	10.00
Mesa Verde	6.42	6.28	12.37	12.1	11.71	11.38	11.21	10.96	10.67	10.32	10.00
Mount Rainier	6.42	6.28	12.37	12.1	11.71	11.38	11.21	10.96	10.67	10.32	15.00
Olympic	6.42	6.28	12.37	12.1	11.71	11.38	11.21	10.96	10.67	10.32	15.00
Petrified Forest	6.42	6.28	12.37	12.1	11.71	11.38	11.21	10.96	10.67	10.32	10.00
Rocky Mountain	6.42	6.28	12.37	12.1	17.56	17.08	16.81	16.43	16.01	20.65	20.00
Theodore Roosevelt	5.14	5.02	12.37	12.1	11.71	11.38	11.21	10.96	10.67	10.32	10.00
Yellowstone	12.85	12.56	24.74	24.2	23.41	22.77	22.41	21.91	21.34	20.65	25.00
Yosemite	6.42	6.28	24.74	24.2	23.41	22.77	22.41	21.91	21.34	20.65	20.00
Zion	6.42	6.28	12.37	12.1	23.41	22.77	22.41	21.91	21.34	20.65	20.00

Table 1. Fees of national parks included in the sample (constant 2006 dollars).

Visitation data

The dependent variable in this analysis is yearly visitation rate, defined as number of recreation visitors per year. These data, spanning from 1996 to 2006, were obtained from the National Park Service Public Use Statistics Office ([Butch Street], personal communication), and were generated from park gate records. While this variable appears to be valid, NPS reports indicate occasional failures of vehicle counters at park gates which result in underreporting of visitor numbers.

Fee data

Per-vehicle fee is the primary independent variable used in the analysis. Entrance fees from 1996 to 2006 for all parks in the demonstration program were obtained from a Fee Management Program analyst with the National Park Service. Data were adjusted for inflation using the Consumer Price Index and reported in constant 2006 dollars.

Other independent variables

Average yearly unemployment rates, as reported by the Current Population Survey, were obtained from the Bureau of Labor Statistics. Average yearly gasoline prices were obtained from the Energy Information Administration. These prices were adjusted for inflation using the Consumer Price Index and reported in constant 2006 cents. Two geospatial data sets were downloaded from the National Atlas website[7]: United States county boundaries for the year 2000, and population data from the year 2000 Decennial Census (U.S. Census Bureau, 2000). Two other geospatial data sets were downloaded from the National Park Service Data Store website[8]: National park boundaries, and national park visitor services locations.

[7] National Park Service Data Store website. http://science.nature.nps.gov/nrdata/. (July, 2007).
[8] Ibid.

IV. Analytical approach

Analysis was performed in three stages. First, the data were plotted graphically and checked for (1) problems stemming from inconsistent collection methods, (2) consistency in trends over time among parks, and (3) any immediate indications of a relationship between fee levels and visitor numbers. Second, parks were clustered into small homogenous groups on which difference-in-difference analyses were performed; parks that raised fees were compared with those that did not. Finally, the natural log of visitor numbers was regressed on the natural log of fees in a series of progressively complex regressions, in an attempt to determine the precise price elasticity of demand for park visitation.

A. Data checking and preliminary assessment

Yearly visitation rates and per-vehicle entrance fees were graphed for each park from 1996 to 2006 (see Appendix C), as was the combined visitation rate for all parks in the sample over this same time period (Figure 2). The graphs served three purposes: First, they allowed me to examine the data for any inconsistencies which might have arisen from changes in recording methods. Second, viewing the degree to which visitation rates for different parks trended together over time allowed me to determine how well parks could serve as controls for each other in later regression analyses. Finally, the graphs allowed me to look for any immediately obvious effects of fee changes on visitation rates.

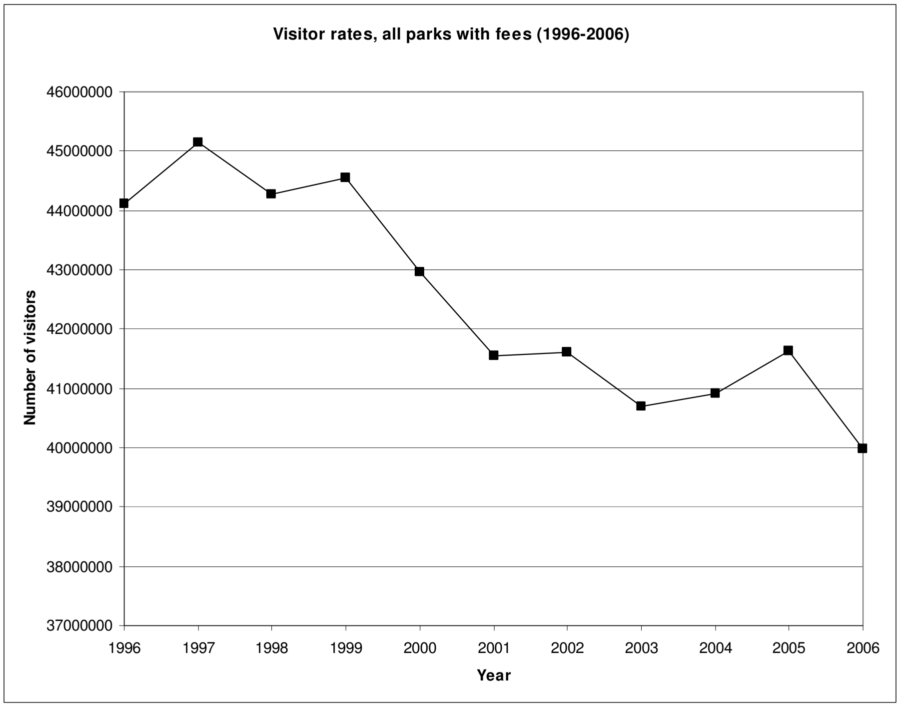

Figure 2. Visitor rates of all fee-charging parks, 1996-2007

B. Difference-in-difference analysis

The graphical analysis revealed that parks differ greatly in their visitation patterns over time. This variation indicates that different parks are influenced by different factors, or by the same factors at different times. In order to remove some of the bias introduced by these differences, parks were grouped into small, homogenous clusters that were presumed to respond similarly to all external factors. Within each cluster, visitor numbers of parks that increased fees were then compared with those that did not. Results were examined non-parametrically in a difference-in-difference analysis; a strong tendency for parks that raised fees to have a more downward trend in visitor numbers than those that did not raise fees would have been interpreted as evidence that increased fees result in decreased visitor numbers.

Clustering parks

1. Estimated population within 100 km of each park visitor center

This criterion was chosen based on the rationale that difficult-to-access parks should be less responsive to fee increases than those that are easier to access. Because entrance fees make up such a small fraction of the overall cost of a typical visit to a remote national park, one would expect that these fees would have little influence over a prospective visitor's decision of whether or not to visit.

The following steps were performed using ESRI ARC GIS 9.2 to achieve the estimation:

(a) Visitor services points were intersected with park boundaries to limit the points to only those that fall within park boundaries.

(b) Among the visitor services points, only those with a "visitor center" attribute were selected.

(c) 100 km buffers were drawn around each visitor center.

(d) Population census data was joined to the spatial county data using the FIPS code.

(e) The area of each county contained in each buffer was calculated.

(f) To estimate the population of each portion of each county comprising the buffers, the areas calculated in the previous step were multiplied by the population density of each county (this data was included with the census population data set). Summing the results for each park resulted in an estimate of the number of people residing within 100 km of each park visitor center.

(g) Parks were then segregated into four categories by applying a Jenks Natural Breaks procedure to the resulting population distribution. Figure 3 provides a graphical representation of the results for parks in the lower 48 states.

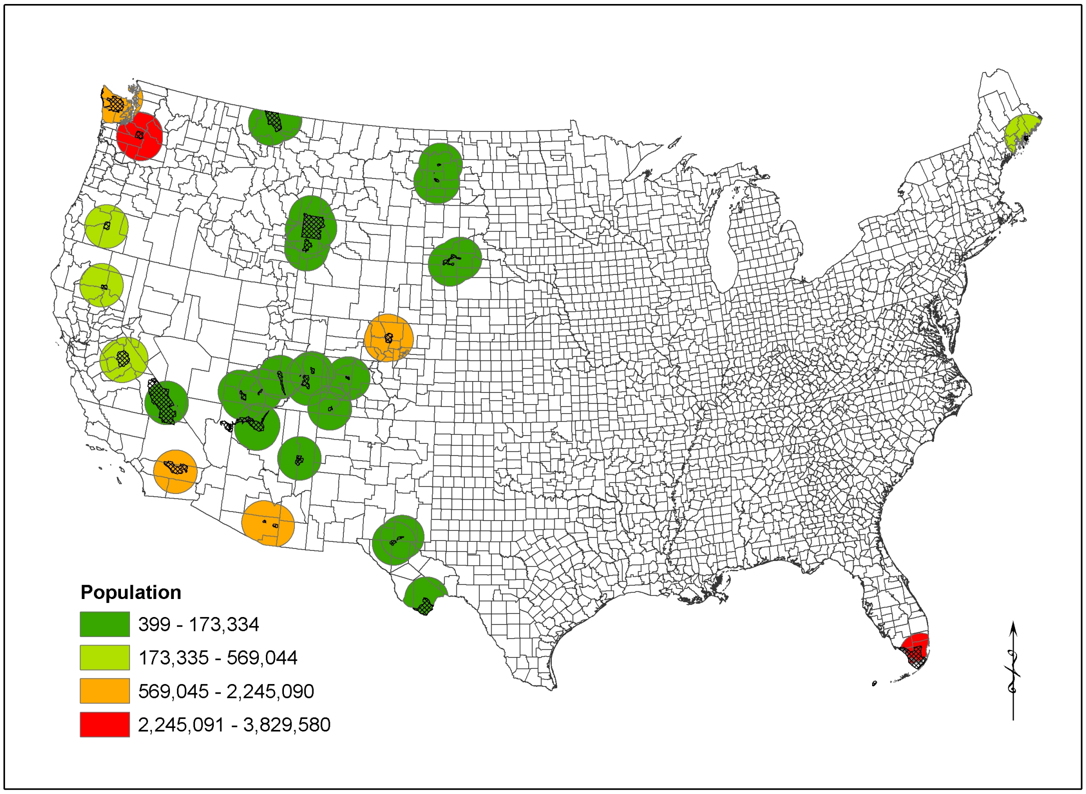

Figure 3. Estimated population within 100 km of National Parks in the sample.

2. Driving time to the nearest interstate highway.

Driving times from park visitor centers to nearest interstate highway were obtained using Google Maps.[9] Coordinates of park visitor centers (from the national park visitor services data set cited above) were entered as starting locations, and the nearest interstate highway entrance was entered as ending locations. Parks within one-half hour of interstate highways were considered as distinct from those parks which are more distant from highways. The assumption was that a non-trivial number of visitors to parks close

[9] Google Maps. http://www.maps.google.com. (July, 2007).

to highways are travelers who stop for a quick and easy diversion while passing by on the interstate to a different destination.

3. Number of visitors

Parks that differed greatly in the number of visitors they receive were placed in different clusters.

4. Geographic location

Parks that would be expected to react similarly to similar regional conditions, or would be expected to have similar visitor patterns due to their similar locations, were generally and subjectively clustered together based. Clusters with strong geographic influence included: Hawaii parks, Midwestern parks, Big Bend and Denali – the spatially isolated parks; small Pacific coast parks; secondary Grand Canyon area parks; tertiary Grand Canyon area parks; and southwestern Colorado parks.

5. Visual assessment of graphed year-to-year trends in visitation

All parks were indexed to 100 visitors in 1999, and graphed in preliminary clusters based on a subjective review of the results of the preceding steps. The resulting graphs depicted the trends in visitor numbers from year to year for each park in such a way that easy inter-park comparisons could be made. Parks were shuffled among clusters until each cluster contained only parks which trended relatively closely together (Table 2). See Appendix D for the final graphs. Arrows were added to these graphs to indicate the year and magnitude of fee increases.

Cluster 1. Remote destination parks
Grand Canyon , Yellowstone, Acadia, Grand Teton
Cluster 2. Hawaii parks
Haleakala, Hawaii Volcanoes
Cluster 3. Midwestern parks
Theodore Roosevelt , Badlands
Cluster 4. Spatially isolated parks
Big Bend, Denali
Cluster 5. Destination parks in heavily populated areas
Joshua Tree, Everglades, Rocky Mountain, Mount Rainier, Olympic, Yosemite
Cluster 6. Smaller Pacific parks
Lassen Volcanic, Crater Lake
Cluster 7. Secondary Grand Canyon parks
Arches, Bryce Canyon, Death Valley
Cluster 8. Tertiary Grand Canyon parks
Petrified Forest, Canyonlands, Capitol Reef
Cluster 9. Southwestern Colorado parks
Black Canyon of the Gunnison, Mesa Verde
Cluster 10. Popular, remote parks
Glacier, Zion

Table 2. Final clustering of parks.

Analyzing differences

After the parks were clustered, a difference-in-difference analysis was performed. For each park, the percent change in visitors over each possible three-year time period was calculated. For each three-year period in each cluster, parks that increased entrance fees in the second year were put in one group and those that did not increase fees that year were put in a second group. The median value of the first group was then subtracted from that of the second group for each cluster.

C. Regression analyses

In an attempt to determine the elasticity of the relationship between fees and visitor numbers, regression analyses were conducted. This procedure expanded on the previous difference-in-difference analysis by considering magnitudes of effects. The fee variable and the visitor number variable were both log transformed so that the results could be interpreted as the price elasticity of demand for park visitation.

The regressions were performed in a progressively complex sequence:

(a) A fixed effects regression was run, in which the natural log of visitor number was regressed on the natural log of per-vehicle fees, yearly unemployment rates, and the natural log of the yearly average gas prices, with dummy variables included for each park. These park dummy variables in this case control for all differences among parks that might affect visitor numbers. Gas prices and unemployment rate (used here as a general indicator of the state of the U.S. economy) were included because they are easily and accurately measured, and likely influence national trends of park visitor numbers.

(b) Unemployment rates and gas prices from the previous regression were replaced with year dummy variables, resulting in a full panel regression. Including year dummy variables in this specification controlled for all factors beyond gas prices and unemployment rates which might influence national trends in visitor numbers, but which were omitted from the previous specification.

(c) Another full panel regression was run, again including dummy variables for parks and years, but this time interacting the park dummy variables with the fee variable. This specification considered the possibility that different parks react differently to changes in fee levels. In particular, this specification allows for the slope coefficient on the log fee variable to differ from park to park.

V. Results

Graphing trends in visitor numbers over time

Review of the graphs did not reveal any obvious problems with the data in terms of inconsistencies in collection methods over time or between parks. The review also did not reveal any consistent effect of fees on visitation rates.

Difference-in-difference

The difference-in-difference analysis produced nine negative and six positive results (Table 3).

	1997-1999	1998-2000	1999-2001	2000-2002	2001-2003	2002-2004	2003-2005	2004-2006
Cluster 1							-20.2	
Cluster 2								
Cluster 3								-2.0
Cluster 4						-20.7	-15.6	
Cluster 5			0.8					7.2
Cluster 6	-16.6		-7.5	-7.1				
Cluster 7								
Cluster 8	-3.6		10.1					
Cluster 9							-5.5	
Cluster 10	1.6						10.5	

Table 3. Net median percent change in number of visitors, parks that increased fees in middle year minus those that did not.

Regression analyses

The first regression suggested that increasing fees negatively influences visitor numbers. However, when the second regression was run with year fixed effects included, that influence was no longer observed. When the park variable was interacted with the fee variable in the third regression, eight parks showed a significant relationship between fees and visitor numbers (five negative and three positive).

See Appendix E for the STATA log file detailing the specifications and results of the regressions. Tables 4 and 5 below describe the coefficients and standard errors for the two fixed effects regressions that did not contain interaction terms. The first, which controlled for gas prices, unemployment and park fixed effects, showed a 10 percent increase in fees resulting in a 0.51 percent decrease in number of visitors (significant at the 1% level). The second regression, which replaced the gas and unemployment variables with year dummy variables, resulted in a slope coefficient on the fee variable that was insignificant at the 5 percent level. An F-test indicated that the addition of the 10 year dummy variables produced a significant improvement in the specification (see STATA log file for the test details).

4. Effects of per-vehicle entrance fees on national park visitation rates, 1996 to 2006
Estimated regression coefficients and standard errors
Dependent variable: Natural log of yearly visitor count
Park fixed effects included

R^2 = .990	Fee (natural log)	Unemployment	Average yearly gas price (natural log)
Regression coefficient	-.051[a]	-.034[a]	-.094[a]
Standard Error	(.019)	(.0086)	(.028)

[a] Significant at the 1% level   Note: Regression based on 303 observations

5. Effects of per-vehicle entrance fees on national park visitation rates, 1996 to 2006
Estimated regression coefficients and standard errors
Dependent variable: Natural log of yearly visitor count
Park and year fixed effects included

R^2 = .990	Fee (natural log)
Regression coefficient Standard Error	.013* (.0035)

* Not significant at the 5% level Note: Regression based on 303 observations

Table 6 shows the results of the third regression, in which fees and parks were interacted. An F-test indicated that the interaction as a whole was significant (see STATA log file for details of the test). As Acadia National Park was the omitted category in this regression, the coefficient listed for that park represents the percent change in visitor numbers for that park when fees are raised by one percent. The coefficients listed for the other parks, when added to the coefficient for Acadia, represent the percent change in number of visitors to those parks when fees are raised by one percent.

6. Effects of per-vehicle entrance fees on national park visitation rates, 1996 to 2006
Estimated regression coefficients and standard errors
Dependent variable = Natural log of yearly visitor count
Park and year fixed effects included
Parks and fees interacted

	Interaction Coefficient	Standard Error
Acadia (omitted category)	-0.176[a c]	0.069
Arches	-0.431	0.614
Badlands	0.113	0.110
Black Canyon of the Gunnison	-0.009	0.153
Big Bend	0.400[a *]	0.100
Bryce Canyon	0.045[*]	0.081
Canyonlands	0.086	0.103
Capitol Reef	-0.259	0.497
Crater Lake	0.130	0.130
Denali	0.369[a *]	0.088
Death Valley	-0.077[*]	0.104

Everglades	0.392[a]	0.130
Glacier	0.382[a] *	0.114
Grand Canyon	0.077	0.127
Grand Tetons	0.134	0.127
Haleakala	0.156	0.103
Hawaii Volcanoes	-0.007	0.130
Joshua Tree	0.364[a]	0.119
Lassen Volcanic	0.145	0.130
Mesa Verde	-0.116*	0.130
Mount Rainier	0.126	0.119
Olympic	0.044	0.119
Petrified Forest	-0.208*	0.130
Rocky Mountain	0.217[b]	0.088
Saguaro	0.213	0.178
Theodore Roosevelt	0.305[a]	0.103
Yellowstone	0.218	0.127
Yosemite	0.099	0.081
Zion	0.237[a]	0.081

[a] Significantly different from Acadia at the 1% level
[b] Significantly different from Acadia at the 5% level
* Slope is significantly different from zero at the 5% level
$R^2 = .993$
Note: Regression based on 303 observations

Table 7 lists the parks for which a significant relationship was found between fees and visitor numbers, and the magnitude of those effects.

Park	Percent change in visitor numbers from a 10% raise in fees
Petrified Forest	-3.24
Mesa Verde	-2.32
Death Valley	-1.93
Acadia	-1.76
Bryce Canyon	-0.71
Denali	2.54
Glacier	2.66
Big Bend	2.84

Table 7. Parks with significant relationship between fees and visitor numbers.

VI. Discussion

Immediately upon graphing visitation numbers over time it became apparent that visitor numbers at few of the parks in the sample have trended together. This fact made the attempt to detect an overall effect of fees on visitor numbers challenging.

Grouping the parks into small clusters was a first attempt to deal with this variation among parks. This was a difficult task, given the huge degree to which the parks vary across many dimensions. While most of the final clusters were based on convincing reasoning and resulted in groupings of parks which indeed trended together over time, some of the parks proved difficult to place into groupings.

The difference-in-difference analysis produced one and a half times as many comparisons that yielded a net negative effect than those that yielded a net positive effect. It would be unwise to interpret these results on their own as proof of a causal relationship between raised fees and reduced visitor numbers, given the subjectivity of the process and the paucity of the data points. However, had the other results obtained from this analysis shown a similar, negative effect of fees on visitor numbers, this difference-in-difference analysis could have served to bolster the claim that a causal relationship exists.

The results of the regression analyses were inconclusive. While the first regression showed a significant negative effect of fees on visitor numbers, the second regression negated this result. It is likely that there are other time-related variables in addition to fees, gas prices and national unemployment which may account for much of the variability assigned to fees in the first regression. Possibilities for such variables, which were omitted due to the difficult to impossible nature of gathering data for them, include: the strength of the U.S. dollar on the international market, national and regional weather patterns, and the cost of air travel.

Another problem with each of the first two regressions is that the parks vary so much in their response to fees that we may not be able to conclude anything from a test designed to find just one significant slope coefficient for all parks. The third regression attempted to address this concern by interacting fees and parks, and thus allowing for the slope of the relationship between fees and visitor numbers to differ for each park. Once again, however, the results were contradictory and less than convincing. A possible explanation is that employing a full panel regression including an interaction term consumes a large amount of degrees of freedom, and thus results in a large amount of error. The upshot is that even fairly large effects, if they existed, would be lost in the noise. Nonetheless, with only eight significant results, and three of these showing strong *positive* effects, it becomes still more difficult to make any case for a negative overall effect of fees on visitor numbers.

It is difficult to reconcile the results of this final regression analysis with the final clusters I chose for the difference-in-difference analysis. Contrary to expectations, the parks that showed significant fee effects were almost entirely from distinct clusters. Two were clustered together – Bryce Canyon and Death Valley; but if we want to believe that the clusters were adequate, or that the regression results were legitimate, then we should in this case have seen Arches – the third park in this cluster – also showing a significant negative effect of fees. This was not the case.

As inconclusive as the results of this analysis appear, when taken as a whole they do indicate that there is no clear, overall effect of fees on visitor numbers, at least at the level of fees that have been charged to date. The possibility remains that fee levels do have an effect on visitor numbers at some individual parks. However, it appears from this analysis that to tease such an effect out of the myriad other influences on demand for park entry would require an experiment of the type that would be impractical to perform in the context of National Parks. Randomly assigning National Parks to control and treatment groups and centrally determining the level of fees that each park could charge would be politically impossible, as well as simply bad for business.

The generally inelastic relationship between National Park entrance fees and visitation rates indicated by this analysis aligns well with economic theory. When people visit parks they typically incur travel and lodging expenses greatly in excess of the park entrance fees. Furthermore, ready substitutes for National Park visits simply do not exist; the Grand Canyon and Arches National Park, for example, are unique to this world. The results of this analysis suggest that in basing its fee policy on this economic theory, DOI has acted wisely.

References

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Appendix A. Data analyzed by the Department of Interior

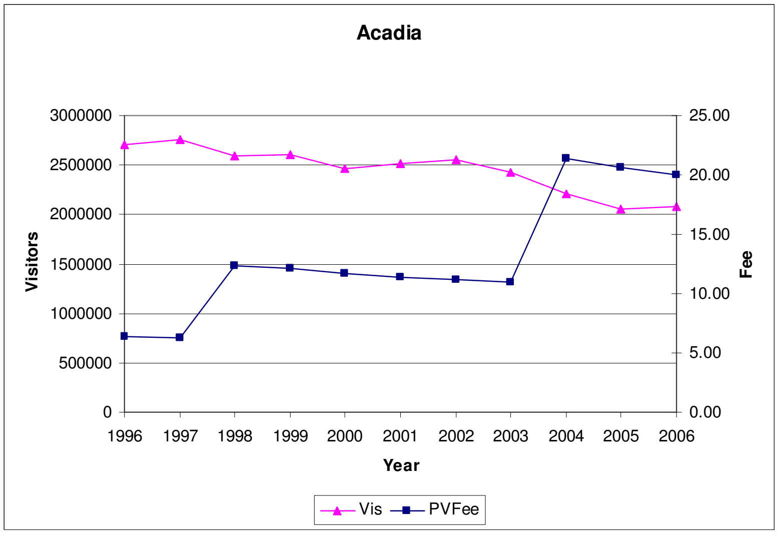
	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Fee demo sites	164.8	166.6	159.9	164.4	163.2	163.7	164.4	161.9	161.9	216.4	229.9	220.4
All other sites	101.7	103.0	105.9	110.8	123.5	123.4	122.1	123.3	123.3	56.9	35.5	56.0
NPS Total	266.5	269.6	265.8	275.2	286.7	287.1	286.5	285.2	285.2	277.3	265.4	276.5

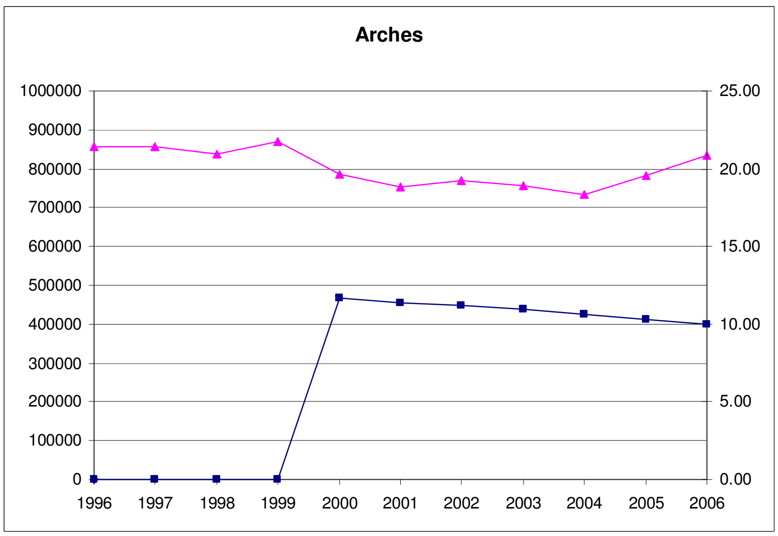
Source: DOI FY 2004 Recreation Fee Demonstration Program Summary.

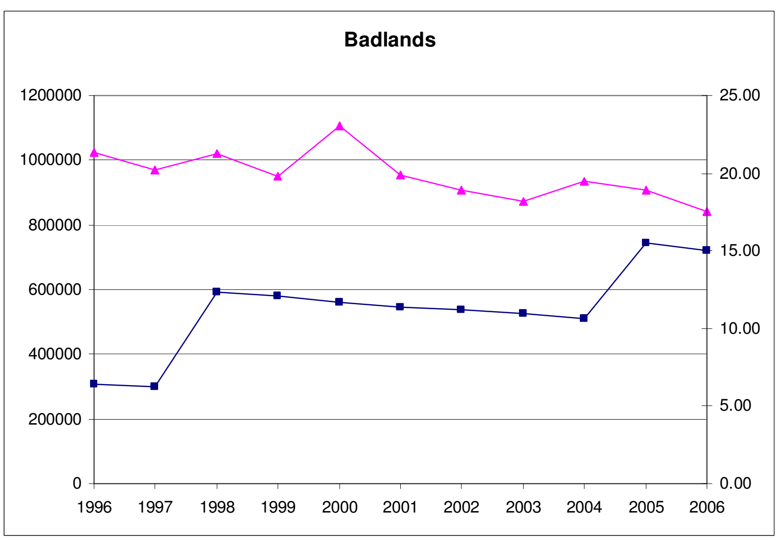
Appendix B. Variable descriptions and distribution of fees at U.S. National Parks

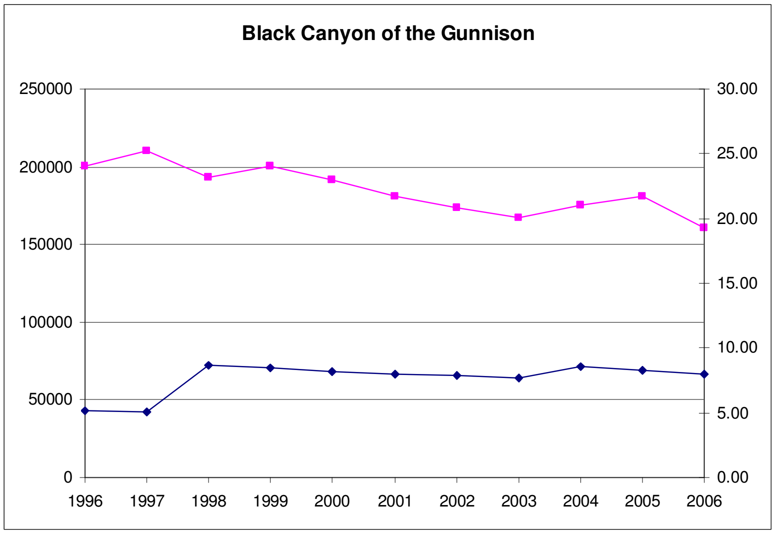
Variable	Mean	Standard Deviation	Min	Max
Per vehicle fee, $	11.24	6.55	0	25
Yearly visitor count	1,401,864	1,130,304	160,450	4,791,668
Yearly average gas price, ¢	178.09	38.92	132.55	261.83
Unemployment rate, %	4.97	0.62	4	6

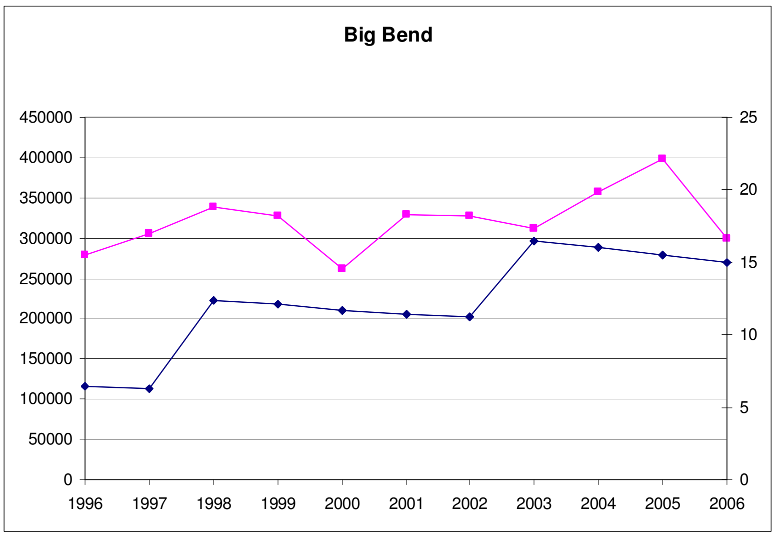
Appendix C. Visitor numbers and fees from 1996 to 2006 for parks in the sample

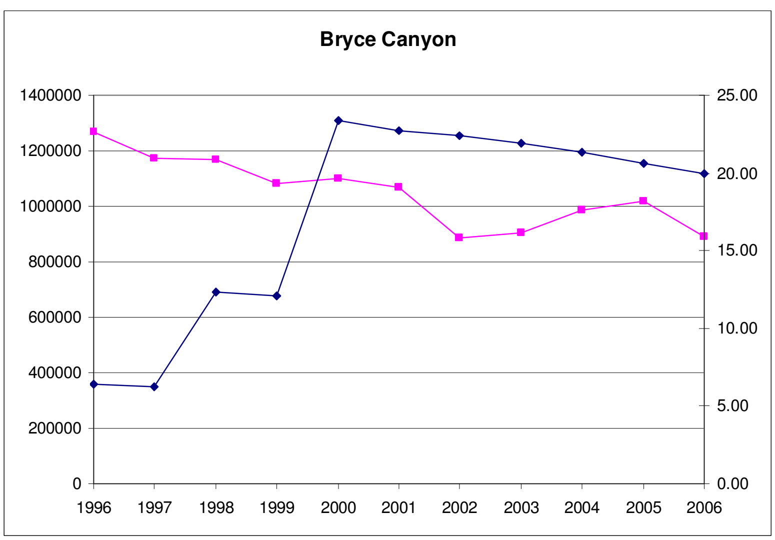


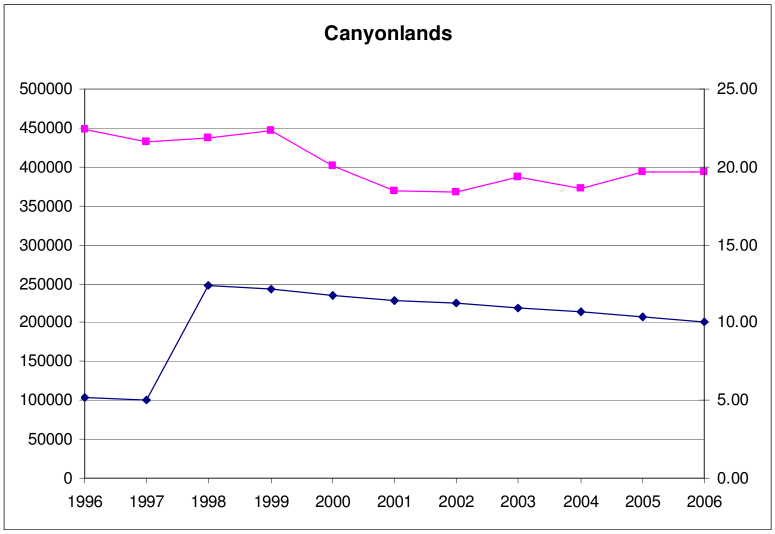


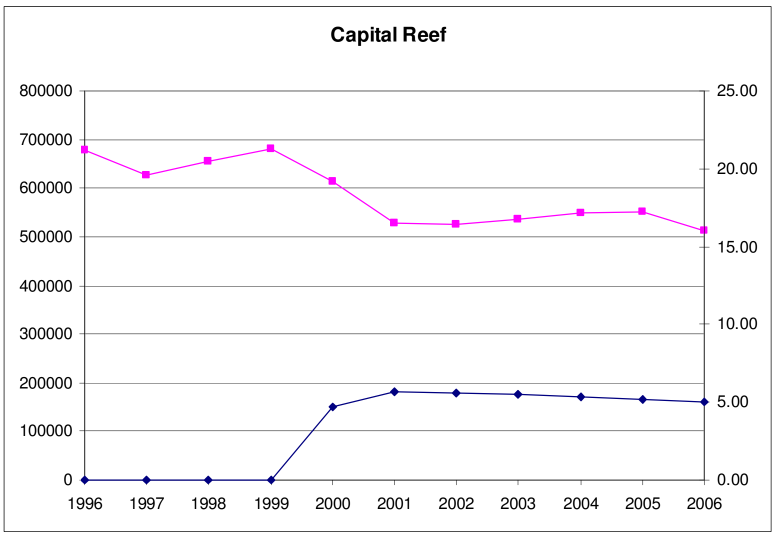


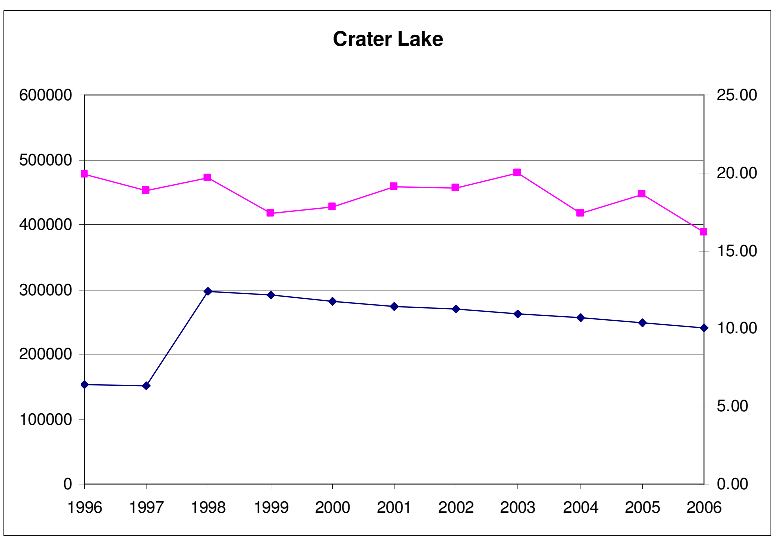

Black Canyon of the Gunnison
250000
200000
150000
100000
50000
0
30.00
25.00
20.00
15.00
10.00
5.00
0.00
1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006

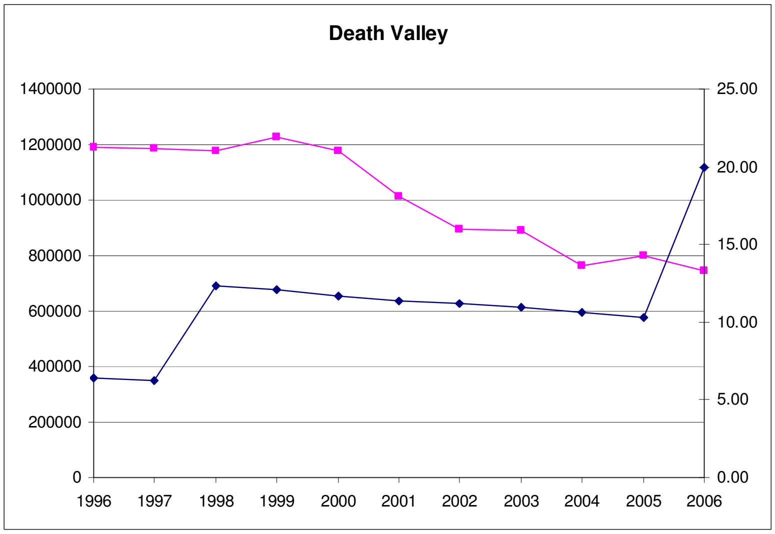

Big Bend
450000
400000
350000
300000
250000
200000
150000
100000
50000
0
25
20
15
10
5
0
1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006

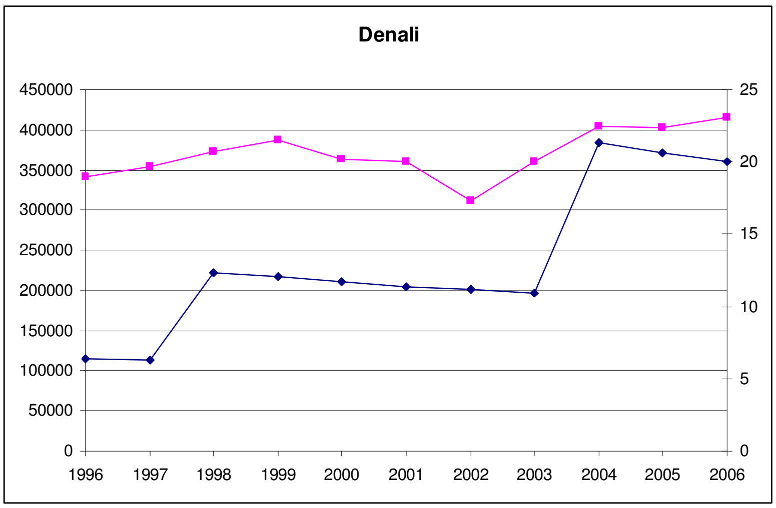

Bryce Canyon
1400000
1200000
1000000
800000
600000
400000
200000
0
25.00
20.00
15.00
10.00
5.00
0.00
1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006

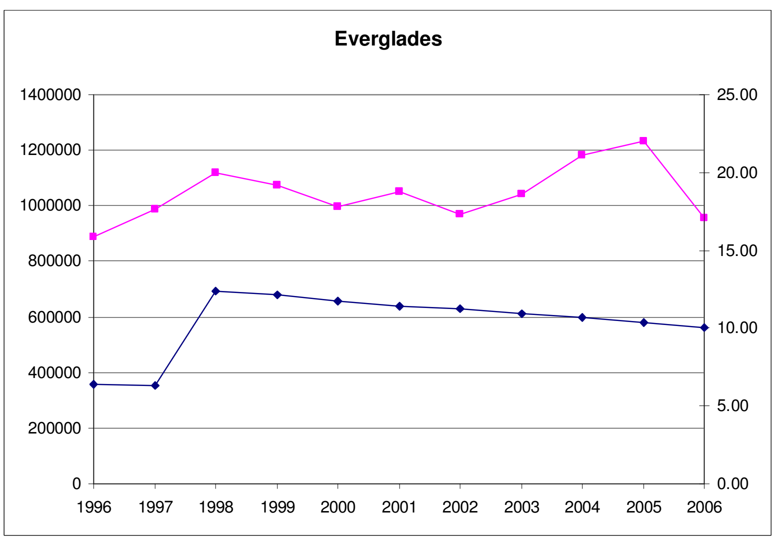

Canyonlands
500000
450000
400000
350000
300000
250000
200000
150000
100000
50000
0
25.00
20.00
15.00
10.00
5.00
0.00
1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006

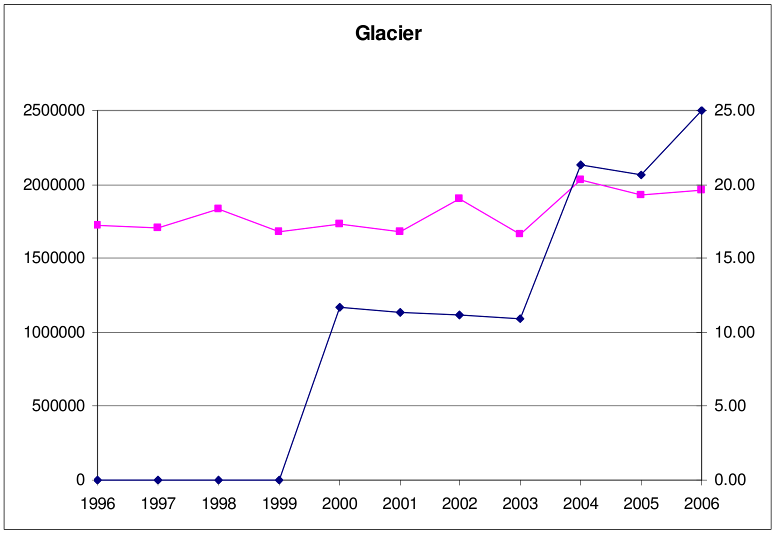

Capital Reef
800000
700000
600000
500000
400000
300000
200000
100000
0
25.00
20.00
15.00
10.00
5.00
0.00
1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006

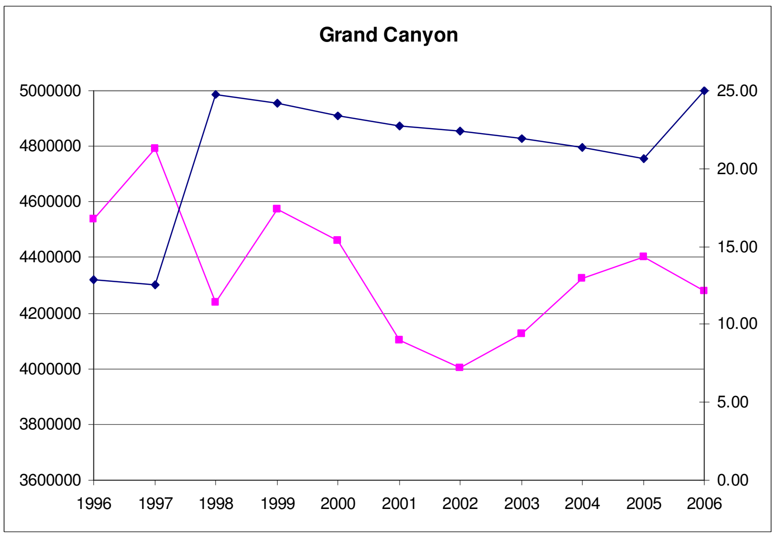

Crater Lake
600000
500000
400000
300000
200000
100000
0
25.00
20.00
15.00
10.00
5.00
0.00
1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006

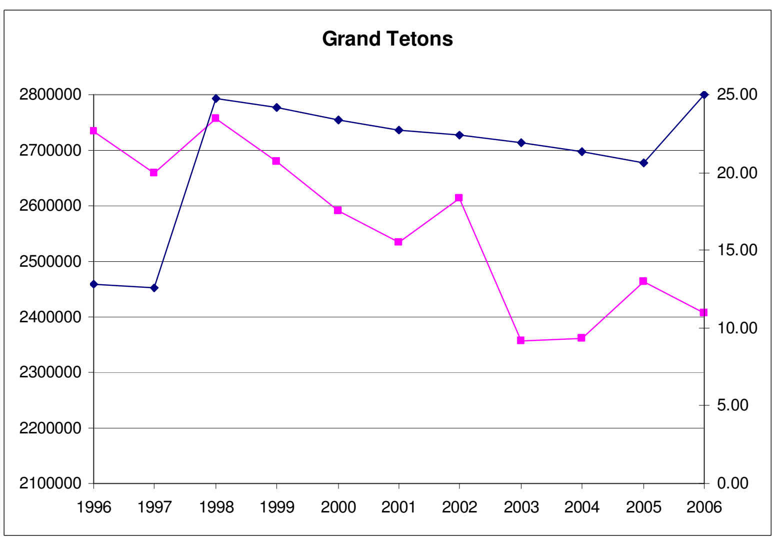

Death Valley
1400000
1200000
1000000
800000
600000
400000
200000
0
25.00
20.00
15.00
10.00
5.00
0.00
1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006

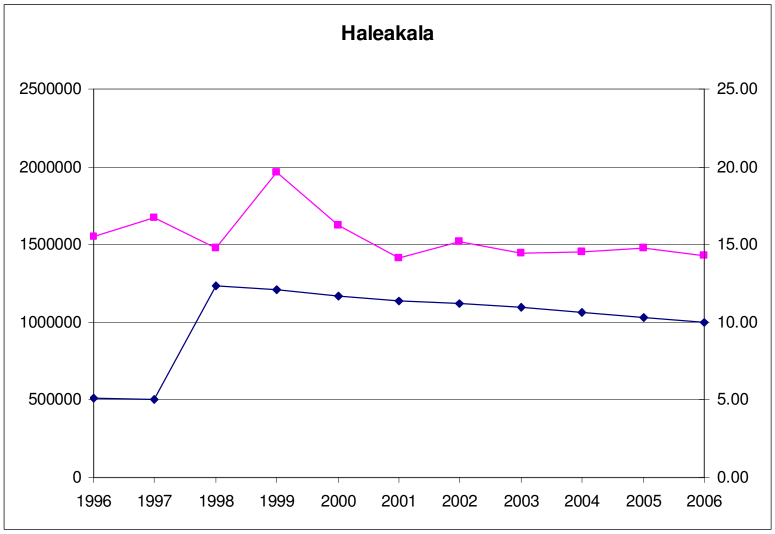

Denali
450000
400000
350000
300000
250000
200000
150000
100000
50000
0
25
20
15
10
5
0
1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006

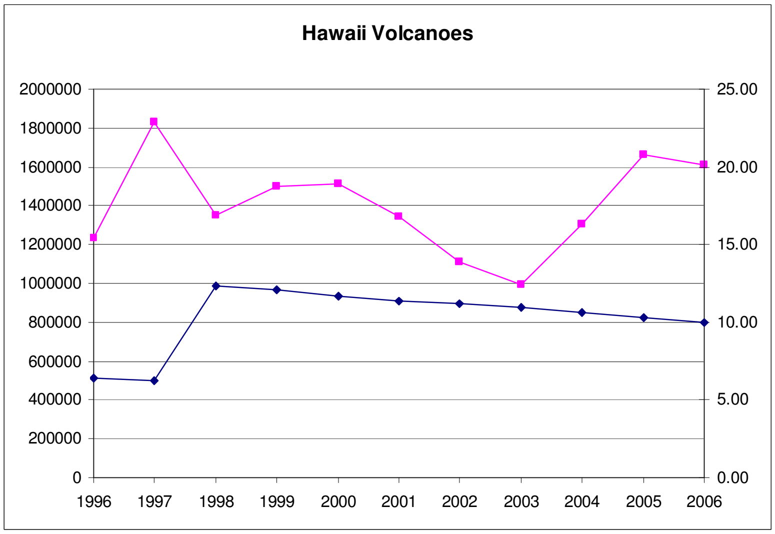

Everglades
1400000
1200000
1000000
800000
600000
400000
200000
0
25.00
20.00
15.00
10.00
5.00
0.00
1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006

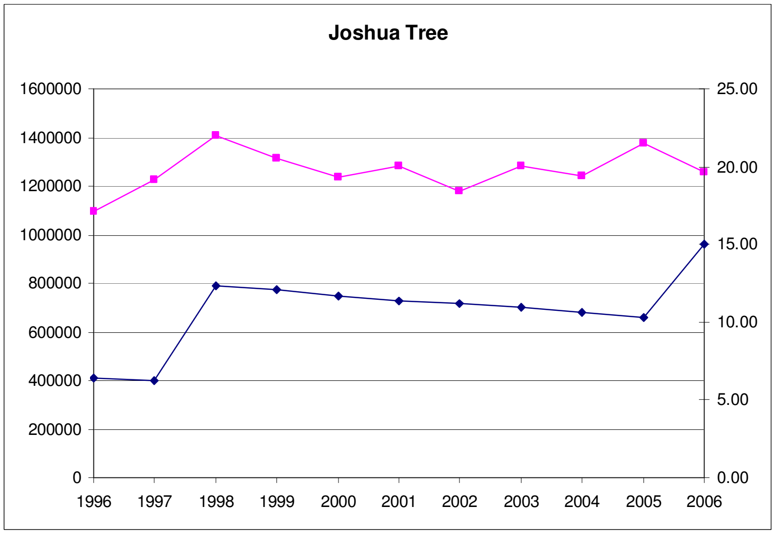

Glacier
2500000
2000000
1500000
1000000
500000
0
25.00
20.00
15.00
10.00
5.00
0.00
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006

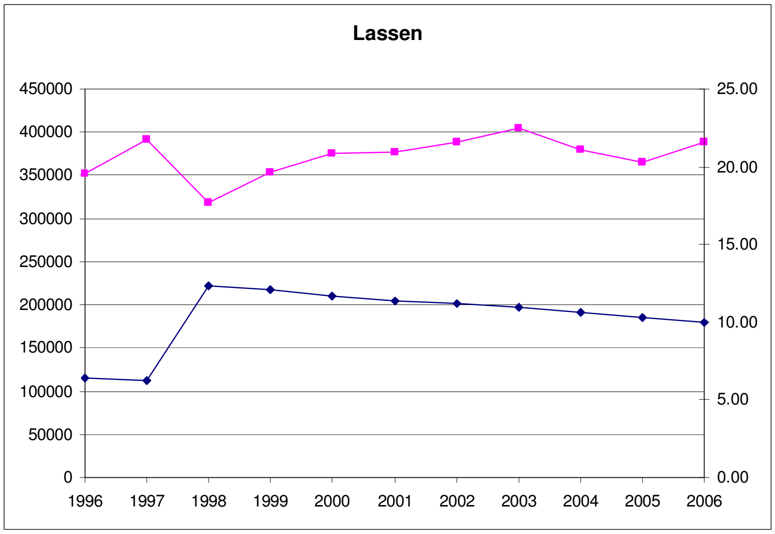

Grand Canyon
5000000
4800000
4600000
4400000
4200000
4000000
3800000
3600000
25.00
20.00
15.00
10.00
5.00
0.00
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006

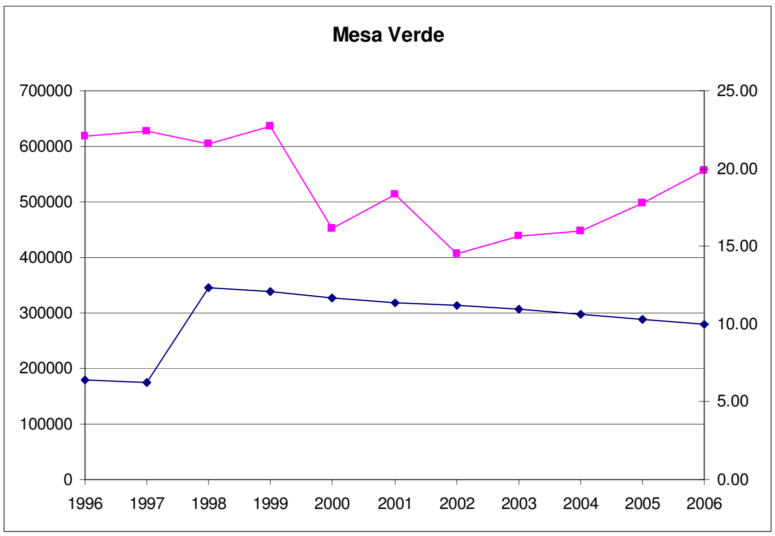

Grand Tetons
2800000
2700000
2600000
2500000
2400000
2300000
2200000
2100000
25.00
20.00
15.00
10.00
5.00
0.00
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006

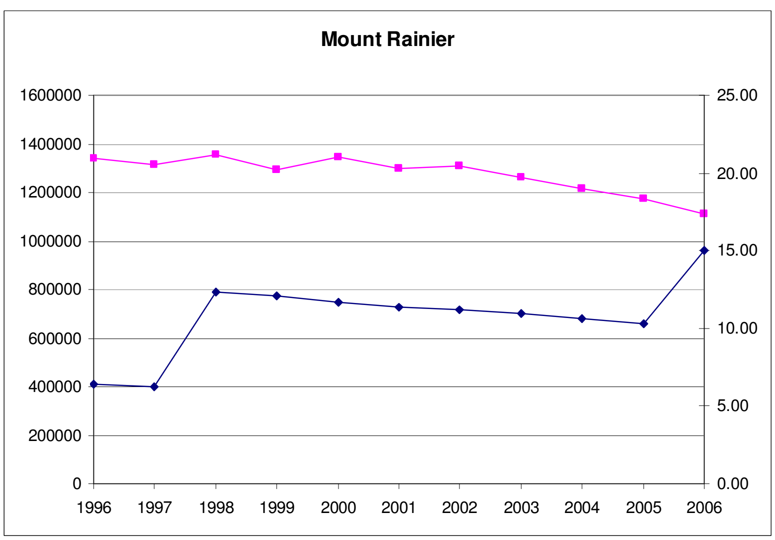

Haleakala
2500000
2000000
1500000
1000000
500000
0
25.00
20.00
15.00
10.00
5.00
0.00
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006

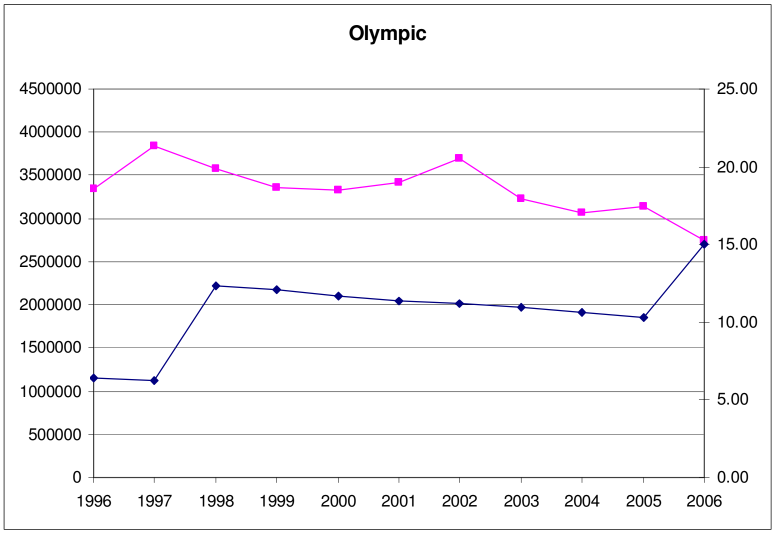

Hawaii Volcanoes
2000000
1800000
1600000
1400000
1200000
1000000
800000
600000
400000
200000
0
25.00
20.00
15.00
10.00
5.00
0.00
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006

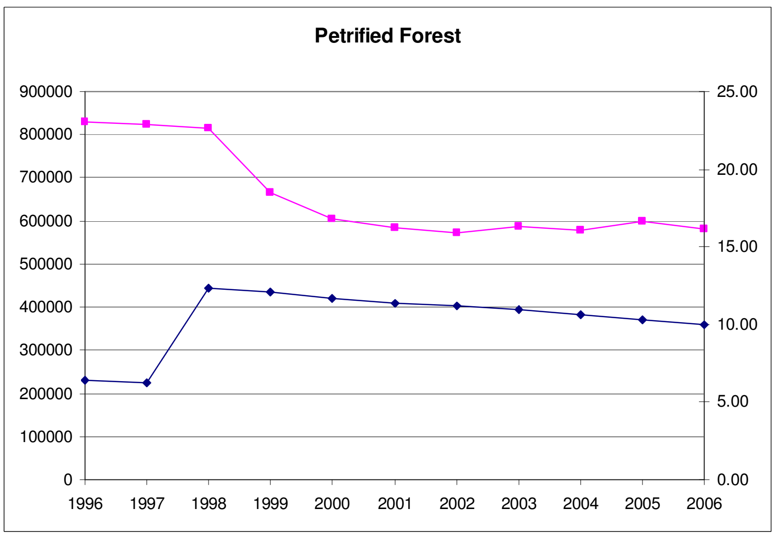

Joshua Tree
1600000
1400000
1200000
1000000
800000
600000
400000
200000
0
25.00
20.00
15.00
10.00
5.00
0.00
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006

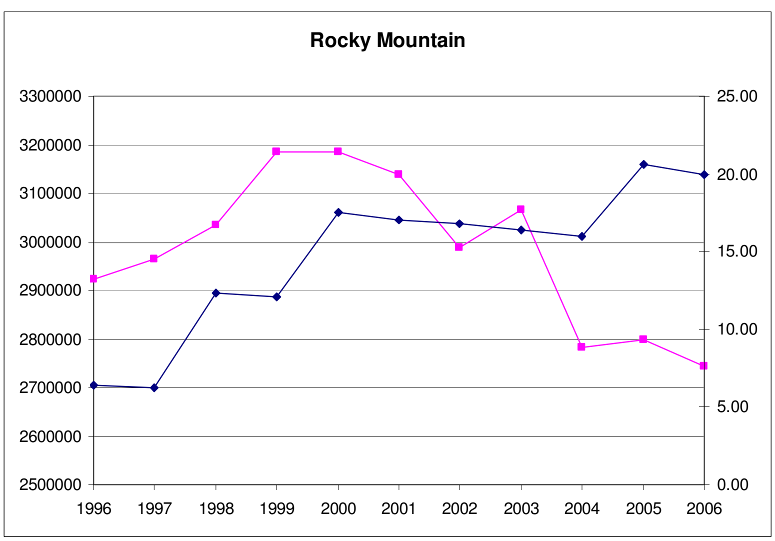

Lassen
450000
400000
350000
300000
250000
200000
150000
100000
50000
0
25.00
20.00
15.00
10.00
5.00
0.00
1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006

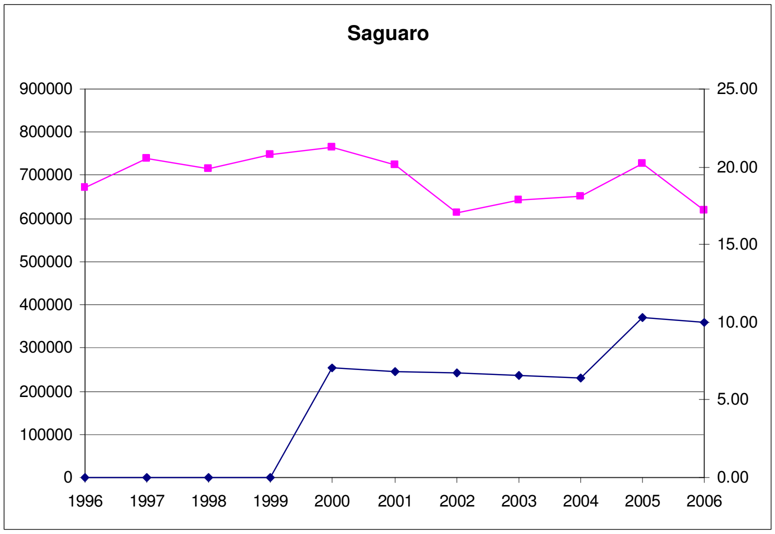

Mesa Verde
700000
600000
500000
400000
300000
200000
100000
0
25.00
20.00
15.00
10.00
5.00
0.00
1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006

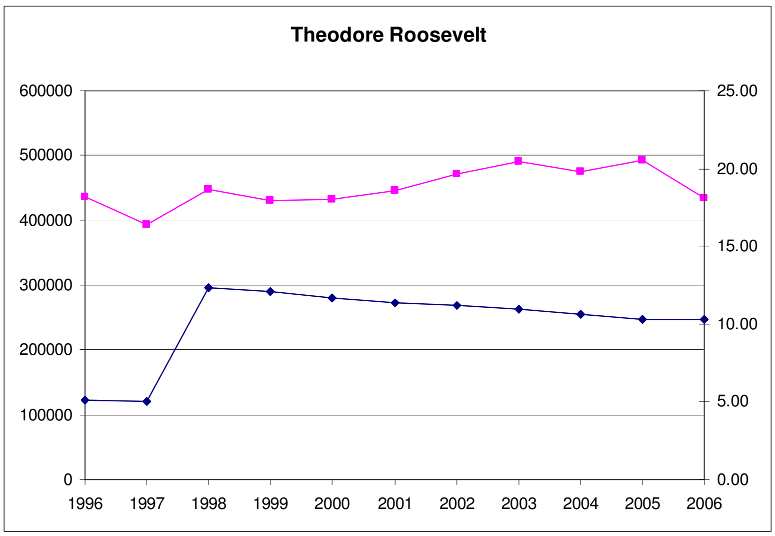

Mount Rainier
1600000
1400000
1200000
1000000
800000
600000
400000
200000
0
25.00
20.00
15.00
10.00
5.00
0.00
1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006

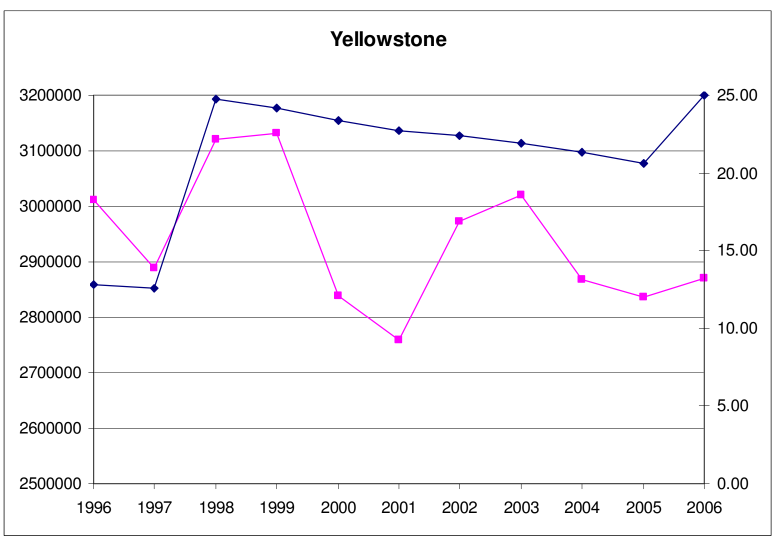

Olympic
4500000
4000000
3500000
3000000
2500000
2000000
1500000
1000000
500000
0
25.00
20.00
15.00
10.00
5.00
0.00
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006

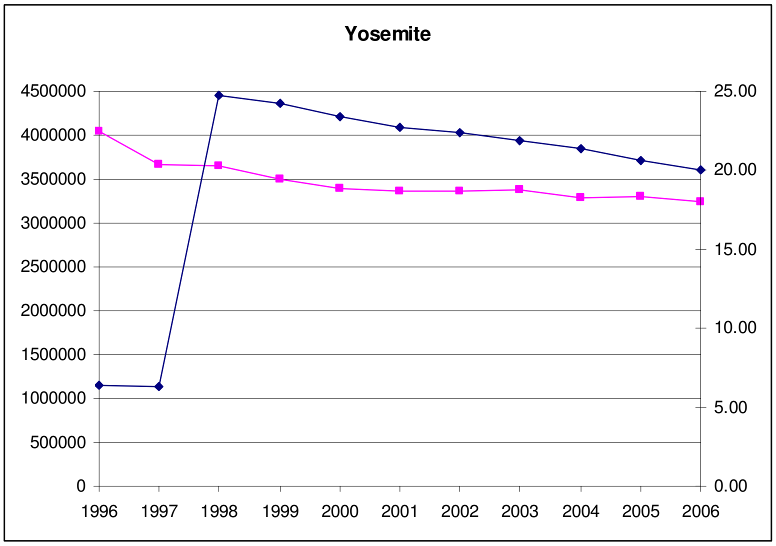

Petrified Forest
900000
800000
700000
600000
500000
400000
300000
200000
100000
0
25.00
20.00
15.00
10.00
5.00
0.00
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006


Rocky Mountain
3300000
3200000
3100000
3000000
2900000
2800000
2700000
2600000
2500000
25.00
20.00
15.00
10.00
5.00
0.00
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006

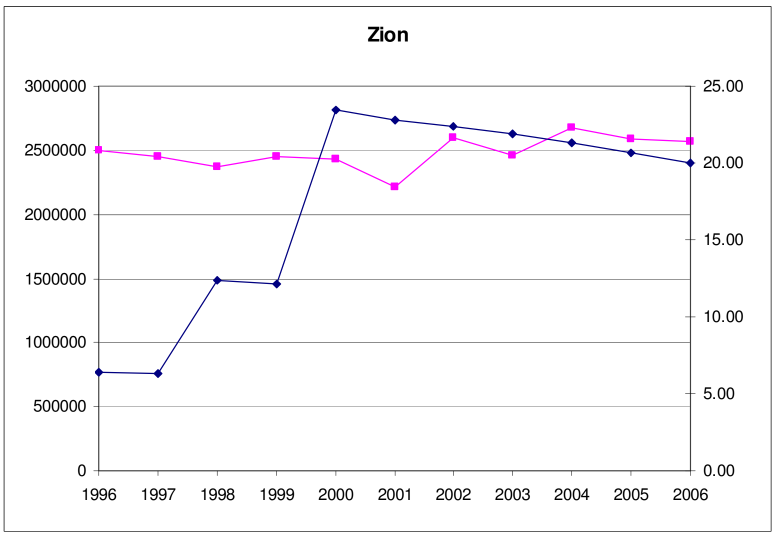

Saguaro
900000
800000
700000
600000
500000
400000
300000
200000
100000
0
25.00
20.00
15.00
10.00
5.00
0.00
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006


Theodore Roosevelt
600000
500000
400000
300000
200000
100000
0
25.00
20.00
15.00
10.00
5.00
0.00
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006


Yellowstone
3200000
3100000
3000000
2900000
2800000
2700000
2600000
2500000
25.00
20.00
15.00
10.00
5.00
0.00
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006

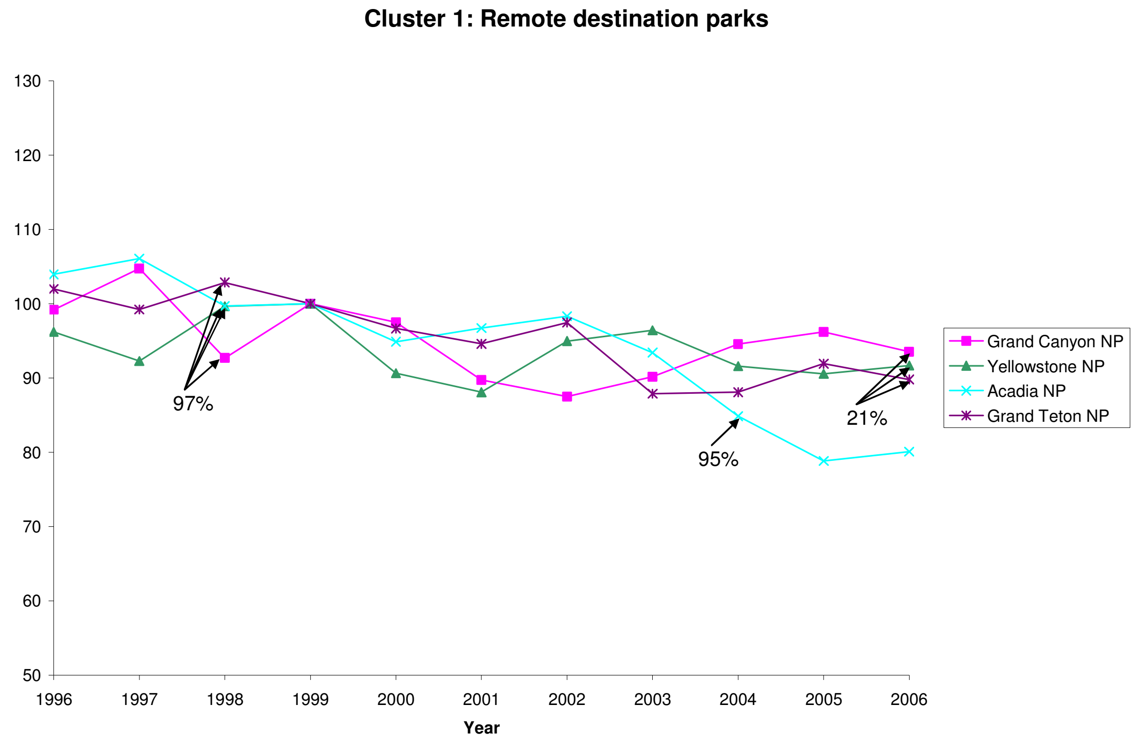


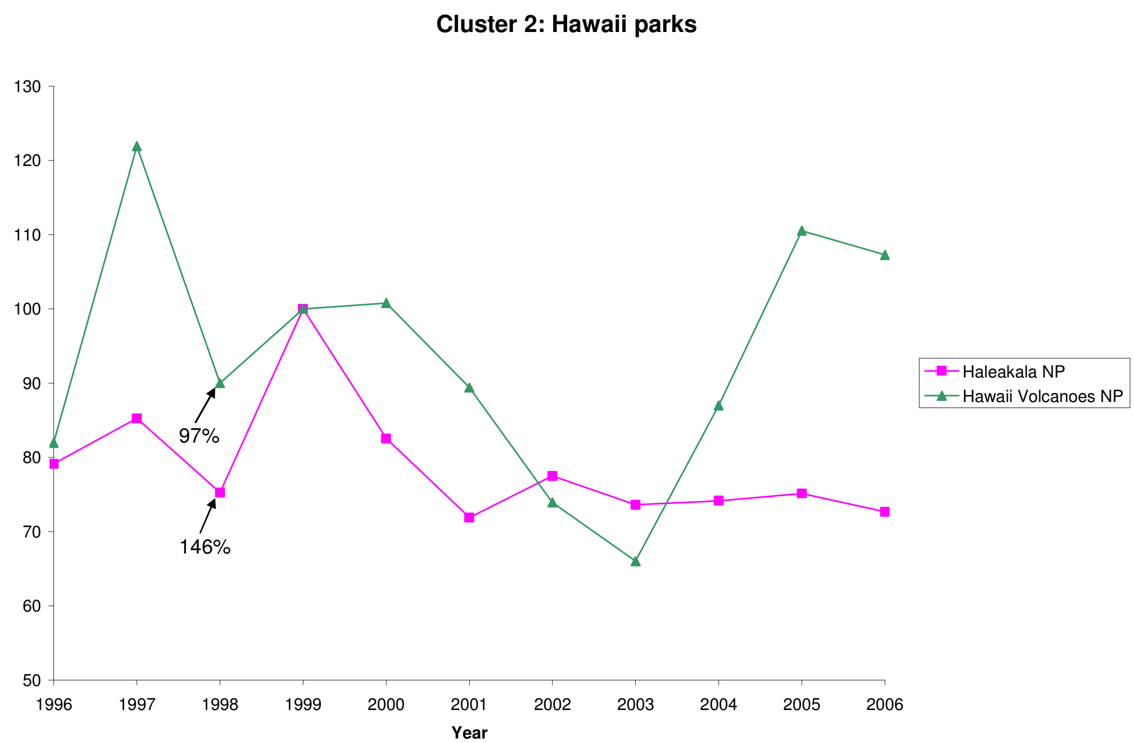
Yosemite
4500000
4000000
3500000
3000000
2500000
2000000
1500000
1000000
500000
0
25.00
20.00
15.00
10.00
5.00
0.00
1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006



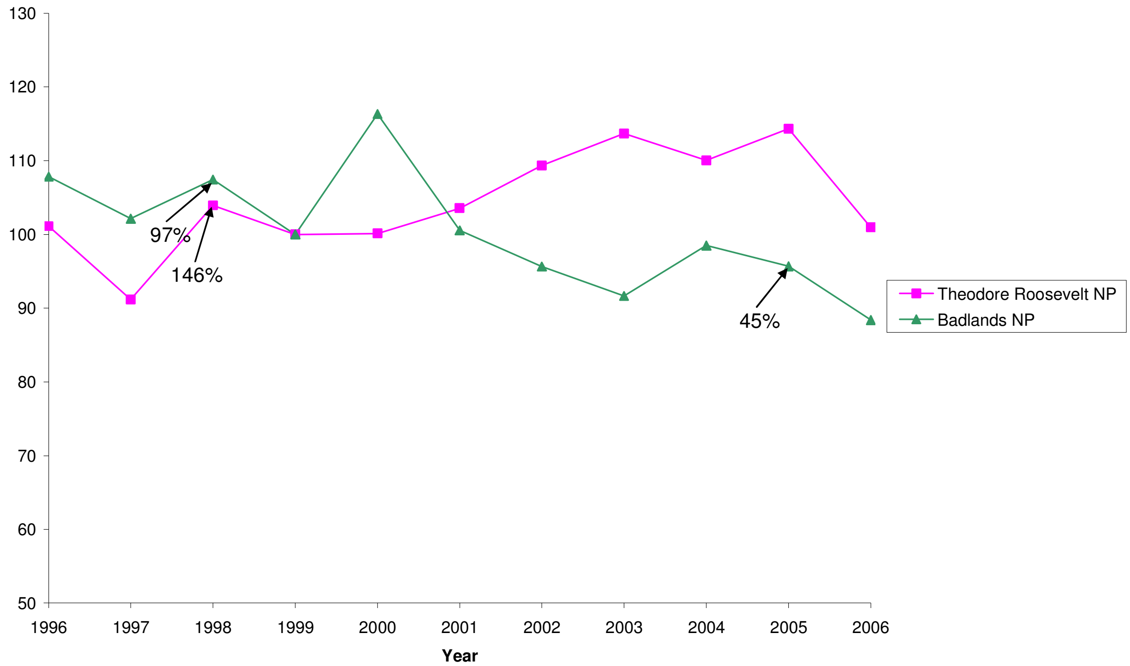
Zion
3000000
2500000
2000000
1500000
1000000
500000
0
25.00
20.00
15.00
10.00
5.00
0.00
1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006

Appendix D. Visitor trends, graphed by cluster (indexed to 100 in year 1999)

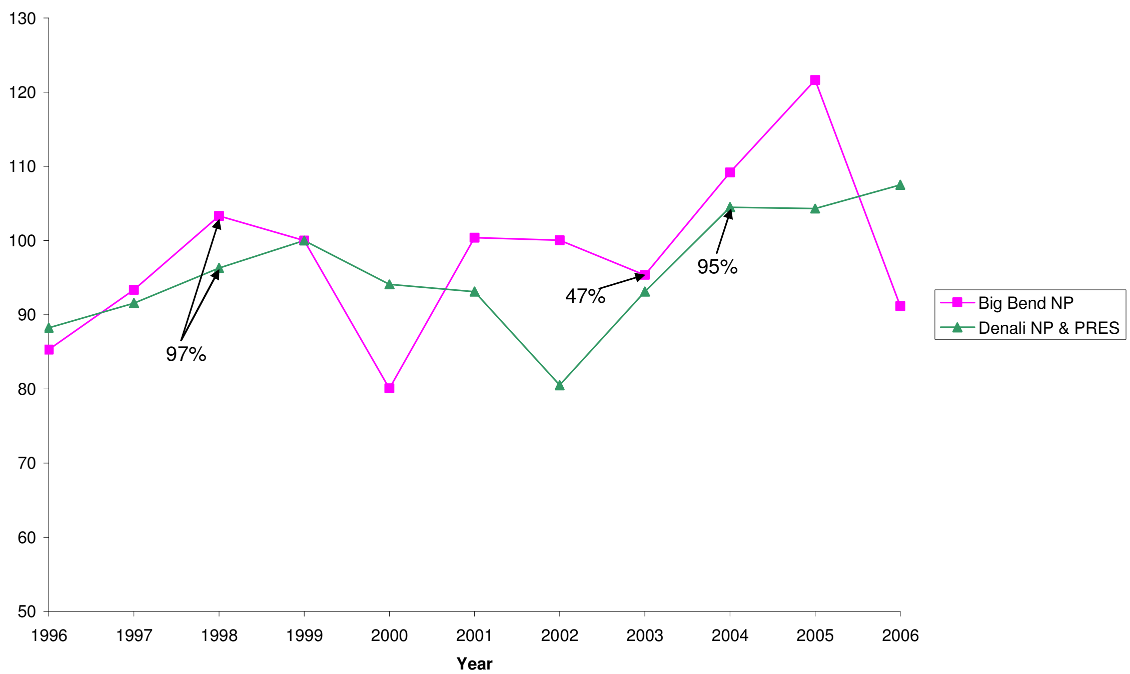




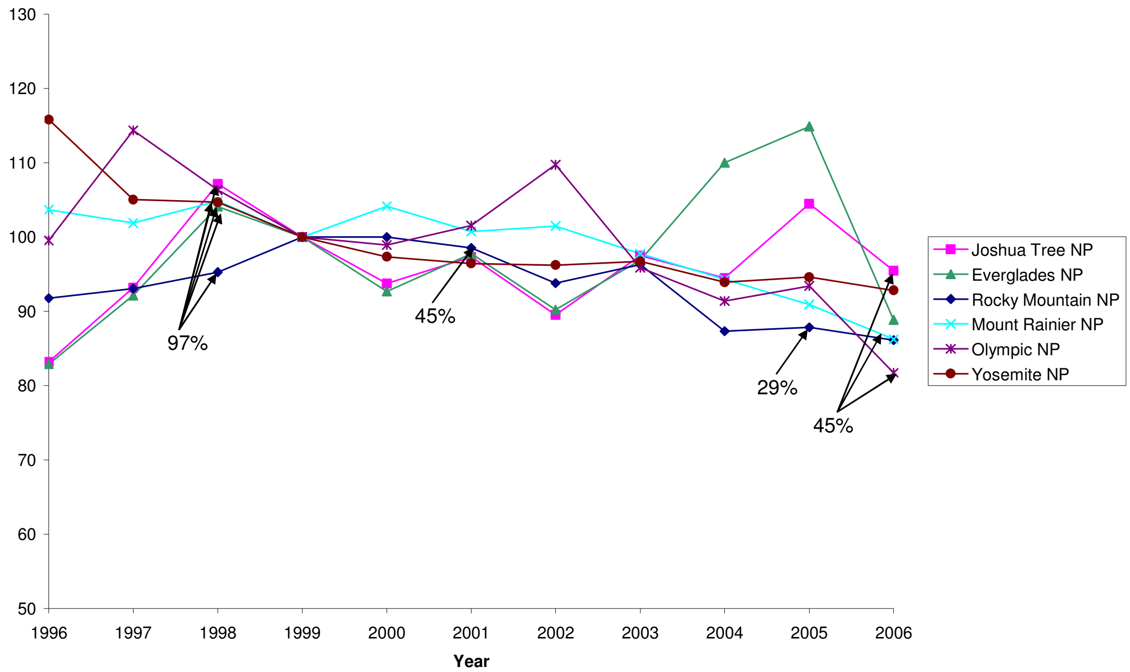
Cluster 3: Midwestern parks



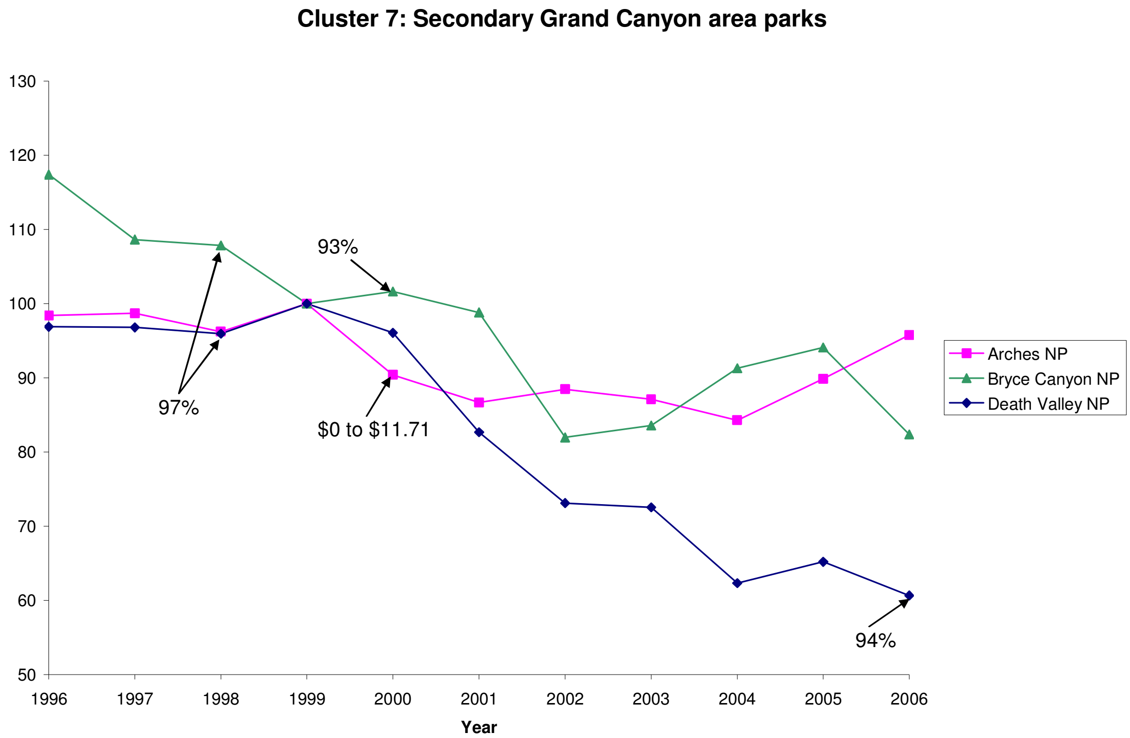
Cluster 4: Spatially isolated parks

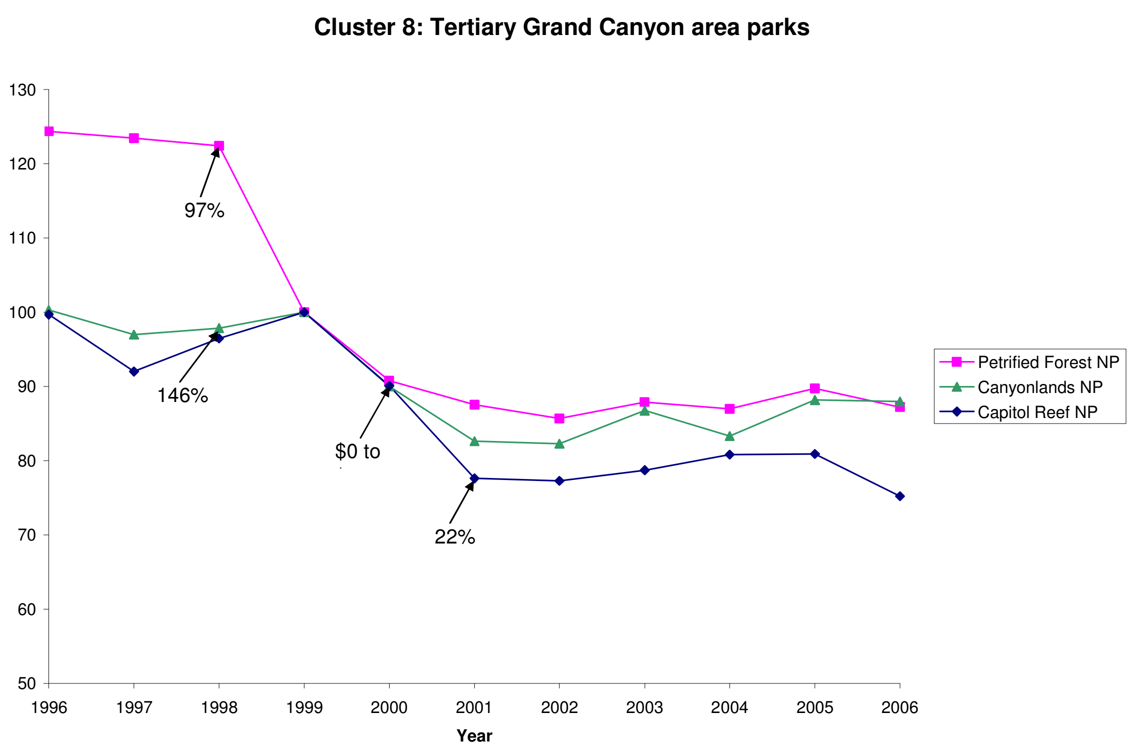


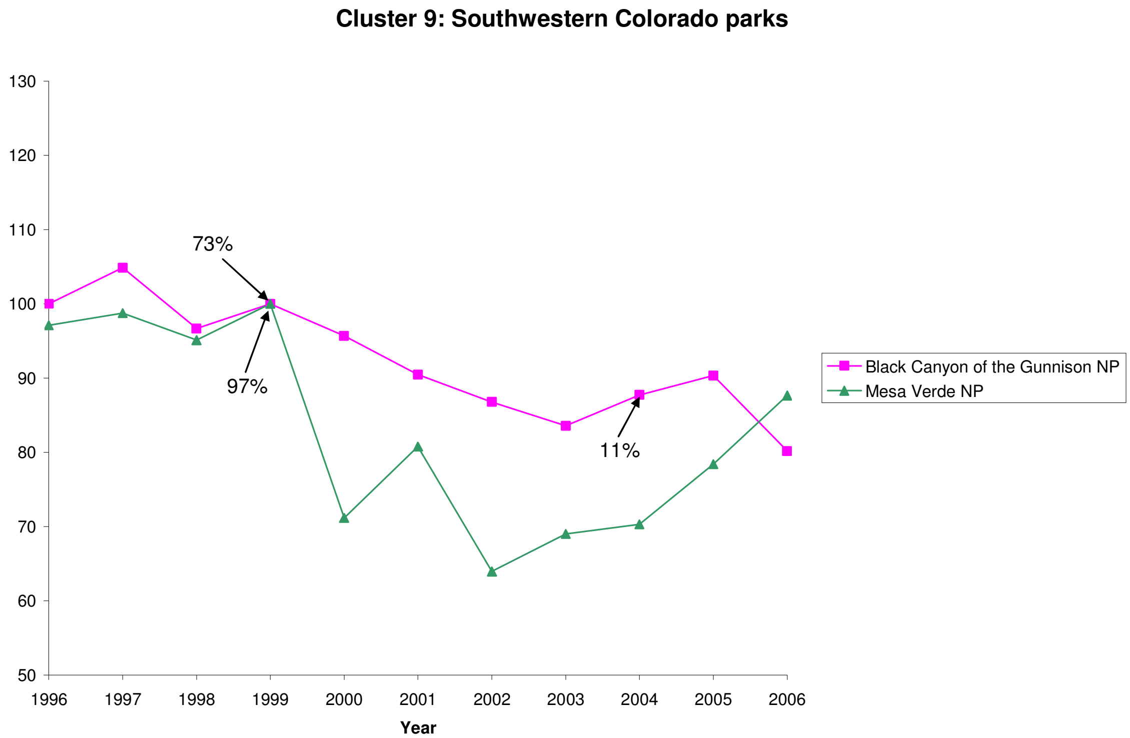
Cluster 5: Destination parks in heavily populated areas

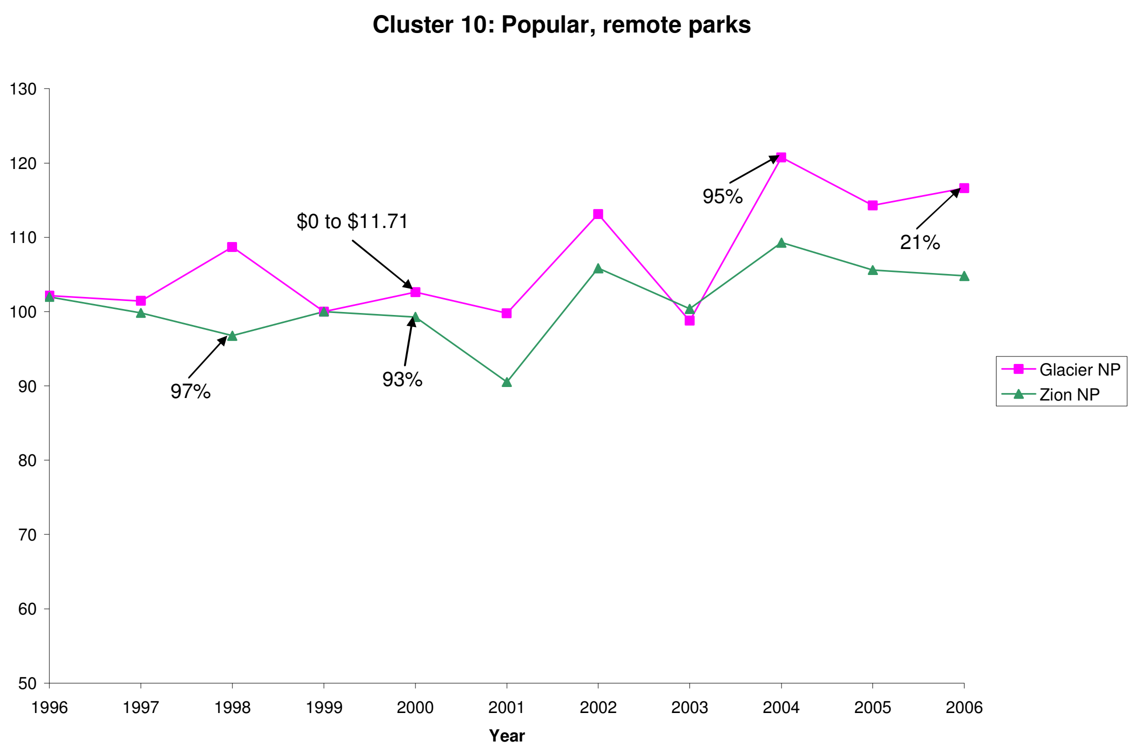


Cluster 6: Smaller pacific parks


Cluster 7: Secondary Grand Canyon area parks
130
120
110
100
90
80
70
60
50
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
Year
93%
97%
$0 to $11.71
94%
Arches NP
Bryce Canyon NP
Death Valley NP


Cluster 8: Tertiary Grand Canyon area parks
130
120
110
100
90
80
70
60
50
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
Year
97%
146%
$0 to
22%
Petrified Forest NP
Canyonlands NP
Capitol Reef NP


Cluster 9: Southwestern Colorado parks
130
120
110
100
90
80
70
60
50
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
Year
73%
97%
11%
Black Canyon of the Gunnison NP
Mesa Verde NP


Cluster 10: Popular, remote parks
130
120
110
100
90
80
70
60
50
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
Year
$0 to $11.71
95%
21%
97%
93%
Glacier NP
Zion NP

Appendix E. STATA log file

```
  log:  z:\MP\Analysis\Stata\log.log
  log type:  text
 opened on:  15 Jun 2007, 21:29:01

. set mem 20m
(20480k)

. use "Z:\MP\Analysis\Stata\MPData.dta"

. set matsize 100

. gen logvis = ln(vis)

. gen logpvfee = ln(pvfee)

. gen logpgas = ln(pgas)

. tab park, gen(dumpark)

       park |      Freq.     Percent        Cum.
------------+-----------------------------------
       ACAD |         11        3.45        3.45
       ARCH |         11        3.45        6.90
       BADL |         11        3.45       10.34
       BCGU |         11        3.45       13.79
       BIBE |         11        3.45       17.24
       BRCA |         11        3.45       20.69
       CANY |         11        3.45       24.14
       CARE |         11        3.45       27.59
       CRLA |         11        3.45       31.03
       DENA |         11        3.45       34.48
       DEVA |         11        3.45       37.93
       EVER |         11        3.45       41.38
       GLAC |         11        3.45       44.83
       GRCA |         11        3.45       48.28
       GRTE |         11        3.45       51.72
       HALE |         11        3.45       55.17
       HAVO |         11        3.45       58.62
       JOTR |         11        3.45       62.07
       LAVO |         11        3.45       65.52
       MEVE |         11        3.45       68.97
       MORA |         11        3.45       72.41
       OLYM |         11        3.45       75.86
       PEFO |         11        3.45       79.31
       ROMO |         11        3.45       82.76
       SAGU |         11        3.45       86.21
       THRO |         11        3.45       89.66
       YELL |         11        3.45       93.10
       YOSE |         11        3.45       96.55
       ZION |         11        3.45      100.00
------------+-----------------------------------
      Total |        319      100.00

. tab year, gen(dumyear)

       year |      Freq.     Percent        Cum.
------------+-----------------------------------
       1996 |         29        9.09        9.09
```

1997	29	9.09	18.18
1998	29	9.09	27.27
1999	29	9.09	36.36
2000	29	9.09	45.45
2001	29	9.09	54.55
2002	29	9.09	63.64
2003	29	9.09	72.73
2004	29	9.09	81.82
2005	29	9.09	90.91
2006	29	9.09	100.00
Total	319	100.00	

. regress logvis logpvfee dumpark2-dumpark29 unemp logpgas /**note that fee coefficient is significant**/

Source	SS	df	MS		
				Number of obs =	303
				F(31, 271) =	832.13
Model	218.570179	31	7.05065094	Prob > F =	0.0000
Residual	2.29618972	271	.008473025	R-squared =	0.9896
				Adj R-squared =	0.9884
Total	220.866369	302	.731345592	Root MSE =	.09205

logvis	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
logpvfee	-.0511115	.0187857	-2.72	0.007	-.0880961	-.014127
dumpark2	-1.141549	.0446978	-25.54	0.000	-1.229548	-1.05355
dumpark3	-.9485185	.0393096	-24.13	0.000	-1.02591	-.8711274
dumpark4	-2.608557	.0402934	-64.74	0.000	-2.687885	-2.529229
dumpark5	-2.035159	.0392576	-51.84	0.000	-2.112447	-1.95787
dumpark6	-.8379516	.0395342	-21.20	0.000	-.9157849	-.7601184
dumpark7	-1.813273	.0394862	-45.92	0.000	-1.891012	-1.735534
dumpark8	-1.530303	.0475726	-32.17	0.000	-1.623962	-1.436644
dumpark9	-1.714632	.0394102	-43.51	0.000	-1.792221	-1.637043
dumpark10	-1.889022	.0392498	-48.13	0.000	-1.966296	-1.811749
dumpark11	-.9097263	.0393212	-23.14	0.000	-.9871402	-.8323124
dumpark12	-.8624955	.0394102	-21.89	0.000	-.9400847	-.7849064
dumpark13	-.2587464	.0447207	-5.79	0.000	-.3467906	-.1707023
dumpark14	.6028648	.0404672	14.90	0.000	.5231949	.6825348
dumpark15	.0724285	.0404672	1.79	0.075	-.0072415	.1520984
dumpark16	-.4723561	.0394862	-11.96	0.000	-.5500949	-.3946173
dumpark17	-.5765584	.0394102	-14.63	0.000	-.6541476	-.4989692
dumpark18	-.6686619	.0393539	-16.99	0.000	-.74614	-.5911837
dumpark19	-1.892852	.0394102	-48.03	0.000	-1.970441	-1.815262
dumpark20	-1.554683	.0394102	-39.45	0.000	-1.632272	-1.477094
dumpark21	-.6593005	.0393539	-16.75	0.000	-.7367787	-.5818223
dumpark22	.3023324	.0393539	7.68	0.000	.2248542	.3798106
dumpark23	-1.331683	.0394102	-33.79	0.000	-1.409272	-1.254094
dumpark24	.2052348	.0393159	5.22	0.000	.1278314	.2826383
dumpark25	-1.294301	.0456631	-28.34	0.000	-1.3842	-1.204401
dumpark26	-1.704308	.0394804	-43.17	0.000	-1.782036	-1.626581
dumpark27	.2110813	.0404672	5.22	0.000	.1314113	.2907512
dumpark28	.3697228	.039887	9.27	0.000	.291195	.4482506
dumpark29	.0278756	.0395342	0.71	0.481	-.0499577	.1057089
unemp	-.0336836	.0086328	-3.90	0.000	-.0506796	-.0166876
logpgas	-.0937051	.0279478	-3.35	0.001	-.1487275	-.0386826
_cons	15.487	.1432839	108.09	0.000	15.20491	15.76909

. regress logvis logpvfee dumpark2-dumpark29 dumyear2-dumyear11

```
      Source |       SS       df       MS              Number of obs =     303
-------------+------------------------------           F( 39,   263) =  687.11
       Model |  218.719758    39  5.60819891           Prob > F      =  0.0000
    Residual |  2.14661132   263   .00816202           R-squared     =  0.9903
-------------+------------------------------           Adj R-squared =  0.9888
       Total |  220.866369   302  .731345592           Root MSE      =  .09034

------------------------------------------------------------------------------
      logvis |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    logpvfee |   .0133734   .0353485     0.38   0.705    -.0562287    .0829755
    dumpark2 |  -1.118222   .0447225   -25.00   0.000    -1.206282   -1.030163
    dumpark3 |  -.9410793    .038738   -24.29   0.000    -1.017355   -.8648032
    dumpark4 |  -2.577283   .0421653   -61.12   0.000    -2.660307   -2.494258
    dumpark5 |  -2.032472   .0385509   -52.72   0.000    -2.108379   -1.956564
    dumpark6 |  -.8542001    .039539   -21.60   0.000    -.9320534   -.7763467
    dumpark7 |  -1.798464   .0393688   -45.68   0.000    -1.875982   -1.720945
    dumpark8 |  -1.460216   .0556913   -26.22   0.000    -1.569873   -1.350558
    dumpark9 |  -1.702439   .0390983   -43.54   0.000    -1.779424   -1.625453
   dumpark10 |  -1.889022   .0385228   -49.04   0.000    -1.964875    -1.81317
   dumpark11 |  -.9015966   .0387797   -23.25   0.000    -.9779548   -.8252385
   dumpark12 |  -.8503024   .0390983   -21.75   0.000     -.927288   -.7733169
   dumpark13 |  -.2566359   .0439743    -5.84   0.000    -.3432224   -.1700495
   dumpark14 |     .56905   .0427503    13.31   0.000     .4848735    .6532265
   dumpark15 |   .0386137   .0427503     0.90   0.367    -.0455628    .1227902
   dumpark16 |  -.4575466   .0393688   -11.62   0.000    -.5350649   -.3800284
   dumpark17 |  -.5643653   .0390983   -14.43   0.000    -.6413508   -.4873798
   dumpark18 |  -.6588457   .0388968   -16.94   0.000    -.7354344    -.582257
   dumpark19 |  -1.880658   .0390983   -48.10   0.000    -1.957644   -1.803673
   dumpark20 |   -1.54249   .0390983   -39.45   0.000    -1.619475   -1.465504
   dumpark21 |  -.6494844   .0388968   -16.70   0.000    -.7260731   -.5728957
   dumpark22 |   .3121485   .0388968     8.03   0.000     .2355599    .3887372
   dumpark23 |   -1.31949   .0390983   -33.75   0.000    -1.396475   -1.242504
   dumpark24 |   .1974153   .0387605     5.09   0.000     .1210948    .2737357
   dumpark25 |  -1.247421   .0488942   -25.51   0.000    -1.343694   -1.151147
   dumpark26 |  -1.689684   .0393481   -42.94   0.000    -1.767161   -1.612206
   dumpark27 |   .1772665   .0427503     4.15   0.000       .09309     .261443
   dumpark28 |   .3453475   .0407742     8.47   0.000      .265062     .425633
   dumpark29 |   .0116271    .039539     0.29   0.769    -.0662262    .0894805
    dumyear2 |   .0275228   .0255654     1.08   0.283    -.0228161    .0778616
    dumyear3 |   .0074154   .0356884     0.21   0.836    -.0628559    .0776867
    dumyear4 |   .0082075   .0351481     0.23   0.816        -.061     .077415
    dumyear5 |  -.0378049   .0351874    -1.07   0.284    -.1070898    .0314801
    dumyear6 |  -.0626894   .0346742    -1.81   0.072    -.1309637     .005585
    dumyear7 |  -.0880982   .0342961    -2.57   0.011     -.155628   -.0205683
    dumyear8 |  -.0910004   .0340878    -2.67   0.008    -.1581201   -.0238807
    dumyear9 |  -.0778039   .0353177    -2.20   0.028    -.1473453   -.0082625
   dumyear10 |  -.0466993    .035527    -1.31   0.190    -.1166528    .0232543
   dumyear11 |  -.1027352   .0372347    -2.76   0.006    -.1760514   -.0294191
       _cons |   14.71691   .0753209   195.39   0.000      14.5686    14.86522
------------------------------------------------------------------------------

. testparm dumyear*  /*shows that year dummies are significant and belong */

 ( 1)  dumyear2 = 0
 ( 2)  dumyear3 = 0
 ( 3)  dumyear4 = 0
 ( 4)  dumyear5 = 0
 ( 5)  dumyear6 = 0
 ( 6)  dumyear7 = 0
 ( 7)  dumyear8 = 0
 ( 8)  dumyear9 = 0
```

```
 ( 9)  dumyear10 = 0
 (10)  dumyear11 = 0

       F( 10,   263) =    4.87
            Prob > F =    0.0000


. xi: regress logvis i.park*logpvfee i.year
i.park            _Ipark_1-29         (_Ipark_1 for park==ACAD omitted)
i.park*logpvfee   _IparXlogp_#        (coded as above)
i.year            _Iyear_1996-2006    (naturally coded; _Iyear_1996 omitted)

      Source |       SS       df       MS              Number of obs =     303
-------------+------------------------------           F( 67,   235) =  491.73
       Model |  219.302115    67   3.2731659           Prob > F      =  0.0000
    Residual |  1.56425358   235  .006656398           R-squared     =  0.9929
-------------+------------------------------           Adj R-squared =  0.9909
       Total |  220.866369   302  .731345592           Root MSE      =  .08159

------------------------------------------------------------------------------
      logvis |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     _Ipark_2 |  -.1175087   1.468203    -0.08   0.936     -3.01003    2.775013
     _Ipark_3 |  -1.232701   .2690131    -4.58   0.000    -1.762686   -.7027154
     _Ipark_4 |  -2.650729   .3204243    -8.27   0.000       -3.282   -2.019458
     _Ipark_5 |  -3.024619   .2505499   -12.07   0.000    -3.518229   -2.531008
     _Ipark_6 |  -.9301412   .2142573    -4.34   0.000    -1.352252   -.5080308
     _Ipark_7 |  -2.036583    .244177    -8.34   0.000    -2.517639   -1.555528
     _Ipark_8 |  -1.194688   .8390199    -1.42   0.156     -2.84765    .4582734
     _Ipark_9 |  -2.038207   .3074502    -6.63   0.000    -2.643918   -1.432496
    _Ipark_10 |  -2.812002   .2230947   -12.60   0.000    -3.251523   -2.372481
    _Ipark_11 |   -.742582   .2543652    -2.92   0.004    -1.243709   -.2414545
    _Ipark_12 |  -1.792833   .3074502    -5.83   0.000    -2.398544   -1.187122
    _Ipark_13 |  -1.257519   .3046943    -4.13   0.000    -1.857801   -.6572382
    _Ipark_14 |   .4340802   .3732209     1.16   0.246     -.301206    1.169366
    _Ipark_15 |  -.2672869   .3732209    -0.72   0.475    -1.002573    .4679993
    _Ipark_16 |  -.8540313    .244177    -3.50   0.001    -1.335087   -.3729757
    _Ipark_17 |  -.5830793   .3074502    -1.90   0.059     -1.18879    .0226314
    _Ipark_18 |  -1.541304   .2847514    -5.41   0.000    -2.102296   -.9803127
    _Ipark_19 |  -2.250451   .3074502    -7.32   0.000    -2.856161    -1.64474
    _Ipark_20 |  -1.311291   .3074502    -4.27   0.000    -1.917002   -.7055804
    _Ipark_21 |   -.973263   .2847514    -3.42   0.001    -1.534255   -.4122715
    _Ipark_22 |   .1798945   .2847514     0.63   0.528    -.3810971    .7408861
    _Ipark_23 |  -.8747964   .3074502    -2.85   0.005    -1.480507   -.2690857
    _Ipark_24 |  -.3479848   .2289989    -1.52   0.130    -.7991378    .1031682
    _Ipark_25 |  -1.773366    .376388    -4.71   0.000    -2.514892    -1.03184
    _Ipark_26 |  -2.426251   .2441581    -9.94   0.000     -2.90727   -1.945233
    _Ipark_27 |  -.3835652   .3732209    -1.03   0.305    -1.118851    .3517209
    _Ipark_28 |   .1328937   .2170653     0.61   0.541    -.2947488    .5605361
    _Ipark_29 |  -.5931709   .2142573    -2.77   0.006    -1.015281   -.1710605
     logpvfee |  -.1761182   .0687462    -2.56   0.011    -.3115558   -.0406807
 _IparXlogp_2 |  -.4306228   .6143097    -0.70   0.484     -1.64088    .7796349
 _IparXlogp_3 |   .1131563    .110373     1.03   0.306    -.1042906    .3306032
 _IparXlogp_4 |  -.0091623   .1531749    -0.06   0.952    -.3109338    .2926091
 _IparXlogp_5 |   .4004825    .100349     3.99   0.000     .2027839     .598181
 _IparXlogp_6 |   .0449561   .0812341     0.55   0.581     -.115084    .2049961
 _IparXlogp_7 |   .0857399   .1028747     0.83   0.405    -.1169346    .2884145
 _IparXlogp_8 |  -.2587948   .4974122    -0.52   0.603    -1.238752    .7211619
 _IparXlogp_9 |   .1298295   .1301862     1.00   0.320    -.1266517    .3863107
 _IparXlog~10 |   .3692904   .0881698     4.19   0.000     .1955863    .5429945
 _IparXlog~11 |  -.0770686   .1043041    -0.74   0.461    -.2825591    .1284219
 _IparXlog~12 |    .392469   .1301862     3.01   0.003     .1359878    .6489502
 _IparXlog~13 |   .3815242   .1137929     3.35   0.001     .1573397    .6057088
```

```
_IparXlog~14 |   .0774994   .1266033     0.61   0.541     -.171923    .3269218
_IparXlog~15 |   .1340294   .1266033     1.06   0.291     -.115393    .3834518
_IparXlog~16 |   .1555141   .1028747     1.51   0.132    -.0471604    .3581886
_IparXlog~17 |  -.0074087   .1301862    -0.06   0.955    -.2638899    .2490726
_IparXlog~18 |   .3636872   .1185706     3.07   0.002       .13009    .5972843
_IparXlog~19 |   .1445568   .1301862     1.11   0.268    -.1119244    .4010381
_IparXlog~20 |  -.1155844   .1301862    -0.89   0.376    -.3720656    .1408968
_IparXlog~21 |   .1256582   .1185706     1.06   0.290    -.1079389    .3592554
_IparXlog~22 |    .044058   .1185706     0.37   0.711    -.1895392    .2776551
_IparXlog~23 |  -.2079963   .1301862    -1.60   0.111    -.4644776    .0484849
_IparXlog~24 |    .216889   .0883272     2.46   0.015     .0428748    .3909033
_IparXlog~25 |   .2125347   .1779887     1.19   0.234    -.1381226    .5631921
_IparXlog~26 |   .3052058   .1027862     2.97   0.003     .1027058    .5077059
_IparXlog~27 |     .21834   .1266033     1.72   0.086    -.0310824    .4677624
_IparXlog~28 |   .0987309   .0806037     1.22   0.222    -.0600672     .257529
_IparXlog~29 |   .2371764   .0812341     2.92   0.004     .0771364    .3972165
 _Iyear_1997 |   .0261841   .0231052     1.13   0.258    -.0193357    .0717039
 _Iyear_1998 |    .048336   .0423065     1.14   0.254    -.0350124    .1316845
 _Iyear_1999 |   .0478055   .0413588     1.16   0.249     -.033676     .129287
 _Iyear_2000 |   .0029795   .0412129     0.07   0.942    -.0782145    .0841736
 _Iyear_2001 |  -.0207504   .0400541    -0.52   0.605    -.0996614    .0581607
 _Iyear_2002 |  -.0474107   .0394878    -1.20   0.231     -.125206    .0303846
 _Iyear_2003 |  -.0550683   .0391595    -1.41   0.161    -.1322168    .0220802
 _Iyear_2004 |  -.0474722   .0397247    -1.20   0.233    -.1257343    .0307899
 _Iyear_2005 |  -.0186914   .0394946    -0.47   0.636    -.0965002    .0591173
 _Iyear_2006 |   -.070961   .0425431    -1.67   0.097    -.1547755    .0128535
       _cons |   15.16064   .1644294    92.20   0.000     14.83669    15.48458
------------------------------------------------------------------------------

. testparm _Iyear_* /* shows that year dummies are significant and belong */

 ( 1)  _Iyear_1997 = 0
 ( 2)  _Iyear_1998 = 0
 ( 3)  _Iyear_1999 = 0
 ( 4)  _Iyear_2000 = 0
 ( 5)  _Iyear_2001 = 0
 ( 6)  _Iyear_2002 = 0
 ( 7)  _Iyear_2003 = 0
 ( 8)  _Iyear_2004 = 0
 ( 9)  _Iyear_2005 = 0
 (10)  _Iyear_2006 = 0

       F( 10,   235) =    5.94
            Prob > F =    0.0000

. testparm _IparXlogp_* /*same as previous command -- shows that interaction is
significant as a whole*/

 ( 1)  _IparXlogp_2 = 0
 ( 2)  _IparXlogp_3 = 0
 ( 3)  _IparXlogp_4 = 0
 ( 4)  _IparXlogp_5 = 0
 ( 5)  _IparXlogp_6 = 0
 ( 6)  _IparXlogp_7 = 0
 ( 7)  _IparXlogp_8 = 0
 ( 8)  _IparXlogp_9 = 0
 ( 9)  _IparXlogp_10 = 0
 (10)  _IparXlogp_11 = 0
 (11)  _IparXlogp_12 = 0
 (12)  _IparXlogp_13 = 0
 (13)  _IparXlogp_14 = 0
 (14)  _IparXlogp_15 = 0
 (15)  _IparXlogp_16 = 0
```

```
 (16)  _IparXlogp_17 = 0
 (17)  _IparXlogp_18 = 0
 (18)  _IparXlogp_19 = 0
 (19)  _IparXlogp_20 = 0
 (20)  _IparXlogp_21 = 0
 (21)  _IparXlogp_22 = 0
 (22)  _IparXlogp_23 = 0
 (23)  _IparXlogp_24 = 0
 (24)  _IparXlogp_25 = 0
 (25)  _IparXlogp_26 = 0
 (26)  _IparXlogp_27 = 0
 (27)  _IparXlogp_28 = 0
 (28)  _IparXlogp_29 = 0

       F( 28,   235) =    3.12
            Prob > F =    0.0000

.
. /**Test significance of fee coefficient for each park**/
. /**NOTE only ACAD (1), PEFO (23), MEVE (20), DEVA (11), BRCA (6), DENA (10),
BIBE (5), and GLAC (13) are significant */
.
. test logpvfee + _IparXlogp_2 = 0

 ( 1)  logpvfee + _IparXlogp_2 = 0

       F(  1,   235) =    0.99
            Prob > F =    0.3201

. test logpvfee + _IparXlogp_3 = 0

 ( 1)  logpvfee + _IparXlogp_3 = 0

       F(  1,   235) =    0.39
            Prob > F =    0.5325

. test logpvfee + _IparXlogp_4 = 0

 ( 1)  logpvfee + _IparXlogp_4 = 0

       F(  1,   235) =    1.50
            Prob > F =    0.2222

. test logpvfee + _IparXlogp_5 = 0

 ( 1)  logpvfee + _IparXlogp_5 = 0

       F(  1,   235) =    6.59
            Prob > F =    0.0109

. test logpvfee + _IparXlogp_6 = 0

 ( 1)  logpvfee + _IparXlogp_6 = 0

       F(  1,   235) =    5.20
            Prob > F =    0.0235

. test logpvfee + _IparXlogp_7 = 0

 ( 1)  logpvfee + _IparXlogp_7 = 0

       F(  1,   235) =    0.98
            Prob > F =    0.3227
```

```
. test logpvfee + _IparXlogp_8 = 0

 ( 1)  logpvfee + _IparXlogp_8 = 0

       F(  1,   235) =    0.78
            Prob > F =    0.3771

. test logpvfee + _IparXlogp_9 = 0

 ( 1)  logpvfee + _IparXlogp_9 = 0

       F(  1,   235) =    0.14
            Prob > F =    0.7106

. test logpvfee + _IparXlogp_10 = 0

 ( 1)  logpvfee + _IparXlogp_10 = 0

       F(  1,   235) =    7.90
            Prob > F =    0.0054

. test logpvfee + _IparXlogp_11 = 0

 ( 1)  logpvfee + _IparXlogp_11 = 0

       F(  1,   235) =    7.58
            Prob > F =    0.0064

. test logpvfee + _IparXlogp_12 = 0

 ( 1)  logpvfee + _IparXlogp_12 = 0

       F(  1,   235) =    3.02
            Prob > F =    0.0838

. test logpvfee + _IparXlogp_13 = 0

 ( 1)  logpvfee + _IparXlogp_13 = 0

       F(  1,   235) =    4.93
            Prob > F =    0.0274

. test logpvfee + _IparXlogp_14 = 0

 ( 1)  logpvfee + _IparXlogp_14 = 0

       F(  1,   235) =    0.67
            Prob > F =    0.4152

. test logpvfee + _IparXlogp_15 = 0

 ( 1)  logpvfee + _IparXlogp_15 = 0

       F(  1,   235) =    0.12
            Prob > F =    0.7279

. test logpvfee + _IparXlogp_16 = 0

 ( 1)  logpvfee + _IparXlogp_16 = 0

       F(  1,   235) =    0.05
            Prob > F =    0.8215
```

```
. test logpvfee + _IparXlogp_17 = 0

 ( 1)  logpvfee + _IparXlogp_17 = 0

       F(  1,   235) =    2.17
            Prob > F =    0.1420

. test logpvfee + _IparXlogp_18 = 0

 ( 1)  logpvfee + _IparXlogp_18 = 0

       F(  1,   235) =    2.86
            Prob > F =    0.0922

. test logpvfee + _IparXlogp_19 = 0

 ( 1)  logpvfee + _IparXlogp_19 = 0

       F(  1,   235) =    0.06
            Prob > F =    0.8002

. test logpvfee + _IparXlogp_20 = 0

 ( 1)  logpvfee + _IparXlogp_20 = 0

       F(  1,   235) =    5.48
            Prob > F =    0.0200

. test logpvfee + _IparXlogp_21 = 0

 ( 1)  logpvfee + _IparXlogp_21 = 0

       F(  1,   235) =    0.21
            Prob > F =    0.6497

. test logpvfee + _IparXlogp_22 = 0

 ( 1)  logpvfee + _IparXlogp_22 = 0

       F(  1,   235) =    1.42
            Prob > F =    0.2351

. test logpvfee + _IparXlogp_23 = 0

 ( 1)  logpvfee + _IparXlogp_23 = 0

       F(  1,   235) =    9.51
            Prob > F =    0.0023

. test logpvfee + _IparXlogp_24 = 0

 ( 1)  logpvfee + _IparXlogp_24 = 0

       F(  1,   235) =    0.34
            Prob > F =    0.5616

. test logpvfee + _IparXlogp_25 = 0

 ( 1)  logpvfee + _IparXlogp_25 = 0

       F(  1,   235) =    0.05
            Prob > F =    0.8261
```

```
. test logpvfee + _IparXlogp_26 = 0

 ( 1)  logpvfee + _IparXlogp_26 = 0

       F(  1,   235) =    2.01
            Prob > F =    0.1581

. test logpvfee + _IparXlogp_27 = 0

 ( 1)  logpvfee + _IparXlogp_27 = 0

       F(  1,   235) =    0.12
            Prob > F =    0.7271

. test logpvfee + _IparXlogp_28 = 0

 ( 1)  logpvfee + _IparXlogp_28 = 0

       F(  1,   235) =    1.78
            Prob > F =    0.1829

. test logpvfee + _IparXlogp_29 = 0

 ( 1)  logpvfee + _IparXlogp_29 = 0

       F(  1,   235) =    1.13
            Prob > F =    0.2897

.
. log close
       log:  z:\MP\Analysis\Stata\log.log
  log type:  text
 closed on:  15 Jun 2007, 21:29:04
--------------------------------------------------------------------------------
--------------------------------------------------------------------
```