DISSERTATION

USING RANDOM UTILITY MODELS TO INCORPORATE SUBSTITUTION WHEN ESTIMATING ECONOMIC VALUES AND IMPACTS OF CLOSING A UNIQUE RECREATION SITE: THE CASE OF SNOWMOBILING IN YELLOWSTONE

Submitted by

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WE HEREBY RECOMMEND THAT THE DISSERTATION PREPARED UNDER OUR SUPERVISION BY CHRISTOPHER TODD BASTIAN ENTITLED USING RANDOM UTILITY MODELS TO INCORPORATE SUBSTITUTION WHEN ESTIMATING ECONOMIC VALUES AND IMPACTS OF CLOSING A UNIQUE RECREATION SITE: THE CASE OF SNOWMOBILING IN YELLOWSTONE BE ACCEPTED AS FULFILLING IN PART REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY.

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ABSTRACT OF **DISSERTATION**

USING RANDOM UTILITY MODELS TO INCORPORATE SUBSTITUTION WHEN ESTIMATING ECONOMIC VALUES AND IMPACTS OF CLOSING A UNIQUE RECREATION SITE: THE CASE OF SNOWMOBILING IN YELLOWSTONE

Random Utility Models (RUMs) are used to incorporate substitution effects into economic impact and benefit estimates associated with closing a unique recreation site. While RUMs have been used extensively in benefit estimates, there has been little systematic research linking substitution effects and regional economic impacts. RUMs are used to quantify how substitution away from Yellowstone (YNP) and Grand Teton National Parks (GTNP) may affect snowmobile recreationist benefits and the economies of communities surrounding the parks, given a proposed snowmobile ban. The first essay analyzes the sample of snowmobile visitors and finds two distinct user types coming to YNP and GTNP. Nearly 60 percent of the sample is comprised of snowmobilers taking multiple snowmobile trips within the region (Wyoming, Idaho and Montana) surrounding the parks, but they typically visit one site per trip (*single destination* visitors). The other segment can be described as snowmobilers coming to the region for an annual winter vacation during which they visit multiple snowmobile sites (*multiple destination* segment). Results indicate visitor heterogeneity is likely an important consideration for economic analyses related to site closure. Essay two investigates the prediction of trip estimates of the *single destination* segment using revealed (RP) and stated preference (SP) data given site closure. Results indicate the SP data predict trip visitation loss to the region surrounding the park at levels five times that of the RP predictions, and the null hypothesis of preference homogeneity is rejected. Essay three draws upon economics, tourism and economic geography literature to develop a tractable and theoretically consistent framework with which to model the *multiple destination* segment. This model is consistent with theory and statistically significant in explaining behavior. Essay four investigates the policy implications of banning snowmobiles in YNP and GTNP. Ignoring heterogeneity potentially underestimates snowmobiler welfare losses and overestimates regional trip losses associated with site closure. Essay five uses the RUMs developed in earlier essays to drive trip and expenditure predictions used in regional economic impact estimation for the three states surrounding the parks. Results indicate that substitution effects and visitor heterogeneity are important considerations for regional economic impact analyses of recreation site closure.

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PREFACE

Much has appeared in the news regarding the controversy surrounding snowmobile recreation inside Yellowstone (YNP) and Grand Teton National Parks (GTNP). It is surprising that with all the public attention focused on the on again, off again ban of snowmobiling inside these park boundaries, that little economic analysis has been conducted regarding changes in snowmobile recreation benefits and local economies should a ban be the final policy outcome. The focus of this research project has been the estimation of changes in snowmobile recreation benefits, site visits and economic activity in the three state region surrounding the parks should a ban take place. This dissertation is meant to provide useful information regarding potential changes in snowmobile recreation activity and substitution effects in the region surrounding the parks.

This research project is not a full blown benefit-cost analysis associated with winter recreation in these national parks. Nor is it meant to be interpreted as such. The potential for substitution across recreational activities or increased demand for recreation in YNP or GTNP absent of snowmobiles is beyond the scope of this analysis.

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CHAPTER 1

HETEROGENEITY OF YELLOWSTONE NATIONAL PARK SNOWMOBILE USERS: IMPLICATIONS FOR ECONOMIC AND POLICY ANALYSES

Introduction

Winter recreation has become an important tourism activity in many areas of the United States. This is particularly true in the Rocky Mountain region. Of the many winter recreation activities offered, snowmobiling has become both popular and controversial (Rapp 2004). Snowmobiling is the third most popular winter recreation activity among residents in Wyoming, trailing only cross-country skiing and downhill skiing (Buchanan and Kamby 1990). Taylor, Fletcher and Skidgel (1995) estimated economic activity generated by snowmobiling to be $189.4 million in Wyoming alone.

One of the most important winter recreation areas in the Rocky Mountain region for a number of activities, and particularly snowmobiling, is Yellowstone National Park. Yellowstone National Park's unique wildlife and thermal features make it a popular winter destination (Greater Yellowstone Coordinating Committee 1999). The number of winter recreation visitors averaged 129,068 annually for 1992-2001, and snowmobile visitors averaged 61.7 percent of that volume or 79,646 during the same time period (National Park Service 2002). Duffield and Neher's (2000) winter use survey found that nearly 67 percent of those sampled participated in snowmobiling and 30 percent participated in cross-country skiing as recreation activities in the Greater Yellowstone area.

Given the unique thermal features, abundant wildlife and expansion of human activities in the Greater Yellowstone area (GYA), it is not surprising that concerns have arisen regarding the impacts of winter recreation on this environmental resource. Olliff, Legg, and Kaeding (1999) review scientific studies conducted both in and out of the park regarding the impacts of winter recreation on wildlife and habitats critical to wildlife. This review indicates that human interaction both from snowmobilers and cross-country skiers can negatively affect energy conservation by wildlife during the winter. This issue is especially critical for species that utilize thermally affected habitats frequented by winter recreators. Moreover, the document indicates potential noise, air, water and snow pollution from snowmobile emissions.

In response to environmental issues, seven alternatives for winter use management in Yellowstone National Park (YNP), Grand Teton National Park (GTNP), and the John D. Rockefeller, Jr., Memorial Parkway (JDRMP) were documented in a final environmental impact statement (EIS) (National Park Service 2000). At the time this research was conducted, the alternative designated as preferred in the EIS eliminated snowmobile travel in YNP, GTNP and the JDRMP, but it allowed snow coach travel and other forms of winter recreation. This alternative was to start implementation in the 2001-2002 winter season. Snowmobiling was to be capped and phased out in three years. That decision was set aside on June 29, 2001 in the settlement of a lawsuit brought by the state of Wyoming and snowmobile manufacturers (Thorne 2002).

The policy under the Bush Administration, to begin implementation in the 2003-2004 winter season, was that daily visitation was capped at 1,100 snowmobiles per day (on average current visitation is below this cap with peak vacation or weekend days most likely being affected in the next several seasons), eighty percent of snowmobiles allowed in the park must be led by commercial guides for the 2004-2005 season with the other twenty percent eventually being led by someone who had taken a National Park Service training course, and for the 2003-2004 season commercial snowmobiles must be powered by four-stroke engines with private snowmobiles being required to have such technology by the 2004-2005 season (Hamilton 2002). That language called for monitoring and adaptive management, i.e. the flexibility to make changes to this policy.

Environmental groups filed a lawsuit in December of 2002 against the Bush administration to block changes removing the ban on snowmobiles in YNP, GTNP and the JDRMP proposed under the Clinton administration (Sullivan 2002). Moreover, a group of senators and representatives introduced the "Yellowstone Protection Act," a bipartisan bill directing the National Park Service to implement the Clinton administration ban, in March of 2003 (Israelsen 2003). Judge Emmet G. Sullivan of the U.S. District Court in Washington, D.C., reinstated the Clinton era ban on December 16, 2003, the day before the park was to open to snowmobile use (Lipsher 2004). Under that decision snowmobiles were capped at 490 per day into YNP and 50 snowmobiles per day into GTNP (Monoson 2004). That decision caused a number of appeals to be filed, and businesses in the area claimed significant drops in business for the 2003 – 2004 season (Monoson 2004; Lipsher 2004). A federal district judge issued a temporary restraining order February 10 setting aside the ban reinstated by Judge Sullivan (Black 2004). Mr.

Denny Rehberg a U.S. Representative from Montana announced, in February 2004, he would draft legislation to overturn the snowmobile ban and ask for federal grant money to help the town of West Yellowstone investigate alternatives for diversifying its economy (McMillion 2004). As of early May, Secretary Gale Norton, of the Department of Interior, held a press conference and indicated the park would be open in 2004-2005 season to snowmobiling, but Norton indicated that management practices may have to be changed given the differing court decisions by federal judges (Stark 2004). The policy debate regarding snowmobile recreation within YNP, GTNP and the JDRMP will likely continue for years to come with discussion centering on environmental concerns versus economic interests.

Problem Statement

The original EIS stated that the expected socioeconomic effects of banning snowmobiles were "[1] minor effect on local and state economies; [2] larger, major adverse effect on the economies of communities within the GYA; and, [3] minor negative effect on total current trip nonmarket visitor benefits (through reduced visitation)" (Table S-2). However, very little is really known about how snowmobilers will respond to a ban or reduction in allowed visits. Will snowmobilers substitute to other sites in the Greater Yellowstone Area (GYA), in Wyoming or choose a different activity or destination altogether? How will substitution away from this unique site affect the economic benefits to the recreationists? How will these substitutions affect the economies of communities surrounding YNP? The current paucity of research on this issue provides the impetus for this analysis. Research addressing these questions could provide valuable information regarding potential congestion at other recreation sites in the GYA, help local and state officials manage for the changes associated with the chosen policy, and ultimately add to the body of knowledge concerning how recreation visitors adjust to closure of unique recreation sites. Such information may be useful to the National Park Service for evaluating future restrictions such as changes in current snowmobile policy, jet ski phase out or reducing scenic over flights.

Past Snowmobile Research

Given the importance and popularity of snowmobiling in Wyoming and other states, it is noteworthy that the body of research regarding the characteristics and motivations of snowmobilers is relatively small but growing. Understanding the motivations of snowmobilers could be a valuable tool in planning for changes to policies regarding snowmobile recreation sites.

Jackson and Wong (1982) found that being with family and friends, adventure and challenge, doing some very different things, meeting other people, getting away from radio and TV, interest in getting to a destination, and prestige were the motivations perceived as most important by snowmobilers in Alberta, Canada. McLaughlin and Paradice (1980) found snowmobilers were older than cross-country skiers, completed a high school education, and considered themselves experienced at the sport. Moreover, 70 percent of the sampled snowmobilers in that study were in family groups. Finally, these snowmobilers found it desirable to see groups or individuals engaged in motorized recreation.

Keith et al. (1978) found that the average snowmobiler had a higher income than the general population in Utah, had more children at home than the general population of Utah, and had completed 1.8 years of college. Just over half, 53 percent, of the respondents were employed in professional, technical, or managerial fields. It was estimated that many of the trips were family trips as 80 percent of the trips involved more than two people.

May et al. (2001) examined characteristics, preferences, and motivations of Wyoming snowmobilers. They found five distinct groups of snowmobilers based on reasons for recreating using cluster analysis procedures. Enjoying nature, escaping physical pressure, being with family and friends, and achievement/stimulation, were important dimensions to the recreational experience for respondents. The first cluster can best be described as, "The Nature Lovers Who Need To Be Alone" cluster. These individuals scored high on the composite reason variables that encompass the Enjoy Nature dimension and the Escape Physical Pressure dimension. The second cluster can best be described as, "Those Who Want To Experience It All." These individuals scored very high on all the composite reason variables. Achievement/Stimulation is of somewhat less importance to this group. Although, they still viewed it as important when considering their most recent trip. The third cluster is best described as, "Those Who Want To Be Alone But Not Get Too Excited." These individuals scored high on the composite reason variable for Escaping Physical Pressure and scored low on the composite reason variable for Achievement/Stimulation. Also of importance to this group is Enjoying Nature and Being with Family and Friends. The fourth cluster is best described as, "Nature Lovers Who Don't Want To Get Too Excited." This group scored relatively high on the composite reason variable for Enjoy Nature and low on the Achievement/Stimulation composite reason variable. The fifth cluster is best described as, "Nature Lovers Who Want To Be With Family and Friends." This group scored high on the composite reasons variables for Enjoy Nature and Being with Family and Friends. Coupal et al. (2001) found that the five distinct types of snowmobilers in May et al. (2001) had different benefit estimates.

Bastian et al. (2003) examined the economic impacts in Wyoming of non-resident snowmobilers using their own machines and snowmobile tourists or outfitter clients who rented snowmachines. They found that outfitter clients in the sample spent more money, but they visited fewer days than nonresidents. Their estimate of economic impacts indicated that nonresidents generated $34.3 million in earnings as opposed to $15.8 million from outfitter client snowmobilers. Grand Teton National Park (GTNP) and YNP were the top sites visited by the outfitter client group, but nonresidents chose Wyoming state trails outside those parks as their favorite destination.

Duffield and Neher (2000) found that 81.5 percent of winter visitors to the GYA traveled with family and friends and 67 percent of visitors to the GYA participated in snowmobiling. Average number of hours spent in the park while snowmobiling was 13.3 hours. Duffield and Neher (2000) estimated trips by non-residents of the GYA would decrease by 31.6 percent to the GYA and 20.5 percent to YNP compared to the estimated baseline trips if YNP and GTNP were open only to snow coach, skiing and snowshoeing but not to snowmobiles. Residents in the GYA said they would decrease visits to GYA by 12.7 percent and YNP by 0.04 percent compared to estimated baseline trips. The authors note that these results are based on relatively small samples and should be viewed with caution.

Borrie et al. (1999) found that 71 percent of winter visitors to YNP used only snowmobiles and over 60 percent of the sample respondents entered the park through the West Yellowstone entrance. Borrie et al. (1999) also found that approximately 70% of the respondents entering YNP at the North, West and South entrances rented their snowmobiles, but only 44% of respondents entering the park from the East entrance rented snowmachines. Moreover, 84% of Borrie et al.'s respondents stayed in the vicinity of YNP during their trip. The top five reasons respondents visited YNP in the winter were 'scenic beauty', 'everyone should see at least once,' 'wildlife sanctuary,' 'protection for fish and wildlife habitat' and 'display of natural curiosities ' (Borrie et al., 1999). The authors conclude that winter users of YNP were highly satisfied, and they state "urgency to address issues associated with winter use in YNP is not originating from the majority sentiment of winter users (p. 67)." This may not be a surprising result given the majority of the current users are snowmobilers.

The above discussion provides some insights into snowmobile enthusiast behavior. Nature, being with family and friends and mechanized recreation seem to be important attributes for snowmobile recreationists. May et al. (2001) and Coupal et al. (2001) indicate that heterogeneity exists within snowmobiler recreationists' motivations and benefits. Bastian et al. (2003) points toward differing economic impacts and favored sites between non-resident snowmobilers who rent versus those who own their own machines. Borrie et al. (1999) indicates that winter recreators are currently very satisfied with their winter experience in YNP. Duffield and Neher (2000) provides some baseline data as to how visits to YNP may change with a proposed site closure, but that study provides nothing in terms of where snowmobilers will go or the changes in economic value to snowmobilers associated with recreating at a different site. Moreover, the University of Wyoming Institute of Environment and Natural Resources (2000) points to the need for a more scientific sampling procedure and better information regarding demographics and expenditures of winter recreationists in the GYA to better develop and implement policy.

The purpose of this paper, and the dissertation overall, is to explore the potential differences in snowmobile recreationists using YNP and GTNP and where they might go should this type of recreation no longer be allowed there.

Data Collection and Analysis

Data collection for this project involved intercept sampling and a follow up mail survey sent to YNP snowmobile recreators agreeing to participate in the project. Analysis of the data for this paper utilized descriptive statistics such as means and frequencies. Following Bohnsack et al. (2002), hypotheses regarding differences in means for two types of snowmobilers were tested using t-statistics. Hypotheses concerning potential differences in frequencies of responses to binary or categorical questions were tested using a Chi-square test of independence (Bohnsack et al. 2002).

Intercept Sampling

A research permit was needed to do intercept sampling within park boundaries. Chris Bastian and John Loomis drafted a research permit proposal. Upon review, a permit was granted in September 2001 by the Yellowstone National Park research committee, which allowed intercept sampling within park boundaries during the winter season. Intercept sampling took place thirty-three days between December 15, 2001 through February 28, 2002 (see Appendix A for dates, locations and sampler script).

Dates were randomly chosen for week and weekend days during the sampling period. Intercept sampling took place at the West, South and East entrances of the park an equal number of weekdays and weekend days. The number of days sampled at each entrance was in proportion to snowmobile visitation statistics from the previous winter season (Figure 1.1). It should be noted that the North entrance averaged only 2 percent of winter visitation with many days of no visitors using it, and it was not sampled.

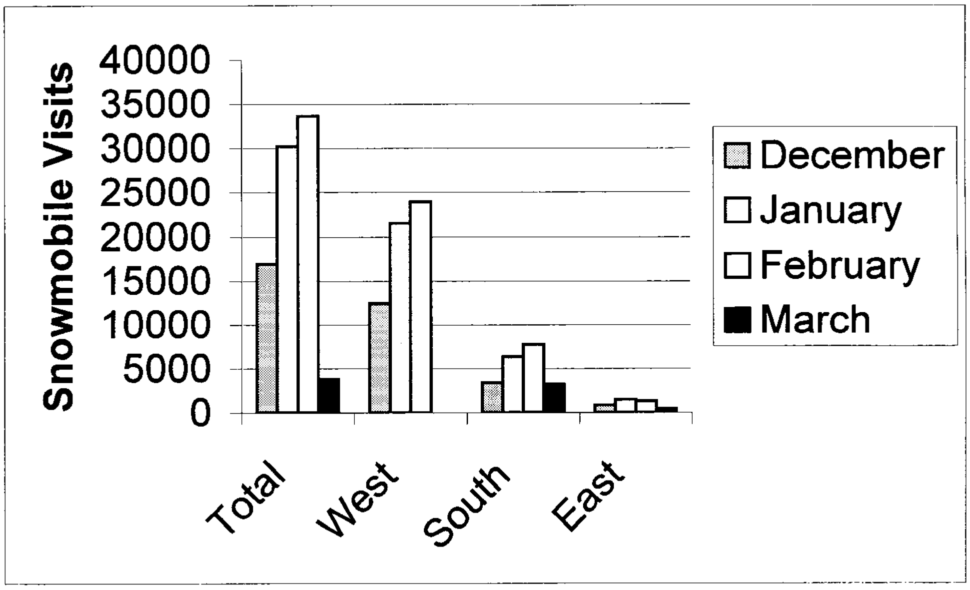

Figure 1.1. 2000-2001 YNP Snowmobile Visits by Month and Entrance.

Snowmobilers were asked if they would be willing to participate in a recreation study. Recreators agreeing to participate were then asked to fill out a card with their mailing address, and they were informed that a questionnaire would be sent to them the first part of March. Moreover, each contact was given a one-page trip record sheet and asked to keep a log of their trips and the sites they visited between December 15, 2001 and February 28, 2002. Twice during the winter season survey participants were sent postcard reminders asking them to keep their trip record sheets up to date and to remind them this information would be important for filling out the survey they would receive in March. Contact with participants was brief so as to not inhibit their recreation experience. During the thirty-three days of sampling the objective was to gather the names of 1200 to 1600 participants to which a mail survey would be sent. During the intercept sampling procedure the refusal rate was 9.5% and the final number of contacts in the database was 1162 (see Appendix A, Table A-1 for more detail). Of those 1162 respondents, several were removed due to bad addresses, foreign mailing addresses in Canada, and contacts that were professional guides. The final database for the first mailing had 1148 addresses.

Survey

The mail survey followed a modified Dillman (1978) design to insure an adequate response rate (See Appendix A for survey timeline). The finalized survey was mailed to respondents March 4^{th}. This first initial mailing included a cover letter expressing importance and anonymity of responses, a survey and a postage paid return envelope. Postage on the return envelopes was pre-printed. Seven days after the initial mailing of the questionnaire a postcard reminder was sent to each participant in the database. Three weeks after the postcard reminder, a second survey with a letter reiterating the importance of the respondent's participation was mailed. The response rate was 701 returns out of 1148 (61 percent).

The questionnaire is divided into seven sections (see Appendix A). Section one asks basic questions about the respondent's snowmobile experience and days snowmobiled during the season. Section two asks for site specific trip information during the December through February period, and it asks stated preference questions in several different formats regarding where respondents think they would take snowmobile trips if YNP were no longer available. Section three asks specific questions about their most recent trip to YNP including hours snowmobiled per day, number in party, etc. Section four asks respondents for information about their expenditures in and out of the YNP region on their most recent snowmobile trip. Section five asks several questions about their opinions regarding the potential phase out of snowmobile use in the park. Section six asks questions designed to elicit preferences for site and trip attributes. Section seven asks for demographic information about the respondent.

Additionally, data regarding average snow depth by site for both the 2000-2001 and 2002-2003 seasons for all 48 sites in respondents' choice set, and other site attributes such as miles of groomed trail, services within five miles of the trail head, and high and low elevation along the trails for each site were recorded. Travel distances and times via car or truck were estimated for each respondent to each of the 48 sites from their home zip codes were estimated using PC-Miler by ALK Technologies. These data coupled with the survey responses resulted in a data set with 948 variables.

Analysis

During data entry of trip information, it was discovered that a number of respondents provided information indicating that they made a single trip to the region surrounding Yellowstone National Park (i.e., Wyoming, Montana and Idaho), and while here they visited a number of snowmobile sites. This was ascertained by examining questions 5 (which asked for the total number of days spent snowmobiling in YNP, Wyoming, Montana, and/or Idaho between the dates of December 15, 2001 through February 28, 2002) and 19 (which asks for the days spent snowmobiling on the most recent trip – see survey in Appendix A for further detail). If respondents' answers for question 5 and question 19 matched in terms of days spent snowmobiling during the time YNP was open and the days spent snowmobiling on the most recent trip and multiple snowmobile sites were visited according to their trip record sheet, these respondents were coded with a 1 for a variable called "singmult" indicating single trip to region and multiple snowmobile sites visited during their trip ("singmult"). This visitor segment will be labeled as "multiple destination" visitors for this paper and the rest of the dissertation. This segment of visitors face a joint travel cost issue, and this ultimately influences our modeling of their behavior. Those respondents coded as 0 for the "singmult" variable, represent visitors who visit one site during a trip to the region. These respondents (singmult = 0), which are labeled as single destination visitors may have traveled once or made multiple trips to the region, but on each trip they only visited a single site. This segment of the data is easier to model as travel costs are easily allocated to the site visited on each trip.

During initial data analysis, it was found that approximately 40% of respondents were multiple destination visitors. This has a number of implications for economic and policy analyses regarding snowmobile recreation, and it was felt that further analysis testing potential differences between these respondents and the single destination visitors was warranted. Differences in means were analyzed using t-tests. A two-tailed, folded form of the F statistic was used to test the assumption of equal variances between the two types of snowmobilers (SAS 1989). An approximated t-statistic, following Steel and Torrie (1980), was used in the case of unequal variances (see Proc TTEST in SAS). Chi-square tests were used to test differences in responses for binary and categorical questions. These two different visitor segments will be modeled separately in subsequent chapters.

Results

Snowmobile Recreation: Experience and Commitment

Tables 1.1 through 1.8 provide an indication of the importance of snowmobiling as a recreational activity and Yellowstone National Park as a snowmobiling site to each respondent type. These tables also provide some information regarding how much people were willing to spend to snowmobile in this region. Overall, respondents categorized as multiple destination visitors on average have significantly more years experience snowmobiling, owned more snowmobiles of their own, spent significantly more days snowmobiling on their most recent trip, and traveled more miles on a snowmachine per day (Table 1.1). While these respondents spent slightly more time snowmobiling per day the mean was not significantly different from the other group. These initial results begin to indicate a potential difference in respondents. It should be noted that people taking a single snowmobile trip to Yellowstone National Park were categorized as a single destination visitor because there was likely not a joint cost issue to be dealt with in later recreational demand modeling. These people ultimately visited a single snowmobile site (YNP) during their one and only trip to the region. Those respondents could be less experienced and less avid snowmobilers in general which could lower several of the averages for the single destination visitors.

Even though both groups seem to be relatively avid snowmobilers, the majority of respondents indicated they did not belong to a snowmobile club. The multiple destination respondents belonged to a snowmobile club nearly 20 percent more often than the single destination respondents (Table 1.2). The difference in frequencies for these two groups is significant at the 5% level according to the chi-square test of independence.

Table 1.1 Means and t-tests of Number of Years Have been Snowmobiling, Number of Snowmobiles Owned, Days Spent Snowmobiling on Most Recent Trip to YNP, Miles Traveled per Day, and Hours Spent Snowmobiling Per Day for Multiple Destination versus Single Destination Respondents.

Variable	Mean	Mean	t-statistic
	Multiple Destination N=279	Single Destination N=417	
Years Snowmobiling	15.62	10.99	-5.10**
Number of Snowmobiles Owned	1.74	1.24	-3.14**
Days Spent Snowmobiling on Most Recent Trip to YNP	4.70	2.63	-11.51**
Miles Traveled Per Day on Snowmobile on Most Recent Trip to YNP	106.15	91.01	-4.89**
Hours Spent on Snowmachine Per Day on Most Recent Trip to YNP	7.29	6.94	-1.38

Note: Levels of significance: ** = 5%, * = 10%.

The majority of both respondent groups indicated snowmobiling was the primary purpose of their trip (Table 1.3). Nearly 96% of the multiple destination trip respondents indicated snowmobiling was their primary purpose while approximately 83% of the single destination respondents indicated yes to the question. These results may be somewhat counter to the notion many locals have that a large number of snowmobilers

Table 1.2 Chi-square test of Independence for Responses Regarding Whether Belonged to Snowmobile Club for Multiple Destination versus Single Destination Respondents.

Response Frequency (%)	Mean	Mean	χ^2 – statistic
	Multiple Destination N=279	Single Destination N=417	
1 – No	174 (62.37)	346 (82.97)	
2 – Yes	102 (36.56)	70 (16.79)	
3 - No Answer	3 (1.08)	1 (0.24)	
Total	279 (100.00)	417 (100.00)	37.98**

Note: Levels of significance: ** = 5%, * = 10%.

come to Yellowstone as part of a winter vacation, which includes a number of different recreational activities.

Interestingly, given the experience and desire of respondents overall to participate in snowmobiling, both groups are split nearly in half regarding whether they had snowmobiled in Yellowstone National Park before their most recent trip (Table 1.4). This result suggests there are nearly as many newcomers to Yellowstone National Park for snowmobiling as there are repeat recreationists for both groups. The chi-square statistic indicates there is not a significant difference in the frequency of responses for the two groups in this regard.

Table 1.3 Chi-square test of Independence for Responses Regarding Whether Snowmobiling Was Primary Purpose of Most Recent Trip to YNP for Multiple Destination versus Single Destination Respondents.

Response Frequency (%)	Mean	Mean	χ^2 – statistic
	Multiple Destination N=279	Single Destination N=417	
1 – Yes	268 (96.06)	347 (83.21)	
2 – No	11 (3.94)	64(15.35)	
3 - No Answer	1 (0.00)	6 (1.44)	
Total	279 (100.00)	417 (100.00)	27.31**

Note: Levels of significance: ** = 5%, * = 10%.

Table 1.4 Chi-square test of Independence for Responses Regarding Whether Snowmobiled in YNP Before for Multiple Destination versus Single Destination Respondents.

Response Frequency (%)	Mean	Mean	χ^2 - statistic
	Multiple Destination N=279	Single Destination N=417	
1 – Yes	138 (49.46)	214 (51.32)	
2 – No	139 (49.82)	201(48.20)	
3 - No Answer	2 (0.72)	2 (0.48)	
Total	279 (100.00)	417 (100.00)	0.37

Note: Levels of significance: ** = 5%, * = 10%.

Approximately 38 percent of both types of respondents indicated they used their own snowmobiles on their most recent trip to Yellowstone National Park (Table 1.5). On a percentage basis though nearly 10 percent of the single destination respondents took guided tours compared to approximately 3 percent of multiple destination respondents. That 6 percent difference is picked up in a higher percentage of the multiple destination respondents indicating they rented snowmobiles as compared to the single destination respondents. Overall, the majority of both respondent types are using snowmobiles other than their own, but the differences between "tour" or "rented" is enough different in the frequencies to show a significant chi-square statistic. The higher percentage of "tour" responses in the single destination respondents may in part be the result of a significant number of people in that category coming to the region for their first and only trip in the region at Yellowstone National Park.

Table 1.5 Chi-square test of Independence for Responses Regarding Snowmobile Rental on Most Recent Trip to YNP for Multiple Destination versus Single Destination Respondents.

Response Frequency (%)	Mean	Mean	χ^2 – statistic
	Multiple Destination N=279	Single Destination N=417	
1 – Rented	146 (52.33)	193 (46.28)	
2 - Took Guided Tour	9 (3.23)	40 (9.59)	
3 - Used My Own	107 (38.35)	162 (38.85)	
4 - No Answer	17 (6.09)	22 (5.28)	
Total	279 (100.00)	417 (100.00)	11.09**

Note: Levels of significance: ** = 5%, * = 10%.

The most important natural feature of a favored snowmobile site is wildlife viewing opportunity followed by scenic conditions for single destination respondents (Table 1.6). Good snow conditions is the third most frequent response for this group. Scenic views and good snow conditions are the top natural features for multiple destination trip respondents, while wildlife viewing opportunities is a close third in response frequency for this group. The chi-square statistic indicates there is a significant difference in frequencies of responses for the two groups.

Table 1.6 Chi-square test of Independence for Responses Regarding Respondent's Opinion on Most Important Natural Feature that Makes an Area Your Most Frequently Visited Site for Multiple Destination versus Single Destination Respondents.

Response Frequency (%)	Mean	Mean	X^2 - statistic
	Multiple Destination N=279	Single Destination N=417	
1 – Wildlife viewing opportunity	66 (23.66)	106 (25.42)	
2 – Solitude	3 (1.08)	14 (3.36)	
3 – Rugged terrain	6 (2.15)	5 (1.20)	
4 – Scenic views	69 (24.73)	105 (25.18)	
5 – Good snow conditions	68 (24.37)	75 (17.99)	
6 – Open areas	6 (2.15)	9 (2.16)	
7 – Off-trail powder	18 (6.45)	45 (10.97)	
8 – Trail availability/quality	35 (12.54)	24 (5.76)	
9 – Other	0 (0.00)	13 (3.12)	
10 – No answer	8 (2.87)	21 (5.04)	
Total	279 (100.00)	417 (100.00)	31.22**

Note: Levels of significance: ** = 5%, * = 10%.

Average total trip expenditures are only slightly higher for the multiple destination trip respondents compared to the single destination respondents. Trip expenditures within the region are slightly less for the multiple destination trip respondents as compared to the single destination respondents (Table 1.7). This likely reflects the lower average number of days per trip for the single destination respondents. The number of people represented by these expenditures is slightly higher (3.78) for the single destination respondents as compared to the multiple destination trip respondents (3.23). There is not a significant difference in average trip expenditures for the two respondent groups. The multiple destination trip respondents spent significantly more on annual snowmobile expenditures overall, but significantly less within the region compared to the single destination respondents.

Table 1.7 Means and t-tests of Trip Expenditures (Total and Within Region) and Expenditures on Snowmobile Equipment (Total and Within Region) for Multiple Destination versus Single Destination Respondents.

Variable	Mean	Mean	t-statistic
	Multiple Destination N=275	Single Destination N=408	
Expenditures Most Recent Trip – Total	2093.95	2027.96	-0.11
Expenditures Most Recent Trip – WY, MT & ID	1706.89	1823.97	0.23
Annual Snowmobile Equipment Expenditures –Total	4162.72	3340.32	-1.71*
Annual Snowmobile Equipment Expenditures – WY, MT & ID	490.67	1732.88	4.84**
Number of People Represented by Trip Expenditures	3.23	3.78	0.67
Number of People Represented by Equipment Expenditures	2.54	2.45	-0.20

Note: Levels of significance: ** = 5%, * = 10%.

Table 1.8 indicates that multiple destination respondents on average traveled farther and longer to get to any of the top five sites in Wyoming, Montana, and Idaho as compared to the single destination respondents. Mean travel times and travel distances to any of these sites from respondents' home zip codes are significantly different between the two respondent groups. Given these results it is not surprising that multiple destination respondents are bundling sites visited while on their trip to the region.

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Tables 1.9, 1.10 and 1.11 indicate significant differences in the average number of trips to some sites within Wyoming, Montana and Idaho. Generally, respondents in the multiple destination group take more average numbers of trips to sites in close proximity to Yellowstone National Park than single destination respondents. This also is reflected in the mean number of trips being higher for the Idaho sites for the multiple destination

Table 1.8 Average Travel Distances and Travel Times of Multiple Destination versus Single Destination Respondents with t-statitisics for Top Four Sites in Each State Based on Total Sample Visitation by Both Visitor Types.

Site	Mean Travel Distance (miles)	Mean Travel Time (hours)	Mean Travel Distance (miles)	Mean Travel Time (hours)	t-statistic Distance	t-statistic Time
	Multiple Destination N=279		Single Destination N=417			
Wyoming						
Yellowstone National Park	1230.86	20.71	883.21	15.47	-7.05**	-6.71**
Grand Teton National Park	1272.72	21.76	885.17	15.45	-8.07**	-8.64**
Togwotee	1252.71	21.77	871.37	15.59	-8.17**	-8.44**
Dubois	1223.11	20.96	859.54	15.19	-8.11**	-8.36**
Montana						
Big Sky Trails –Madison	1264.23	19.91	928.48	14.85	-6.48**	-6.45**
Big Sky Trails – Cabin Creek	1290.08	20.42	939.64	15.09	-6.62**	-6.65**
Cooke City	1245.22	19.99	945.96	15.56	-6.21**	-6.06**
Big Sky Trails – Upper Bozeman	1260.96	19.81	926.50	14.79	-6.49**	-6.44**
Idaho						
Two Top	1291.44	20.82	924.58	15.40	-7.00**	-6.57**
Big Springs	1293.58	20.97	922.80	15.43	-7.08**	-6.69**
Mesa Falls	1301.64	21.16	915.89	15.32	-7.34**	-7.01**
Cave Falls	1292.35	21.39	904.14	15.36	-7.68**	-7.45**

Note: Levels of significance: ** = 5%, * = 10%.

respondents as there are a number of Idaho sites very close to the park. The average number of trips to sites in Wyoming is higher for the single destination group. This likely reflects more trips being taken to sites farther away from the park during the season by this group as compared to the multiple destination respondents. There is not a significant difference in the average number of trips taken by respondents to

Table 1.9 Sums, Means and t-tests of Snowmobile Trips to Wyoming Sites for Multiple Destination versus Single Destination Respondents.

Site	Sum	Mean	Sum	Mean	t-statistic
	Multiple Destination N=279		Single Destination N=417		
Beartooth Mountains	7	0.0977	61	0.1463	1.39
North Bighorns	4	0.0143	42	0.1007	2.10**
South Bighorns	1	0.0036	26	0.0624	1.93*
Bearlodge Mountains	0	0	2	0.0048	1.42
Black Hills	0	0	21	0.0504	2.41**
Casper Mountain	0	0	42	0.1007	1.19
Snowy Range	1	0.0036	49	0.1175	3.36**
Sierra Madre Mountains	0	0	10	0.0240	1.67*
Uinta Mountains	0	0	8	0.0192	1.89*
Alpine/Horse Creek	2	0.0072	27	0.0647	3.16**
Afton/Labarge	0	0	19	0.0456	2.92**
Kemmerer	0	0	1	0.0024	1.00
Granite Hot Springs	5	0.0179	44	0.1055	1.18
Togwotee	40	0.1434	89	0.2134	1.25
Dubois	13	0.0466	67	0.1607	1.64
Gros Venre	5	0.0179	24	0.0576	1.60
Pinedale	5	0.0179	25	0.0600	1.97**
Lander	2	0.0072	35	0.0839	2.49**
Grand Teton National Park	43	0.1541	45	0.1079	-1.26
Yellowstone National Park	373	1.3369	536	1.2854	-0.63
All Wyoming Sites	501	1.7957	1173	2.8129	4.15**

Note: Levels of significance: ** = 5%, * = 10%.

Montana sites. These numbers begin to indicate potential differences in substitution patterns by these two groups should Yellowstone National Park no longer allow snowmobiling.

Table 1.10 Sums, Means and t-tests of Snowmobile Trips to Idaho Sites for Multiple Destination versus Single Destination Respondents.

Site	Sum	Mean	Sum	Mean	t-statistic
	Multiple Destination N=279		Single Destination N=417		
Cave Falls	35	0.1254	38	0.0911	-1.01
Mesa Falls	58	0.2079	58	0.1391	-1.83*
Two Top	294	1.0538	172	0.4125	-7.37**
Big Springs	141	0.5054	166	0.3981	-1.06
Coeur d' Alene	4	0.0143	6	0.0144	0.00
Magic Mountain	2	0.0072	3	0.0072	0.00
McCall Trails	0	0	10	0.0240	1.00
Bone Trails	0	0	15	0.0360	1.41
Sun Valley Trails	0	0	10	0.0240	1.00
Stanley Trails	1	0.0036	16	0.0384	0.96
Rexburg –Driggs	0	0	29	0.0695	1.46
Idaho Falls Area	0	0	6	0.0144	1.34
Howell Canyon	4	0.0143	3	0.0072	-0.45
Burley Area	2	0.0072	6	0.0144	0.45
Salmon Area	0	0	15	0.0360	1.00
All Idaho Sites	541	1.9391	553	1.3261	-2.81**

Note: Levels of significance: ** = 5%, * = 10%.

Several questions were asked of respondents regarding their thoughts about snowmobiling policy. Respondents were asked whether they were aware of issues surrounding the proposed snowmobile phase-out in Yellowstone National Park. The majority of respondents in both groups indicated they were aware of the potential policy. The chi-square test of independence does not indicate a significant difference in response frequencies between multiple destination and single destination respondents.

Table 1.11 Sums, Means and t-tests of Snowmobile Trips to Montana Sites for Multiple Destination versus Single Destination Respondents.

Site	Sum	Mean	Sum	Mean	t-statistic
	Multiple Destination N=279		Single Destination N=417		
Big Sky Trails –Madison	82	0.2939	60	0.1439	-3.11**
Big Sky Trails – Cabin Creek	55	0.1971	43	0.1031	-2.74**
Big Sky Trails – Upper Bozeman	18	0.0645	26	0.0624	-0.08
Cooke City	2	0.0072	96	0.2302	1.92*
Lincoln Area	2	0.0072	29	0.0695	1.85*
Helena Area	0	0	5	0.0120	1.00
Wise River/Wisdom	0	0	1	0.0024	1.00
Livingston Area	0	0	1	0.0024	1.00
Deer Lodge Trails	0	0	8	0.0192	1.00
Hamilton/Skalkaho	0	0	8	0.0192	1.00
Pryor Mountains	0	0	6	0.0144	1.00
Georgetown Lake Area	0	0	13	0.0312	1.32
Kings Hill/Little Belts	5	0.0179	20	0.0480	1.55
All Montana Sites	159	0.5700	316	0.7578	1.16

Note: Levels of significance: ** = 5%, * = 10%.

Table 1.12 Chi-square test of Independence for Responses Regarding Whether Respondents Were Aware of Issues Surrounding Proposed Snowmobiling Phase Out in YNP for Multiple Destination versus Single Destination Respondents.

Response Frequency (%)	Mean	Mean	χ^2-statistic
	Multiple Destination N=279	Single Destination N=417	
1 – Yes	243 (87.10)	373 (89.45)	
2 – No	29 (10.39)	39 (9.35)	
3 - No Answer	7 (2.51)	5 (1.20)	
Total	279 (100.00)	417 (100.00)	1.95

Note: Levels of significance: ** = 5%, * = 10%.

The majority of respondents in both groups felt there should be no ban. Slightly over 40 percent of single destination respondents and nearly 45 percent of multiple destination respondents felt that no ban was needed but cleaner, quieter snowmobiles should be required in YNP or GTNP (Table 1.13). Interestingly nearly twice as many

(10.55%) of single destination respondents felt there should be limited snowmobile access in the park as compared to the multiple destination respondents. The chi-square test of independence indicates there is significant difference between the two respondent types. The requirement of cleaner, quiet snowmobiles was the most popular policy option for respondents.

When asked whether they would change the number of trips to the region (WY, MT, and ID), the majority of respondents answered they would in fact decrease their trips (Table 1.14). Approximately 9 percent more of the multiple destination respondents indicated they would decrease their trips to the region (64.52%) as compared to single destination respondents (55.40%). Nearly 7 percent more of the single destination respondents indicated they would not change the number of trips to the region as compared to multiple destination respondents. Given that multiple destination respondents are bundling a number of sites together on their trips, the higher number of respondents decreasing their trips could have more significant visitation impact than the single destination respondents' trip reductions. The chi-square test indicates a difference between the two respondent types regarding their responses to this question.

Table 1.13 Chi-square test of Independence for Responses Regarding Respondent's Opinion on Best Solution for Snowmobiling Conflict in National Parks for Multiple Destination versus Single Destination Respondents.

Response Frequency (%)	Mean	Mean	χ^2 – statistic
	Multiple Destination N=279	Single Destination N=417	
1 – Ban snowmobiles and snow coaches	0 (0.00)	3 (0.72)	
2 – Ban snowmobiles and allow snow coaches	1 (0.36)	8 (1.92)	
3 – Partial snowmobile ban in sensitive areas	10 (3.58)	21 (5.04)	
4 – Rotation of snowmobile allowance areas in park	2 (0.72)	2 (0.72)	
5 – Lottery or permit system	8 (2.87)	10 (2.40)	
6 – Limited snowmobile access per day or per season	12 (4.30)	44 (10.55)	
7 – No ban but require cleaner, quieter machines	123 (44.09)	175 (41.97)	
8 – No ban, no additional requirements	79 (28.32)	84 (20.14)	
9 – No opinion about this issue	3 (1.08)	5 (1.20)	
10 – Other	20 (7.17)	28 (6.71)	
11 – No answer	21 (7.53)	37 (8.87)	
Total	279 (100.00)	417 (100.00)	19.74**

Note: Levels of significance: ** = 5%, * = 10%. Chi-square may not be valid test in this instance as several cells have counts of less than 5.

Table 1.14 Chi-square test of Independence for Responses Regarding Whether Respondents Would Increase, Decrease or Not Change the Number of Trips to Region if No Longer Able to Snowmobile in YNP and GTNP for Multiple Destination versus Single Destination Respondents.

Response Frequency (%)	Mean	Mean	χ^2 - statistic
	Multiple Destination N=279	Single Destination N=417	
1 – Increase	4 (1.43)	12 (2.88)	
2 – Decrease	180 (64.52)	231 (55.40)	
3 – Not Change	90(32.26)	163(39.09)	
4 – No Answer	5 (1.79)	11 (2.64)	
Total	279 (100.00)	417 (100.00)	6.54*

Note: Levels of significance: ** = 5%, * = 10%.

Tables 1.15, 1.16 and 1.17 probe into the issue of where and how respondents might change site visits should YNP and GTNP no longer be available as a snowmobile site. The results reveal some interesting differences between the two respondent types. Perhaps the most interesting result is that multiple destination respondents indicated a

Table 1.15 Sums, Differences of Stated Preference (Question 12) and Revealed Preference Responses, and t-tests for Snowmobile Visits to Wyoming Sites for Multiple Destination versus Single Destination Respondents, if Yellowstone and Grand Teton National Parks No Longer Allowed Snowmobiles.

Site	Sum SP	Sum SP
	Multiple Destination N=279	Single Destination N=417
Beartooth Mountains	3	62
North Bighorns	8	53
South Bighorns	3	26
Bearlodge Mountains	0	5
Black Hills	7	20
Casper Mountain	0	44
Snowy Range	9	65
Sierra Madre Mountains	2	15
Uinta Mountains	0	16
Alpine/Horse Creek	4	28
Afton/Labarge	1	22
Kemmerer	1	5
Granite Hot Springs	5	39
Togwotee	34	114
Dubois	9	74
Gros Venre	4	22
Pinedale	7	22
Lander	2	47
Sum SP trips WY sites	99	679
Difference in trips:		
SP trips – actual trips	-402	-494
% change from actual	(-80%)	(-42%)
t – statistic	t = 16.54**	t = 11.05**

Note: Levels of significance: ** = 5%, * = 10%. The t-statistics reported for each respondent type tests whether the difference between stated preference visitation (Question 12) and actual visitation is significantly different from zero for each respondent type.

larger percentage decrease in site visits compared to their visitation for sites in all three states as compared to the single destination respondents. This is consistent with responses in Table 1.14 in that multiple destination respondents had a higher percentage

Table 1.16 Sums, Differences of Stated Preference (Question 12) and Revealed Preference Responses, and t-tests for Snowmobile Visits to Idaho Sites for Multiple Destination versus Single Destination Respondents, if Yellowstone and Grand Teton National Parks No Longer Allowed Snowmobiles.

Site	Sum Multiple Destination N=279	Sum Single Destination N=417
Cave Falls	18	23
Mesa Falls	33	39
Two Top	118	114
Big Springs	71	123
Coeur d' Alene	4	6
Magic Mountain	0	3
McCall Trails	0	11
Bone Trails	0	47
Sun Valley Trails	0	30
Stanley Trails	0	37
Rexburg –Driggs	0	21
Idaho Falls Area	0	6
Howell Canyon	2	3
Burley Area	0	6
Salmon Area	0	15
Sum SP Trips ID Sites	246	484
Difference in trips:		
SP trips – actual trips	-295	-69
% change from actual	(-55%)	(-12%)
t – statistic	t = 10.38**	t = 1.27

Note: Levels of significance: ** = 5%, * = 10%. The t-statistics reported for each respondent type tests whether the difference between stated preference visitation (Question 12) and actual visitation is significantly different from zero for each respondent type.

of "decrease" responses when asked about a potential change in their trips to the region. Couple this with the fact that these respondents visit multiple sites on their trip and these higher percentage drops seem consistent. Moreover, t-tests at the bottom of Tables 1.15, 1.16, and 1.17 on whether the difference between respondents' actual visitation and their stated preference visitation with YNP closure for all sites within a state was different from zero were significant for the multiple destination trip respondents for all of the states.

Table 1.17 Sums, Differences of Stated Preference (Question 12) and Revealed Preference Responses, and t-tests for Snowmobile Visits to Montana Sites for Multiple Destination versus Single Destination Respondents, if Yellowstone and Grand Teton National Parks No Longer Allowed Snowmobiles.

Site	Sum	Sum
	Multiple Destination N=279	Single Destination N=417
30 – Big Sky Trails –Madison	44	37
31 – Big Sky Trails – Cabin Creek	24	27
32 – Big Sky Trails – Upper Bozeman	12	26
33 – Cooke City	8	101
34a. – Lincoln Area	2	29
34b. – Helena Area	0	5
34c. – Wise River/Wisdom	0	1
34d. – Livingston Area	0	0
34e. – Deer Lodge Trails	0	10
34f. – Hamilton/Skalkaho	0	10
34g. – Pryor Mountains	0	6
34h. – Georgetown Lake Area	0	18
34i. – Kings Hill/Little Belts	0	16
Sum SP Trips MT Sites	90	286
Difference in trips:		
SP trips – actual trips	-69	-30
% change from actual	(-43%)	(-9.5%)
t – statistic	t = 4.12**	t = 1.59

Note: Levels of significance: ** = 5%, * = 10%. The t-statistics reported for each respondent type tests whether the difference between stated preference visitation (Question 12) and revealed preference visitation is significantly different from zero for each respondent type.

The difference in actual trips versus stated trips with YNP closure indicates a significant difference for the multiple destination users to all three states but only for Wyoming in the case of the single destination respondents. There also were more significant differences in average number of stated visits after YNP closure to sites in Wyoming across respondent types as compared to the other two states.

These results could be indicative of the potential for economic impacts being different across states given a YNP closure. It is important to keep in mind that single destination respondents included people who only took a single trip to the region, which was to Yellowstone and or Grand Teton National Park. Moreover, YNP and GTNP were coded as Wyoming sites. Overall, the questions regarding potential changes in visitation to the region indicate some significant differences in the patterns of potential substitutions and economic impacts both to snowmobilers and economies between the two different types of respondents if Yellowstone and Grand Teton National Parks were no longer available as snowmobile sites.

Demographics

Tables 1.18, 1.19 and 1.20 all have significant chi-square statistics indicating potential demographic differences between the two respondent types. Females were

Table 1.18 Chi-square test of Independence for Gender of Respondents for Multiple Destination versus Single Destination Respondents.

Response Frequency (%)	Mean	Mean	χ^2 – statistic
	Multiple Destination N=279	Single Destination N=417	
1 – Male	224 (80.29)	293 (70.26)	
2 – Female	52 (18.64)	112 (26.86)	
3 – No Answer	3 (1.08)	12 (2.88)	
Total	279 (100.00)	417 (100.00)	9.57**

Note: Levels of significance: ** = 5%, * = 10%.

more likely to answer the survey in the single destination respondents group than the multiple destination group. The majority of respondents, approximately 60 percent for both respondent types, were in the 41 to 64 years of age category (Table 1.19). This is consistent with past results regarding snowmobiler ages (see May et al. 2001). A higher percentage of respondents, nearly twice, were in the 21 to 30 category for the single destination respondents as compared to the multiple destination respondents. Approximately, 7 percent more of the multiple destination respondents were in the 31-40 age group as compared to single destination respondents.

Table 1.19 Chi-square test of Independence for Responses Regarding Respondent's Age Category for Multiple Destination versus Single Destination Respondents.

Response Frequency (%)	Mean	Mean	χ^2 - statistic
	Multiple Destination N=279	Single Destination N=417	
1 – Under 21 years of age	0 (0.00)	4 (0.96)	
2 – 21 – 30	22 (7.89)	61 (14.63)	
3 – 31 – 40	75 (26.88)	81 (19.42)	
4 – 41 – 50	84 (30.11)	130 (31.18)	
5 – 51 – 64	84 (30.11)	121 (29.02)	
6 – 65 years and older	12 (4.30)	14 (3.36)	
7 – No answer	2 (0.29)	6 (1.44)	
Total	279 (100.00)	417 (100.00)	14.48**

Note: Levels of significance: ** = 5%, * = 10%.

The multiple destination group had slightly higher percentages in the education categories associated with finishing high school, some college, and obtained a college degree as compared to the single destination group (Table 1.20). The single destination group had nearly 8 percent more of its respondents indicating they had obtained a graduate degree as compared to the multiple destination respondents. Overall, the single destination group had a slightly higher percentage of respondents indicating at least some post secondary education (80.33%) as compared to the multiple destination group (76.7%). The chi-square statistic is significant at the 10% level regarding the frequency of responses for education.

Table 1.20 Chi-square test of Independence for Responses Regarding Respondent's Education Category for Multiple Destination versus Single Destination Respondents.

Response Frequency (%)	Mean	Mean	χ^2 - statistic
	Multiple Destination N=279	Single Destination N=417	
1 – Grades 1 through 8	1 (0.36)	0 (0.00)	
2 – Some high school	1 (0.36)	4 (0.96)	
3 – Finished high school	60 (21.51)	70 (16.79)	
4 – Some college	77 (27.60)	103 (24.70)	
5 – Obtained a college degree	88 (31.54)	119 (28.54)	
6 – Some postgraduate work	17 (6.09)	31 (7.43)	
7 – Obtained graduate degree	32 (11.47)	82 (19.66)	
8 – No answer	3 (1.08)	8 (1.08)	
Total	279 (100.00)	417 (100.00)	13.42*

Note: Levels of significance: ** = 5%, * = 10%.

The respondents in both groups seem to have frequencies of responses across categories that are very similar as it relates to household income. The only noticeable differences are in the "$75,000 - $99,999" and "over $300,000" categories. There was nearly a 7 percent higher frequency of responses in the "$75,000 - $99,999" category for the multiple destination respondents as compared to the single destination respondents, and there was a 4 percent disparity between single destination respondents as compared to multiple destination respondents in the "over $300,000" category. The chi-square test of independence does not indicate a significant difference in income category frequencies for these to groups. It is important to note, however, that there were a number of categories or cells, which had zero observations in them for this particular test. This phenomenon reduces the validity of the chi-square test. Overall, there is not a discernible income difference between these two groups. As an additional comparison, the midpoint of each income ranges was used to compute a mean income level for each visitor segment. The estimated mean for the multiple destination segment was slightly less than the single destination segment, $105,637 versus $112,368. Both of these estimated means are well above the mean household income of $54,208 reported by the United States Census Bureau (n.d.) for 2001.

Table 1.21 Chi-square test of Independence for Responses Regarding Respondent's Range of Household Income Before Taxes Last Year for Multiple Destination versus Single Destination Respondents.

Response Frequency (%)	Mean	Mean	χ^2 - statistic
	Multiple Destination N=279	Single Destination N=417	
1 – Under $5,000	0 (0.00)	0 (0.00)	
2 – $5,000 - $9,999	0 (0.00)	3 (0.75)	
3 – $10,000 - $14,999	0 (0.00)	4 (1.01)	
4 – $15,000 - $19,999	3 (1.12)	3 (0.75)	
5 – $20,000 - $24,999	1 (0.37)	7 (1.76)	
6 – $25,000 - $29,999	4 (1.50)	6 (1.51)	
7 – $30,000 - $34,999	6 (2.25)	13 (3.27)	
8 – $35,000 - $39,999	6 (2.25)	10 (2.51)	
9 – $40,000 - $49,999	20 (7.49)	27 (6.78)	
10 - $50,000 - $74,999	67 (25.09)	102 (25.63)	
11 - $75,000 - $99,999	67 (25.09)	73 (18.34)	
12 - $100,000 - $149,999	54 (20.22)	74 (18.59)	
13 - $150,000 – $199,999	14 (5.24)	26 (6.53)	
14 - $200,000 - $300,000	13 (4.87)	18 (4.52)	
15 – Over $300,000	12 (4.49)	32 (8.04)	
Total	267 (100.00)	398 (100.00)	15.44

Note: Levels of significance: ** = 5%, * = 10%. Chi-square may not be a valid test as cell counts in a number of cells are less than 5.

Overall, the tables regarding demographics indicate some significant differences between responses for the two types of snowmobile users. This further supports the hypothesis that at least two distinctly different types of Yellowstone National Park snowmobile users were sampled in this study. The analysis of these differences provides important information regarding economic and policy analyses associated with the potential closure of Yellowstone and Grand Teton National Parks as snowmobile sites.

Conclusions

The above results point toward several important implications regarding policy and economic analyses. First, nearly forty percent of respondents are of the multiple destination type, and there is a jointness problem associated with statistically analyzing changes in benefits for these respondents. A significant number of respondents in this category indicated they would decrease their number of trips to the region should YNP and GTNP no longer allow snowmobile use. Since these respondents visited multiple sites during their trips to the region, many respondents would lose not only the benefits associated with snowmobiling in the park but also benefits from visiting other sites as well, if policy were to ban or drastically reduce the number of snowmobiles in YNP and GTNP. Moreover, non-market valuation techniques based on the travel cost method would have to address the "jointness" issue in travel cost or price to a site, i.e., how do you assign travel cost to a site when travel to a region results in multiple sites visited. How the "jointness" issue is addressed could significantly impact benefit estimates regarding policy changes.

The results of the above analysis indicates many significant differences between the multiple destination and single destination respondents in the sample. This suggests there are at least two different populations of snowmobile users that utilize YNP and GTNP as a winter recreation site. Given the proportions of the two types of users in the sample and their significantly different responses to questions that could be utilized for economic analyses, it is likely that ignoring one type of user could seriously affect conclusions regarding economic outcomes associated with a policy which bans or drastically reduces snowmobile access to YNP and GTNP.

Comparison of actual trips versus stated trips if YNP is closed in the above analysis suggests that economic impacts in the region associated with a ban or drastic reductions in snowmobile access, could be unevenly distributed across communities within Wyoming, Idaho, and Montana. An economic impact analysis, which ignored the potential substitution information from the stated preference data would likely not capture these distribution issues well. This potential distribution issue also is complicated by the heterogeneity of recreationists using Yellowstone and Grand Teton National Parks as snowmobile sites.

The above analysis reveals several important findings. First, it is likely that Wyoming, Idaho and Montana would experience reduced snowmobile site visitation, if snowmobiling were banned outright in Yellowstone and Grand Teton National Parks. The distribution of those potential reductions and substitutions varies across the region. Second, estimates of changes in non-market benefits for snowmobilers and economic impacts will likely be affected by the heterogeneity of populations that utilize these parks as snowmobile sites. Third, economic analyses of YNP and GTNP snowmobile policy changes would likely provide better information, if both revealed and stated preference data were utilized. While these findings point toward a number of analytical challenges, ignoring them completely could grossly misrepresent any policy relevant conclusions regarding the potential economic outcomes associated with a ban or drastic reduction in snowmobile access in these parks.

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CHAPTER 2

COMPARING REVEALED AND STATED PREFERENCES IN A RECREATIONAL DEMAND SYSTEM FACING CLOSURE OF A UNIQUE SITE

Introduction

Economists continually face questions posed by society regarding the impacts of a proposed exogenous shock. Yet traditional analytical methods often require ex post observation before such a shock can be empirically investigated. Unfortunately, waiting until a policy is implemented before evaluating its economic consequences can be a costly practice. It is the need to understand economic agent behavior in the face of a proposed change that has motivated over thirty years of investigation into the use of stated preference methods (Azevedo, Herriges and Kling 2003; Louiviere, Hensher and Swait 2000).

Much of this work in the resource and environmental economics literature has focused on nonmarket valuation, namely the contingent valuation method (CVM). Stated preference methods such as CVM have the advantage of eliciting preferences for the change ex ante, and thus, a potential problem of trial and error is avoided (Brookshire and Crocker 1981). Concerns have been raised about the potential for inaccurate benefit estimates associated with stated preference methods due to such phenomena as strategic bias or hypothetical values (Freeman 1993; Loomis and Walsh 1997). It is not surprising that there has been investigation into combining the strengths of revealed and stated preference data when estimating benefits from environmental change.

Louviere and Timmermans (1990) encourage the use of stated preference methods in recreational research. The authors argue there are numerous advantages to be gained from this type of data, particularly in discrete choice models. Louviere, Hensher and Swait (2000) state that combining revealed (RP) and stated preference (SP) data can exploit strengths found in both types of data while ameliorating their weaknesses. These authors label the estimation of models from a combined RP and SP data set as "data enrichment (p. 231)." This data enrichment paradigm proposes that combining data sets allows analysts to produce an improved predictive model of economic agent behavior relating to potential future scenarios.

Louviere, Hensher and Swait (2000) state that SP data are ideally suited to considering fundamentally different markets created by structural shifts as they can be particularly rich in attribute tradeoff information. Various authors have used a data enrichment approach in a random utility framework regarding the estimation of benefits from proposed changes in environmental attributes (Adamowicz, Louviere and Williams 1994; Haener, Boxall and Adamowicz 2001; Morey, Waldman and Breffle 2001). Little seems to exist in the literature regarding visitation behavior when recreationists are faced with a site closure, rather than attribute changes, given the availability of other potential substitute sites.

Problem Statement

In response to environmental issues, a preferred winter use management alternative of banning the use of snowmobiles in Yellowstone National Park (YNP), Grand Teton National Park (GTNP), and the John D. Rockefeller, Jr., Memorial Parkway (JDRMP) was proposed in an environmental impact statement (EIS) during the spring of 2000 (National Park Service 2000). Various changes in that policy have taken place since its proposed adoption as a result of federal administration turnover and court decisions stemming from appeals (Thorne 2002; Hamilton 2002; Sullivan 2002; Lipsher 2004; Black 2004). The future of snowmobile recreation inside the boundaries of YNP and GTNP continues to be uncertain, but the fundamental question of where snowmobilers will recreate, if these parks are closed, remains. This question has implications regarding the change in nonmarket benefits to snowmobilers and potential economic impacts faced by communities within the states surrounding the parks.

Given the fact that numerous snowmobile sites exist in Wyoming, Idaho and Montana, the issue of substitutability is central to the estimation of benefit changes and economic impacts in the region surrounding these national parks. In the face of park closure, will snowmobilers continue to come to the region and recreate at other sites? Observed behavior can be obtained regarding trips taken in the region, but will the loss of a unique site such as YNP or GTNP alter preferences to take trips in this region? The purpose of this research is to investigate the ability of survey respondents to reallocate multiple trips across a large number of possible sites when their choice set is altered in a stated preference context as compared to revealed preference data.

Specifically, two propositions are investigated.

Proposition # 1: Respondents can reallocate trips across multiple recreation sites in a stated preference format, when the choice set is altered, in a manner that is consistent with maximizing utility.

Proposition # 2: Preferences between revealed preference and stated preference data are consistent or exhibit homogeneity regarding trip shares across recreational sites when the choice set is altered.

Theory and Random Utility Models

Given the potential for substitution across a number of sites throughout the season, an analytical framework for modeling behavior is needed that can capture the essence of a more complex recreational demand system than a traditional TCM. The random utility model is chosen for this analysis. In this case the choice to participate or not, along with site choice lends itself to the nested logit specification (Morey 1999; Chen, Lupi, and Hoehn 1999). While the Kuhn-Tucker model of recreation demand has some appealing features, the large number of sites in this problem makes that model problematic to estimate (Herriges, Kling and Phaneuf 1999).

Random utility theory poses that individuals will choose the recreation option, for a given decision period, that will provide them with the greatest utility given their constraints (Louviere, Hensher and Swait 2000). The utility function for an individual then contains both a deterministic component (V) and a component that is unobservable to the researcher or stochastic (ε). This is represented in equation 1.

(1) $U=V+\varepsilon$

where V is the indirect utility function and can be characterized as follows:

(2) $V_i=\beta_k X_i$

For this function (2) X is a vector of k attributes associated with alternative i and β is a coefficient vector. The error terms for the nested logit specification are assumed to be generated by a generalized extreme value (GEV) distribution as proposed by McFadden (1978).

The probability of choosing a specific site (denoted as gni, where g∈L, n∈M, and i∈J) in a three-level nested-logit model is depicted in Morey (1999) as follows:

$$(3)\quad \text{Prob(gni)} = \frac{\exp(sV_{gni})\left[\sum_{m=1}^{Mg}\left[\sum_{j=1}^{Jgm}\exp(sV_{lmj})\right]^{(t/s)}\right]^{(1/t)-1}\left[\sum_{j=1}^{Jgm}\exp(sV_{gnj})\right]^{((t/s)-1)}}{\sum_{l=1}^{L}\left[\sum_{m=1}^{Ml}\left[\sum_{j=1}^{Jlm}\exp(sV_{gmj})\right]^{(t/s)}\right]^{1/t}}$$

where, for our model, L has two elements (nonparticipation or participation in snowmobiling). M has two groups of sites (YNP group or all other sites), and J in the YNP group has five sites, or J in the "all other sites" group has 43 sites. For this notation and our estimation, which follows Morey (1999), s=1/(1-σ) in McFadden's (1978) notation, or s=1/θ in Kling and Herriges (1995) where they refer to θ as the dissimilarity coefficient.

The probability of choosing a site in other nesting structures can be obtained from equation (3). The probability equation for a two-level nested logit is obtained by placing a one in the above equation for *t*, and when a one is substituted for both *s* and *t* the above probability equation collapses down to the standard probability given for a straight multinomial logit model.

Per-choice occasion expected maximum utility is

(4) U = ln D + 0.57721 (Euler's constant),

where for the three-level nested logit

$$(5)\ D = \sum_{l=1}^{L}\left[\sum_{m=1}^{Ml}\left[\sum_{j=1}^{Jlm}\exp(sV_{lmj})\right]^{(t/s)}\right]^{1/t}$$

For our purposes we will focus on trip prediction and preference homogeneity across the revealed and stated preference data. Welfare estimates can be derived from equations (4) and (5) and are given for completeness in our discussion of theory and RUMs.

Brief Review of Literature

Traditional travel cost (TCM) and random utility models (RUM) use revealed preference data to predict change in value associated with quality change or site closure. The strength of revealed preference data is the observed behavior of responses. This respondent experience reduces concerns about his or her ability to understand the good in question and place a value on it.

Stated preference (SP) questions allow respondents to make choices about goods described in hypothetical decision contexts. Louviere, Hensher and Swait (2000) list a number of advantages of SP data, but they state these data are reliable when respondents understand and are committed to the choice they are asked to make. This places the responsibility on the researcher to make sure the respondent fully comprehends the good or change in question.

Behavior and decisions regarding recreational trips as the intended good is the focus of our research. Loomis (1993) uses a test-retest format to investigate reliability of intended visitation, number of trips and length of stay at a hypersaline lake in California (Mono Lake) with different water levels. The author uses chi-square tests and t-tests and finds that there is no statistical difference between indications of intended visitation, number of trips and length of stay after an eight-month interval for survey respondents.

The author then uses a t-test to check validity of intended length of stay. The author found no statistical difference between intended length of stay and actual length of stay at lake level number two in the scenarios. This research lends credence to the use of stated preference data in nonmarket valuation studies, particularly when the good in question is recreational trips.

Cameron (1993) was the first in the nonmarket valuation research literature to combine TCM and CVM data to empirically estimate a quadratic utility curve. The CVM and TCM data are used to estimate a joint model with cross-equation parameter restrictions from a simultaneously estimated demand model (TCM) and discrete choice model (take it or leave it CVM). She uses a log likelihood function that accounts for the joint or correlated nature of the error terms. The model seems to be robust given Monte Carlo simulations of welfare estimates. The author concludes that future surveys collecting travel cost data and contingent valuation responses can (and should) be designed so that it is feasible to adopt the more rigorous "random utility" stochastic specifications customarily used in the discrete/continuous choice literature.

Cameron et al. (1996) estimate recreation demand for nine different river and reservoir sites at alternative water levels using TCM and CVM data. They conclude that the combination of data was necessary to address multicollinearity and that controlling for nonresponse bias was important. Englin and Cameron (1996) and Loomis (1997) conclude that combining contingent behavior questions with travel cost data reduces omitted variable bias associated with straight revealed preference methods, provides a wider range of policy application and when combined with panel data estimators can improve welfare estimation.

Adamowicz, Louviere, and Williams (1994) combine stated preference and revealed preference data to estimate random utility models for water based recreation in Alberta, Canada. They estimate a revealed preference model based on actual trip behavior, and they estimate a stated preference model based on questions from a survey regarding water recreation attributes and preferences for taking a trip. The signs of the parameter estimates and performance of the two models are consistent. The authors conclude that the choice sets are consistent and both the RP and SP models can be estimated in a RUM framework regarding participation in running water, standing water and other non-water recreation. They estimate the joint model and simultaneously estimate the relative scale factor for the stated preference data, which results in the highest likelihood value. They accomplish this in two steps: 1) Separate estimation of revealed and stated models and (2) concatenation of both data sets, and rescaling of stated preference data, relative to the RP data, where the scale factor is revealed by conducting a grid search in the manner suggested by Swait and Louviere (1993). After estimating the RP, SP and joint models, the authors estimate welfare measures from the models for a change in instream flow. They find that the joint model welfare measures are between the RP and SP models, with the joint estimate being closer to the RP data. Moreover, signs of the joint model are consistent with apriori expectations and more of the parameter estimates in the joint model are significant as compared to the RP model due to reduced collinearity.

Haener, Boxall and Adamowicz (2001) examine the ability of revealed preference, site-specific stated preference, transferred SP, and joint RP-SP RUMs to predict aggregate and individual recreation site choice in a holdout sample for moose hunting. The authors use RP data for Saskatchewan moose hunting and combine it with SP data on pairs of attributes affecting trip choice for different samples of hunters in Alberta and Saskatchewan. The authors then use the data to predict trips to management zones in Alberta and Saskatchewan. They set up like RUM models for sites using RP and SP data and use several different tests to evaluate model performance and trip prediction for Saskatchewan holdout samples. The authors find the Alberta SP data was a better predictor of trips than the RP data for Saskatchewan according to the sum of absolute errors (SAE), but they find the individual level prediction tests indicate the Saskatchewan RP and Alberta SP models have superior predictive ability. They also find that the joint RP-SP models were reliable predictors of trips for the holdout samples. The authors conclude with the following: "In pursuit of more realistic predictive models, we also need to demonstrate how well RP, SP and joint models predict behavioral responses to *actual attribute changes*. The results reported in this article, in conjunction with other current research (e.g. Swait, Louviere and Williams 1994), suggest that SP models may be best at predicting responses of individuals facing resource tradeoffs. This suggestion needs to be tested in other studies involving different activities and environments (p.641)."

Morey, Waldman and Breffle (2001) combine revealed preference data (RP) data with stated preference (SP) and stated frequency data to estimate welfare changes for quality changes in angling on Green Bay. The authors discuss the decision protocols assumed for RP and SP data and how this does not change the underlying likelihood functions for estimation. The SP data asked for preferred choice on eight pairs of quality alternatives and then ask respondents for expected change in trip frequency to Green Bay.

The authors estimate a probit model. They find that the precision of parameter estimates increases with the use of SP data. Estimation is generalized by allowing for nonzero covariance between the various stochastic components associated with the different types of data (probit rather than logit or nested logit), but the authors conclude that one could adopt either of the latter two specifications.

The above literature points to the potential for improving random utility model performance and welfare estimates with the inclusion of SP data. As such, two different contingent behavior questions regarding the closure of Yellowstone National Park and trip behavior were incorporated into the survey used for this project. This data will be used to compare RP, SP and joint model specifications to address our research propositions.

Data Collection

Data collection for this project involved intercept sampling and a follow up mail survey sent to YNP snowmobile recreators agreeing to participate in the project. Intercept sampling occurred on thirty-three days between December 15, 2001 and February 28, 2002 (see Chapter 1, and Appendix A for full details of sampling design). Recreators agreeing to participate were then asked to fill out a card with their mailing address, and they were informed that a questionnaire would be sent to them the first part of March. Moreover, each contact was given a one-page trip record sheet with a map on the reverse side for listed sites and asked to keep a log of their trips and the sites they visited between December 15, 2001 and February 28, 2002. Twice during the winter season survey participants were sent postcard reminders asking them to keep their trip record sheets up to date and to remind them this information would be important for filling out the survey they would receive in March. During the intercept sampling procedure the refusal rate was 9.5% and the final number of contacts in the database was 1162 (see Appendix A, Table A-1 for more detail). Of those 1162 respondents, several addresses were removed due to bad addresses, foreign mailing addresses in Canada, and contacts that were professional guides. The final database for the first mailing had 1148 addresses. The finalized survey was mailed to respondents March 4th. The mail survey followed a modified Dillman (1978) design to insure an adequate response rate (See Chapter 1 and Appendix A for a more in-depth description of the survey instrument, design and timeline). The response rate was 701 returns out of 1148 (61 percent).

Survey

The questionnaire is divided into seven sections (see Appendix A for specific questions and detail). Section one asks basic questions about the respondent's snowmobile experience and days snowmobiled during the season. Section two asks for site specific trip information during the December through February period, and it asks stated preference questions in several different formats regarding where respondents think they would take snowmobile trips if YNP and GTNP were no longer available. Section three asks specific questions about their most recent trip to YNP including hours snowmobiled per day, number in party, etc. Section four asks respondents for information about their expenditures in and out of the YNP region on their most recent snowmobile trip. Section five asks several questions about their opinions regarding the potential phase out of snowmobile use in the park. Section six asks questions designed to elicit preferences for site and trip attributes. Section seven asks for demographic information about the respondent.

Additionally, data regarding average snow depth by site for both the 2000-2001 and 2002-2003 seasons for all 48 sites in respondents' choice set, and other site attributes such as miles of groomed trail, services within five miles of the trail head, and high and low elevation along the trails for each site were recorded. Travel distances and travel times for each respondent using a car or truck to each of the 48 sites from their home zip codes were estimated using PC-Miler by ALK Technologies.

Revealed and Stated Preference Question Details

Specifically the revealed preference question in section two provided a table with 28 different sites from Wyoming, Idaho and Montana allowing respondents to list the number of trips and days spent at each site during the specified survey period. Respondents were asked to refer to their trip record sheet or place the trip record sheet in the survey upon returning it for this question. Respondents were also given the opportunity to list "other" sites for each state that they recreated at and were asked to list the name of the site. An additional 20 sites were added to the choice set as a result of this question, bringing the total sites in the choice set to 48. This format was used to allow respondents to more accurately define the relevant choice set.

Much work has been done suggesting ill-defined choice sets for RUMs can produce biased results and welfare estimates (see Parsons and Kealy 1992; Parsons and Needleman 1992; Feather 1994; Karou et al. 1995; Haab and Hicks 1997; Parsons and Hauber 1998; Parsons, Plantinga and Boyle 2000). The aforementioned research has implications for choice set definition in this project. First, aggregation seems to have serious consequences on model and welfare estimation. As such, sites are not aggregated, but rather trail systems are presented as alternatives to sample respondents in this study. It is expected that individual trails within the identified systems are homogeneous enough in characteristics that this should not pose a problem. Moreover, given the large distances snowmobiles can cover within a day, trail systems seem to be the relevant site alternative for decision purposes. If an error has been made in choice set definition, it has likely been to include too many sites. The above research suggests this has less serious consequences on welfare estimates than narrow choice set definition. Questions were not included in the survey asking familiarity with all sites in the defined choice set as suggested by Hicks and Strand (2000) other than a map showing the geographic location of the listed sites and specifics about YNP characteristics due to concerns regarding questionnaire length.

Once respondents had finished the revealed preference question, the stated preference questions were framed as follows:

Stated Preference Question # 1 (SP1)

9. It is currently proposed that snowmobiling in Yellowstone and Grand Teton National Parks will be phased out beginning in the 2003-2004 season. If you were no longer able to snowmobile in Yellowstone or Grand Teton National Park, would you change the number of trips you would take during the season in Wyoming, Montana and/or Idaho? Please mark the most appropriate choice and fill in your estimate of the change in the number of trips.

______ *Yes, I would **increase** my snowmobile trips to WY, MT and/or ID by (#)______ trips.*

______ *Yes, I would **decrease** my snowmobile trips to WY, MT and/or ID by (#)______trips.*

______ *No, I would **not change** the number of snowmobile trips to WY, MT, ID.*

10. Referring to your trip record sheet or your answer to question 7 (they should be exactly the same), what was the site with the most trips other than Yellowstone National Park or Grand Teton National Park? ____________ (Number of Site).

11. Would your trips to the site in the previous question (question 10) change if you were no longer able to snowmobile in Yellowstone National Park and Grand Teton National Park? Please mark the most appropriate choice and fill in your estimate of the change in the number of trips.

______ *Yes, I would **increase** my snowmobile trips to the site in question 10 by (#)______ trips.*

______ *Yes, I would **decrease** my snowmobile trips to the site in question 10 by (#)______trips.*

_______ *No, I would **not change** the number of snowmobile trips to the site in question 10.*

Stated Preference Question #2 (SP2)

12. *Assume that this snowmobile season was the same in every way, **except that you were no longer able to snowmobile at Yellowstone and Grand Teton National Parks**. Based on this, please indicate the number of trips you would have taken to each location and the number of days you would have spent at each location between the dates of December 15, 2001 through February 28, 2002. (please refer to the map on the back of your trip record).*

	# of Trips	**# of Days**		**# of Trips**	**# of Days**
01 - Beartooth Mountains			**08 – Uinta Mountains**		
02 – Bighorn Mountains			**09 – Wyoming Range**		
2a.- North Bighorns			9a.- Alpine/Horse Creek		
2b.- South Bighorns			9b.- Afton/Labarge		
			9c.- Kemmerer		
03 – Bearlodge Mountains					
			10-Granite Hot Springs		
04 – Black Hills					
			11 - Continental Divide		
05 – Casper Mountain			11a.-Togwotee		
			11b.-Dubois		
06 – Snowy Range			11c.-Gros Ventre		
			11d.-Pinedale		
07 – Sierra Madre Mountains			11e.-Lander		
Other Wyoming Trail Areas					
12 –Grand Teton National Park	**NOT Available**	**NOT Available**	**14-Other Areas in Wyoming**		
13-Yellowstone National Park	**NOT Available**	**NOT Available**			
Trail Areas Outside Wyoming					
30-Big Sky Trails – Madison area			**40-Cave Falls**		
31-Big Sky Trails- Cabin Creek			**41-Mesa Falls**		
32-Big Sky Trails – Upper Bozeman area			**42-Two Top**		
33-CookeCity			**43-Big Springs**		
34-Other Montana Area – Please Specify			**44-Other IdahoArea- Please Specify**		
50-Areas in Colorado			**70-Areas in Utah**		
60-Areas in South Dakota			**80-Areas outside WY, MT, ID, CO, SD, UT**		

The above stated preference questions were designed to test several stated preference formats with varying degrees of difficulty. Question 11 comprised the data in the analysis referred to as SP1, and question 12 comprised the data in the analysis referred to as SP2. It is important to note that a number of respondents referred directly to question 12 when answering question 11 (i.e., "see next question.."; "see next page.."). The exact same responses for trips and days for each site were coded for both questions in these instances. The trip data from both the RP and SP questions were used along with the other survey and attribute data to estimate the random utility models needed to address our research propositions.

Econometric Estimation of Models

Initial analyses using descriptive statistics, t-tests and chi-square tests (see Chapter 1 for details and results) indicated two distinct groups within the sample. One of the two groups was comprised of snowmobilers who took multiple snowmobile trips during the season but visited a single site per trip (labeled as single destination visitors). This group comprised 60% of the sample. The other group could be categorized as people taking a single trip to the region but recreating at multiple sites during their stay. This multiple destination group poses analytical challenges related to joint travel cost issues, and these respondents are excluded from the analysis for purposes of comparing RP and SP in this paper (see Chapter 3 for an analysis of the multiple destination segment). After controlling for item nonresponse in the questionnaire for model estimation and deleting the multiple destination group there were 328 individuals representing 1,744 trips taken in the three state region surrounding and including YNP and GTNP.

As with any econometric model, specification of and estimation procedure for the RUM can affect model performance and the resulting welfare estimates. Pendleton and Mendelsohn (2000) compare hedonic travel cost model (HTC) and random utility model (RUM) using hiker data from the Smoky mountains. The authors conclude that functional form in the RUM is important (linear versus quadratic in this case). Kling and Thomson (1996) look at different specifications, estimators and nesting structures regarding welfare estimations for nested logit models of saltwater angling. The authors' results indicate that welfare estimates are sensitive to specification and nesting structure. They also conclude that the likelihood dominance criterion (LDC) by Pollack and Wales (1991) is a useful tool for model selection. Kling and Thomson (1996) and Morey (1999) suggest that Full Information Maximum Likelihood (FIML) has several advantages over sequential estimation. Kling and Thomson (1996) obtained larger welfare estimates with sequential estimators compared to FIML estimators.

All models were estimated using FIML in Gauss.[1] Attribute variables and functional form were chosen based on theory, apriori expectations and goodness of fit criteria for the revealed preference model. It was hypothesized that sites immediately surrounding YNP and GTNP could comprise a separate nest in the model. This three-level nested-logit (Figure 2.1) was compared to a two-level nested logit in which all sites were grouped together in the participation choice. Pollack and Wale's (1991) LDC was used to determine whether the two-level nest or three-level nest specification was appropriate for this model. We found that the two level nesting was rejected in favor of the three level nesting structure based on the LDC.

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[1] See Tables B.2, B.3, B.6 and B.7 in Appendix B for specific Gauss code used in analysis.

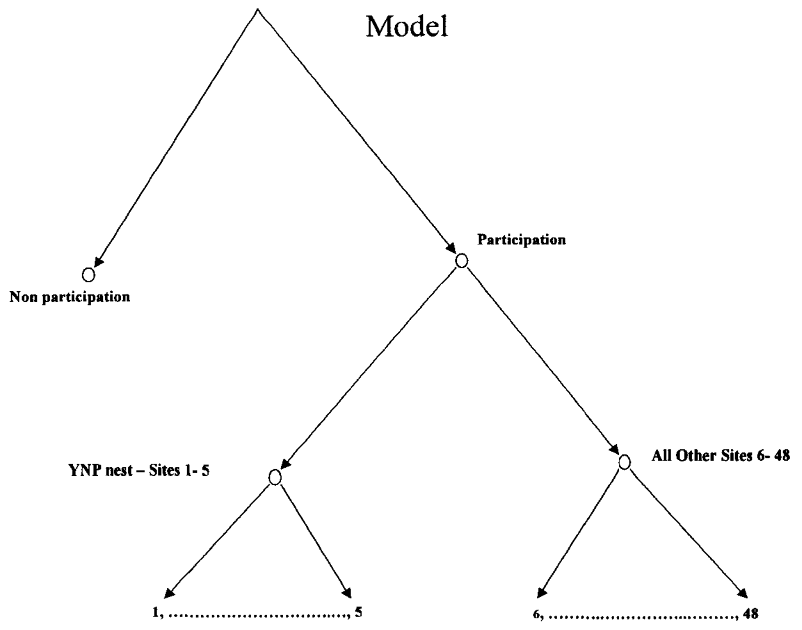

Figure 2.1. Depiction of three nested-logit model regarding participation and site choice.

Variables in the indirect utility equations for each site include a travel cost variable (TC1) based on individual costs such as lodging, gas minus snowmobile gas, trip repairs and airfare if traveled by air. These expenses were summed and then divided by roundtrip YNP distance to get a rate/mile. This rate was then multiplied by roundtrip site distance. Travel time to the site was also included as a separate variable (Stehr). Cesario (1976), McConnell and Strand (1981) and Freeman (1993) all point out that individuals must choose between work and leisure time, and thus, travel time becomes an opportunity cost affecting recreational demand. The (Stehr) variable was based on driving time estimated in PC-Miler or adjusted by travel time by air if the respondent indicated mode of travel to YNP included air travel. The remainder of the variables include site specific attributes such as length of trail (Stelng), an interaction between length of trail and trail grooming (Stetlgm), a binary variable indicating if 50% or more of the trail is groomed (Stegrm), a binary variable indicating if services were either on the trail or within five miles of the trailhead (Stesrv), the difference between the high and low point in elevation on the trail (Steeldf), and the average snowpack from snotel sites on the trail system for January and February of 2002 (Sn02ste). The dependent variable for each site equation is represented by whether the respondent took a trip to the site on a given choice occasion between December 15, 2001 and February 28, 2002.

The equation for nonparticipation includes a binary variable for whether the respondent belongs to a snowmobile club (Club), a constant, a variable for the respondent's annual investment in snowmobile equipment (Snoinvst), binary variables on whether respondents snowmobiled on weekend days (Weeknd) or week days (Weekd) with the base being snowmobiling only on holidays. The number of choice occasions for individuals in this segment of the data is based on the number of days available to snowmobile during the specified dates in the trip record sheet. Nonparticipation was estimated as number of choice occasions minus total trips taken according to the trip record sheet or the revealed preference table in the survey. A variable based on education level of the respondent is included as well (Educ). The final variable included in the nonparticipation equation is based on the respondent's number of years of snowmobiling experience (yrssnow).

It is important to note that for our models we assume constant marginal utility of income across all respondents. Herriges and Kling (1999) investigate the sensitivity of welfare estimates to nonlinear income effects in a Random Utility Model using southern California saltwater angling data. They find that for most of their models the assumption of underlying error distribution has more impact on welfare estimates than nonlinear income effects. The authors indicate these results may be somewhat sample specific, but the overall results point to the relative robustness of the linear income nested logit model. Thus, for this paper we do not deal with income effects in our model.

The pooled models (RP-SP1 and RP-SP2) were estimated using scale adjusted data sets where the RP and SP data were concatenated. The SP data matrices in these concatenated sets were then multiplied by the relative scale factor coming from the estimation of the separate RP and SP models and their corresponding scale parameters (see Louviere, Hensher and Swait 2000; Haener, Boxall and Adamowicz 2001). This procedure normalizes the error variance of the SP data to that of the RP data.

Results

Results of the LDC indicated the three-level nested-logit was the appropriate specification for the RP model. The model is designed to capture the decision to participate or not in snowmobiling and the resulting site choice in either the group of sites including YNP or the group of sites categorized as all other sites not grouped with YNP. This general specification using the vector of variables described in the model estimation section above was then used in the SP1, SP2, pooled RP-SP1 and pooled RP-SP2 models for purposes of addressing our research propositions.[2]

The individual RP and SP model estimations provide some interesting results (Table 2.1). Likelihood ratio tests comparing constant only models with s and t constrained to one and unrestricted models indicate the models are highly significant. The functional form of the model uses a quadratic on the travel cost variable (TC1). The

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[2] See Tables C.1 and C.2 in Appendix C for alternative specifications of the revealed preference model.

Table 2.1. Results for RP, SP1 and SP2 Models (N=328).

Variable	RP	SP1	SP2
TC1	-0.0139	-0.0122	-0.1108
	(0.0021)	(0.0638)	(0.0000)
$TC1^2$	0.0001	0.0001	0.0007
	(0.0422)	(0.2283)	(0.0000)
Stehr	-0.3445	-0.6042	-0.7094
	(0.0000)	(0.0000)	(0.0000)
Stelng	-0.0125	-0.0082	-0.0004
	(0.0000)	(0.0061)	(0.9095)
Stetlgm	0.0114	0.0024	-0.0059
	(0.0000)	(0.4217)	(0.0740)
Stegrm	-0.0650	0.1006	0.1928
	(0.0165)	(0.0096)	(0.0000)
Stesrv	0.0812	0.1387	0.1791
	(0.0000)	(0.0000)	(0.0000)
Steeldf	0.0617	0.0358	0.0390
	(0.0000)	(0.0000)	(0.0000)
Sn02ste	-0.0005	0.0020	0.0020
	(0.0376)	(0.0000)	(0.0000)
Club	-0.3057	-0.5688	-0.5353
	(0.0000)	(0.0000)	(0.0000)
Constant	6.8406	5.0539	4.5695
	(0.0000)	(0.0000)	(0.0000)
Snoinvst	-0.0644	-0.0710	-0.0473
	(0.0000)	(0.0000)	(0.0000)
Weeknd	-0.4117	-0.5207	-0.3367
	(0.0000)	(0.0000)	(0.0001)
Weekd	-0.6523	-0.7642	-0.6907
	(0.0000)	(0.0000)	(0.0000)
Educ	0.0251	0.0109	0.0259
	(0.0753)	(0.5358)	(0.1273)
Yrssnow	-0.0229	-0.0245	-0.0211
	(0.0000)	(0.0000)	(0.0000)
s	7.0167	5.3720	4.3974
	(0.0000)	(0.0000)	(0.0000)
t	0.2384	2.1684	1.9551
	(0.0332)	(0.0000)	(0.0000)
McFaddens R^2	0.1878	0.2205	0.2293
LL	-10616.7368	-7347.5280	-7463.4760
LL – Constant	-13071.5872	-9425.8344	-9684.0360
Model χ^2	4909.7008	4156.6128	4441.1200
Critical $\chi^2_{\alpha=0.05}$	27.587	27.587	27.587

* Probabilities reported in parentheses for asymptotic t-statistics.

signs on the travel cost (TC1) variables are negative, and they are significant at the alpha equal 0.10 level in all three of the models. The signs on the quadratic ($TC1^2$) variables are all as expected apriori, but this variable is not significant in the SP1 model. Travel time (Stehr) is negative and significant in all three models. The models exhibit several sign changes. The grooming variable (Stegrm), interaction between trail length and grooming (Stetlgm), and snowpack (Sn02ste) all change in signs in at least one of the stated preference models as compared to the RP model. The variables in the nonparticipation equation all have the expected signs apriori in all three models. The education variable becomes insignificant in the two SP models, however.

The SP models seem to have slightly better goodness of fit as compared to the RP model. Moreover, even though the LDC indicated the three-level nest was superior compared to the two-level nest specification in the RP model, the *s* and *t* parameters do not indicate the RP model is globally well behaved. The necessary and sufficient conditions for the density function underlying the three-level nest to be globally well behaved is $s \geq t \geq 1$ (Morey 1999).[3] It is interesting to note, however, that the SP models meet the necessary and sufficient conditions for being globally well behaved. Overall, while there seems to be some differences between the RP and SP models, these results would suggest that respondents can, in fact, reallocate multiple trips across multiple sites for a stated preference question in a manner consistent with utility theory.

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[3] It is important to note that while the RP model does not meet the necessary and sufficient conditions to be globally well behaved, the model parameter estimates are stable. Different start values were used for each of the reported models and no parameter estimates changed in sign or by more than several thousandths across the range of start values tested.

Trip Prediction and Preference Homogeneity

Given these differences between the RP and SP models, the question comes to mind as to how these models predict trips will change in the states surrounding YNP should these parks be closed to snowmobiling. These predictions are based on the average number of visitors to YNP and GTNP between 1992 and 2001 and assuming all of the visitors exhibited behavior consistent with the single destination group in this sample. These models predict vastly different outcomes in the face of park closure. The RP without closure provides a base estimate, given the number of choice occasions represented during the season by visitors to YNP and GTNP, predicting 576,924 trips would be taken in Wyoming, Idaho and Montana (Table 2.2). When you shock the RP model and increase price, effectively to infinity, such that trip share probabilities for both YNP and GTNP go to zero, the model predicts visitors will substitute to a number of different sites and only 28,630 trips are lost to the region. This represents only 4.96 percent of the predicted base case trips. The SP models predict a much bigger loss in trips, however. The SP1 and SP2 models are fairly consistent with both predicting 90.5 percent of the trips represented by YNP visitors would be lost to the region as compared to the base case RP estimate. These numbers are obviously very different, and point to the question as to whether stated preference responses indicate a change in preferences between the RP and SP data given the proposed closure of the parks.

Table 2.2. Predicted Trips Taken in WY, ID and MT with and without Site Closure.

	RP w/o closure	RP w/ closure	SP1 w/ closure	SP2 w/ closure
Predicted Trips	576,924	--------	--------	--------
Change in Trips	0	-28,630	-522,149	-522,192
% Change	0	- 4.96 %	- 90.5 %	- 90.5 %

Louviere, Hensher and Swait (2000) outline a test to see if preference homogeneity holds across RP and SP models. This essentially involves testing whether the parameter vectors for the RP and SP models are equal. First, the concept of the scale factor for both the RP and SP models must be discussed. Following Louviere, Hensher and Swait (2000) let us represent the common attributes of the RP and SP utility functions as X^{RP} and X^{SP} and assume Z and W are different attributes for each data set, respectively. The RP and SP utility functions are represented as follows:

(6) $U_i^{RP} = \alpha_i^{RP} + \beta^{RP} X_i^{RP} + \omega Z_i + \varepsilon_i^{RP}, \forall i \in C^{RP}$

(7) $U_i^{SP} = \alpha_i^{SP} + \beta^{SP} X_i^{SP} + \delta W_i + \varepsilon_i^{SP}, \forall i \in C^{SP}$

where i is an alternative in choice sets C^{RP} or C^{SP} and αs are data source-specific alternative-specific constants. The choice sets need not be the same in the data sources. In our case, YNP and GTNP are removed from the SP choice set as compared to the RP data.

Assuming the error terms for both utility functions are IID extreme value type 1 Louviere, Hensher and Swait (2000) represent the resulting multinomial discrete choice models in the following way.

(8) $$P_i^{RP} = \frac{\exp\left[\lambda^{RP}(\alpha_i^{RP} + \beta^{RP} X_i^{RP} + \omega Z_i)\right]}{\sum_{j \in C^{RP}} \exp\left[\lambda^{RP}(\alpha_j^{RP} + \beta^{RP} X_j^{RP} + \omega Z_j)\right]}$$

(9) $$P_i^{SP} = \frac{\exp\left[\lambda^{SP}\left(\alpha_i^{SP} + \beta^{SP} X_i^{SP} + \delta W_i\right)\right]}{\sum_{j \in C^{SP}} \left[\lambda^{SP}\left(\alpha_j^{SP} + \beta^{SP} X_j^{SP} + \delta W_j\right)\right]}$$

where λ^{RP} and λ^{SP} are scale parameters for each model. These scale factors are an inverse function of the standard deviation of the unobserved effects for alternative i for a given decision period. The above equations, (8) and (9), point to an identification problem given the multiplicative nature of the scale factor and the parameter estimates for the two models. Thus, comparison across model parameters for the RP and SP models is inappropriate unless it is known the two models have identical scale factors. For this reason, the SP data are multiplied by the relative scale factor between the RP and SP data when estimating a pooled model. As mentioned previously, this normalizes the error variance of the SP data to the RP data for the pooled model estimation. The dissimilarity coefficients coming from the *s* parameters in the nested-logit models provide the relative scale factor with which the SP data are adjusted.

The test for preference homogeneity involves estimating the pooled RP-SP model and comparing that log-likelihood to the sum of the log-likelihoods of the individual RP and SP models. Specifically, the test statistic is estimated by $-2[(L^{RP} + L^{SP}) - L^{joint}]$ (Louviere, Hensher and Swait 2000). This test statistic is distributed as chi-squared with the degrees of freedom being equal to the sum of the number of RP and SP model parameters minus the number of common attribute parameters plus 1. Thus, the null hypothesis to be tested is that the common parameters in the RP and SP models are equal.

The results of the pooled models, RP-SP1 and RP-SP2, are reported in Table 2.3. Given the closeness in change in predicted trips between the SP1 and SP2 models, it is not surprising that the parameter estimates of the pooled models are nearly identical. Some of the properties reported by Adamowicz, Louviere and Williams (1994) for the pooled models seem to be consistent in these results in that the number of significant parameter estimates is increased in the pooled model as compared to the SP models. Moreover, signs in the pooled model generally seem to hold with apriori expectations. While both models are highly significant, it is interesting to note that *s* and *t* parameters

Table 2.3. Results for the Pooled RP-SP1 and RP-SP2 Models (N=656).

Variable	RP-SP1	RP-SP2
TC1	-0.0160	-0.0160
	(0.0005)	(0.0006)
$TC1^2$	0.0001	0.0001
	(0.0116)	(0.0119)
Stehr	-0.3443	-0.3443
	(0.0000)	(0.0000)
Stelng	-0.0126	-0.0126
	(0.0000)	(0.0000)
Stetlgm	0.0115	0.0115
	(0.0000)	(0.0000)
Stegrm	-0.0659	-0.0659
	(0.0166)	(0.0169)
Stesrv	0.0824	0.0824
	(0.0000)	(0.0000)
Steeldf	0.0623	0.0623
	(0.0000)	(0.0000)
Sn02ste	-0.0005	-0.0005
	(0.0387)	(0.0388)
Club	-0.3073	-0.3073
	(0.0000)	(0.0000)
Constant	6.8588	6.8598
	(0.0000)	(0.0000)
Snoinvst	-0.0644	-0.0644
	(0.0000)	(0.0000)
Weeknd	-0.4074	-0.4074
	(0.0000)	(0.0000)
Weekd	-0.6544	-0.6544
	(0.0000)	(0.0000)
Educ	0.0251	0.0251
	(0.0726)	(0.0756)
Yrssnow	-0.0229	-0.0229
	(0.0000)	(0.0000)
S	6.9276	6.9276
	(0.0000)	(0.0000)
T	0.2366	0.2365
	(0.0335)	(0.0321)
McFaddens R^2	0.5119	0.3633
LL	-10615.064**	-10615.064**
χ^2 H_0: $\beta^{RP} = \beta^{SP}$	14698.4016**	19371.4176**

* Probabilities reported in parentheses for asymptotic t-statistics.

** Significant as compared to critical χ^2 at α=0.05.

do not indicate the models are globally well behaved just as in the RP model. However, the parameter estimates are stable. The chi-squared statistics indicate the null hypotheses of equal parameter estimates across the RP and SP models are rejected. Thus, we cannot conclude that preference homogeneity holds across the revealed preference and either of the stated preference questions. This suggests that respondents' underlying site choices change when YNP and GTNP are removed from the choice set.

While we reject the notion of preference homogeneity across the RP and SP data, results of Haener, Boxall and Adamowicz (2001) would suggest the pooled model could be a reasonable predictor of change in trips. Table 2.4 compares the RP prediction with the pooled RP-SP1 and RP-SP2 models. The pooled models both predict higher losses in trips to the region than the RP model, but these estimates are much closer to the RP estimates than the SP estimates. The RP-SP2 model predicts lost visits to the region of 47,460 or 8.2 percent of the base case prediction. The RP-SP1 predicts less change in visitation than the RP-SP2, 43,248 lost trips, or 7.5 percent of the base case. Since the parameter estimates are nearly identical, this difference in prediction is likely due to the difference in the relative scale parameters and the estimated averages of the variables used to calculate the trip share probabilities. These results are consistent with past research with the pooled model giving estimates between the RP and SP models, but the results are closer to the RP model.

Table 2.4. Predicted Trips Taken in WY, ID and MT with and without Site Closure Pooled Models.

	RP w/o closure	RP w/ closure	RP-SP1 w/ closure	RP-SP2 w/ closure
Predicted Trips	576,921	--------	--------	--------
Change in Trips	0	-28,630	-43,248	-47,460
% Change	0	- 4.96 %	- 7.5 %	- 8.2 %

External Evaluation of Predictions

The question becomes which prediction is closest to the truth. Given the analysis here is ex ante of closure, we can only conjecture which is closest to the truth. However, given a court decision which reversed policy back to the Clinton ban levels of snowmobile visitation before the 2003-2004 season started and then another decision before President's day weekend which temporarily lifted the ban, this past season may provide some evidence as to how snowmobilers responded to limits in number of snowmobiles and uncertainty regarding access in the parks (Lipsher 2004; Black 2004). It should be noted that the 2003-2004 season was two years after our survey was conducted. Table 2.5 reports snowmobile visitation statistics for the 2003-2004 season, along with hotel occupancy rates for Jackson, Wyoming and resort tax collection information for the city of West Yellowstone, Montana as some potential evidence as to how snowmobilers responded this season. Snowmobile visitation was reduced by nearly 53 percent this season as compared to the 2002-2003 season and nearly 68 percent below the 1992-2001 average of 79,646 to the park (National Park Service accessed 2004).

Table 2.5. Change in Snowmobile Visitation, Resort Tax and Hotel Occupancy Statistics for 2002-2003 and 2003-2004 Winter Seasons.

Statistic of Interest	Total for Period	Change from Previous
YNP Snowmobile Visitation[a]		
Dec. 2002 – Mar. 2003	54,084	-30.73%
Dec. 2003 – Mar. 2004	25,609	-52.65%
West Yellowstone, MT - Resort Tax Collections[b]		
Dec. 2002 – Mar. 2003	$476,037	-11.3%
Dec. 2003 – Mar. 2004	$401,664	-15.6%
Jackson, WY – % Hotel Occupancy[c]		
Dec. 2002 – Mar. 2003	59.1%	+5.2%
Dec. 2003 – Mar. 2004	52.9%	-6.2%

[a] National Park Service Public Use Statistics (n.d.).
[b] Roos (2004).
[c] Wyoming Lodging and Restaurant Association (2002; 2003; 2004).

West Yellowstone, Montana has its own resort tax. Data regarding these collections during the 2002-2003 and 2003-2004 seasons indicates collections were off nearly 16 percent this season as compared to the previous season and off nearly 27 for the two seasons following the 2001-2002 season (Roos 2004). It is important to remember that nearly 60 percent of all snowmobile visitors enter YNP through the West gate at the town's edge. While there is not a perfect correlation between snowmobile visitors and resort tax collections, the data would seem to suggest at a minimum the RP projections are likely too low in terms of lost visitation. Given the fact that other recreators could be using the West Yellowstone area, it is hard to say how much substitution may be a result of snowmobilers. Overall, these data would suggest losses in tax collections are, in percentage terms, in between what the pooled predictions and the stated preference predictions might indicate.

The hotel occupancy data for Jackson paints a somewhat different picture, but several things must be kept in mind. First, Jackson is a major destination for downhill skiers, and second, approximately 30 percent of snowmobilers enter the park through the south entrance, which is nearly sixty miles from Jackson. This means snowmobilers could be staying at other locations than Jackson, when entering from the south. Overall, hotel occupancy is estimated to be down 6.2 percent overall for the 2003-2004 season as compared to the previous season (Wyoming Lodging and Restaurant Association 2003; 2004). Again the correlation between snowmobilers and hotel occupancy in Jackson is likely much less than perfect, but the drop in snowmobilers this season could very well be driving a fair amount of the drop in hotel occupancy. This would suggest again that the RP prediction may be too conservative overall. It would seem that a larger shock in snowmobile visitation would be necessary to change hotel occupancy significantly in Jackson given the potential for other recreators to fill those rooms as well as the potential for snowmobilers to stay at other locations when entering from the southern entrance.

Discussion

These results can be interpreted in several ways. The interpretation may depend somewhat on the researcher's preconceived notions regarding revealed preference versus stated preference responses. Azevedo, Herriges and Kling (2003) point out some researchers with test results pointing to inconsistencies between RP and SP data might view this as a validation that RP data are superior to SP data or vice versa. The RP data in this analysis provide a more conservative estimate of the potential impact on trips taken in the region should the parks be closed. Economic researchers often prefer to err on the side of providing conservative predictions. Anecdotal evidence in the 2003-2004 season seems to indicate that at a minimum the RP estimates may be too low. Given the unique amenities provided by these parks, it seems plausible that recreationists' site choices could very well change if YNP and GTNP were no longer in the choice set for snowmobiling. If in fact, the SP data are more reflective of the potential outcome if closure occurred, policy makers and community planners would be better off with such knowledge in hand. In either case, the data and resulting models support the premise that substitution is in fact important to this issue as none of the models predict all trips taken in the region by snowmobilers who come to YNP will be lost.

These tests only prove that faced with site closure, the stated preference responses are not consistent with revealed preference responses. However, both the RP and SP data are consistent with utility theory. This suggests respondents can provide stated preference data for complex problems that are consistent with economic theory. Short of a study after closure, there is no way of determining which data and resulting model more accurately predict the impact of closing the parks to snowmobiling. It is interesting to note even though Haener, Boxall and Adamowicz (2001) find the joint models do a reasonably good job of predicting trips in hold out samples, the authors conclude that preference homogeneity does not hold across their RP and SP models. "A test of whether the coefficient vectors are jointly equal within a factor of proportionality reveals that even when scale differences are accounted for, the coefficient vectors are significantly different"..(p. 635).

These results indicate more research regarding the use of RP and SP data is needed. Louviere, Hensher and Swait (2000) conclude their discussion regarding "data enrichment" in the face of homogeneity rejection by saying the researcher's judgement as to model superiority is important. "If this [rejection of H_o] occurs, analysts must decide whether to disregard the statistical information and continue with a partially or fully pooled model. There probably are situations in which this is both warranted and will produce a good outcome, but at the present time there is too little empirical experience to permit generalizations (p. 248)." Unfortunately, given the outcomes reported in this paper, the underlying question of which results and data (RP or SP) are better remains. Perhaps the best a researcher may be able to do is to provide estimates from both types of data in an attempt to provide some bounded range of potential outcomes.

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CHAPTER 3

WELFARE IMPACT OF RECREATION SITE CLOSURE ON SINGLE TRIP--MULTIPLE DESTINATION VISITORS

Introduction

Valuing the environment through the use of recreation demand models has been a topic of much research. A typical approach is the Travel Cost Method (TCM) (Haab and McConnell 2002). The cost of the trip is used as a proxy for price to a destination, and the quantity demanded is defined as the number of trips to the site in question with TCM. Consumer surplus is then calculated from the estimated demand function. A key assumption of this method is that the trip be for a single purpose to a single destination (Loomis, Yorizane and Larson 2000). Smith and Kopp (1980) point out there are spatial limits to the TCM, and that after a certain distance the assumption of a single purpose trip becomes questionable at best.

The assumption of single purpose and single destination in the recreation demand model avoids the issue associated with joint travel cost in a multiple destination trip. Often times multiple destination visitors are dropped from the sample before model estimation due to the joint travel cost problem (Walsh, Johnson and McKean 1988). When the number of visitors to a site that are of the "multiple destination" category are small, potentially little information is lost if they are eliminated from the researcher's sample.

The multiple destination visitor goes to more than one destination while on a trip away from home. The question becomes how do visitors allocate visits to multiple destinations while on a single trip away from home? Because what the researcher usually observes is the total cost of the trip away from home, little evidence exists as to how price per destination may be assigned or more importantly how site allocation is affected while on the trip. Hanson (1980) criticizes the assumptions made in most choice models and states "when examined, [these assumptions] yield a rather poor approximation of actual choice behavior, particularly in the context of destination choice on multistop or multipurpose journeys (p. 246)."

Given the difficulties associated with modeling multiple destination visitors, policy analysis for locations frequented by this visitor type becomes problematic. What are the implications of a policy that proposes closure of a unique destination when a significant portion of that site's visitors is of the multiple destination kind? Welfare estimates may very well be inaccurate if multiple destination visitors are dropped from the sample or assumed to behave as single destination visitors in the face of the joint travel cost issue. Modeling behavior so as to allow for substitution to other destinations seems a logical approach, particularly for this type of visitor. The purpose of this paper is to develop a modeling approach that explains site choice in a multiple destination trip and provides welfare change estimation for this type of visitor given a site closure.

The remainder of this paper will first review relevant literature pertaining to multiple destination visitors and modeling their behavior. A potential model is then proposed based on this literature and relevant economic theory. This modeling approach is then applied to a snowmobile recreation site that is frequented by a significant number of multiple destination visitors and which faces uncertainty as to snowmobile access. Welfare estimates associated with site closure are provided for the sample of multiple destination visitors. This modeling approach's strengths, its limitations and suggestions for further efforts are then discussed.

Selected Travel Research Relating to Multiple Destination

Wall (1978) uses parking lot intercept interview data to delve into single versus multi-destination trip tourists at Mammoth Cave National Park and Carter Cave state park, Kentucky. Proportionally more people traveled farther and were on multi-destination trips to the National Park as compared to the state park. The author concludes that both types of visitors frequent both sites and assumptions cannot be made about types of visitors frequenting one site over another. The author also concludes that the two types of recreational visitation should be modeled separately.

Hanson (1980) defines the assumptions of the spatial choice models of that time and provides criticisms as to why those assumptions are not accurate of all behavior. The author examines data from several intraurban travel studies and estimates descriptive statistics from which to draw conclusions. The data bears out that people do in fact bundle destinations together on some trips. Hanson (1980) concludes that multipurpose and multi-destination trips must receive more attention in the research literature.

Hwang and Fesenmaier (2003) study multi-destination travel using the 1995 American Travel Survey household data. Destinations are broken down by state and purpose in their results for domestic travel only. The authors state that the importance of spatial characteristics in the multi-destination travel decision is closely related to the idea of economic rationalism and explains travelers' choice as a strategy for minimizing travel cost. The authors plot round-trip distance against cumulative percentage for single-destination and multi-destination trips. As distance increased percentage of multi-destination trips increased. About 80% of single-destination trips occurred within 340 miles roundtrip; on the other hand, the travel distance for multi-destination travel extended to 760 miles (roundtrip). The authors conclude that multi-destination travel can be characterized as an en route pattern, but base camp travel is dominant when travelers visit only one additional destination. Base camp travel occurs when visitors go to a destination away from home and then take shorter trips from that destination to other sites before returning home. Enroute travel occurs when visitors go to a number of destinations along their roundtrip route before returning home. The authors further speculate that length of stay, purpose of stay, and extent of prior experience at the primary destination might mediate to a large degree the extent of enroute or base camp type destination bundling.

Economic Research Relating to Multiple Destination

Smith and Kopp (1980) argue that the typical TCM results from necessary assumptions when estimating a zonal TCM to represent the individual's demand for a given recreational site's services. The most important of these assumptions is that the objective of the trip to the recreational site is for recreational use and not multiple objectives. The authors propose a test for estimating the stability of the estimated demand functions' parameters be used to define the spatial limits of the model. The authors use Forest Service data to estimate the demand for an area in California that had recently been burned. Their test results (the BDE cusum statistic) indicate that at 672 miles the model becomes unstable. The authors re-estimate the model without the data past 672 miles and results are different for both parameter and welfare estimates. The important contribution of this article is the suggestion that TCM assumptions may become untenable at far distances, particularly the assumption of single purpose and single destination trips.

The results of Smith and Kopp (1980) motivated a number of economic researchers to investigate alternative TCM specifications to address diversity in visitors (Kerkvliet and Nowell 1999). One approach by Parsons and Wilson (1997) presents several theoretical utility maximization models regarding incidental (side) trips and joint consumption recreation trips, and they estimate several empirical models to test the theoretical models. Empirically the model uses a binary variable for multiple purpose or destination and then interacts that variable with both travel cost and travel time as well as several other variables. The authors use Maine fishing trip data sets to test their model. Their results suggest a small bias when incidental trips are not dealt with in both the model and welfare estimation. They conclude that omitted variable bias exists in empirical models if incidental jointness is not accounted for.

Loomis, Yorizane and Larson (1999) extend the work of Parsons and Wilson (1997) with a more general TCM to allow for inclusion of multi-destination visitors in a single pooled equation for whale watching. The authors conclude that omitting multi-destination visitors results in underestimation of benefits which could be policy relevant, but the benefit estimates from the primary purpose model and the model including incidental and joint trips were not significantly different. Both of these papers provide a framework for addressing multiple destination visitors when looking at benefit estimates for a single site, but the issue of site allocation amongst possible substitute sites is not addressed by this approach.

Mendelsohn et al. (1992) present a model, which uses a system of inverse demand equations to account for multiple destination recreation trips. Combinations of multiple destinations are essentially treated as "unique" destinations in this system. The demand system focuses on single destination and multiple destination trips for Bryce, Grand Canyon, Las Vegas and Arches National Park. One of the model's contributions is that it is based on demand theory and forces symmetry on the system. The authors use a system of price dependent travel cost models, which is based on 1982 data for trip itineraries of visitors to Bryce National Park. Cross-price effects emphasize the importance of substitute sites in this model. Results indicate that consumer surplus estimates that don't include multiple destination demands underestimate the value of a site. The authors conclude this is an important step toward using travel cost models in complete valuation of sites. While this approach is theoretically consistent, it requires bundling of sites into a unique destination and variables such as cost and site attributes must somehow be aggregated to represent the "unique" multiple site bundle. Moreover, if a choice set has a large number of sites this approach becomes difficult as permutations of which sites should or should not be bundled becomes large, and bundled site equations pose a potential aggregation bias.

Bell and Leeworthy (1990) argue that traditional TCMs, which typically assume one day trips, are not applicable to travelers coming long distances as per Smith and Kopp (1980). They develop a recreation demand model for beach days building on the work of Pearse (1968), Gibbs and Conner (1973), Gibbs (1974) and Green (1986). The authors define “tourists” for the purposes of their paper as those that come from significant distances to use principally beach resources. They develop a model based on past literature which posits that trip length is positively related to travel cost, i.e., the more dollars spent on total trip cost, the longer the number of days spent recreating. Utility is defined as a function of beach days recreated over a specified time (BDAYS) and q is a composite good or all other goods and services. BDAYS is also defined as a composite good containing recreational attributes such as swimming, sunning, and or fishing. Their assumption is that utility is additively separable in the recreational activity, all other income, and all other leisure time. “Tourists” as defined by the authors face two distinct types of costs, TCPT or travel cost per trip, and POS or price on-site cost per day, in the consumption of BDAYST or beach days per trip. They posit that TCPT and BDAYST are positively related. They conclude that as TPCT increases economic agents will take less trips but the individual trips will be longer in days. They pose the following demand equation for their model: BDAYS = F(POS, TCPT, Y, OTHD, SOC, PERC), where BDAYS = number of days spent at saltwater beaches per year; POS = actual on-site cost per day; TCPT = travel cost per trip to saltwater beaches adjusted for percent of total vacation days spent in non-beach recreation; Y = household income; OTHD = a vector of substitute and/or other complementary recreational activities expressed in days; SOC = a vector of socioeconomic characteristics; and PERC = a vector of perceptions regarding saltwater beaches. Note that the OTHD vector adjusts for other recreational activity in addition to beach activity, and the authors suggest “other activity” is generally ignored by the TCM. The authors gather data using an intercept sampling and interview method at all major highways and airports as visitors leave the state of Florida. Empirical models were estimated using OLS linear, log-log, and semi-log forms. The linear form performed the best. The models were significant, and the key results were that POS was significant and negative in sign while TCPT was positive and significant. This supported the authors conclusion that cost to come to the region was in fact positively correlated to trip length while on-site cost negatively affected days demanded on site. The authors use a bias adjustment in their welfare calculation and estimate a final consumer surplus figure of $33.91/person/day for "tourists" using beach resources in Florida.

Hof and King (1992) provide a theoretical model suggesting that Bell and Leeworthy's (1990) model is consistent with theory used to derive the TCM. They argue, however, that what Bell and Leeworthy (1990) propose is powerful theoretically but sometimes difficult to estimate depending on the resource and empirical data available. The authors examine a site in a national forest in Arizona and use intercept sampling to gather data. They find mixed visitors, i.e., short and long distance travelers in their sample. They estimate both a TCM and an on-site cost model as posed by Bell and Leeworthy (1990) using various functional forms. Their on-site model performs worse than the TCM in terms of estimation overall. The authors support Bell and Leeworthy's (1990) model but point out its potential empirical difficulties in some cases.

Shaw (1991) in another comment applauds Bell and Leeworthy (1990) for taking on the issue of "tourists" and the spatial limits of the single-site TCM but raises several concerns with their approach. He argues that there are likely three stages to the decision process for tourists that relate to the estimation of demand for beach days in Florida. Stage 1 is to decide whether to recreate out of state. Shaw (1991) proposes this decision is a function of total outdoor recreation budget, prices and characteristics of in-state recreation services, travel costs to all out-of-state sites, and on-site price and characteristics of all out-of-state recreation sites, including nonbeach sites. Shaw's (1991) decision tree posits that if the tourist decides to go out of state they move on to stage 2. Stage 2 is the decision to recreate at Florida beaches versus recreating at other recreation sites. This decision becomes a function of on-site prices and characteristics of Florida beaches, on-site prices and characteristics of all nonbeach recreation, and the recreation budget allocated to Florida vacation recreation. If the tourist chooses to recreate on Florida beaches, he/she moves to stage 3 of Shaw's (1991) decision process. Finally, the decision to recreate BDAYS at the jth Florida beach is a function of price and characteristics for the jth and kth ($k \neq j$) beach in Florida and the recreation budget allotted to Florida beach recreation. Shaw recommends an approach of developing a likelihood function to estimate demand conditioned on decisions in the described stages given available data. Second, Shaw points out a potential endogeneity issue in the demand equation as the dependent variable (BDAYS) as price is prorated on total annual expenditures on Florida beach recreation by the percentage of each day spent on the beach. Simultaneity between price and BDAYS exists as modeled by Bell and Leeworthy (1990). Shaw also indicates a potential problem with not including individual beach site characteristics in estimating the demand for BDAYS.

Kerkvliet and Nowell (1999) do a TCM for trout fishing in Yellowstone National Park (see also Kervliet, Nowell and Lowe 2002). The authors point out that the spatial limits of TCM is related to stability of parameter estimates in the model and use the BDE cusum statistic as proposed in Smith and Kopp (1980) to estimate the model's parameters' stability. The authors use the on-site travel cost model as proposed by Bell and Leeworthy (1990) where days is the dependent variable and long distance travel cost and on-site cost are broken out separately. The authors take into account the heterogeneity of visitors by defining costs differently and incorporating binary variables to shift the intercept using a normal visitor as the base. Their definitions of different visitor types and how costs are defined for each type are as follows: 1) Type I visitors: Single-day visitors. These visitors visit the site for one day only, regardless of how far they traveled to the site. In most cases, these are locals but some visitors flew to West Yellowstone, rented car and fished for one day then flew home. These visitors are consistent with normal assumptions as price of on-site cost for one day is the only cost (on site costs are the summation of previous night's lodging, travel costs for the current day, license and equipment costs for current day); 2) Type II visitors: Single-destination tourists. These tourists travel to a single site for multiple days. They pay a one time long distance travel cost to get to the area and an on-site cost for each day's visit; 3) Type III visitors: Multiple-destination tourists. Multiple-destination tourists visit more than one destination in the course of a trip, including Yellowstone. Allocating all long distance travel costs to the site visit is inappropriate in both the travel cost and on-site cost models. The authors distinguish between two types of multiple destination tourists. A) This multiple destination tourist stops at the site of interest while on the way to her primary destination. She indicated that her long distance costs were unaltered by her visit to the site. These visitors are similar to Type I visitors in that the long distance travel costs were unaltered by her visit to the site. Long distance travel costs are irrelevant to this tourist (Parsons and Wilson (1997) define this as an incidental trip). B) This multiple-destination tourist alters her route to her primary destination in order to visit the site of interest. In this case, visitation to the site alters her long distance travel costs, and both on-site and long distance travel costs are relevant. By defining costs this way and using binary variables in the TCM the authors improve performance of the model and the cusum tests shows the parameters are stable in this formulation. The authors make a contribution as they delve into how travel costs should be handled for different visitor types, thereby extending the on-site TCM.

The above literature points to several important issues when modeling multiple destination visitors. First, traditional TCM modeling is inadequate to explain behavior and estimate benefits for visitors other than the single purpose, single site visitors. Second, there are different types of multiple destination visitor behavior such as incidental, enroute or base camp behavior, which is likely affected by purpose of trip and the spatial nature of available destinations. Third, the potential for substitute sites or activities is important. How costs are defined for multiple destination visitors is important and dependent on the type of visitor being modeled. Important components of cost are those relating to the long distance traveled to get to the area of destination and the cost associated with the individual site. A modeling approach that addresses these issues should make an important research contribution.

Theory and General Model

The general framework of the Random Utility Model (RUM) seems to provide a basis to address several important issues laid out in the literature above. First, the RUM allows for decision making of the type described by Shaw (1991) where decisions are made in stages such as come to the region or not, participate in the recreation activity of interest or not, and site choice among a number of alternative sites. More specifically a repeated nested logit model allows these different decision stages to be modeled while addressing the Independence of Irrelevant Alternatives (IIA) assumption (Morey 1999; Chen, Lupi, and Hoehn 1999). The RUM is also theoretically consistent with utility maximization and benefit estimates are easily calculated from the model once estimated.

Random utility theory poses that individuals will choose the destination or recreation option, on a given decision period, that will provide them with the greatest utility given their constraints (Louviere, Hensher and Swait 2000). The utility function for an individual then contains both a deterministic component (V) and a component that is unobservable to the researcher or stochastic (ε). This is represented in equation 1.

(1) $U = V + \varepsilon$

where V is the indirect utility function and can be characterized as follows:

(2) $V_i = \beta_k X_i$

For this function (2) X is a vector of k attributes associated with alternative i and β is a coefficient vector. The error terms for the nested logit specification are assumed to be generated by a generalized extreme value (GEV) distribution as proposed by McFadden (1978).

As Hwang and Fesenmaier (2003) point out multiple destination visitors seem to be cost minimizers when it comes to overall trip costs, i.e., rather than make a number of expensive trips to visit each site individually they bundle destinations together that are spatially close. This is congruent with Bell and Leeworthy's (1990) findings that length of trip is positively related to total trip cost. Thus, one would expect that multiple destination visitors investing in a long distance single-trip away from home, would tend to maximize total trip utility. This simply occurs when the visitor equates the ratios of the marginal utilities to prices across sites once in the region.

What becomes important for our model is how price per destination is defined. Following Bell and Leeworthy (1990) and the concept of the on-site travel cost model, individual site or destination price has two components. We define the two components as that portion of the long distance trip cost associated with getting to the area or region where sites or destinations are bundled, which can be attributed to a specific site or destination, and the variable cost of getting to the site once in the area where site choice occurs. This total site cost can be represented as follows:

(3) $SC_i = \tau_i \text{ LDTC} + VC_i$

SC_i is defined as the total site cost for destination or site *i*. τ_i is scalar or proportion by which the long distance trip cost (LDTC) to the region is multiplied by for site or destination *i*. The specifics of how this is calculated will be discussed when we discuss the data and estimation of the model. VCi is the variable cost associated with getting to site or destination *i* once the visitor is in the region where sites or destinations are bundled.

Our approach assumes the multiple destination visitor is most likely of the base camp type discussed by Hwang and Fesenmaier (2003). τ_i provides the ability of LDTC to be assigned along a continuum, which might allow for several of the visitor types discussed by Kerkvliet and Nowell (1999), however. For example, if the person makes a side trip enroute that does not add to total long distance trip cost, τ is assigned a zero, and the only cost associated with the visit is the variable cost associated with that site. At the other end of the spectrum, the single destination and purpose visitor could have a τ that equaled one, if the different components of cost could be identified as described above. Obviously, in such a case the SC variable would mimic the normal travel cost variable used in the TCM for a single destination trip.

The indirect utility functions for each potential site or destination within a region have a vector of site attributes and an SC unique to that individual and site. Our site cost (SC) variable includes components of both travel cost to come to the region and variable cost to get to the site from the base camp destination. Recall that Bell and Leeworthy's (1990) travel cost per trip (TCPT) is the total roundtrip cost to the aggregate site in the on-site travel cost model. This variable is only appropriate in our model when $\tau = 1$ and all travel costs can be assigned to one site. Indirect utility functions for participating in other activities or deciding to come to the region or not could be modeled as well with our approach, given the available data as per Shaw's (1991) suggestions.

Our approach differs from the on-site travel cost model as proposed by Bell and Leeworthy (1990) in that the dependent variable becomes visits to each destination within the bundle of available sites rather than days spent on site. Moreover, number of days spent in the region, now becomes opportunities for more choice occasions to visit destinations within the site bundle region. Thus, as TPCT as defined by Bell and Leeworthy (1990) increases we assume the number of choice occasions to visit sites within the destination region increases. Given the RUM formulation, we then assume, that on a given choice occasion, an individual site, which is available on the trip to the region, will be chosen when the utility from that site is greater than the other sites given the visitor's constraints. This approach allows visitors to visit a site as many times as they prefer up to the maximum number of choice occasions they have while in the region from their base camp destination.

The next step is to test our approach. Will this approach explain site allocation amongst multiple destination visitors in a manner consistent with theory? Can welfare estimates be obtained from this approach for a proposed site closure within the potential bundle of destinations?

Application of Model to a Unique Snowmobile Recreation Site

Now that we have laid out the basics of our modeling approach for multiple destinations, it is important understand the case in which we are applying it. More specific details of the model are dictated by the particular problem and data it is being estimated for.

In response to environmental issues, a preferred winter use management alternative of banning the use of snowmobiles in Yellowstone National Park (YNP), Grand Teton National Park (GTNP), and the John D. Rockefeller, Jr., Memorial Parkway (JDRMP) was proposed in an environmental impact statement (EIS) during the spring of 2000 (National Park Service 2000). Various changes in that policy have taken place since its proposed adoption as a result of federal administration turnover and court decisions stemming from appeals (Thorne 2002; Hamilton 2002; Sullivan 2002; Lipsher 2004; Black 2004). The future of snowmobile recreation inside the boundaries of YNP and GTNP continues to be uncertain, but the fundamental question of where snowmobilers will recreate, if these parks are closed, remains. This question has implications regarding the change in nonmarket benefits to snowmobilers and potential economic impacts faced by communities within the states surrounding the park.

Given the fact that numerous snowmobile sites exist in Wyoming, Idaho and Montana, the issue of substitutability is central to the estimation of benefit changes and economic impacts in the region surrounding these national parks. It has been proposed by a number of businesses in the region that a significant number of YNP visitors come to the region for a winter vacation and visit a number of sites while in the region (Lipsher 2004). In the face of a park closure to snowmobiles, what would the welfare impact be on these multiple destination visitors should the park be closed to snowmobiling? Given the potential for visitors to visit other snowmobile sites in the region, this case provides a natural experiment to apply our modeling approach to.

Data Collection

Data collection for this project involved intercept sampling and a follow up mail survey sent to YNP snowmobile recreators agreeing to participate in the project. Intercept sampling occurred on thirty-three days between December 15, 2001 and February 28, 2002 (see Chapter 1, and Appendix A for full details of sampling design). Recreators agreeing to participate were then asked to fill out a card with their mailing address, and they were informed that a questionnaire would be sent to them the first part of March. Moreover, each contact was given a one-page trip record sheet with a map on the reverse side for listed sites and asked to keep a log of their trips and the sites they visited between December 15, 2001 and February 28, 2002. Twice during the winter season survey participants were sent postcard reminders asking them to keep their trip record sheets up to date and to remind them this information would be important for filling out the survey they would receive in March. During the intercept sampling procedure the refusal rate was 9.5% and the final number of contacts in the database was

1162 (see Appendix A, Table A-1 for more detail). Of those 1162 respondents, several addresses were removed due to bad addresses, foreign mailing addresses in Canada, and contacts that were professional guides. The final database for the first mailing had 1148 addresses.

Survey

The mail survey followed a modified Dillman (1978) design to insure an adequate response rate (See Chapter 1 and Appendix A for a more in-depth description of the survey instrument, design and timeline). The finalized survey was mailed to respondents March 4th. The response rate was 701 returns out of 1148 (61 percent).

The questionnaire is divided into seven sections (see Appendix A for specific questions and detail). Section one asks basic questions about the respondent's snowmobile experience and days snowmobiled during the season. Section two asks for specific trip information during the December through February period. Specifically the revealed preference question provided a table with 28 different sites from Wyoming, Idaho and Montana allowing respondents to list the number of trips and days spent at each site during the specified survey period. Respondents were asked to refer to their trip record sheet or place the trip record sheet in the survey upon returning it for this question. Respondents were also given the opportunity to list "other" sites for each state that they recreated at and were asked to list the name of the site. An additional 20 sites were added to the choice set as a result of this question, bringing the total sites in the choice set to 48. This format was used to allow respondents to more accurately define the relevant choice set.

Much work has been done suggesting ill-defined choice sets for RUMs can produce biased results and welfare estimates (see Parsons and Kealy 1992; Parsons and Needleman 1992; Feather 1994; Karou et al. 1995; Haab and Hicks 1997; Parsons and Hauber 1998; Parsons, Plantinga and Boyle 2000). The aforementioned research has implications for choice set definition in this project. First, aggregation seems to have serious consequences on model and welfare estimation. As such, sites are not aggregated, but rather trail systems are presented as alternatives to sample respondents in this study. It is expected that individual trails within the identified systems are homogeneous enough in characteristics that this should not pose a problem. Moreover, given the large distances snowmobiles can cover within a day, trail systems seem to be the relevant site alternative for decision purposes. If an error has been made in choice set definition, it has likely been to include too many sites. The above research suggests this has less serious consequences on welfare estimates than narrow choice set definition. Questions were not included in the survey asking familiarity with all sites in the defined choice set as suggested by Hicks and Strand (2000) other than a map showing the geographic location of the listed sites and specifics about YNP characteristics due to concerns regarding questionnaire length.

Section three asks specific questions about their most recent trip to YNP including hours snowmobiled per day, number in party, etc. Section four asks respondents for information about their expenditures in and out of the YNP region on their most recent snowmobile trip. Section five asks several questions about their opinions regarding the potential phase out of snowmobile use in the park. Section six asks questions designed to elicit preferences for site and trip attributes. Section seven asks for demographic information about the respondent.

Additionally, data regarding average snow depth by site for both the 2000-2001 and 2002-2003 seasons for all 48 sites in respondents' choice set, and other site attributes such as miles of groomed trail, services within five miles of the trail head, and high and low elevation along the trails for each site were recorded.

Econometric Estimation and Model Specifics

Initial analyses using descriptive statistics, t-tests and chi-square tests (see Chapter 1 for details and results) indicated two distinct groups within the sample. One of the two groups was comprised of snowmobilers who visited multiple snowmobile sites during a single trip to the region (WY, ID, MT) surrounding YNP. This group comprised 40% of the sample. The other group could be categorized as people taking multiple snowmobile trips to a single site per trip, i.e., the classic single purpose and destination visitor. After controlling for item nonresponse in the questionnaire for model estimation and removing the single destination visitors there were 254 individuals representing 1,075 site visits taken in the three state region surrounding and including YNP and GTNP that will be used for this investigation in multiple destination trip modeling.

Table 3.1 Descriptive Statistics for Multiple Destination Segment - Selected Variables N=254.

Question	Yes	No	No Answer
Q8. Taken Snowmobile Trip to YNP before	49.21%	50.00%	0.79%
Q13. YNP primary destination of most recent trip	81.89%	17.72%	0.39%
Q17. Snowmobiling primary purpose of most recent trip to YNP	96.06%	3.94%	0.00%

Table 3.1 indicates that 96.06% of the snowmobilers that came to YNP on their most recent trip did so as their primary purpose and 81.89% of these visitors indicated YNP was the primary destination of their most recent trip. On the surface it would seem that modeling these individuals as single destination and purpose visitors would make sense. However, additional descriptive statistics indicate (reported in Chapter 1) that these visitors made a single trip from home, and visited multiple sites while in Wyoming, Idaho and Montana visiting YNP. Moreover, these visitors traveled farther on average than the classic single destination portion of the sample. Our results seem to be consistent with past research. Borrie et al. (1999) found that 52 percent of all winter visitors sampled also recreated in other areas outside YNP on their trip while 84 percent stayed within the vicinity of YNP during their trip. Given these results, our approach to modeling these visitors assumes "base camp" behavior. That is, given that snowmobiling was the primary purpose of the trip for the vast majority of these visitors and YNP was their primary destination, we assume these visitors come to the region surrounding YNP and then make primarily additional snowmobile trips from one community.

During the intercept sampling process, data was coded with study participants as to which gate they were contacted at. We assume for purposes of this model that the community closest to the gate where contact was made is the base camp destination of the multiple destination respondents. For example, if the respondent is coded as being intercepted at the west entrance, West Yellowstone, MT is assumed to be that respondent's base camp destination. Travel distances and travel times using ground transportation for each respondent to the base camp destination from their home zip codes, and from the base camp destination to each of the 48 snowmobile sites were estimated using PC-Miler by ALK Technologies.

As discussed previously, these visitors are modeled in a RUM framework. Unfortunately, questions specific to decisions about coming to the region or not were not included in the survey. Thus, we model the decision to participate or not in snowmobiling once in the region, and subsequently the site choice decision is modeled if the visitor chooses to snowmobile. Nonparticipation in this model assumes they use a choice occasion while in the region to do something other than snowmobile. The choice to participate or not, along with site choice lends itself to the two level nested logit specification (Morey 1999; Chen, Lupi, and Hoehn 1999). The decision to come to the region or not is exogenous to our model. Figure 3.1 diagrammatically depicts our modeling approach for this problem.

It was hypothesized that sites immediately surrounding YNP and GTNP could comprise a separate nest in the model. The three-level specification would not converge after trying a number of start values indicating the two-level nested-logit was the appropriate specification for the model.

The probability of choosing a specific site in this two-level nested-logit model is depicted in Morey (1999) as follows:

$$(3)\quad \text{Prob(ni)} = \frac{\exp(s_n V_{ni}) \left[\sum_{j=1}^{Jn} \exp(s_n V_{nj}) \right]^{(1/s_n)-1}}{\sum_{m=1}^{M} \left[\sum_{j=1}^{Jm} \exp(s_m V_{mj}) \right]^{1/s_m}}$$

where, for our model, M has two elements (nonparticipation or participation in snowmobiling once in the region). Dimension J has 48 sites. In this notation $n \in M$, and i∈J. For this notation and our estimation, which follows Morey (1999), s=1/(1-σ) in McFadden's (1978) notation, or s=1/θ in Kling and Herriges (1995) where they refer to θ as the dissimilarity coefficient.

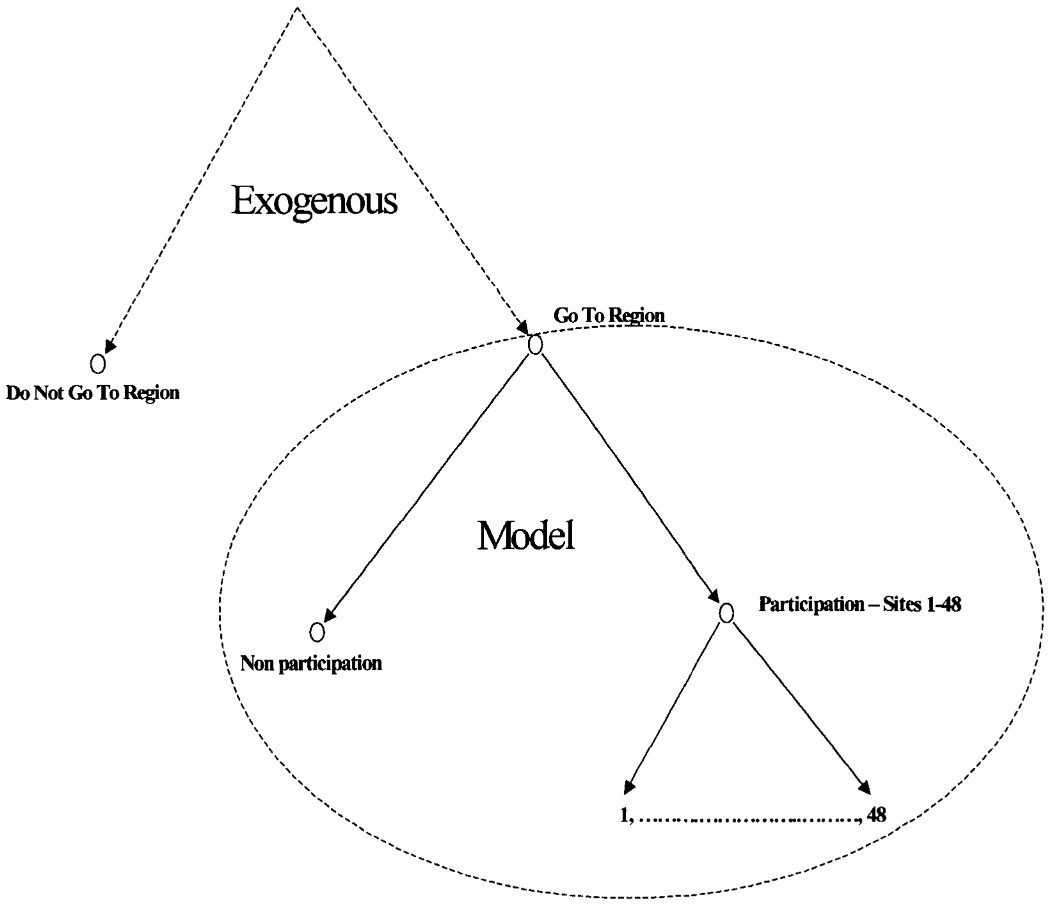

Figure 3.1. Depiction of two-level nested-logit model regarding site choice on multiple destination trip.

Per-choice occasion expected maximum utility is

(4) U = ln D + 0.57721 (Euler's constant),

where

(5) $D = \sum_{m=1}^{M}\left[\sum_{j=1}^{Jm}\exp(S_m V_{mj})\right]^{1/Sm}$

Typical RUMs are linear in income, thereby imposing a constant marginal utility of income. For our model we assume zero income effects, i.e., constant marginal utility of income across all respondents. Herriges and Kling (1999) investigate the sensitivity of welfare estimates to nonlinear income effects in a Random Utility Model using southern California saltwater angling data. The authors use McFadden's (1974) algorithm for computing willingness to pay in a nested logit model with nonlinear income effects as well as several other approaches for estimating welfare from nonlinear income effects. They find that for most of their models the assumption of underlying error distribution has more impact on welfare estimates than nonlinear income effects. The authors point out these results may be somewhat sample specific, but the overall results point to the relative robustness of the linear income nested logit model. Moreover, computational burden is quite large for some of the techniques used by the authors. Thus, for this paper we do not deal with income effects in our model. Moreover, this is likely acceptable because our constant marginal utility of income only need hold locally, at the range of our compensating variation estimates, not globally at the full range of household income.

Given our assumption of zero income effects, compensating variation (CV) for site closure is calculated by the following:

(6) $$CV = \left(\frac{1}{\mu}\right)\left(\ln D^1 - \ln D^0\right)$$

where D^1 is defined as the expected maximum utility per choice occasion after site closure, and D^0 is the expected maximum utility per choice occasion before site closure. The change in expected maximum utility is obtained by multiplying by the inverse of the constant marginal utility of money ($1/\mu$). This is the absolute value of the parameter estimate of the price or SC variable for our model.

As with any econometric model, specification of and estimation procedure for the RUM can affect model performance and the resulting welfare estimates. Pendleton and Mendelsohn (2000) conclude that functional form in the RUM is important (linear versus quadratic in this case). Kling and Thomson (1996) and Morey (1999) suggest that Full Information Maximum Likelihood (FIML) has several advantages over sequential estimation. Kling and Thomson (1996) obtained larger welfare estimates with sequential estimators compared to FIML estimators. Thus, our model was estimated using GAUSS and FIML.[4] The use of a quadratic term for price (SC) was investigated.
Attribute variables and functional form were chosen based on theory, apriori expectations and goodness of fit criteria for the model. Moreover, goodness of fit criteria indicated the quadratic term on price was the appropriate specification.

Variables in the indirect utility equations for each site included a site cost variable (SC2). Recall from our previous discussion this cost had two components, which included a portion of the long distance trip costs to come to the region and the variable cost associated with traveling to the site from the base camp destination. The survey asked respondents for total trip costs by category and expenditures by category in Wyoming, Idaho and Montana. Long distance trip costs were assumed to be those costs that were incurred just to come to the region (WY, ID, and MT). These were based on individual costs such as lodging, gas, trip repairs and airfare if traveled by air on a per person basis. Expenditures for these categories within the region were subtracted from the total trip costs in these categories. This difference comprised the long distance trip costs which were apportioned to each site. The proportion (τ) of LDTC assigned to each

[4] See Tables B.4 and B.5 in Appendix B for specific Gauss code used in analysis.

site was estimated based on roundtrip travel time to get to the site, plus actual or average on-site time. This site time estimate was converted to days by dividing by 10 (i.e., 10 hours per recreation day was assumed). This site time in days was then divided by total days in the region for an estimate of τ. Thus, the more time it took to get to and from a site the more of the long distance trip costs were assigned to that site. The variable cost to get to the site was based on roundtrip distance to the site from the base camp destination multiplied by a standard mileage rate of $0.2185/mile.[5] These two components were summed to estimate site cost for each individual to each of the 48 sites in the choice set.

The value of travel time to the site was not included in site cost or as a separate variable to avoid potential collinearity or simultaneity problems given our site cost variable. There continues to be debate as to how travel time and on-site time should be valued (see McConnell 1992; Larson 1993; Freeman 1993; Feather and Shaw 1999; Shaw and Feather 1999; and Berman and Kim 1999). The remainder of the variables included in the indirect utility functions for each site beside SC were site specific attributes such as length of trail (Stelng), an interaction between length of trail and trail grooming (Stetlgm), a binary variable indicating if 50% or more of the trail is groomed (Stegrm), a binary variable indicating if services were either on the trail or within five miles of the trailhead (Stesrv), the difference between the high and low point in elevation on the trail (Steeldf), and the average snowpack from snotel sites on the trail system for January and February of 2002 (Sn02ste). A binary variable was also included to capture

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[5] This rate was based on the assumption of a six-cylinder SUV capable of towing a trailer with one or two snowmobiles and using a AAA estimate for operating such a vehicle in 2001 dollars.

the potential unique amenities of YNP and GTNP as compared to the other sites (Steamn) where YNP and GTNP were coded as 1 and other sites were not. The dependent variable for each site equation is the respondent's trips taken to that site for their choice occasions between December 15, 2001 and February 28, 2002.

The indirect utility equation for nonparticipation includes a constant and a variable for the respondent's level of education (Educ). The final variable included in the nonparticipation equation is based on the respondent's number of years of snowmobiling experience (yrssnow). The number of choice occasions for individuals in this segment of the data is based on the number of days available to snowmobile, i.e., number of days in the region during the specified dates in the trip record sheet, on their single trip to the region. Nonparticipation was estimated as number of choice occasions minus total trips or site visits taken according to the trip record sheet.

Model Results and Welfare Estimate

As can be seen in Table 3.2 the model is highly significant in explaining site choice behavior for our multiple destination segment of the data according to the model chi-square statistic. The pseudo or McFadden's r^2 of 0.2533 suggests the fit is reasonably good, especially for these types of models. The scale parameter is greater than one and significant indicating the model is globally well behaved (Morey 1999).

All of the variables in the model are significant at the α=0.10 level, and many meet with apriori expectations regarding sign. First, and foremost the cost variable (SC2ste) is highly significant and negative indicating the probability of choosing a site decreases as price increases. The quadratic term on price is positive and significant as well. The majority of the site attributes are also as expected. Results indicate that length of trail (Stelng), grooming (Stegrm), services on or near the trail head (Stesrv), elevation

Table 3.2 Model Results for Single Trip to Region and Multiple Sites Visited Segment –N=254.

Variable	SC2 2NL Quadratic
SC2ste	-0.1288
	(0.0055)
$SC2ste^2$	0.0043
	(0.0058)
Stelng	0.0034
	(0.0664)
Stetlgm	-0.0068
	(0.0165)
Stegrm	0.0677
	(0.0303)
Stesrv	0.0939
	(0.0093)
Steeldf	0.0061
	(0.0882)
Steamn	0.1946
	(0.0062)
Sn02ste	0.0027
	(0.0071)
Constant	0.4587
	(0.0362)
Educ	-0.0775
	(0.0144)
Yrssnow	-0.0150
	(0.0004)
s – scale	11.5906
	(0.0058)
McFaddens R^2	0.2533
LL	-3953.3830
LL – Constant	-5294.5030
Model χ^2	2682.2400
Critical $\chi^2_{\alpha=0.05}$	21.026

* Probabilities reported in parentheses for asymptotic t-statistics.

difference which could be a proxy for roughness (Steeldf), and average snowpack (Sn02ste) are all positive and significant. These variables indicate that the probability of taking a trip to the site increases as these attributes either are present or are relatively higher in quantity relative to other sites in the choice set.

An interesting result is the interaction term between grooming and trail length (Stetlgm), which is negative in sign and significant at the $\alpha = 0.05$ level (Table 3.2). This suggests that as there is more groomed trail at a site the probability of visiting the site decreases. This may very well suggest these snowmobile recreators prefer trails that are less developed or maintained. This variable could also be a proxy for congestion, in that you would expect more snowmobilers, and perhaps more novice snowmobilers, at more developed and better maintained trail sites. The site amenities variable (Steamn) is positive and significant indicating the unique amenities of YNP and GTNP do increase probability of this segment snowmobiling at this site. This could be an artifact of the sampling frame, but RUMs estimated for the other segment (single destination segment) of the data did not suggest this variable added to the explanatory of the model.[6] Overall, this may suggest that YNP and GTNP is very much a draw for this visitor segment to snowmobile in this region on their winter vacation.

The equation for nonparticipation has some interesting results. As expected, years of snowmobiling experience (yrssnow) is significant and negatively related to nonparticipation (Table 3.2). As snowmobile experience increases in this visitor type, the probability of not snowmobiling once in the region decreases. The variable related to education is significant and also negative, suggesting the more education this visitor type has the more likely they are to snowmobile once in the region. This variable may very well be acting as a pseudo proxy for income.

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[6] See Tables C.3 and C.4 in Appendix C for results to support this statement.

Using Model to Estimate Loss in Benefits from Snowmobile Ban in YNP & GTNP

The compensating variation for this group was estimated by evaluating D^0 at the means of all the variables for the sample, and D^1 was estimated by forcing the price of YNP and GTNP to essentially go to infinity or where trip share probability for these two sites went to zero. This essentially simulates a ban on snowmobiling in the two parks. The estimates were adjusted for the scaling in price (i.e., multiplied by 100), which was done to keep parameter estimates near the same magnitudes during model estimation. Moreover, a 95 percent confidence interval (CI) was estimated around the resulting welfare estimate to test whether benefit estimates from this model were non-zero. This was done using the Krinsky and Robb (1986) procedure as proposed in Creel and Loomis (1991).

The per choice occasion CV for this segment of the sample is estimated to be a loss of $15.86. The 95 percent confidence interval indicates a potential range in loss of $20.27 to $12.82, suggesting the loss is nonzero. The annual CV estimate is based on an average of nearly seven choice occasions per individual in the sample during the season.

Table 3.3 Predicted Change in Welfare or Compensating Variation (CV) Trips with Site Closure.

	CV Estimate
Per Choice Occasion CV	-$15.86
95 % CI	-$20.27 to -$12.82
Annual Change in CV	-$106.92
95 % CI	-$136.65 to -$86.41

This puts the estimated annual loss to multiple destination visitors in this sample at $106.92 if YNP and GTNP are closed to snowmobiling. The 95 percent CI indicates the resulting annual loss ranges between $136.65 and $86.41 for each individual of this visitor type. Even though there are number of sites available for this visitor segment to go to in the region, the closure of YNP and GTNP still results in an estimated welfare loss to them. Assuming visitors to YNP and GTNP are similar to our sample proportions, approximately 33,288 visitors per year would lose total benefits ranging between $4.5 and $2.9 million annually. These estimates represent benefits lost in the region given our decision to come to the region is exogenous. The magnitude of estimated loss suggests ignoring or dropping these visitors from the sample would likely bias welfare loss estimates for snowmobilers.

Discussion

A key assumption of most recreation demand models used in nonmarket valuation is that each trip taken is for a single purpose and to a single destination. The assumption of single purpose and single destination in the recreation demand model avoids the issue associated with joint travel cost in a multiple destination trip. Often times multiple destination visitors are ignored in many policy analyses because of the difficulties they pose. This practice would provide inaccurate welfare estimates and policy information in our case study of banning snowmobiles from Yellowstone and Grand Teton National Parks. The purpose of this paper has been to illustrate a modeling approach that explains site choice in a multiple destination trip and provides welfare change estimation for this type of visitor given a site closure.

Our approach builds on concepts in the travel literature as well as the economic literature. This approach extends the concepts used in the on-site travel cost models, but uses trips or site visits as the dependent variable rather than days on site. This approach better addresses site allocation and the potential for substitution than traditional on-site travel cost models. Price is modeled as a sum of two components, a proportion of the long distance travel cost to come to a region where bundling of sites occurs and the variable cost associated with visiting an individual site in the region destination. This approach seems to address a number of concerns expressed in the literature with the on-site TCM. The model seems to perform relatively well, and the results are consistent with theory in explaining site choice for a sample of multiple destination visitors faced with the potential loss of a unique snowmobile recreation site. Welfare estimates are also relatively easily obtained from this approach.

We argue this approach makes a contribution to the research literature as it stands, but it is certainly not without its limitations. As with any model several simplifying assumptions were made to make the model tractable and estimable. First, given data limitations, the decision to come to the region of interest where the potential sites were bundled was assumed to be exogenous to the model. Greater insight into multiple destination behavior would likely be gained by including this decision stage in the model. Gathering more information in the survey instrument focused on this decision could allow this decision stage to be modeled. The visitors in our sample were assumed to behave in a "base camp" fashion. Thus, they were assumed to come to one destination in the region from which all snowmobile trips originated. While we believe this is a reasonable assumption for this particular data set, this type of assumption is a limitation when applying this approach to a broad range of policy relevant problems. Finally, we believe the long distance travel cost (LDTC) represents an investment to come to the region and is important to apportion to individual site cost. Research that investigates whether site cost modeled solely as the variable cost to get to a site once in the region performs similarly both in model and welfare estimation would be beneficial.

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CHAPTER 4

POTENTIAL CHANGES IN SNOWMOBILER TRIPS AND ECONOMIC LOSSES WITH SITE CLOSURE

Introduction

In response to environmental issues, seven alternatives for winter use management in Yellowstone National Park (YNP), Grand Teton National Park (GTNP), and the John D. Rockefeller, Jr., Memorial Parkway (JDRMP) were documented in a final environmental impact statement (EIS) (National Park Service 2000). At the time this research was conducted, the alternative designated as preferred in the EIS eliminated snowmobile travel in YNP, GTNP and the JDRMP, but it allowed snowcoach travel and other forms of winter recreation. This alternative was to start implementation in the 2001-2002 winter season (Thorne 2002). Policy changes due to changes in federal administrations coupled with a number of federal suits and resulting court decisions have created much uncertainty regarding the future of snowmobile recreation in YNP and GTNP (Hamilton 2002; Sullivan 2002; Israelsen 2003; Lipsher 2004; Black 2004; McMillion 2004; and Monoson 2004). As of early May, Secretary Gale Norton, of the Department of Interior, held a press conference and indicated the park would be open in 2004-2005 season to snowmobiling, but Norton indicated that management practices may have to be changed given the differing court decisions by federal judges (Stark 2004).

Environmental interests will most likely continue to support a ban of snowmobiles in the parks, while snowmobile recreationists will advocate access. Time will ultimately reveal the outcome, but the question of what will happen to snowmobile visitation and recreation benefits if policy regarding snowmobile access to these parks is eliminated warrants investigation, as these potential losses have not been systematically quantified.

Problem Statement

Very little is really known about how snowmobilers will respond to a ban or reduction in allowed visits. Will snowmobilers substitute to other sites in Wyoming, Idaho and Montana or choose a different destination altogether? How will substitution away from these unique sites affect the economic benefits to snowmobilers? The purpose of this paper is to address these questions by estimating change in visitation to snowmobile sites and loss in benefit estimates for snowmobilers should a ban be the final policy outcome.

Analytical Approach

Single site recreation demand models such as the Travel Cost Method (TCM) do not adequately take into account the potential for substitution to a number of other potential snowmobile sites. The random utility model (RUM) is chosen as the model to use for this analysis because of its ability to utilize trip information across a number of recreation sites and estimate the probability of an individual going to a site on a given choice occasion (Morey 1999; Haab and McConnell 2002). Once the RUM is estimated the means of the variables along with the parameter estimates can be used in the appropriate formulas to calculate what are known as trip share probabilities to all the sites being analyzed (see Chapters 2 and 3 for a full explanation of the RUM and the appropriate probability formulas). These trip share probabilities can then be used to estimate the number of trips to a site, and trip share probabilities can be estimated for sites if YNP and GTNP are closed to snowmobiles.

Data was gathered during the 2001-2002 snowmobile season from recreationists who snowmobiled one or more times at YNP and GTNP (see Chapter 1 and Appendix A for sampling and survey design). The sampling procedure and survey instrument were designed to facilitate the estimation of random utility models. Additionally, data regarding average snow depth by site for both the 2000-2001 and 2001-2002 seasons for all sites in the respondents' choice set, and other site attributes such as miles of groomed trail, services within five miles of the trail head, and high and low elevation along the trails for each site were recorded. The RUMs were estimated using both the survey data regarding individual trip information and the site attributes data. Estimates from these models were then used to calculate changes in trip share probabilities and the predicted number of trips to sites with and without YNP and GTNP being open for snowmobile recreation. Moreover, these models were used to estimate the loss in benefits to snowmobilers if snowmobile recreation were banned in YNP and GTNP (see Chapter 3 for a formula to estimate the change in compensating variation (CV) for snowmobilers).

Location of Sites Used by YNP and GTNP Snowmobilers

Trip information required to estimate the RUMs came from section two of the survey instrument (see Appendix A). Section two asked for specific trip information during the December through February period. Specifically the revealed preference question provided a table with 28 different sites from Wyoming, Idaho and Montana allowing respondents to list the number of trips and days spent at each site during the specified survey period. These original 28 sites came from past research as well as suggestions from trails managers in all three states. Respondents were asked to refer to their trip record sheet or place the trip record sheet in the survey upon returning it for this question. Moreover, respondents were asked to refer to their trip record sheet and indicate on a separate trip matrix the *number of days and trips they would have spent at the listed sites had YNP and GTNP not been available*. This is referred to as the stated preference question. Respondents were also given the opportunity to list "other" sites for each state that they recreated at and were asked to list the name of the site. An additional 20 sites were added to the choice set as a result of this question, bringing the total sites in the choice set to 48. This format was used to allow respondents to more accurately define the relevant choice set for modeling. RUMs were calculated for both the revealed preference and stated preference data for the expanded set of snowmobile sites (see Chapters 2 and 3 and Appendix C for model explanation and results).

The sites used in the final model estimation and analyses are displayed in Figures 4.1, 4.2 and 4.3. These figures are meant to give a general depiction of geographic location within state boundaries and do not reflect total area covered by the trail systems at each of the sites. It should be noted that the Bighorn Mountains are divided into the North Bighorns and South Bighorns trail areas for the analysis. Moreover, zip codes of the closest town to the trailhead or access point was used for estimating travel distances and travel times. It is interesting to note that the choice set of snowmobilers using YNP and GTNP seems to indicate the majority of sites tend to be closer to the parks than farther away. This likely is a function both of location of available trails and behavior of

Wyoming

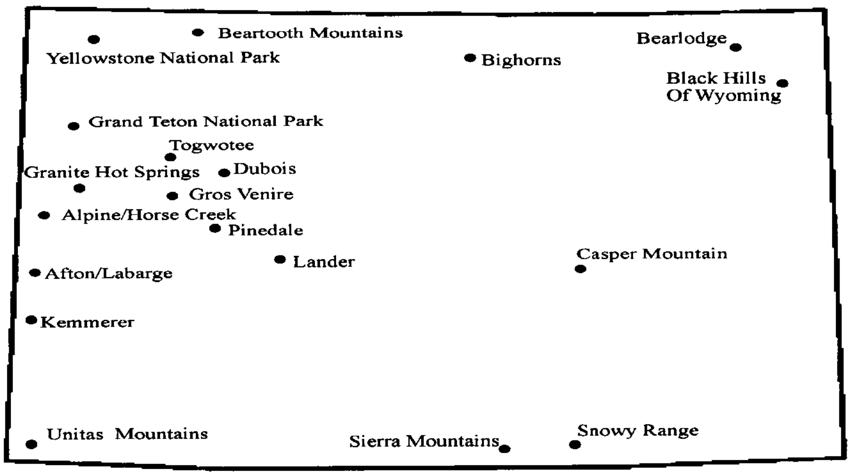

Figure 4.1 Geographic locations of Wyoming snowmobile trails analyzed.

Montana

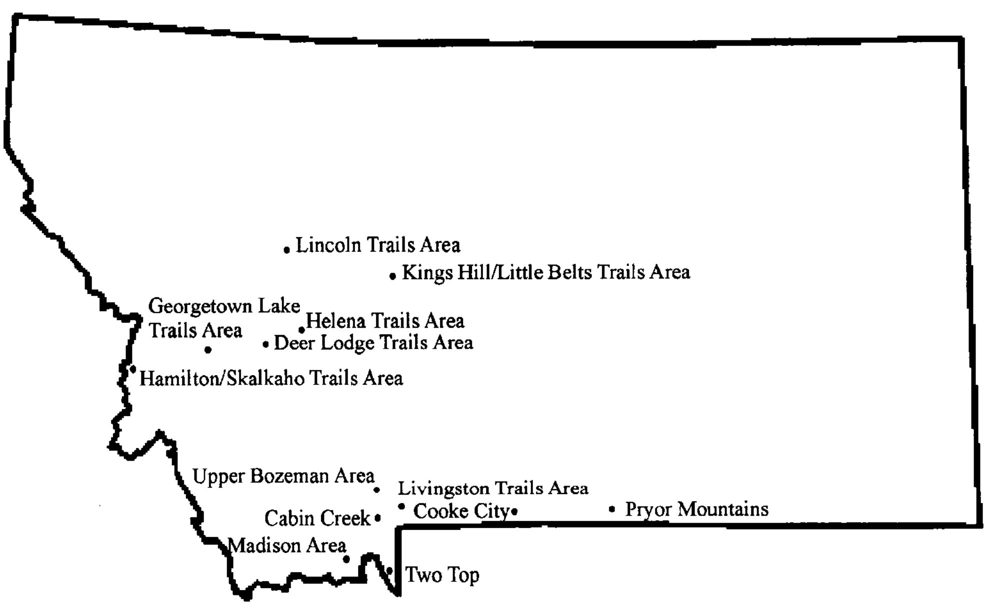

Figure 4.2 Geographic locations of Montana snowmobile trails analyzed

Figure 4.3 Geographic locations of Idaho snowmobile trails analyzed.

the respondents. The choice set does not include all snowmobile recreation sites for the three states.

Two Distinct User Groups

Initial analyses using descriptive statistics, t-tests and chi-square tests (see Chapter 1 for details and results) indicated two distinct user groups within the sample. One of the two groups was comprised of snowmobilers who visited multiple snowmobile sites during a single trip to the region (WY, ID, MT) surrounding YNP. This group comprised 40% of the sample (labeled as "multiple destination" visitors). The other group could be categorized as people taking multiple snowmobile trips during the season to a single site per trip, i.e., a single purpose and destination visitor (labeled as "single destination" visitors). After controlling for item nonresponse in the questionnaire for model estimation there were 254 individuals in the multiple destination group representing 1,075 site visits taken and 328 individuals in the single destination group which had taken 1,744 trips to the sites in the three state region surrounding and including YNP and GTNP listed in Figures 4.1, 4.2, and 4.3.

Each of these groups, single destination or multiple destination, was modeled separately to better address their unique attributes (see Chapters 2 and 3 for more detail regarding model estimation for these group types). Individuals in the single destination group essentially took one trip from their home to a site, recreated and went back home again. This "single purpose and destination" behavior is easier to model because the cost of a trip can be easily assigned to the appropriate site. Individuals in the multiple destination group came from longer distances away from home, stayed in the region for an extended period, visited multiple snowmobile recreation destinations and then returned home. Analyzing recreation activity of individuals in this group is more difficult because there is a joint travel cost problem, i.e., how to assign trip cost to the bundle of sites visited is not obvious to the researcher. An analytical approach for this group is described in chapter 3. Often individuals of the multiple destination type are dropped from policy analyses because of the joint travel cost problem. For purposes of this paper, we will investigate the sensitivity of trip predictions and welfare estimates to taking into account the heterogeneity of the visitors snowmobiling at YNP and GTNP as compared to just assuming all visitors were to act as the single destination group, i.e., what would the policy conclusions be if the multiple destination group were dropped from the sample.

Trip or Site Visit Predictions

The RUM used for each segment of the data includes an indirect utility function for each site and one for nonparticipation in the snowmobiling activity. This is designed to capture the possibility of respondents substituting away from snowmobiling altogether as well as if they choose to go to another site. Thus, the RUM for each segment estimates a joint probability estimate in that each trip share probability for a site is conditional upon an individual choosing to snowmobile on a given choice occasion. It is important to remember then that the RUM model is estimating the probability of going to a snowmobile site on a given choice occasion. This means that to calculate trips one must first determine total number of choice occasions represented by snowmobile visitors to YNP and GTNP.

According to the National Park Service Public Use Statistics (n.d.) website, the average number of snowmobile visitors to YNP during the seasons for 1992 through 2001 was 79,646. During this same period GTNP averaged 3,573 snowmobile visitors per year. The parks normally open around mid-December and close in early March depending on availability of snow. Thus, it was assumed that on average there were approximately 80 days per season in which the parks were open to snowmobile recreation. These averages were used to smooth out potential fluctuations due to snow or weather conditions per season, and the years after 2001 were deleted from the average given the potential for visitor fluctuations due to policy uncertainty. The number of choice occasions for the single destination group was equal to the number of visitors multiplied by 80 choice occasions per season. Descriptive statistics indicate the average number of choice occasions faced by multiple destination visitors when they snowmobiled in the region was 6.74. The decision for these respondents to come to the region was assumed to be exogenous to our model, so we are only modeling these visitors as if they have come to the region, and what their probability of choosing a site is once here for the revealed preference model.

Table 4.1 records the predicted visitation without site closure from the RUMs assuming no heterogeneity, i.e., assuming all visitors acted as if they were all of the single destination type, and assuming heterogeneity of the visitors in the same proportion of our sample. Thus, for the "no heterogeneity" scenario we assume there is 83,219 visitors * 80 choice occasions per visitor to be allocated across the sites and no participation (83,219 visitors * 80 choice occasions/visitor = 6,657,520 choice occasions). The heterogeneity scenario assumes that 60% of the visitors to YNP and GTNP were of the single destination type and 40% were of the multiple destination type. Using these proportions then the total number of choice occasions to be allocated across the probabilities for both models was 4,218,870.4 ((83,219 visitors * 0.60 * 80 choice occasions/visitor) + (83,219 visitors * 0.40 * 6.74 choice occasions/visitor)). The choice occasions (single destination or multiple destination) for each scenario was then multiplied by the estimated trip share probability for each site for the appropriate model to estimate visits to a site.

Table 4.1. Base Visitation Predictions and Comparison to Actual Snowmobile Visits for YNP and GTNP Without Site Closure (rounded to nearest hundredth).

Region or Site	Predicted Assuming No Heterogeneity	Predicted Assuming Heterogeneity	Actual Average Snowmobile Season Visitation for 1992-2001*
YNP & GTNP	72,924.84	82,461.34	83,219
Wyoming**	273,755.18	216,129.33	--------
Montana	111,887.70	103,476.41	--------
Idaho	191,281.47	167,372.14	--------
Total for WY, MT, ID	576,924.35	486,977.88	--------

* Based on National Park Service Public Use Statistics for snowmobile visitation assuming a season being for December – March, for years 1992 – 2001.
** Wyoming prediction includes YNP & GTNP.

Several important conclusions can be made from Table 4.1. First, the models seem to predict average annual visitation at YNP and GTNP fairly well. The heterogeneity scenario predicts 82,461 visitors compared to the actual average of 83,219 or 99.1 percent of the actual average visitation. Dropping the multiple destination visitors and assuming all visitors are of the single destination type to avoid the joint travel cost issue reduces the accuracy of the prediction. The "no heterogeneity" scenario, assuming all visitors of the single destination type, predicts only 87.6 percent of the actual average visitation at 72,924.84. While 88 percent accuracy for these models is relatively good, accounting for heterogeneity improves prediction of visits to YNP and GTNP by 11.5 percent. This is an initial indication that accounting for heterogeneity in the policy analysis could be important. Another conclusion is that visitors to YNP and GTNP certainly do take a number of trips to other snowmobile sites within the three state region surrounding the parks. Thus, the initial conclusion that visitors may substitute to other sites in the face of park closure seems reasonable. Moreover, sites in Wyoming and

Idaho seem to receive more visitors that go to YNP and GTNP than Montana sites. This could mean the impacts of site closure could be less for Montana overall, as compared to Wyoming or Idaho.

The next step in the analysis was to predict change in site visitation using the revealed preference random utility models. The formulas for each site probability along with nonparticipation were entered into a spreadsheet using the estimated model parameters and the mean values for each of the variables, the resulting trip share probabilities were estimated. This provided the base from which site closure was predicted (Table 4.1). Site closure was simulated by changing the price variable for the GTNP and YNP sites to infinity, i.e., raising the price high enough that the predicted trip share probability was forced to zero. The trip share probabilities from the equations without site closure were then subtracted from the trip share probabilities with site closure. This change in trip share probability for each site was then multiplied by the appropriate number of choice occasions as discussed in the base case. This provided the predicted change in site visits from the revealed models as reported in Table 4.2.

Table 4.2. Predicted Change in Site Visitation from Revealed Preference Models With Site Closure (rounded to nearest hundredth).

Region or Site	Predicted Assuming No Heterogeneity	Predicted Assuming Heterogeneity
YNP & GTNP	-67,990.07	-77,526.58
Wyoming*	-70,612.82	-74,127.47
Montana	-1,461.20	12,427.66
Idaho	43,443.68	43,942.58
Total for WY, MT, ID	-28,630.34	-17,757.23

* Wyoming prediction includes YNP & GTNP.

Results of the revealed preference models suggest that some sites may actually receive increased visits to the point that there are net gains from closing YNP and GTNP

(Table 4.2). This is true of Idaho for both the "no heterogeneity" and "heterogeneity" scenarios. The "heterogeneity" scenario predicts site loss to YNP and GTNP at 77,527 visitors versus the actual average of 83,219. That predicted loss is more than the "no heterogeneity" scenario predicts. The "heterogeneity" scenario predicts less net loss of site visits overall. Montana, and Wyoming sites are predicted to increase in site visits overall after site closure according to the "heterogeneity" scenario. It is important to remember that the multiple destination visitors' decisions to come to the region are exogenous to our model, so the choice occasions for this group remains the same for the site closure scenario. This means all of the multiple destination visitors would come to the region, and they would decide to stay the same amount of time on average, even if YNP and GTNP were closed to snowmobiling. This may be a tentative assumption. Overall, the results point to potentially different outcomes between the "heterogeneity" and "no heterogeneity" scenarios in the event of site closure.

The revealed preference results suggest snowmobilers could largely substitute to other sites with relatively minor losses in trips overall for the three state region. The stated preference results are presented to provide some indication of what snowmobilers think might happen should the parks be closed to snowmobile recreation. Loomis (1993) investigated the revealed preference visitation behavior of lake visitors as compared to their stated preference behavior under differing water level scenarios. The author concluded visitors often behaved as they said they would.

The stated preference model results for the single destination segment used in this analysis was compared to the revealed preference results in Chapter 2. The hypothesis of preference homogeneity between the stated preference and revealed preference models was rejected. The conclusions in Chapter 2 suggest that differences in revealed and stated preferences for site closure may provide a relevant bounded range of potential outcomes.

The change in visits by the single destination group is estimated as the number of choice occasions multiplied by the difference in the stated preference trip share probabilities with site closure and the revealed preference trip share probabilities. The change in visits by the multiple destination group is estimated by the change in estimated trips predicted for each site between the stated preference model and the revealed preference model. This allowed the number of choice occasions to differ from the revealed preference scenario as compared to the stated preference scenario. This provides flexibility for a change in the decision to come to the region (which is exogenous in both the revealed and stated preference models) and adjustment for number of choice occasions while in the region for the multiple destination group. The choice occasions for the multiple destination group varies by individual, and for the stated preference case the number of choice occasions is based on the number of trips and days per trip plus an estimate of nonparticipation. Nonparticipation is kept proportionally the same for each individual between the stated preference and revealed preference data. For example if an individual was in the region for five days and took three snowmobile trips, the estimated nonparticipation for this individual was two (5 choice occasions – 3 trips). If in the stated preference data the individual indicated they would only take two trips, it was assumed that the proportion of nonparticipation was the same as in the revealed preference data. The total calculated choice occasions for the stated preference data for this individual was equal to two plus two times (2/5). This was necessary because the stated preference data did not ask for total days respondents would have stayed in the region if the parks were closed. These stated preference results for both scenarios are reported in Table 4.3.

Table 4.3. Predicted Change in Site Visitation from Stated Preference (SP2) Models With Site Closure (rounded to nearest hundredth).

Region or Site	Predicted Assuming No Heterogeneity	Predicted Assuming Heterogeneity
YNP & GTNP	-67,990.07	-49,523.99
Wyoming*	-247,230.21	-152,327.39
Montana	-100,722.82	-71,365.45
Idaho	-174,239.39	-112,077.41
Total for WY, MT, ID	-522,192.42	-335,770.25

* Wyoming prediction includes YNP & GTNP.

The stated preference results in Table 4.3 paint a much different picture than that of Table 4.2. Wyoming is predicted to lose the most site visits in the "no heterogeneity" scenario and the second largest loss in the "heterogeneity" scenario. The results are quite different between the "heterogeneity" and "no heterogeneity" scenarios as overall losses in site visitation are much smaller for the "heterogeneity" prediction. Overall, the stated preference results indicate there will be a loss in visitation to all three states, with Montana being the least affected. This pattern of relative loss among the states is similar to that of the revealed preference results in Table 4.2. What is different between the two scenarios is that Montana and Idaho are estimated to now lose in visitation and losses are forecast at nearly 20 times the predicted losses in the revealed preference scenario. The potential outcome of site closure likely lies between the revealed and stated preference results.

Yellowstone and Grand Teton National parks have what could be considered very unique amenities compared to most other snowmobile sites in the Rocky Mountain region. Thus, it seems plausible that the loss of such sites is not viewed as a marginal change by snowmobilers, and such a loss could very well affect site choices overall in the region. The revealed preference models could very well be more suited to predicting marginal changes. Hence, the stated preference models' predictions seem to be very different and could be a reflection of this structural change in site choices by respondents. Results in chapter 2 suggest that preference homogeneity is in fact rejected for the single destination visitors between the revealed and stated preference data. Louiviere, Hensher and Swait (2000) and Haener, Boxall and Adamowicz (2001) indicate that combining the strengths of revealed and stated preference data in a model using both kinds of data could be a reasonable approach to predicting behavior.

Models using the pooled stated and revealed preference data sets for both visitor types were estimated using the same variables and functional forms as those reported for the revealed preference models (see chapters 2 and 3 for more detail). The pooled models were estimated using scale adjusted data sets where the revealed and stated preference data were concatenated. The stated preference data matrices in these concatenated sets were then multiplied by the relative scale factor coming from the estimation of the separate revealed preference and stated preference models and their corresponding scale parameters (see Louviere, Hensher and Swait 2000; Haener, Boxall and Adamowicz 2001). This procedure normalizes the error variance of the SP data to that of the RP data. These pooled models were then utilized in the same manner as described above for the revealed preference models to predict changes in trips to the region surrounding the parks, where price is raised to infinity to simulate site closure. The difference in trips for the multiple destination segment is based on choice occasions before site closure (revealed preference) and then choice occasions after site closure (stated preference). These calculated choice occasions are multiplied by the corresponding trip shares and then the difference in trips per site is estimated. The results for the pooled model scenarios are reported in Table 4.4.

Table 4.4. Predicted Change in Site Visitation from Pooled (RP-SP2) Models With Site Closure (rounded to nearest hundredth).

Region or Site	Predicted Assuming No Heterogeneity	Predicted Assuming Heterogeneity
YNP & GTNP	-118,399.74	-90,609.62
Wyoming*	-122,505.44	-101,827.24
Montana	-2,885.17	-19,872.27
Idaho	77,931.05	18,513.20
Total for WY, MT, ID	-47,459.55	-103,186.31

* Wyoming prediction includes YNP & GTNP.

The pooled models provide estimates that are in between those reported for the revealed preference and the stated preference models. The "no heterogeneity" scenario is larger than the revealed preference model but much less than the stated preference model. This scenario predicts a loss of 118,399 to the parks, which is over the average visitation levels, but it also predicts that Idaho will actually see an increase in visitation after park closure. Wyoming will see the largest loss in visitation, while Montana will see a more modest loss according to these predictions. Interestingly the "heterogeneity" scenario now predicts more loss than the "no heterogeneity" scenario for the pooled models. This is largely being driven by the assumptions made about choice occasions before and after closure for the multiple destination visitors. This "heterogeneity" scenario is between the revealed and stated preference "heterogeneity" scenarios, and it also predicts Idaho will pick up slightly in number of visits while Wyoming loses the majority of visits. This scenario does come close to predicting the loss in visitation to the parks to be relatively close to the average annual visitation of 83,219 for 1992–2001. Again, while this scenario has some appeal, the actual outcome of site closure is an unknown. Statistics for resort tax collections in West Yellowstone, Montana and hotel occupancy in Jackson, Wyoming during the 2003-2004 snowmobile season suggest the RP results may underestimate loss in visitation as compared to the pooled and stated preference models (see Chapter 2, Table 2.5).

Welfare Estimates

Changes in benefits for snowmobile recreationists were calculated using both the revealed preference and pooled models. Using these models the expected maximum utility before and after site closure is estimated (see Chapter 3 for formula). The difference of the logarithm transformed expected maximum utility after site closure and the logarithm transformed expected maximum utility before site closure is then multiplied by the inverse ratio of the marginal utility of money, or the parameter estimate on price, to estimate the per choice occasion compensating variation (CV) estimate. This measure of economic welfare estimates how much an individual would have to be paid per choice occasion to accept the closure of YNP and GTNP (Morey 1999). Annual loss per visitor is estimated by multiplying per choice occasion CV by the appropriate number of choice occasions per year (Morey 1999). The total loss is then estimated by multiplying the annual loss per visitor by the number of affected visitors. A welfare loss estimate using the stated preference models was not done because of the identification problem associated with the parameter estimates and the potential scale differences between the revealed and stated preference models for each visitor type (see chapter 2 or Louviere, Hensher and Swait (2001) for discussion of this issue). Additionally, a 95 percent confidence interval (CI) is estimated for the per choice occasion CV for each segment to test whether welfare estimates for the two segments were statistically different. This was done using the Krinsky and Robb (1986) procedure as proposed in Creel and Loomis (1991).[7]

The "no heterogeneity" scenario assumes all visitors are like the single destination visitors, i.e., total estimated welfare loss is based on the assumption that all 83,219 visitors to the park are single destination visitors. The "heterogeneity" scenario assumes the visitors to the park are proportionally like our sample, i.e., 60 percent of the visitors are of the single destination type, and 40 percent are of the multiple destination type. Thus, total welfare estimates are based on both the single and multiple destination model results multiplied by the corresponding number of visitors given the average annual visitation of 83,219. The revealed preference model results are reported in Table 4.5.

Table 4.5. Predicted Change in Welfare or Compensating Variation (CV) with Site Closure (YNP & GTNP) from Revealed Preference Models.

		Predicted Assuming Heterogeneity	
	Predicted Assuming No Heterogeneity	Multiple Destination Group	Single Destination Group
Per Choice Occasion CV	-$0.13*	-$15.86*	-$0.13*
95% CI	-$2.74 to -$0.007	-$20.27 to -$12.82	-$2.74 to -$0.007
Mean Annual Change in CV Per Visitor	-$10.04*	-$106.93*	-$10.04*
Mean Segment Total		-$3,559,443.10	-$501,311.26
Total Estimated Mean CV Loss	-$887,114.54	-$4,060,754.40	

* Estimates rounded to nearest penny. Per choice and annual CV estimates may be different due to rounding.

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[7] See Appendix B, Table B.10 for example GAUSS code used to estimate 95 percent confidence interval using the Krinsky-Robb technique.

The results in Table 4.5 indicate that per choice occasion loss in benefits is much less for the single destination group as compared to the multiple destination group. This is not surprising given the fact that the primary reason for coming to the region is to snowmobile at YNP for the multiple destination group, and they have limited opportunities to substitute to other sites as compared to the single destination group. The single destination visitors have a number of opportunities throughout the season to snowmobile at other sites, and are more likely to do so, according to the trip prediction results in Table 4.1. Moreover, the 95 percent confidence interval estimates indicate that the per choice occasion CV estimates for each segment are statistically different. Thus, the loss in benefits would be expected apriori to be less for the single destination group as compared to the multiple destination visitors, and these results support that hypothesis. The total mean predicted welfare loss is much less if all visitors are assumed to be of the single destination type as compared to the "heterogeneity" scenario. The total estimated loss in benefits given closure of YNP and GTNP is $4.060 million for the "heterogeneity" scenario as compared to less than $1 million in lost benefits for the "no heterogeneity" scenario.

The pooled model results are somewhat similar to the general conclusions between the "no heterogeneity" and "heterogeneity" of the revealed preference model estimates in that the single destination visitors are predicted to lose much less than the multiple destination visitors both on a per choice occasion basis and annually (Table 4.6). Again, the 95 percent confidence intervals indicate per choice occasion CV estimates are statistically different across the two segments. The mean total estimated welfare loss to snowmobilers is much higher for the "heterogeneity" scenario, as well.

An interesting result of the pooled model estimates is that the single destination visitors are predicted to lose more per choice occasion as compared to the revealed preference results, while the multiple destination visitors per choice occasion CV is reduced by almost half as compared to the revealed preference results. This

Table 4.6. Predicted Change in Welfare or Compensating Variation (CV) with Site Closure (YNP & GTNP) from Pooled (RP-SP2) Models.

		Predicted Assuming Heterogeneity	
	Predicted Assuming No Heterogeneity	Multiple Destination Group	Single Destination Group
Per Choice Occasion CV	-$0.20*	-$9.13*	-$0.20*
95% CI	-$3.58 to -$0.012	-$13.34 to -$7.61	-$3.58 to -$0.012
Mean Annual Change in CV Per Visitor	-$15.10*	-$61.56*	-$15.10*
Mean Segment Total		-$2,049,184.70	-$1,256,606.90
Total Estimated Mean CV Loss	-$1,256,606.90	-$3,305,791.60	

* Estimates rounded to nearest penny. Per choice and annual CV estimates may be different due to rounding.

difference is likely being driven by the way choice occasions and nonparticipation is estimated for the multiple destination group. Choice occasions are allowed to vary across individuals and across the revealed and stated preference data. For example, the average number of choice occasions in the revealed preference data for the multiple destination visitors is 6.74 compared to 2.48 in the stated preference data. The average number of site visits is 4.22 for the revealed preference data as compared to 1.50 in the stated preference data. Since nonparticipation is assumed to be proportionally constant across the revealed and stated preference data, the overall number of choice occasions and trips drop for the multiple destination group in the stated preference data as compared to the revealed preference data. This means the expected utility for YNP and GTNP likely goes down in the pooled model as compared to the revealed preference model. Less trips in the region and less choice occasions when these sites are closed has the effect of reducing the per trip utility for YNP and GTNP in the pooled model as compared to the revealed preference model. This is somewhat confirmed by examining the indirect utility equations for YNP and GTNP and their resulting estimate of e^{SV} (e raised to the scale parameter times the indirect utility equation evaluated at the variable means for that site). The estimate for e^{SV} in the revealed preference model is 11.46504 and 17.31204 for YNP and GTNP, respectively, as compared to 4.351938 and 7.163762 in the pooled model. The reverse trend in magnitudes for these sites is true for the single destination revealed preference and pooled model estimates, i.e., revealed preference less than pooled, which meets apriori expectations. The question is how appropriate are the assumptions made about choice occasions for the multiple destination visitors in the stated preference data. Regardless of which welfare estimate is more accurate, both results suggest just dropping the multiple destination visitors and assuming all visitors are like the single destination visitors would likely underestimate welfare losses for snowmobilers, if snowmobiling was banned at these sites.

Discussion

Original policy recommendations in an EIS published by the National Park Service were to ban snowmobile recreation in Yellowstone and Grand Teton National parks starting with the 2001-2002 winter season (National Park Service 2000). Changes in federal administrations coupled with a number of federal suits and resulting court decisions have changed this policy recommendation, but much uncertainty remains regarding the future of snowmobile recreation in YNP and GTNP. The purpose of this paper is to estimate the potential change in visitation to snowmobile sites and benefit estimates for snowmobilers should a ban be the final policy outcome.

The results in this paper indicate that YNP and GTNP visitors also visit a number of other snowmobile sites in Wyoming, Montana and Idaho. The potential exists for these visitors to substitute away to other sites should the parks be closed to snowmobile recreation. Moreover, results indicate there are two distinct visitor types that snowmobile in YNP and GTNP. One group can be described as taking a number of "single purpose and destination" snowmobile trips throughout the season (single destination group). Visitors in the other group take one major trip away from home to this region, and snowmobile at a number of sites before returning home (multiple destination group). Both the predicted change in trips and the estimated loss in benefits are much different if the heterogeneity in the snowmobile visitors to YNP and GTNP is not accounted for.

The estimated net loss in trips to Wyoming, Montana and Idaho combined is estimated to be between 17,748 for the revealed preference models and 335,770 for the stated preference models given heterogeneity in snowmobile visitors to the parks. Yellowstone and Grand Teton National parks have very unique amenities, and it seems plausible that the loss of such sites is not viewed as a marginal change by snowmobilers. The stated preference data could be picking up such a change, or some strategic bias could be impacting the stated preference estimates. Because of the potential for preferences to be largely affected by site closure, models using pooled data from revealed and stated preference data were estimated to perhaps capture information contained in both data sources. Past research on moose hunting indicated pooled models predicted out of sample trips relatively well (Haener, Boxall and Adamowicz 2001). A set of pooled models predicts trip losses to the region of 103,186. If the revealed preference prediction is closer to the final outcome, the analysis indicates sites in Idaho could see a large increase in visitation if the park closes. If the pooled prediction is correct, Idaho sites could see a small net increase in visitation, while Wyoming and Montana see net losses. If the stated preference prediction is correct all states in the region could see net visitation losses if the parks were closed to snowmobile recreation.

While the estimated range in trip changes is large, none of the predicted outcomes indicate that all snowmobile visitors and their trips to the region will be lost should the parks be closed to snowmobiling. Some visitors will substitute to other sites, and the analysis indicates that there will likely be a net loss of site visits to the region as whole. The magnitude of visitation loss depends on whether snowmobile visitors act more like the revealed preference prediction, the pooled model prediction or the stated preference prediction. The final outcome will likely be between the revealed and stated preference predictions. An important variable in the final outcome will be the impact of park closure on the multiple destination visitors' decisions to come to the region to snowmobile.

The welfare analysis indicates that the per choice occasion CV estimates are different across the two segments. The large number of potential opportunities to visit a number of snowmobile sites throughout the season likely translates into a smaller loss in benefits for the single destination recreators as compared to the multiple destination group should the parks be closed. The mean estimated annual loss in benefits is nearly ten times higher (-$106.93 versus -$10.04) for the multiple destination group as compared to the single destination group in the revealed preference estimates. Mean total loss to the multiple destination group comprises nearly 88 percent of the estimated total loss of $4.060 million in benefits if the parks are closed to snowmobiling according to these models. The pooled models predict the annual loss to the multiple destination visitors is on the magnitude of nearly four times larger (-$61.56 versus -$15.10) than the single destination visitors. Moreover, per choice occasion CV estimates are statistically different across the segments for the pooled models as well. The mean total loss to snowmobilers for these models is estimated to be nearly $3.305 million with the multiple destination visitors comprising nearly 62 percent of the loss. Overall, the welfare analysis re-enforces the notion that heterogeneity is important when analyzing snowmobile policy for YNP and GTNP.

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CHAPTER 5

SUBSTITUTION, VISITOR HETEROGENEITY AND THE ECONOMIC IMPACTS OF RECREATION SITE CLOSURE

Introduction

Rural areas have seen significant structural changes to their economies in the past twenty years. Commodity based industries have declined due to industry changes and national politics, and they are being replaced by new service-based industries (Drabenstott 1999). As these commodity based industries decline rural areas are turning toward the provision of natural amenity based recreation as an economic development strategy (English and Bergstrom 1994).

Site development or changes in environmental policy affecting potential demand for leisure activities in rural areas can greatly impact economic activity at the local and regional levels. Those areas dependent on recreation can face dramatic fluctuations in seasonal employment and stability of income in their economies due to exogenous shocks (Keith, Fawson and Chang 1996). Proposed changes affecting recreation create the need for sound regional analyses that provide local officials and community planners with the potential economic impacts of such changes.

Loomis (1995) states that underestimation of regional economic impacts from recreation site improvement will likely occur if analysts do not account for recreation decisions related to activity participation, decisions about which sites to visit, decisions about frequency of site visitation and length of stay at a recreation site. He discusses several types of recreation demand models that can be used to captures these decisions and finally provides an example of the potential underestimation of visitation and impacts from a site improvement. The author goes on to state that there is a paucity of research linking visitor use estimates to regional economic analysis techniques. Published research related to the potential economic impact of recreation site closure is perhaps scarcer yet.

Given the paucity of research linking changes in recreation demand associated with policy changes to regional economic impacts, researchers, analysts and policy makers have little to draw from if an important recreation site is facing closure. What are the implications of a policy that proposes closure of a unique destination to a particular recreation activity? Loomis (1995) provides some insight as to the important issues to be considered in the face of site closure rather than site improvement. Will recreators continue to come to the region and participate in that activity at other sites? Will they choose not to participate in that activity at all within the region? Will recreators change their preferences for the remaining sites, their trip frequency within the region, or length of stay in the region given the loss of a unique recreation site? A first round economic impact estimate of site closure should attempt to capture these decisions and potential changes in site visitation in the region.

The purpose of this paper is to explore the use of Random Utility Models (RUMs) to predict changes in site visits across a network of potential recreation sites within a region to capture the potential importance of substitution effects and behavior associated with visitor heterogeneity when analyzing the economic impacts of recreation site closure. The remainder of this paper will first review relevant literature pertaining to regional economic impact analyses of recreation. The RUM is then proposed, based on this literature and relevant economic theory, as a potential modeling technique that can be used as an input into economic impact analyses. This modeling approach is then applied to two snowmobile recreation sites that are frequented by a significant number of heterogeneous visitors and face uncertainty as to snowmobile access. Because the analysis is ex-ante of potential site closure, both revealed and stated preference data are used in the recreation modeling to provide evidence of potential changes in preferences for snowmobiling at sites in the region should these sites be closed. Economic impact estimates associated with site closure are provided across a number of scenarios designed to provide a comparison of estimates assuming no substitution effects, substitution effects but not considering visitor heterogeneity, and substitution effects with visitor heterogeneity using both revealed and stated preference data. The predicted changes in site visitation for two of the scenarios incorporating substitution effects and visitor heterogeneity with revealed and stated preference data are then presented spatially using Geographic Information Systems (GIS) to provide further comparison as it relates to potential distribution of the estimated economic impacts. This modeling approach's strengths, its limitations and suggestions for further efforts are then discussed.

Selected Research Regarding Economic Impact Analyses and Recreation

Bergstrom et al. (1990) estimate the economic impacts of recreational visits to selected state parks in North Carolina, South Carolina, Georgia and Tennessee. The authors use the IMPLAN modeling system for the input-output analysis (Minnesota

IMPLAN Group 1997a). Recreational expenditures for state parks were based on the Public Area Recreation Visitors Study. The authors broke expenditures into relevant sectors using Bureau of Economic Analysis personal expenditure worksheets and based visitation estimates on published visitation statistics for 1986. Results indicate that recreational spending has significant impact on the state economies studied. The authors conclude that further research on the impacts of recreational activity is needed.

Cordell et al. (1990) expand on the work of Bergstrom et al. (1990) to investigate the potential economic impacts of river recreation. The authors estimate the economic impacts of recreational visits to three selected parks in the National Park Service, which offer river recreation. The authors use IMPLAN (Minnesota IMPLAN Group 1997a) for the input-output analysis, published visitation statistics and expenditures estimates based on the Public Area Recreation Visitors Study. Results indicate that recreational spending had significant impact on the local economies studied. Cordell et al. (1990) conclude that river recreation could be an important economic development tool for rural areas.

Douglas and Harpman (1995) estimate employment and income effects associated with water recreation below Glen Canyon Dam to the Lee's Ferry site on the Colorado River. The authors argue that jobs estimates are a more appreciated economic yardstick and that such an analysis deepens the public's appreciation for water resources. The authors use survey data to estimate expenditures and trip visitation by day-use rafting, anglers, commercial rafting, and private rafting recreationists gathered by management agencies for the analysis. The authors compare estimates of employment with this data to aggregate data estimating jobs per millions of dollars of expenditures nationally. They conclude their analysis more accurately depicts the regional economy and expenditures.

They estimate jobs resulting from recreation below the Glen Canyon dam at twice that of the national ratio estimate.

Steinback (1999) conducts an impact analysis of party and charter boat anglers in Maine. Survey data from two separate surveys is used to estimate expenditures for both angler types. The author concludes the economic impacts generated from party and charter boat fishing accounted for much lower impacts than marine recreational shore or private and rental boat fishing in Maine in 1996 even though expenditures by party and charter boat anglers were thought to be 2-3 times higher than those by other angler types. This is because effort estimates by the Marine Recreational Fishery Statistics Service indicated that party and charter boat fishing trips represented only 2.7% of total marine recreational fishing trips in Maine during the 1996 season.

Bohnsack, et al. (2002) analyzes the economic impact of recreation Bluefin Tuna in North Carolina. They intercept sample boats during the 51day season and quota sample based on proportion of chartered versus private boat anglers. The authors then use a mail survey to elicit demographic and economic information. They first test the differences between charter boat and private boat anglers using the Student's t-statistic for continuous or interval data, the Mann-Whitley test for ordinal data, and Chi-square test for independence in binary variables. The authors find some significant differences between charter boat and private boat anglers. Charter boat group size was larger, spent more total days fishing but less fishing days per trip, and spent more per day of fishing on average than private boat anglers. They go on to estimate economic impacts on the local economy (Dare county) and the state (North Carolina) economy. The nonresident charter boat anglers had a larger total economic impact than nonresident private boat anglers.

They find that catch and release anglers spend more money than those that retain fish and recommend that for this fishery, a cooperative management strategy between the local industry, community and Federal regulating industries to develop the catch-and-release fishery could improve the local economy while achieving fishery objectives of improving the tuna population.

The above discussion provides examples in the research literature of economic impacts generated by recreation, but they do little methodologically to capture the recreation decisions discussed by Loomis (1995). As such they do not explore the potential importance of substitution effects to other sites in their impact analyses. Steinback (1999) and Bohnsack et al. (2002) do provide some indication that visitor heterogeneity may affect economic impacts, however.

Bergstrom et al. (1996) analyzes different management strategies of aquatic plants in a Lake located in Alabama and their potential effects on recreational expenditures and the resulting economic activity in an eleven county region. The authors gather trip preference and demographic data on anglers and non-anglers using the lake with a stratified sampling framework and in-person surveys. Respondents were given mail back surveys regarding trip expenditures. Moreover, in-person respondents were mailed a questionnaire regarding management alternative preferences and stated preference data regarding changes in trips to the lake under different aquatic plant (weed) management alternatives. Anglers preferred less control of plants as they provide cover and food for fish. Non-anglers preferred more weed control. Economic impacts were estimated via a trip frequency model and percentage of expenditures within the impact region based on percentage of from home trip distance that occurred within an eleven county impact region. The authors conclude that there may be large economic impacts associated with differing levels of aquatic plants in reservoirs. Overall, this research points to the potential for using statistical analyses and stated preference data as inputs in economic impact analyses of proposed changes in a recreation site's qualities. Moreover, different visitor types (anglers and non-anglers) indicated different preferences for plant management alternatives and potentially different estimates of trip frequency resulting from those alternatives.

Hamel et al. (2002) link a participation model to an input-output analysis to investigate the potential impacts of regulatory and quality changes on Pacific halibut and Chinook, and Coho salmon in Cook Inlet, Alaska. The authors use data from a 1997 random survey of 4000 Alaskan anglers. The participation model is based on a probit model of contingent questions regarding price, demographics and angler success expressed in terms of the composition, magnitude, and average size of fish caught. This model was then used to develop a number of simulations projecting participation based on regulatory and quality variables mostly measured by changes in harvest levels. The authors modify expenditures data from the survey by dropping resident local anglers from the expenditures. The authors then modify several sectors in IMPLAN and estimate the economic impacts associated with the different regulatory and harvest levels. The authors conclude that quality and regulatory changes would have significant impact on the local economy in Cook Inlet, Alaska. Moreover, they conclude that the major contribution of the article is the in-depth modeling of the participation in angling across several gradients for several species.

Weiler et al. (2003) estimate confidence intervals (CIs) on economic impacts using standard errors for a trip frequency model that estimates changes in visitation to Rocky Mountain National Park from population growth and climate change. The authors use expenditure data from two different parks and adjust the IMPLAN Input-Output (I-O) model for local endogenous sectors (local government and households). They then estimated regression models for predicted visitation during peak and off peak months for the year 2020 compared to no change in population or climate scenarios. The standard errors in the regressions allowed the estimation of 95% CIs on visitation. These ranges in visitation were then used to estimate upper and lower bounds on jobs created for each scenario. The population change and climate change with population change had CIs that lie outside the no change scenario for peak season indicating statistical difference. Confidence intervals for the population change and climate change with population change overlapped. Thus, the authors conclude that the population change was the significant variable affecting visitation. The contribution of this article is it provides a way for hypothesis tests to be conducted from deterministic I-O models.

Weiler and Seidl (2004) estimate a regression model using time series and cross sectional data which incorporates variables such as population growth and change in designation of national monuments to national parks. The authors use this model to predict change in visitation from changing the designation of the Great Sand Dunes from a National Monument to National Park. They use predicted change in visitation to estimate potential economic impacts on the San Luis Valley in Colorado given the designation change. The authors use expenditures data from two other parks to estimate expenditure categories for the I-O analysis. The authors conclude that an increase in visitation due to designation change would create significant economic impacts in the San Luis Valley. They point out that such a synthesis of econometric and economic impacts can be valuable in understanding the local benefits of such re-designations.

The above literature provides a broad spectrum of approaches to estimate the economic impacts associated with recreational activity. Earlier literature seems to have focused on using existing trip visitation statistics to provide benchmark estimates of what impacts current levels of recreation have on regional economies. Over time economists seem to be addressing policy and site changes which impact visitation levels in the research. Hence there seems to be a growing use of statistical models of recreational demand to drive regional impact analyses. Most of the literature has seemingly focused on site improvement and not site closure, however. Moreover, the literature does not seem to take into account the potential for substitution effects within a region. English and Bergstrom (1994) state that when looking at economic impacts of recreational site improvement one should consider both product (taking more trips to the site or other sites in the region as a result of the improvement) and location (taking the same number of recreation trips in a season, but shifting the destination of some trips to the improved site) substitution effects in the analysis.

The literature also seems to provide some evidence of the potential of visitor heterogeneity to impact both visitation levels and expenditures. Survey methods used to help predict changes in visitation have incorporated stated preference or contingent behavior questions in several of the above studies. A modeling approach for analyzing the potential regional economic impacts of recreation site closure that tries to capture agent behavior as it relates to substitution effects and visitor heterogeneity should make an important contribution.

Theory and Linkage of RUM and I-O Models

The RUM Recreation Model

The general framework of the Random Utility Model (RUM) seems to provide a basis to address several important issues laid out in the literature above. First, the RUM allows for capturing much of the recreation decision making described by Loomis (1995) where decisions are made in stages such as come to the region or not, participate in the recreation activity of interest or not, and site choice among a number of alternative sites. More specifically a repeated nested logit model allows these different decision stages to be modeled while addressing the Independence of Irrelevant Alternatives (IIA) assumption (Morey 1999; Chen, Lupi, and Hoehn 1999). This assumption is relaxed in the nested logit because the random components (captured in the error term of the model) are correlated within a nest (partition of a choice set) but not across nests (Louviere, Hensher and Swait 2000). This leads to creating choice sets within the model that can reflect different degrees of similarity or dissimilarity. The RUM is also theoretically consistent with utility maximization, and it provides trip share probability estimates which can be calculated from the model once estimated. These trip share probabilities can then be used to predict changes in site visitation across a number of sites in the face of one or several sites in the system being closed.

Random utility theory poses that individuals will choose the destination or recreation option, on a given decision period, that will provide them with the greatest utility given their constraints (Louviere, Hensher and Swait 2000). The utility function for an individual contains both a deterministic component (V) and a component that is unobservable to the researcher or stochastic (ε). This is represented in equation 1.

(1) $U = V + \varepsilon$

where V is the indirect utility function and can be characterized as follows:

(2) $V_i = \beta_k X_i$

For this function (2) X is a vector of k attributes associated with alternative i and β is a coefficient vector. The error terms for the nested logit specification are assumed to be generated by a generalized extreme value (GEV) distribution as proposed by McFadden (1978).

The probability of choosing a specific site is estimated from this system while taking into account all other sites in the system and, in our case we have also modeled nonparticipation in the recreation activity as a potential choice. We use a nested logit modeling approach and the Likelihood Dominance Criterion to choose a nesting structure of either a three-level nest or a two-level nest depending on visitor type (see Kling and Thomson 1996; Pollack and Wales 1991).[8]

The probability of choosing a specific site in a three-level nested-logit model is depicted in Morey (1999) as follows:

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[8] When comparing models with different nesting structures for the same data set (model A and model B), the likelihood dominance criterion chooses the model with the larger log-likelihood as long as the difference between the log-likelihoods satisfies $\chi^2_{dB-dA+1} - \chi^2_1 > 2(\ln(L_B) - \ln(L_A)) > \chi^2_{dB+1} - \chi^2_{dA+1}$ (Haab and McConnell 2002). d_A is the estimated parameters in Model A. d_B is the estimated parameters in model B, and the critical chi-square has d degrees of freedom at a given critical level. For the above test $dB \geq dA$. If the difference in log-likelihoods is large and positive, the LDC favors nesting structure B. If the difference is large and negative then the LDC favors nesting structure A.(Haab and McConnell 2002).

$$\text{(3)}\quad \text{Prob(gni)} = \frac{\exp(sV_{gni})\left[\sum_{m=1}^{Mg}\left[\sum_{j=1}^{Jgm}\exp(sV_{lmj})\right]^{(t/s)}\right]^{(1/t)-1}\left[\sum_{j=1}^{Jgm}\exp(sV_{gnj})\right]^{((t/s)-1)}}{\sum_{l=1}^{L}\left[\sum_{m=1}^{Ml}\left[\sum_{j=1}^{Jlm}\exp(sV_{gmj})\right]^{(t/s)}\right]^{1/t}}$$

where, for our model, the first nest L has two choice elements (nonparticipation or participation in snowmobiling). The second nest M has choices between groups of sites (YNP group or all other sites), and third nest J is the choice among sites either in the Yellowstone National Park group that has five sites, or in the "all other sites" group that has 43 sites. In this notation g is an element of L (participate or not participate on a given choice occasion), n is an element of M (choice among groups of sites on a given choice occasion), and i is an element of J (site choice on a given choice occasion). For this notation and our estimation, which follows Morey (1999), $s=1/(1-\sigma)$ is in McFadden's (1978) notation, or $s=1/\theta$ in Kling and Herriges (1995) where they refer to θ as the dissimilarity coefficient. The dissimilarity coefficient, θ, is an estimable parameter which measures the extent to which the standard deviations of the unobservable components differ across alternatives (Louviere, Hensher, and Swait 2000). Our scale parameter s is the inverse of θ. Essentially the s parameter allows us to measure whether alternatives are more similar within a nest or "dissimilar" to the other nests in the model.

For a two-level nested-logit a one can be placed in the above notation for *t* and the following trip share probability equation results.

$$\text{(4)}\quad \text{Prob(ni)} = \frac{\exp(s_n V_{ni})\left[\sum_{j=1}^{Jn}\exp\left(s_n V_{nj}\right)\right]^{(1/s_n)-1}}{\sum_{m=1}^{M}\left[\sum_{j=1}^{Jm}\exp\left(s_m V_{mj}\right)\right]^{1/s_m}}$$

where, for our model, M has two elements (nonparticipation or participation in snowmobiling once in the region). Dimension J has 48 sites. Following the convention discussed for the three-level nested logit $n \in M$, and $i \in J$.

It should be mentioned at this point that RUMs for recreation have traditionally been estimated using observed trip behavior or revealed preference (RP) data. However, several authors have estimated these models using data from stated choice experiments or what is called stated preference (SP) data (see Adamowicz, Louviere, and Williams 1994; Haener, Boxall and Adamowicz 2001 for examples). These types of models can also be estimated using both RP and SP data (see Louviere, Hensher and Swait 2000). The general theory and probability estimates discussed above hold regardless of data set type.

Once the random utility models are estimated, means of the appropriate variables and their corresponding parameter estimates can be substituted in the above probability equations to estimate the trip share probability for each site and nonparticipation. The number of choice occasions during which a recreational visitor could have chosen to go to sites in the region are multiplied by the trip share probabilities to get estimates of site visitation. It is important to note here that for our analysis we are interested in how site visitation may change if a site or sites are removed from the choice set. Thus, we are interested in how the potential choice occasions that could be allocated to those sites slated for closure are re-allocated. For example, a particular site targeted for closure may have a shorter season than the rest of the sites, and the appropriate measure of potential change in visits across those sites is based on the choice occasions for the shorter season. These changes in site visit estimates can then be used to drive changes in expenditures estimates and the resulting I-O model estimates of total regional income and employment.

The Input-Output Model

The standard I-O model can be represented in matrix notation as follows (Miller and Blair 1985):

(5) $Y = (I-A)\,X$

where Y is the vector of final demands, X is the vector of inputs, I is the identity matrix, and A is the matrix of technical coefficients. Solving this system for X yields the following:

(6) $X = (I-A)^{-1}\,Y$

where X becomes the vector of outputs needed to satisfy the final demand sector, and the $(I-A)^{-1}$ is the matrix of interdependence coefficients, which measure the direct and indirect levels of requirements needed from each sector to satisfy specified levels of final demand.

Linking RUM and I-O Model

Our analysis focuses on estimating the needed output vector to satisfy the estimated change in final demands resulting from site closure. This is represented by the following:

(7) $\Delta X = (I-A)^{-1}\,\Delta Y$

where change in final demands is a function of changes in visitation within the region. This is represented in equation 8.

(8) $\Delta Y = \Delta V * E$

where the change in final demands (ΔY) is estimated by the product of the change in visitation (ΔV) for the region and the appropriate vector of average expenditures per visit (E) that are impacted by recreation activity. The change in visitation becomes a function of the change in trip share probabilities and / or change in choice occasions for each visitor in the face of site closure. The change in outputs can then be used to estimate the resulting changes in income and employment for the region in the I-O model. We will compare differences in final demands, income and employment when the change in visitation is assumed to be the total current use (as might be done in a worse case scenario) versus reliance upon empirical estimates from the estimated RUMs that account for site substitution.

Case Study Area and Problem

Snowmobiling is an outdoor recreation activity that has become an important source of revenue for the Rocky Mountain region and particularly the Wyoming tourism industry. Dean Runyan Associates (2001) estimate that total spending in Wyoming for travel and tourism during 2000 was 1,678.6 million, and McManus, Coupal and Taylor (2001) estimated that snowmobiling expenditures equaled approximately 14% of those total estimated travel expenditures during the 2000-01 season.

In response to environmental issues, seven alternatives for winter use management in Yellowstone National Park (YNP), Grand Teton National Park (GTNP), and the John D. Rockefeller, Jr., Memorial Parkway (JDRMP) were documented in a final environmental impact statement (EIS) (National Park Service 2000). At the time the data for this research was gathered, the alternative designated as preferred in the EIS eliminated snowmobile travel in YNP, GTNP and the JDRMP, but it allowed snowcoach travel and other forms of winter recreation. This alternative was to start implementation in the 2001-2002 winter season (Thorne 2002). Policy changes due to changes in federal administrations coupled with a number of federal suits and resulting court decisions have created much uncertainty regarding the future of snowmobile recreation in YNP and GTNP (Hamilton 2002; Sullivan 2002; Israelsen 2003; Lipsher 2004; Black 2004; McMillion 2004; and Monoson 2004). As of early May, Secretary Gale Norton, of the Department of Interior, held a press conference and indicated the park would be open in 2004-2005 season to snowmobiling, but Norton indicated that management practices may have to be changed given the differing court decisions by federal judges (Stark 2004). Time will ultimately reveal the final policy outcome, but the question of what will happen if snowmobile access to these parks is eliminated is an important question for officials representing the National Park Service and state and local governments.

Very little is really known about how snowmobilers will respond to a ban. Will snowmobilers substitute to other sites in Wyoming, Idaho and Montana or choose a different destination altogether? How will substitution away from these unique sites affect the economies of the states surrounding YNP? We investigate the potential economic impacts of a snowmobile ban on the three state region surrounding the parks and the sensitivity of those impact estimates to substitution effects and visitor heterogeneity.

Data for Analysis

Data was gathered during the 2001-2002 snowmobile season from recreationists who snowmobiled one or more times at YNP and GTNP (see Chapter 1 and Appendix A for sampling procedures and survey design following Dillman 1978). The sampling procedure and survey instrument were designed to facilitate the estimation of random utility models. Trip information required to estimate the RUMs came from section two of the survey instrument (see Appendix A). Section two asked for specific trip information during an interval for which Yellowstone National Park was sure to be for snowmobiling, December 15, 2001 through February 28, 20002. Specifically the revealed preference (RP) question provided a table with 28 different sites from Wyoming, Idaho and Montana allowing respondents to list the number of trips and days spent at each site during the specified survey period. These original 28 sites came from past research as well as suggestions from trails managers in all three states. Respondents were asked to refer to their trip record sheet or place the trip record sheet in the survey upon returning it for this question. Moreover, respondents were asked to refer to their trip record sheet and indicate the number of days and trips they would have spent at the listed sites had YNP and GTNP not been available. This is referred to as the stated preference question (SP2). Respondents were also given the opportunity to list "other" sites for each state that they recreated at and were asked to list the name of the site. An additional 20 sites were added to the choice set as a result of this question, bringing the total sites in the choice set to 48. This format was used to allow respondents to more accurately define the relevant choice set for modeling (see Parsons and Kealy 1992; Parsons and Needleman 1992; Feather 1994; Haab and Hicks 1997; Parsons and Hauber 1998; Parsons, Plantinga and Boyle 2000). RUMs were calculated for the revealed preference and stated preference data as well as a pooled revealed and stated preference set using the expanded choice set of snowmobile sites (see Chapters 2 and 3 and Appendix C for model explanation).

Data regarding average snow depth by site for both the 2000-2001 season for all sites in the respondents' choice set, and other site attributes such as miles of groomed trail, services within five miles of the trail head, and high and low elevation along the trails for each site were recorded. The RUMs were estimated using both the survey data regarding individual trip information and the site attributes data.

The survey also asked for expenditures information on their most recent snowmobile trip to YNP. The expenditures data were broken down as to total expenditures and those spent within Wyoming, Idaho and Montana. As is customary in regional economic analyses, it is the within region expenditures data from persons residing outside the region that are used for the economic impact estimation.

Analyzing the economic impacts of potential changes in snowmobile site visitation with a snowmobile ban in YNP and GTNP means we must be able to predict changes in trips and expenditures for the region if the ban were in place. Because we want to get an accurate picture of expenditures from those outside the region of interest, all individuals from within the region (locals) and their choice occasions were deleted. The remaining portion of the sample was then used to estimate average expenditure per site by expense category on a per visitor basis. These average expenditures were then multiplied by the estimated change in visits by visitor type. The total expenditures per category were then used to estimate the potential economic impacts.

Two Distinct User Groups

Initial analyses using descriptive statistics, t-tests and chi-square tests (see Chapter 1 for details and results) indicated two distinct user groups within the sample. One of the two groups was comprised of snowmobilers who visited multiple snowmobile sites during a single trip to the region (WY, ID, MT) surrounding YNP (labeled "multiple destination" visitor). This group comprised 40% of the sample. The other group could be categorized as people taking multiple snowmobile trips to a single site per trip, i.e., a single purpose and destination visitor (labeled "single destination" visitor). After controlling for item nonresponse in the questionnaire for model estimation there were 254 individuals in the "multiple destination" group representing 1,075 site visits taken and 328 individuals in the "single destination" group which had taken 1,744 trips to the sites in the three state region surrounding and including YNP and GTNP.

Each of these groups, "single destination" or "multiple destination," was modeled separately to better address their unique attributes (see Chapters 2 and 3 for more detail regarding model estimation for these group types). Individuals in the "single destination" group essentially took a trip from their home to a site, recreated and went back home again on a given choice occasion. This "single purpose and destination" behavior is easier to model because the cost of a trip can be easily assigned to the appropriate site. Individuals in the "multiple destination" group came from a longer distance away from home, stayed in the region for an extended period, visited multiple snowmobile recreation destinations and then returned home. Analyzing recreation activity of individuals in this group is more difficult because there is a joint travel cost problem, i.e., how to assign trip cost to the bundle of sites visited is not obvious. An analytical approach for this group is described in chapter 3. Often individuals of the "multiple destination" type are dropped from policy analyses because of the joint travel cost problem. We will investigate the sensitivity of economic impact estimates to taking into account the potential substitution effects and heterogeneity of the visitors snowmobiling at YNP and GTNP as compared to just assuming all visitors were to act as the "single destination" group and all snowmobile visits to the parks were lost, i.e., what would the conclusions be if all snowmobile visits to the parks were lost and they were assumed to be of the "single destination" type.

According to the National Park Service Public Use Statistics (2004) website, the average number of snowmobile visitors to YNP during the seasons for 1992 through 2001 was 79,646. During this same period GTNP averaged 3,573 snowmobile visitors per year, making the combined average total visitation 83,219 for the two parks during the 1992 to 2001 period. The parks normally open around mid-December and close in early March depending on availability of snow. Thus, it was assumed that on average there were approximately 80 days per season in which the parks were open to snowmobile recreation. These averages were used to smooth out potential fluctuations due to snow or weather conditions per season, and the years after 2001 were deleted from the average given the potential for visitor fluctuations due to policy uncertainty. The number of choice occasions for the "single destination" group was equal to the number of visitors multiplied by 80 choice occasions per season. Descriptive statistics indicate the average number of choice occasions which "multiple destination" visitors faced when they snowmobiled in the region was 6.74. The decision for these respondents to come to the region was assumed to be exogenous to our model, so we are only modeling these visitors as, if they have come to the region, and what their probability of choosing a site is once here.

Model Estimation and Statistical Results

As with any econometric model, specification of and estimation procedure for the RUM can affect model performance. Pendleton and Mendelsohn (2000) conclude that functional form in the RUM is important (linear versus quadratic in this case). Kling and Thomson (1996) look at different specifications, estimators and nesting structures regarding welfare estimations for nested logit models of saltwater angling. The authors' results indicate that welfare estimates are sensitive to specification and nesting structure. They also conclude that the likelihood dominance criterion (LDC) by Pollack and Wales (1991) is a useful tool for model selection regarding nesting structure. Kling and Thomson (1996) and Morey (1999) suggest that Full Information Maximum Likelihood (FIML) estimation has several advantages over sequential estimation of each nest. Thus quadratic terms for cost variables and the LDC were investigated to properly specify functional form of the models. All models were estimated using FIML in Gauss.

Attribute variables and functional form were chosen based on theory, apriori expectations and goodness of fit criteria for the revealed preference model. The pooled (RP-SP2) and stated preference models were then specified in the same manner for consistency. The pooled models (RP-SP2) were estimated using scale adjusted data sets where the RP and SP data were concatenated. The SP data matrices in these concatenated sets were then multiplied by the relative scale factor coming from the estimation of the separate RP and SP models and their corresponding scale parameters (see Louviere, Hensher and Swait 2000; Haener, Boxall and Adamowicz 2001). This procedure normalizes the error variance of the SP data to that of the RP data.

Single Destination Visitor Model

The single destination visitor random utility model is designed to capture the decision to participate or not in snowmobiling and the resulting site choice in either a group of sites including YNP or the group of sites categorized as all other sites not grouped with YNP in the three-level nested logit model. Figure 5.1 characterizes the decision tree representing the model.

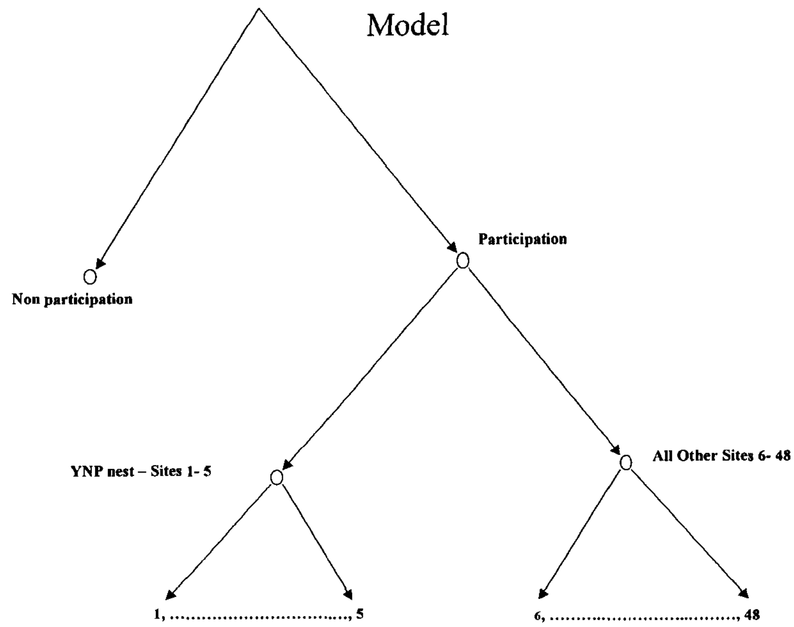

Figure 5.1. Depiction of three nested-logit model for Single Destination Visitors.

Variables in the indirect utility equations for each site include a travel cost variable (TC1) based on individual costs such as lodging, gas minus snowmobile gas, trip repairs and airfare if traveled by air. These expenses were summed and divided by roundtrip YNP distance to get rate/mile. This rate was then multiplied by roundtrip site distance. Travel time to the site was also included as a separate variable (Stehr). This variable was based on driving time estimated in PC-Miler or adjusted by travel time by air if the respondent indicated mode of travel to YNP included air travel. The remainder of the variables include site specific attributes such as length of trail (Stelng), an interaction between length of trail and trail grooming (Stetlgm), a binary variable indicating if 50% or more of the trail is groomed (Stegrm), a binary variable indicating if services were either on the trail or within five miles of the trailhead (Stesrv), the difference between the high and low point in elevation on the trail (Steeldf), and the average snowpack from snotel sites on the trail system for January and February of 2002 (Sn02ste). The dependent variable for each site equation is the respondent's trips taken to that site for their choice occasions between December 15, 2001 and February 28, 2002.

The equation for nonparticipation includes a binary variable for whether the respondent belongs to a snowmobile club (Club), a constant, a variable for the respondent's annual investment in snowmobile equipment (Snoinvst), binary variables on whether respondents snowmobiled on weekend days (Weeknd) or week days (Weekd) with the base being snowmobiling only on holidays. The number of choice occasions for individuals in this segment of the data is based on the number of days available to snowmobile during the specified dates in the trip record sheet. Nonparticipation was estimated as number of choice occasions minus total trips taken according to the trip record sheet or the revealed preference table in the survey. A variable based on education level of the respondent is included as well (Educ). The final variable included in the nonparticipation equation is based on the respondent's number of years of snowmobiling experience (yrssnow).

Model results for the single destination segment are reported in Table 5.1. Overall, the models are statistically significant in explaining site choice allocation. The cost (TC1) and travel time (Stehr) variables are negative and significant which is consistent with demand theory. The pooled model performs as expected with generally improved significance of parameter estimates due to reduced standard errors. All the

Table 5.1 Results for RP, RP-SP2 and SP2 Models for Single Destination Visitors (N=328).

Variable	RP (N=328)	RP-SP2 (N=656)	SP2 (N=328)
TC1	-0.0139	-0.0160	-0.1108
	(0.0021)	(0.0006)	(0.0000)
$TC1^2$	0.0001	0.0001	0.0007
	(0.0422)	(0.0119)	(0.0000)
Stehr	-0.3445	-0.3443	-0.7094
	(0.0000)	(0.0000)	(0.0000)
Stelng	-0.0125	-0.0126	-0.0004
	(0.0000)	(0.0000)	(0.9095)
Stetlgm	0.0114	0.0115	-0.0059
	(0.0000)	(0.0000)	(0.0740)
Stegrm	-0.0650	-0.0659	0.1928
	(0.0165)	(0.0169)	(0.0000)
Stesrv	0.0812	0.0824	0.1791
	(0.0000)	(0.0000)	(0.0000)
Steeldf	0.0617	0.0623	0.0390
	(0.0000)	(0.0000)	(0.0000)
Sn02ste	-0.0005	-0.0005	0.0020
	(0.0376)	(0.0388)	(0.0000)
Club	-0.3057	-0.3073	-0.5353
	(0.0000)	(0.0000)	(0.0000)
Constant	6.8406	6.8598	4.5695
	(0.0000)	(0.0000)	(0.0000)
Snoinvst	-0.0644	-0.0644	-0.0473
	(0.0000)	(0.0000)	(0.0000)
Weeknd	-0.4117	-0.4074	-0.3367
	(0.0000)	(0.0000)	(0.0001)
Weekd	-0.6523	-0.6544	-0.6907
	(0.0000)	(0.0000)	(0.0000)
Educ	0.0251	0.0251	0.0259
	(0.0753)	(0.0756)	(0.1273)
Yrssnow	-0.0229	-0.0229	-0.0211
	(0.0000)	(0.0000)	(0.0000)
s	7.0167	6.9276	4.3974
	(0.0000)	(0.0000)	(0.0000)
t	0.2384	0.2365	1.9551
	(0.0332)	(0.0321)	(0.0000)
McFaddens R^2	0.1878	0.3633	0.2293
LL	-10616.7368	-10615.064	-7463.4760
LL – Constant	-13071.5872	-16673.224	-9684.0360
Model χ^2	4909.7008	12116.320	4441.1200
Critical $\chi^2_{\alpha=0.05}$	27.587	27.587	27.587

* Probabilities reported in parentheses for asymptotic t-statistics.

signs on the variables are consistent across the three models with the exception of Stegrm and Stetlgm. This suggests potential differences in the underlying site choices across the revealed and stated preference data. Following Louiviere, Hensher and Swait (2000), a test statistic is estimated to test the null hypothesis of preference homogeneity across the revealed and stated preference data.[9] The result indicates we reject the null hypothesis of preference homogeneity. Haener, Boxall and Adamowicz (2001) have similar results but find the pooled model predicts out of sample trips well.

Multiple Destination Visitor Model

The multiple destination visitors also are modeled in a RUM framework. Unfortunately, questions specific to decisions about coming to the region or not were not included in the survey. The decision to come to the region is treated as exogenous in this model. Thus, we model the decision to participate or not in snowmobiling once in the region, and subsequently the site choice decision is modeled if the visitor chooses to snowmobile. Figure 5.2 diagrammatically depicts our model for this visitor type. It was hypothesized that sites immediately surrounding YNP and GTNP could comprise a separate nest in the model as was the case for the single destination segment. The three-level specification would not converge after trying a number of start values indicating the two-level nested-logit was the appropriate specification for the multiple destination segment model, however.

Variables in this model were much the same as those used in the single destination model. The indirect utility equations for each site included a site cost variable

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[9] The test for preference homogeneity involves estimating the pooled RP-SP model and comparing that log-likelihood to the sum of the log-likelihoods of the individual RP and SP models. Specifically, the test statistic is estimated by $-2[(L^{RP} + L^{SP}) - L^{joint}]$ (Louviere, Hensher and Swait 2000).

(SC2). This cost variable had two components. The first component included a portion of the long distance trip costs to come to the region associated with a particular site based on roundtrip travel and recreation time. The second component was the variable cost associated with traveling to the site from the base camp destination within the region (see Chapter 3 for more in-depth discussion of this variable). The variable cost to get to the site was based on roundtrip distance to the site from the base camp destination multiplied by a standard mileage rate of $0.2185/mile.[10] These two components (portion of long distance trip cost and variable cost) were summed to estimate site cost for each individual to each of the 48 sites in the choice set.

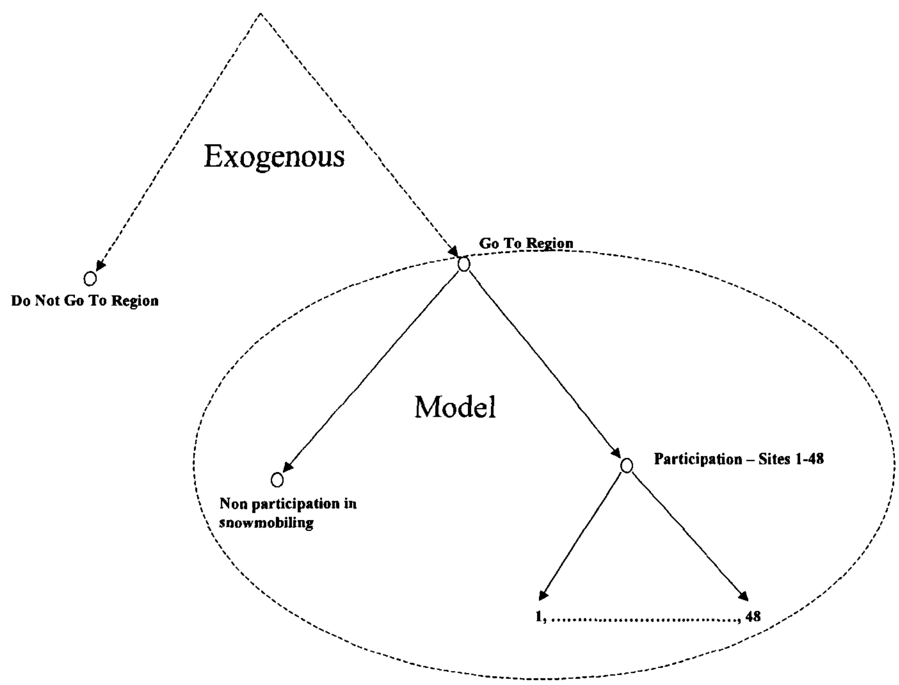

Figure 5.2. Depiction of two-level nested-logit model for Multiple Destination Visitors.

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[10] This rate was based on the assumption of a six-cylinder SUV capable of towing a trailer with one or two snowmobiles and using a AAA estimate for operating such a vehicle in 2001 dollars.

The value of travel time to the site was not included in site cost or as a separate variable to avoid potential collinearity or simultaneity problems given our site cost variable. The remainder of the variables included in the indirect utility functions for each site beside SC were the same as the single destination model with the exception of a binary variable included to capture the potential unique amenities of YNP and GTNP as compared to the other sites (Steamn) where YNP and GTNP were coded as 1 and other sites were not. This variable did not improve model specification for the single destination segment and was not used in that model.

The equation for nonparticipation includes a constant, education level (Educ) and snowmobiling experience (yrssnow). The number of choice occasions for individuals in this segment of the data is based on the number of days available to snowmobile, i.e., number of days in the region during the specified dates in the trip record sheet, on their single trip to the region. Nonparticipation in snowmobiling was estimated as number of choice occasions minus total trips or site visits taken according to the trip record sheet.

Model results for the multiple destination segment are reported in Table 5.2. The models are statistically significant in explaining site choice allocation. The cost (SC2Ste) variable is negative and significant which is consistent with demand theory. As was the case with the single destination segment, the pooled model has generally improved significance of parameter estimates. The sign on the Steeldf variable is not consistent across the models, and goes from being positive and significant in the RP and RP-SP2 models to negative and insignificant. Overall, the majority of the parameter estimates in the SP2 model are not significant at the alpha equal 0.05 level, but they are significant at the alpha equal 0.10 level. This is likely due to the greatly reduced number of trips indicated if site closure occurs for this visitor segment. These results also suggest potential differences in site choice preferences across the RP and SP2 models resulting from the data. The test statistic indicates we reject the null hypothesis of preference homogeneity across the revealed and stated preferences for this visitor type as well.

Table 5.2. Results for RP, RP-SP2 and SP2 Models for Multiple Destination Visitors.

Variable	RP (N=254)	RP-SP2 (N=508)	SP2 (N=254)
SC2Ste	-0.1288	-0.1320	-0.1521
	(0.0055)	(0.0035)	(0.0572)
$SC2Ste^2$	0.0043	0.0045	0.0044
	(0.0058)	(0.0037)	(0.0724)
Stelng	0.0034	0.0036	0.0201
	(0.0664)	(0.0628)	(0.0784)
Stetlgm	-0.0068	-0.0073	-0.0315
	(0.0165)	(0.0124)	(0.0717)
Stegrm	0.0677	0.0759	0.1929
	(0.0303)	(0.0228)	(0.0917)
Stesrv	0.0939	0.1011	0.3218
	(0.0093)	(0.0064)	(0.0671)
Steeldf	0.0061	0.0058	-0.0687
	(0.0882)	(0.1033)	(0.0707)
Steamn	0.1946	0.2065	------
	(0.0062)	(0.0004)	------
Sn02ste	0.0027	0.0029	0.0039
	(0.0071)	(0.0047)	(0.0724)
Constant	0.4587	0.4752	1.2727
	(0.0362)	(0.0312)	(0.0121)
Educ	-0.0775	-0.0703	-0.1313
	(0.0144)	(0.0243)	(0.0485)
Yrssnow	-0.0150	-0.0158	-0.0289
	(0.0004)	(0.0002)	(0.0003)
s	11.5906	10.7067	6.3686
	(0.0058)	(0.0037)	(0.0606)
McFaddens R^2	0.2533	0.4046	0.2212
LL	-3953.3830	-4010.2942	-1462.1256
LL – Constant	-5294.5030	-6735.7244	-1877.4435
Model χ^2	2682.2400	5450.8603	830.6359
Critical $\chi^2_{\alpha=0.05}$	21.026	21.026	19.675

* Probabilities reported in parentheses for asymptotic t-statistics.

I-O Model

IMPLAN is a commonly used I-O modeling system (Weiler et al. 2003). Even though IMPLAN may overstate multiplier effects that might occur in rural economies, it provides more accurate estimates than using Department of Commerce RIMS multipliers or the National Park Service Money Generation Model (Radtke, Detering and Brokken 1985; Johnson, Obermiller and Radtke 1988; Loomis and Walsh 1997). IMPLAN was chosen due to its flexibility, and its ability to provide relatively accurate and consistent estimates across our scenarios without incurring the time and expense of having to gather original regional data and construct our own I-O model.

Several measures were taken to improve the accuracy of the impact estimates coming from IMPLAN. First, Bureau of Economic Analysis (BEA) data for relevant sectors represented by expenditure category were examined regarding labor and income and compared to estimates from IMPLAN for the region of analysis. All estimates of labor and income for the region of interest were within two percent of the BEA data and no adjustments were made to the relevant IMPLAN sectors. Second, regional purchase coefficients (RPC) were examined, and the lodging sector RPC was changed from 0.8 to 0.10. The regional purchase coefficient represents how much of each commodity purchasing industries and institutions buy from regional or local sources (Minnesota IMPLAN Group 1997b). In a tourist-based economy, most lodging is consumed by out of region visitors rather than local households. Margins for expenditures in retail based sectors were adjusted to the household level. "Margins represent the difference between producer and purchaser prices. Margining assigns direct expenditures to the correct I-O sector multipliers. It splits a purchaser price into the appropriate producer values, each value impacting a specific industry (p. 89, Minnesota IMPLAN Group 1997b)." These adjustments were made prior to impact estimation for each of the scenarios.

Results of Economic Impacts Analyses

Table 5.3 points to the potential for visitor heterogeneity to affect impact estimates. The multiple destination segment spent slightly more money while in the region, but they visited more sites and had more people on average in their party than the single destination segment. Thus, the potential loss in expenditures *per visitor and per site* is less for this group than the single destination group. Also, it important to remember that if the multiple destination visitor chooses not to come to the region because of closure, all of their site visits are lost. Thus, assuming no heterogeneity could potentially affect expenditures and impact estimates. It is also interesting to note that

Table 5.3. Means Trip Expenditures (Total and Within Region) for "Single Destination" versus "Multiple Destination" Non-local Respondents.

Variable	Mean	Mean
	Multiple Destination N=246	Single Destination N=248
Expenditures Most Recent Trip – Total	$2,185.46	$1,954.73
Expenditures Most Recent Trip – WY, MT & ID	$1,768.27	$1,709.70
Number of People Represented by Trip Expenditures	3.34	2.94
Number of Sites Visited Within Region During Season	4.38	2.85
Average Expenditure Within Region Per Visitor Per Site Visited Most Recent Trip	$120.87	$581.53
Proportion of Non-local Respondents	49.8%	50.2%

when the "locals" (people with home zip codes from within the region) were deleted from the sample to estimate the impacts, the proportion of multiple destination versus single destination visitors was nearly equal. This is in comparison to the overall sample, which indicated the single destination visitors comprised 60% of the sample as compared to 40% of the sample being made up of the multiple destination visitors. This indicates the majority of the "locals" deleted from the sample for the regional impact analysis were of the "single destination" type. This change in proportion has implications for impact estimates for the current region and other potential regions of interest that could be analyzed. For example, if one were to analyze the counties immediately surrounding YNP the proportion of visitors would likely be closer to the total sample gathered. All of these results point toward the fact that visitor heterogeneity is likely an important factor in economic impact estimation.

Results in Table 5.4 provide a benchmark estimate from which to compare impact estimates that address substitution and visitor heterogeneity. We analyzed our sample to determine the number of respondents that had home zip codes outside of Wyoming, Idaho and Montana by visitor type. Those respondents living outside the region were deleted from the sample because their spending does not reflect new money injected into this region. It was estimated that 74.28 percent of respondents were from zip codes outside the region. As mentioned previously, the remaining respondents were nearly equal proportionally between the multiple and single destination types. Mean within region expenditures per person by expense category were estimated. It was assumed that of the average 83,219 visitors to YNP and GTNP, 74.28 percent were from outside the region, and their expenditures represented money flows into the region. The calculated expenditures from these visitors were then entered into IMPLAN, and the impacts were estimated. The estimated scenario in Table 5.4 then is a gross estimate of the potential impacts to the region if substitution and heterogeneity of visitors are ignored. Taking this simplified approach to estimating the

Table 5.4. Economic Impacts of Snowmobile Visitation to YNP and GTNP: Potential Impact of Site Closure Assuming No Substitution or Visitor Heterogeneity.

Description	YNP & GTNP
Average Annual Snowmobile Visitation (1992-2001)*	83,219
Estimated Visitation from Outside Region	61,820
Expenditures**	
Grocery/Liquor	$1,130,533
Gasoline	$2,227,094
Retail Items	$2,570,559
Other Purchases	$1,557,544
Snowmobile Rental	$5,506,112
Guided Tour Package	$1,248,840
Other Recreation	$1,842,547
Lodging	$11,198,474
Eating & Drinking	$6,333,866
Oil/Trip Repairs/Maintenance	$734,135
Total	$34,349,704
Economic Impacts	
Labor (# of jobs) – Total	945.5
Income – Total	$17,621,887

* Based on National Park Service Public Use Statistics for snowmobile visitation assuming a season being for December – March, for years 1992 – 2001.
** Rounded to Nearest Dollar.

potential impacts if YNP and GTNP were closed to snowmobiling indicates the loss in expenditures could be over $34 million dollars and result in a loss of 945.5 full time jobs and $17.6 million dollars in labor income. This estimate does not take into account the potential for at least some of the 61,820 visitors to choose other sites within the region to snowmobile. The assumption of no substitution seems tenuous at best.

Results in Table 5.5 represent scenarios, which allow for substitution to sites within the region, but they ignore visitor heterogeneity. Trip share probabilities used in the impact analyses for these scenarios come from the RUMs for the "single destination" visitors only. The number of visitors from outside the region was multiplied by 80 choice occasions per person. The estimated number of choice occasions was then multiplied by the change in trip share probabilities across sites after simulating site closure. For the RP, and RP-SP2 models this was simulated by raising price to YNP and GTNP essentially to infinity and forcing trip share probabilities for these sites to go to zero. The SP2 model probabilities are based on the assumption of YNP and GTNP no longer being in the choice set. The change in trips for this scenario is based on the difference between the SP2 estimates and the RP estimates.

Table 5.5. Estimated Economic Impacts of YNP and GTNP Site Closure Assuming Substitution But Not Visitor Heterogeneity (assuming all trips are from single destination visitors).

Description	RP	RP-SP2	SP2
Estimated Change In Visitation from Outside Region	-22,812	-37,815	-416,069
Expenditures*			
Grocery/Liquor	$417,174	$691,535	$7,608,887
Gasoline	$821,812	$1,362,290	$14,989,134
Retail Items	$948,553	$1,572,384	$17,300,779
Other Purchases	$574,744	$952,733	$10,482,823
Snowmobile Rental	$2,031,791	$3,368,032	$37,058,096
Guided Tour Package	$460,830	$763,902	$8,405,135
Other Recreation	$679,912	$1,127,067	$12,400,996
Lodging	$4,132,310	$6,849,991	$75,369,717
Eating & Drinking	$2,337,238	$3,874,360	$42,629,173
Oil/Trip Repairs/Maintenance	$270,901	$449,063	$4,940,991
Total	$12,675,263	$21,011,358	$231,185,730
Economic Impacts			
Labor (# of jobs) – Total	348.9	578.4	6,363.8
Income – Total	$6,502,591	$10,779,125	$118,601,570

* Rounded to Nearest Dollar.

Estimated change in visitation is much less for the revealed preference (RP) and pooled revealed and stated preference (RP-SP2) models (Table 5.5) than the potential

61,820 visitation loss estimate from Table 5.4. The resulting estimates of lost expenditures are also much less. The RP model assuming no heterogeneity generates an estimated loss of $6.5 million in income and 348.9 full time jobs. These estimates are 63 percent less than the no substitution scenario in Table 5.4. Impact estimates from the pooled RP-SP2 model are nearly 39 percent less than the no substitution scenario given an estimated loss in jobs of 578.4 and income of nearly $10.8 million. Initially this would suggest that not accounting for substitution suggests an overestimation of the potential impacts of site closure. However, the estimates coming from the SP2 model indicates that not only would visitation to the YNP and GTNP sites be lost, but once these sites are gone from the choice set many snowmobilers would substitute away from snowmobile sites in the region entirely. The estimated visitation loss from the SP2 model is 573 percent higher than the no substitution scenario, and the estimated impacts are nearly six times as large with estimated losses of 6,363.8 jobs and $118.6 million in income. This would suggest the no substitution scenario underestimates the potential impacts of site closure because it does not take into account the potential for losing additional snowmobile visitation as recreationists substitute away from sites in the region altogether. Regardless of whether the no substitution scenario under or overestimates the potential impacts, the conclusion from the results in Table 5.5 is that substitution effects are potentially very important when conducting regional economic analyses.

The results in Table 5.6 estimate the economic impacts of site closure including both substitution effects and visitor heterogeneity. Trip estimates for each of the models are estimated in essentially the same way as for the scenarios reported in Table 5.5 with the exception that trip share probabilities are now based on models for both visitor types.

Moreover, the choice occasions estimated for each visitor segment is based on visitor type proportions as reported in Table 5.3. Recall from earlier discussion (both here and Chapter 3) that the decision to come to the region is exogenous in the "multiple destination" model. Thus, mean choice occasions for the "multiple destination" pooled (RP-SP2) and stated preference (SP2) models after site closure is based on the stated preference data for these respondents. Choice occasions prior to site closure is assumed to be the same for the multiple destination visitors as in the revealed preference model.

Table 5.6. Estimated Economic Impacts of YNP and GTNP Site Closure Assuming Substitution And Visitor Heterogeneity.

Description	RP	RP-SP2	SP2
Estimated Change In Visitation from Outside Region			
Single Destination Visitors	-11,452	-18,984	-208,877
Multiple Destination Visitors	-1,342	-72,340	-69,767
Total Change in Visitors	-12,794	-91,324	-278,644
Expenditures*			
Grocery/Liquor	$201,938	$740,143	$3,945,054
Gasoline	$354,293	$1,457,299	$7,023,994
Retail Items	$539,281	$1,684,629	$10,346,780
Other Purchases	$455,925	$1,023,522	$8,488,641
Snowmobile Rental	$979,448	$3,604,949	$19,144,175
Guided Tour Package	$381,529	$821,004	$7,080,559
Other Recreation	$516,947	$1,211,286	$9,657,571
Lodging	$2,266,592	$7,337,689	$43,653,521
Eating & Drinking	$1,100,037	$4,146,322	$21,564,198
Oil/Trip Repairs/Maintenance	$76,552	$479,497	$1,624,003
Total	$6,872,544	$22,506,342	$132,528,498
Economic Impacts			
Labor (# of jobs) – Total	188.8	619.5	3,642.4
Income – Total	$3,525,170	$11,546,157	$67,979,747

* Rounded to Nearest Dollar.

The results from Tables 5.4, 5.5 and 5.6 are summarized in Table 5.7 for ease of comparison. Comparing the results in Table 5.6 with those reported in Tables 5.5 (substitution without visitor heterogeneity) and 5.4 (no substitution or visitor heterogeneity) provides some interesting contrasts (Table 5.7). First, the economic impact results compared to the no substitution scenario show generally the same trend as the substitution without heterogeneity scenarios. The RP and RP-SP2 results in Table 5.6 estimate the economic impacts to be less and the SP2 to be much higher than the no substitution results. The estimated job and income losses for the revealed preference model are 188.8 and $3.5 million, respectively. The pooled model scenario including visitor heterogeneity estimates 619.5 jobs and $11.5 million is lost. These estimates are

Table 5.7. Summary of Estimated Impacts for Park Closures Across Scenarios.*

Impact	Park Closure Only (Table 5.4)	Assume All Visitors Are Single Destination Visitors (SD) (Table 5.5)			Assume Single (SD) and Multiple Destination (MD) Visitors (Table 5.6)		
		RP	RP-SP2	SP2	RP	RP-SP2	SP2
Visits To Sites in Region	-61,820	-22,812	-37,815	-416,069	-12,794	-91,324	-278,644
SD		-22,812	-37,815	-416,069	-11,452	-18,984	-208,877
MD		0	0	0	-1,342	-72,340	-69,767
Exp.							
Total	$34.4 M	$12.7M	$21.0 M	$231.2 M	$6.9 M	$22.5 M	$132.5 M
SD		$12.7M	$21.0 M	$231.2 M	$6.7M	$11.0 M	$121.5 M
MD		$0	$0	$0	$212K	$11.5 M	$11.0 M
Jobs							
Total	945.5	348.9	578.4	6,363.8	188.8	619.5	3,642.4
SD		348.9	578.4	6,363.8	183.0	303.3	3,337.4
MD		0	0	0	5.8	316.2	305.0
Income							
Total	$17.6 M	$6.5 M	$10.8 M	$118.6 M	$3.5 M	$11.5 M	$68.0 M
SD		$6.5 M	$10.8 M	$118.6 M	$3.4 M	$5.6 M	$62.3 M
MD		$0	$0	$0	$109K	$5.9 M	$5.7 M

* Expenditures and income rounded to nearest decimal.

less as compared to 945.5 jobs and $17.6 million in the no substitution scenario. An interesting result, however, is that estimated visitation loss is much higher, by nearly 49 percent, in the RP-SP2 scenario in Table 5.6 as compared to the no substitution scenario in Table 5.4. Yet, the estimated economic impacts are less. This is related to the nature of the estimated visitation loss and proportionally much more loss estimated from the "multiple destination visitors", nearly 79 percent of estimated loss in visits, as compared to the "single destination" visitors. Given the mean per person expenditure for each site visited is much less for the "multiple destination" visitors (Table 5.3) this result makes some intuitive sense. As can be seen in Table 5.7 when comparing the single destination (SD) versus the multiple destination (MD) visitors, the multiple destination visitors generally result in less impact per site visit that the single destination visitors. Again, the SP2 results estimate the change in visitation to the region to be much more overall than the no substitution scenario indicating the loss in visitation to other substitute sites in addition to the parks could cause the no substitution scenario to underestimate the impacts of site closure.

Comparison of the results in Tables 5.5 and 5.6 suggest that the visitor type and their resulting change in visitation and expenditures can result in potentially different impact estimates as well (Table 5.7). The revealed preference models and their underlying assumptions regarding choice occasions result in very different visitation estimates. The no heterogeneity scenario predicts nearly twice as many visits are lost and these lost visits are of the "single destination" type. The resulting impact estimates from the visitor heterogeneity scenario (Table 5.6) are nearly 46 percent less than the no heterogeneity scenario (Table 5.5). When comparing the pooled models (RP-SP2), the visitor heterogeneity scenario predicts many more lost site visits in the region, 91,324 versus 37,815, but the majority of those lost site visits come from the "multiple destination" visitors as compared to the "single destination" visitors. Even though the predicted loss in site visits is nearly 2.4 times higher in the heterogeneity scenario the expenditures and resulting economic impact estimates are only marginally higher. The heterogeneity scenario predicts a loss of $22.5 million in expenditures, 619.5 jobs, and $11.5 million in income as compared to $21 million in expenditures, 578.4 jobs, and nearly $10.8 million in income lost in the no heterogeneity scenario. The SP2 scenario predicts total loss in visitation as 33 percent less for the visitor heterogeneity scenario compared to the no heterogeneity scenario with the visitation loss resulting largely from the "single destination" type visitors. The estimated impacts are less for the heterogeneity scenario, a loss of 3,642.4 jobs and $68 million in income, than the no heterogeneity scenario that estimates a loss of 6,363.8 jobs and $118.6 million in income. Regardless of the divergence of estimates across the models (RP, RP-SP2, and SP2), these results indicate that visitor heterogeneity can be an important factor when analyzing potential regional economic impacts of recreation site closure.

Spatial Nature of Potential Visitation Changes and Economic Impacts

The predicted changes in site visits or trips are used in a county level ARC GIS map for the three state region. Each site is represented by the zip code of the town nearest the trailhead for each site. These trips are then coupled with the county level map to give some representation of the spatial nature of the predicted change in visitation at the zip code level. While the correlation between site visitation and expenditures may

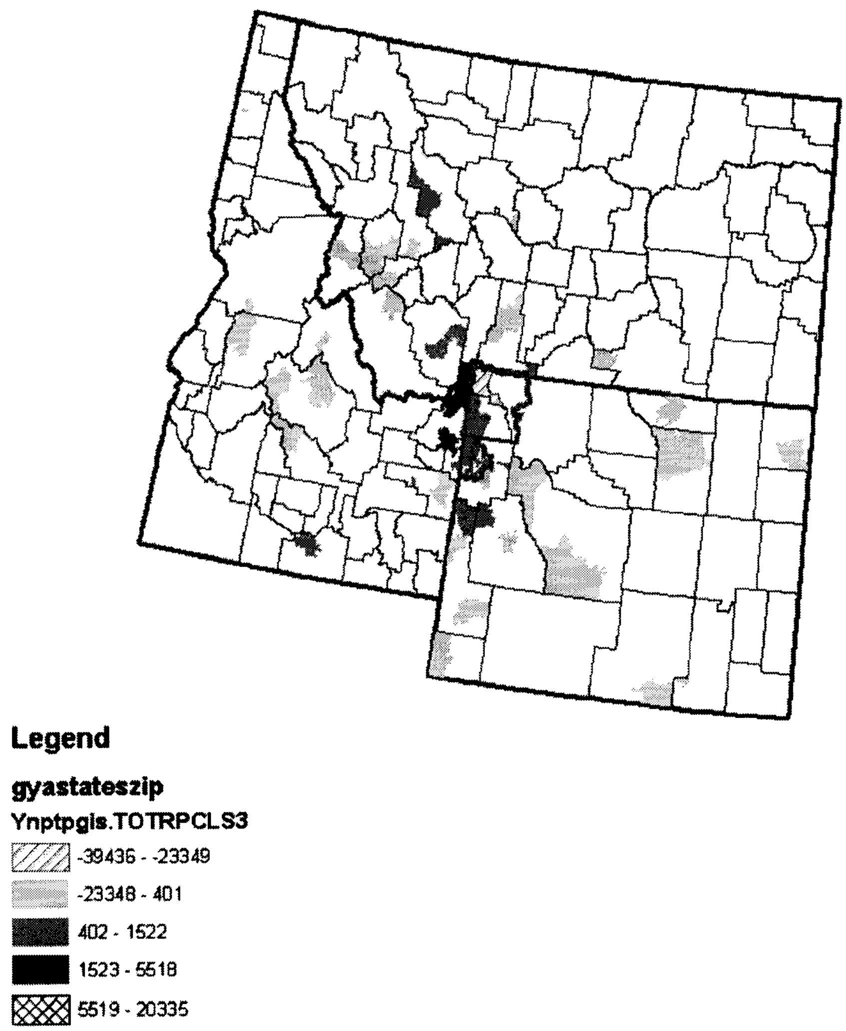

Figure 5.3. GIS Representation of Estimated Visitation Change for RP Substitution and Visitor Heterogeneity with Closing YNP & GTNP to Snowmobiles.

not be perfect, this representation may give some general idea of potential impact distributions. These GIS (geographic information systems) generated maps represent the RP (Figure 5.3), RP-SP2 (Figure 5.4) and SP2 (Figure 5.5) scenarios in Table 5.6 (substitution with heterogeneity).

Figure 5.3 presents some interesting spatial results. Generally areas of black and black cross hatch gain in site visitation while areas of light gray and gray diagonal lines indicate relatively large losses in visitation. The RP scenario indicates some areas are predicted to gain in snowmobile visitation. These areas tend to be geographically near the parks. These predictions are most likely being driven by the small proportion (10.4 percent) of loss in visitation coming from the multiple destination visitors as compared to the single destination visitors. Recall from previous discussion and the results presented in Chapter 1, that the multiple destination visitors tend to concentrate their snowmobile visits to sites closer to the parks as compared to the single destination visitors. This is also related to our assumption that these recreationists tend to behave in a "base camp" fashion making short trips from gateway communities surrounding YNP. Moreover, the RP scenario assumes the multiple destination visitors decide to come back to the region and allocate the same number of choice occasions across sites given site closure. Areas farther away from the parks tend to show more losses with Wyoming being predicted to have more areas of moderate losses to no change in visitation. These areas of loss away from the park are more likely being driven by the predictions for the single destination visitors.

Given the prediction of site visitation losses coming largely from the multiple destination visitors in the pooled (RP-SP2) models. It is not surprising that the

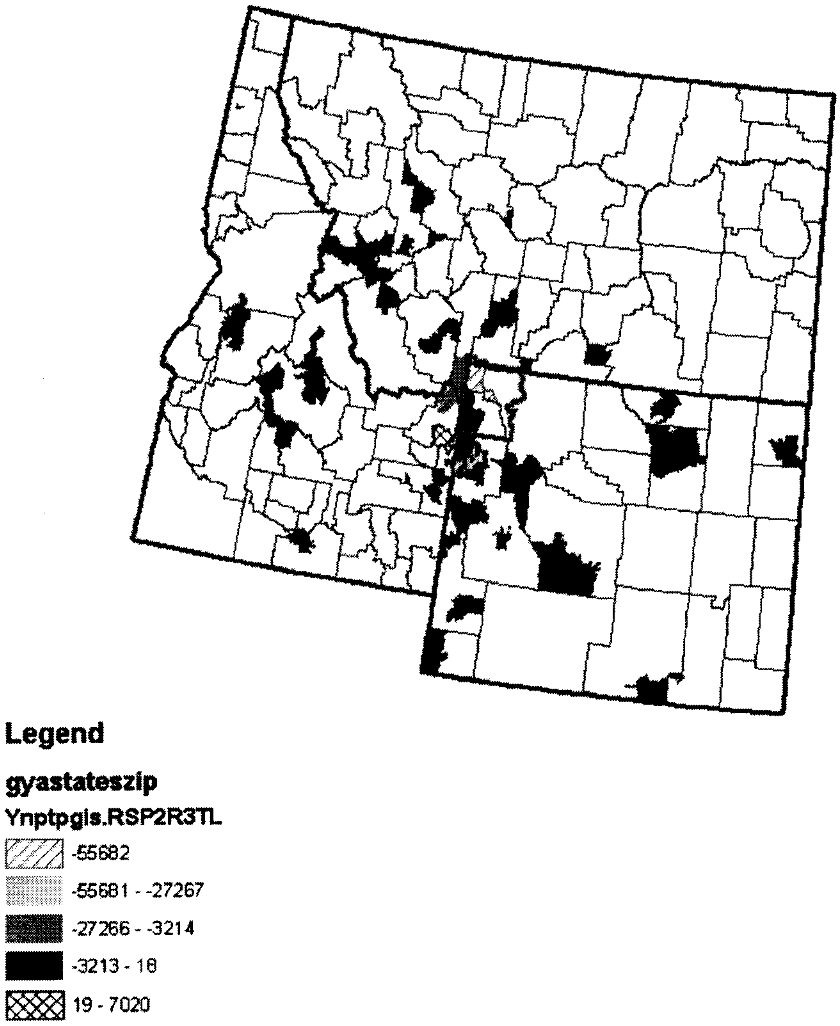

Figure 5.4. GIS Representation of Estimated Visitation Change for RP-SP Substitution and Visitor Heterogeneity.

distribution patterns look much different in Figure 5.4 as compared to Figure 5.3. Areas of heavy loss in visitation are represented by light gray diagonal to dark gray, and black areas represent moderate losses to no change. Geographically most areas away from the parks experience moderate loss to little change with heavier losses near the parks. One area near the park experiences some moderate increase in visitation. Again the multiple destination visitors comprising the largest levels of site visitation losses are likely driving this pattern.

Figure 5.5 presents some different distribution patterns as one might expect given the larger predicted losses in visitation from the SP models. Almost all shades and patterns represent areas of loss in visitation with light gray diagonal and light gray representing largest visitation losses and black and black cross hatch representing areas of least visitation loss. The interesting results from this scenario are that several areas immediately surrounding the parks are predicted to be larger losers of snowmobile visitors. Areas of least loss seem to be farther away from the park. Generally, Wyoming tends to have more predicted areas of larger losses than Montana or Idaho. Compared to the revealed preference scenario in Figure 5.3, which tends to predict some areas near the park could gain in visitation Figure 5.5 provides a stark contrast. This difference in predicted dispersion of changes in visitation is largely a function of the relative proportions of predicted visitation losses by visitor type along with the overall large predicted loss in visits. Nearly 26.4 percent of site visitation losses are predicted to come from the multiple destination visitors in the SP2 scenario compared to only 10.4 percent of lost visitation coming from this visitor type in the revealed preference scenario. As

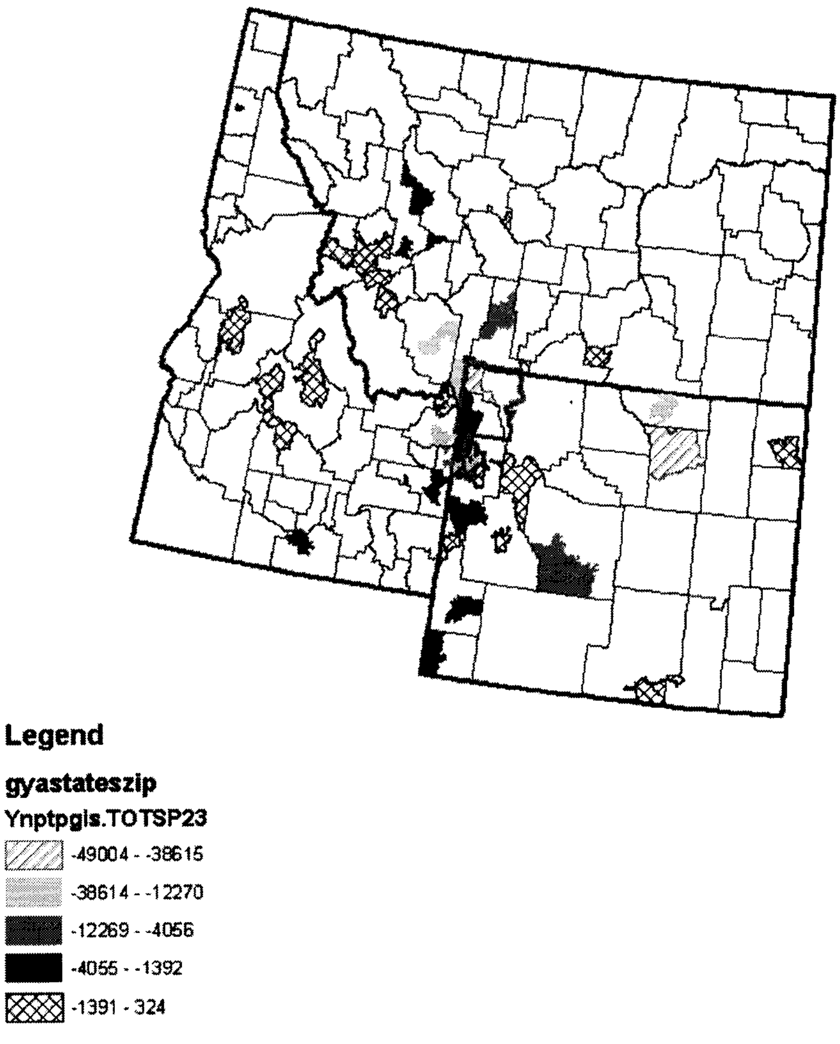

Figure 5.5. GIS Representation of Estimated Visitation Change for SP Substitution and Visitor Heterogeneity.

they tend to visit sites closer to the park, the larger predicted loss in visitation coupled with the larger proportion of loss coming from the multiple destination visitors explains much of this change in distribution across the two scenarios. These maps tend to re-enforce the earlier conclusion that substitution effects and visitor heterogeneity can potentially affect the distribution of potential changes in site visitation and economic impacts.

These spatial results in visitation would tend to suggest that the largest predicted economic impacts generally tend to be near the parks and losses likely become more geographically diffuse in the stated preference prediction as compared to the other predictions. An analysis of the concentration of economic impacts for the six county area surrounding YNP was conducted using the RUM models and the predictions in visitation for the thirteen sites within that geographic area. These results (reported in Appendix C, Tables C.5 and C.6) suggest that the majority of the economic impacts occur in the six county region in the revealed preference and pooled predictions. Even though the overall loss in visitation is small for the three state region in the revealed preference scenario, the sites gaining in visitation in those six counties is not enough to overcome the loss in visitation to the parks. The stated preference scenario shows more geographic dispersion of visitation losses in the three state region (Figure 5.5), and the percentage of total economic impact occurring in the six county region surrounding the park drops to nearly half as compared to 74 to 100 percent for the previous scenarios. This tends to re-enforce conclusions from the spatial representations of the visitation loss and the importance of substitution effects and visitor heterogeneity when conducting impact analyses.

Discussion

Many rural communities in amenity rich areas have turned toward recreation as a potential economic development strategy. Closure of even a single recreation site is often perceived to have major consequences in these areas. However, this perception is often based on models of recreation site demand used to provide trip forecasts for input-output analyses that do not provide estimates related to site substitution. Random Utility Models (RUMs) are demonstrated as a potential method to provide estimates of site substitution for regional economic analysis associated with changes in recreation sites and potentially provide a more realistic estimate of the effect of site closure.

Moreover, recreation site demand models often use travel cost as a proxy for price, and these models assume the recreation visitors come to a single destination for a single purpose. Past research indicates this assumption may be tenuous as often times recreational site visitors go to multiple destinations while on an extended trip from home. These multiple destination visitors are often dropped from recreation demand analyses because of a joint travel cost problem. The purpose of this paper has been to provide a sensitivity analysis of economic impact estimates across a number of scenarios assuming no site substitution, site substitution but not visitor heterogeneity (i.e., assuming multiple destination visitors act like single destination visitors), and site substitution coupled with visitor heterogeneity using the case of a proposed closure of Yellowstone National Park (YNP) and Grand Teton National Park (GTNP) to snowmobile recreation. Because these sites have not yet been closed RUMs using revealed and stated preference data were estimated and used to provide forecasts of changes in site visitation within the three state region surrounding the parks. These forecasts and their resulting impact estimates indicate the assumption of no substitution and no visitor heterogeneity could likely under or overestimate the potential economic impacts of recreation site closure. Moreover, when the predicted losses of visitation are represented spatially both the revealed (RP) and stated preference (SP2) scenarios suggest the potential distribution of economic impacts can be greatly affected by substitution and visitor heterogeneity. Thus, these results suggest that analysts need to consider, gather data and model for potential substitution effects and visitor heterogeneity when conducting regional economic impact analyses related to recreation site development or closure.

Perhaps the most disturbing outcome of this analysis is the broad range in estimates provided by the different models. The revealed preference (RP) model seems to very much represent a lower bound estimate of the potential economic impacts of site closure, while the stated preference estimates are nearly six times larger. Statistics for resort tax collections in West Yellowstone, Montana and hotel occupancy in Jackson, Wyoming during the 2003-2004 snowmobile season suggest the RP results may underestimate loss in visitation as compared to the pooled and stated preference models (see Chapter 2, Table 2.5). The pooled revealed preference and stated preference model (RP-SP2) is in the middle of the two, but these models tend to provide visitation forecasts and resulting impact estimates closer to the revealed estimates than the stated preference estimates.

Several important issues and limitations of this analysis come to light given the broad range in the results. One limitation of this analysis is related to modeling the multiple destination visitor's decision to come to the region as exogenous. While modeling the multiple destination visitor is a likely contribution to the literature in and of itself, probability estimates from this RUM are limited to predicting site allocation once the multiple destination visitor comes to the region. Thus, the only way to capture the potential change in this visitor type's probability of coming to the region is through the use of the stated preference data. This analysis was conducted ex-ante of site closure, and the use of stated preference (SP) data was very much warranted. Past research indicates stated preference data related to site visitation can be reliable, improve parameter estimates and improve trip predictions for recreation demand models (Haener, Boxall and Adamowicz 2001; Adamowicz, Louiviere and Williams 2004; and, Loomis 1993). Azevedo, Herriges and Kling (2003) point out some researchers with test results pointing to inconsistencies between RP and SP data might view this as a validation that RP data are superior to SP data or vice versa. These two sites, Yellowstone National Park and Grand Teton National Park, arguably have unique amenities that make other snowmobile sites less than perfect substitutes. Given the unique amenities provided by these parks, closing these sites does not represent a marginal change, and hence the models using SP data are more likely to better predict these large changes than an RP model. If in fact, the SP data are more reflective of the potential outcome if closure occurred, policy makers and community planners can at least be armed with the knowledge of potential best and worst outcomes from an analysis which uses both RP and SP data.

The nagging question of which estimate is right, will remain unanswered until an ex-post analysis of site closure can be conducted. Site closure could occur well into the future, if ever, as the policy debate and court decisions continue regarding snowmobile recreation in Yellowstone and Grand Teton National Parks. If an ex-post regional analysis of site closure is conducted, the above results indicate the final economic impacts and their distribution will be driven by recreationists' behavior as it relates to substitution and heterogeneity.

It should also be noted that this analysis has focused only on the potential impacts associated with changes in snowmobile activity. While we have tried to focus on the potential for substitution effects within this recreational activity and the defined choice set, we have not attempted to estimate potential changes in demand for recreation in YNP or GTNP from other recreators such as cross-country skiers or snow coach visitors. The potential for substitution across recreational activities or increased demand for recreation in YNP or GTNP absent of snowmobiles is beyond the scope of these results. Additional research that addresses such issues would contribute to a more complete policy analysis.

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Appendix A:

STUDY DESIGN, SURVEY TIMELINE, SAMPLING PROTOCOL, LETTERS AND SURVEY INSTRUMENT

Table A.1 Intercept Sampling Dates, Corresponding Locations, Contacts and Refusal Rate for 2001-2002 Season.

Date	Location*	Contacts	Refusals	Refusal %
Fri. Dec. 21	West	22	1	4.54
Sat. Dec. 22	West	19	3	15.79
Fri. Dec. 28	West	54	8	14.81
Sun. Dec. 30	South	53	8	15.09
Wed. Jan. 2	West	25	2	8.00
Fri. Jan. 4	West	45	2	4.44
Sat. Jan. 5	West	23	1	4.35
Sun. Jan. 6	West	26	1	3.85
Tue. Jan. 8	South	26	2	7.69
Tue. Jan. 15	West	11	5	45.45
Thu. Jan. 17	West	17	2	11.76
Fri. Jan. 18	South	26	4	15.38
Sun. Jan. 20	South	50	6	12.00
Sat. Jan. 26	East	15	0	0
Sun. Jan. 27	East, West	67	4	5.97
Tue. Jan. 29	West	42	2	4.76
Fri. Feb. 1	West	47	3	6.38
Sat. Feb. 2	West, South	127	11	8.66
Sun. Feb. 3	South	52	2	3.85
Thu. Feb 7	West	41	1	2.44
Fri. Feb. 15	West	54	8	14.81
Sat. Feb. 16	West, South	86	12	13.95
Sun. Feb. 17	West	95	7	7.37
Thu. Feb. 21	West	48	7	14.58
Fri. Feb. 22	West	53	5	9.43
Sat. Feb. 23	West	53	4	7.55
Sun. Feb. 24	West, South	65	7	10.77
Mon. Feb. 25	South	38	2	5.26
	Total	1280	120	9.38

* For the West and South gates sampling took place in parking areas. Intercept sampling for the East gate took place at the gate itself.

Table A.2 Mail Survey Design and Timing of Activities

1) Intercept sampling to take place between December 21, 2001 through February 28, 2002.

2) Mail postcard reminder for trip diary/record to those recorded in database at that point in time. Mailing took place January 14.

3) Mail second postcard reminder for trip diary/record. Mailing took place February 8.

4) Mail out first full mailing of survey – Monday, March 4. Included in mailing: Cover letter, survey, and postage paid return envelope. Total sample: 1148.

5) Mail out postcard reminder for mail survey – Monday, March 11.

6) Mail out third and final mailing – Monday, April 1. To be included in mailing; Second cover letter, survey, and postage paid return envelope.

Data entry ongoing as received surveys through mid-May.

Table A.3 Intercept Procedures and Script

YELLOWSTONE NATIONAL PARK SURVEY VISITOR INTERCEPT PROCEDURES

The interviewer approaches the visitors:
As they are returning to their vehicle from snowmobiling the following statement:
"Hello, I am working with the University of Wyoming on a study about your visit to Yellowstone National Park today. This study has received a National Park Service research permit (show if interested), but it is not being conducted for the National Park Service."

"We would like you to take this one page snowmobile trip record with you today as you are leaving. You do not need to fill it out now. Rather take the record sheet with you and record your snowmobile trips after they occur. Later, around March 1st you will be sent a brief survey about your snowmobile trips.

"I do need you to fill out your name address on this card, so we can send you a survey or another trip record if you need one."

"However, your name/address will not be associated with your responses. Your responses are completely confidential and you will not be put on any mailing lists as a result of this survey."

If they refuse to give name and address, keep a tally by site of all refusals (we need this to compute response rate).

Hand them card on a clipboard with pen. Write the DATE on the card and LOCATION intercepted!

If they want results of survey, indicate it will be sent to them. Copy their name from the index card onto a separate sheet of paper, with note, results requested.

THEN THANK THEM for their help in the survey.

For intercepting visitors the following specifications should be used: (a) over 18 years of age; (b) alternating male/female, if possible; (c) one survey per family, alternating husband and wife if possible; (d) avoid obvious foreign visitors since our postage is only good for mailing back in the U.S.; (e) no repeat visitors, i.e., if they previously filled out a card, they are not given another one; (f) JUST ONE PERSON FROM EACH GROUP OR FAMILY.

Be polite, but firm. If they say they don't have time, repeat they do not have to fill it out now, they will be sent a survey later that they can fill out at their leisure and mail back in the stamped envelope over the next week. Say the survey won't take long to fill out.

If they say they have not visited before, say "That is okay, we are interested in all visitors, including first time visitors. All the information you need to complete the survey is included in the packet. There are not right or wrong answers."

Be polite, but firm. If they keep walking away or are insistent they do not want to fill out after you say it won't take long, etc., respect that and say, okay, enjoy the rest of your visit in Yellowstone National Park.
The NPS volunteers and NPS rangers will be watching us, so we must be professional, polite and respect the visitor's right NOT to take a survey. We don't want to force them to take one and have them throw it out. We don't want them reporting us as hassling them.

The interviewer is to keep track of refusals on-site so as to allow for calculation of the overall survey response rate each day and give us that information in written form via email or paper at the end of each day.

REPORT ANY PROBLEMS THAT DAY TO CHRIS BASTIAN OR JOHN LOOMIS.

Table A.4 Postcard Reminder – Trip Record Sheet

A short time ago you received a snowmobile trip record sheet asking you to record trips and days spent snowmobiling at Yellowstone National Park and other areas in Wyoming, Montana and Idaho.

Accurate information about your snowmobiling trips will be extremely important to the people who make winter recreation management decisions such as state trails program managers and local communities providing services to snowmobile recreationists. Please take a moment to make sure your snowmobile trip record is accurate and up to date regarding your trips thus far in the season. If you have already done so, please accept our sincere thanks.

If your trip record has been misplaced or filled up, please call me collect at (307)766-4377 or email me at: bastian@uwyo.edu, and I will mail you a new one today.

Sincerely,

Chris Bastian
Project Leader
University of Wyoming

Table A.5 Cover letter for first full mailing of survey packet

Date

Address
Address
Address

Dear {Name}:

You were mailed this survey because you were a snowmobile visitor in Yellowstone National Park who agreed to fill out a snowmobile trip record and this survey. We want your opinion regarding your snowmobile experiences this season.

Specifically, the University of Wyoming is interested in finding out about your snowmobile trips and how those trips might change if you could no longer snowmobile in Yellowstone National Park. This information will help us better understand where visitors will snowmobile if they cannot snowmobile in Yellowstone National Park each year. This type of information can be used for everything from planning for winter recreation to planning by communities who provide services to winter recreationists.

You are one of a small number visitors being asked to give their opinion on this important issue. In order that the results of the study truly represent the thoughts of people snowmobiling in Yellowstone National Park it is important that each questionnaire be completed and returned. The survey booklet contains all the information you need to complete the survey. There are no right or wrong answers! It is important to hear from each and every person, whether this is your first winter visit to Yellowstone National Park or you are a regular visitor.

A stamped return envelope has been provided to make it easy to mail your survey back to us.

Your responses are completely confidential. You will not be individually identified in our results. Once the data has been recorded and verified, the University of Wyoming Survey Research Center will destroy the printed surveys. The surveys are numbered only to allow us to keep track of which surveys have been returned. We will not use your address for any other mailings than this study.

If you have any questions, please call me at (307) 766-4377 or email me at: bastian@uwyo.edu. I will be happy to answer any questions you have.

We look forward to receiving your survey in the days ahead.

Thanks,

Chris Bastian
Project Leader
University of Wyoming

Table A.6 Postcard Reminder - Questionnaire

Last week you received a questionnaire asking about your snowmobile trips to Yellowstone National Park and other areas in Wyoming, Montana, and Idaho.

If you already completed and returned the questionnaire to us, please accept our sincere thanks. If you have not, please complete the survey and mail it back to us in the postage paid return envelope.

Your response will be very useful to the people who make winter recreation management decisions such as state trails program managers and local communities providing services to snowmobile recreationists.

If your questionnaire has been misplaced, please call me collect at (307)766 – 4377 or email me at: bastian@uwyo.edu, and I will mail you one today.

Sincerely,

Chris Bastian
Project Leader
University of Wyoming

Table A.7 Cover Letter for Second full mailing.

Date

Address
Address
Address

Dear First Name Last Name:

About three to four weeks ago you received a visitor survey package as a result of filling out an address card for our interviewer at Yellowstone National Park. While we have received surveys from others, as of today, we have not received your survey in the mail.

I am writing to you because of the importance that your questionnaire has regarding our knowledge and the management of winter recreation. For our sample to represent all the visitors to the Park, we need your completed survey. Your answers could affect how state agencies provide winter recreation and local communities prepare for any potential changes in winter recreation opportunities.

In case you have misplaced the original survey you were given, I have enclosed a replacement survey and stamped return envelope.

The survey booklet provides all the information you need to complete the questionnaire. Whether you are a first-timer or a frequent visitor, your opinions are very important to us and the success of this study effort. There are no right or wrong answers. We just want your honest opinions. The survey will just take a few minutes to complete, and your answers mean a great deal to us.

Your responses are completely confidential and are not connected in anyway with your name. You will not be individually identified in our results or report. Once the data has been recorded and verified, the University of Wyoming Survey Research Center will destroy the printed surveys. The surveys are numbered only to allow us to keep track of which surveys have been returned. We will not use your address for any other mailings than for this study.

If you have any questions, please call me at (307) 766-4377 or email me at: bastian@uwyo.edu. I will be happy to answer any questions you have.

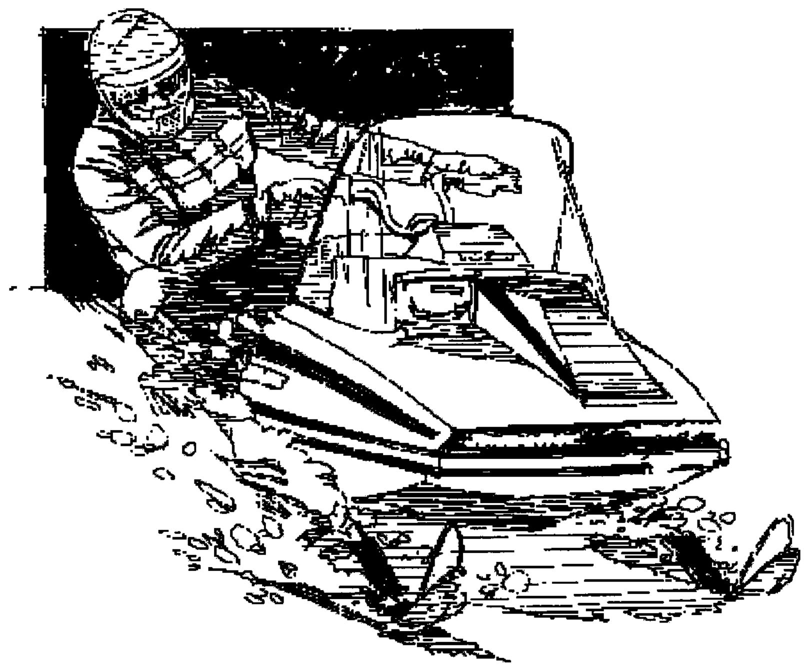
We look forward to receiving your survey in the days ahead.

Thank you,

Chris Bastian
Project Leader
University of Wyoming

Table A.8 Survey Instrument

2001-2002 YELLOWSTONE SNOWMOBILE SURVEY



We are interested in learning about and improving your snowmobile recreation.
Please help us by answering the following questions and providing us with your opinions.

Conducted By:

The University of Wyoming

Table A.8 Survey Instrument (continued).

SECTION 1: *General Season Information*

***This section is provided to help us gain an understanding of your snowmobiling experience and characteristics as well as a few of your opinions.**

1. How many years have you been snowmobiling?

   ______ YEARS

2. How many snowmobiles do you currently own?

   ______ NUMBER OF SNOWMOBILES

3. What was the date of your most recent snowmobile trip to Yellowstone National Park?

   ____

4. Did you rent a snowmobile, take a guided tour, or use your own snowmobile for this most recent trip to Yellowstone National Park?

   ______ RENTED

   ______ TOOK GUIDED TOUR

   ______ USED MY OWN

5. How many **total days** did you snowmobile in **any of the following**: Yellowstone National Park, Wyoming, Montana and/or Idaho between the dates of December 15, 2001 through February 28, 2002?

   ______ # WEEKEND DAYS (NON-HOLIDAYS)

   ______ # WEEKDAYS (NON-HOLIDAYS)

   ______ # HOLIDAYS

6. Do you belong to one or more snowmobile clubs or organizations? If yes, please list the name of these clubs or organizations.

   ______ NO

   ______ YES, Club/Organization Name: ____________________

   ____

   ____

Table A.8 Survey Instrument (continued).

SECTION 2: *Season Trip Information*

7. Please enter the **total number of trips from home** and the **total number of days** you spent snowmobiling at the following locations between the dates of December 15, 2001 through February 28, 2002. Please enter this amount in the blank next to the number of the area from your trip record or attach your trip record to this survey. (Please refer to the map on your trip record for locations.)

	# of Trips	# of Days		# of Trips	# of Days
01 - Beartooth Mountains			**08 – Uinta Mountains**		
02 – Bighorn Mountains			**09 – Wyoming Range**		
2a.- North Bighorns			9a.- Alpine/Horse Creek		
2b.- South Bighorns			9b.- Afton/Labarge		
			9c.- Kemmerer		
03 – Bearlodge Mountains					
			10-Granite Hot Springs		
04 – Black Hills					
			11 - Continental Divide		
05 – Casper Mountain			11a.-Togwotee		
			11b.-Dubois		
06 – Snowy Range			11c.-Gros Ventre		
			11d.-Pinedale		
07 – Sierra Madre Mountains			11e.-Lander		
Other Wyoming Trail Areas					
12 -Grand Teton National Park			**14-Other Areas in Wyoming**		
13-Yellowstone National Park					
Trail Areas Outside Wyoming					
30-Big Sky Trails – Madison area			**40-Cave Falls**		
31-Big Sky Trails- Cabin Creek			**41-Mesa Falls**		
32-Big Sky Trails – Upper Bozeman area			**42-Two Top**		
33-CookeCity			**43-Big Springs**		
34-Other Montana Area – Please Specify			**44-Other IdahoArea- Please Specify**		
50-Areas in Colorado			**70-Areas in Utah**		
60-Areas in South Dakota			**80-Areas outside WY, MT, ID, CO, SD, UT**		

Table A.8 Survey Instrument (continued).

8. Have you ever taken snowmobile trips to Yellowstone National Park before this season?

______ YES ______ NO

9. It is currently proposed that snowmobiling in Yellowstone and Grand Teton National Parks will be phased out beginning in the 2003-2004 season. If you were no longer able to snowmobile in Yellowstone or Grand Teton National Park, would you change the number of trips you would take during the season in Wyoming, Montana and/or Idaho? Please mark the most appropriate choice and fill in your estimate of the change in the number of trips.

______ Yes, I would **increase** my snowmobile trips to WY, MT and/or ID by (#)______ trips.

______ Yes, I would **decrease** my snowmobile trips to WY, MT and/or ID by (#)______trips.

______ No, I would **not change** the number of snowmobile trips to WY, MT, ID.

10. Referring to your trip record sheet or your answer to question 7 (they should be exactly the same), what was the site with the most trips other than Yellowstone National Park or Grand Teton National Park? ____________ (Number of Site).

11. Would your trips to the site in the previous question (question 10) change if you were no longer able to snowmobile in Yellowstone National Park and Grand Teton National Park? Please mark the most appropriate choice and fill in your estimate of the change in the number of trips.

______ Yes, I would **increase** my snowmobile trips to the site in question 10 by (#)______ trips.

______ Yes, I would **decrease** my snowmobile trips to the site in question 10 by (#)______trips.

______ No, I would **not change** the number of snowmobile trips to the site in question 10.

Table A.8 Survey Instrument (continued).

12. Assume that this snowmobile season was the same in every way, ***except that you were no longer able to snowmobile at Yellowstone and Grand Teton National Parks***. Based on this, please indicate the number of trips you would have taken to each location and the number of days you would have spent at each location between the dates of December 15, 2001 through February 28, 2002. (please refer to the map on the back of your trip record).

	# of Trips	**# of Days**		**# of Trips**	**# of Days**
01 - Beartooth Mountains			**08 – Uinta Mountains**		
02 – Bighorn Mountains			**09 – Wyoming Range**		
2a.- North Bighorns			9a.- Alpine/Horse Creek		
2b.- South Bighorns			9b.- Afton/Labarge		
			9c.- Kemmerer		
03 – Bearlodge Mountains					
			10-Granite Hot Springs		
04 – Black Hills					
			11 - Continental Divide		
05 – Casper Mountain			11a.-Togwotee		
			11b.-Dubois		
06 – Snowy Range			11c.-Gros Ventre		
			11d.-Pinedale		
07 – Sierra Madre Mountains			11e.-Lander		
Other Wyoming Trail Areas					
12 -Grand Teton National Park	**NOT Available**	**NOT Available**	**14-Other Areas in Wyoming**		
13-Yellowstone National Park	**NOT Available**	**NOT Available**			
Trail Areas Outside Wyoming					
30-Big Sky Trails – Madison area			**40-Cave Falls**		
31-Big Sky Trails- Cabin Creek			**41-Mesa Falls**		
32-Big Sky Trails – Upper Bozeman area			**42-Two Top**		
33-CookeCity			**43-Big Springs**		
34-Other Montana Area – Please Specify			**44-Other IdahoArea- Please Specify**		
50-Areas in Colorado			**70-Areas in Utah**		
60-Areas in South Dakota			**80-Areas outside WY, MT, ID, CO, SD, UT**		

Table A.8 Survey Instrument (continued).

SECTION 3: **Specific Information on Most Recent Trip**
****Please note that the following questions (Questions 14-20 of Section 3) pertain to <u>your most recent snowmobile trip to Yellowstone National Park</u> during December 15, 2001 – February 28, 2002.***

13. Was Yellowstone National Park the primary destination of your most recent snowmobile trip? (Please choose the appropriate answer and give the location of your primary destination if necessary).

_____________ YES
_____________NO
_____________ If you answered no, what was the primary destination of your trip? (Please give the site's number as designated on the map or your trip record sheet).

14. What was the date of your most recent snowmobile trip to **<u>Yellowstone National Park</u>**?

_______________ date

15. On your most recent snowmobile trip to **<u>Yellowstone National Park</u>**, how many people were in your traveling party that you snowmobiled with, how many passenger vehicles, and how many snowmobiles were taken on the trip for your party?

_____ NUMBER OF PEOPLE IN PARTY
_____ NUMBER OF PASSENGER VEHICLES
_____ NUMBER OF SNOWMOBILES

16. Please enter the travel time and distance (one-way) you traveled from your home to go to **<u>Yellowstone National Park</u>** on your most recent snowmobile trip there.

_____ TRAVEL TIME IN HOURS
_____ MILES TRAVELED FROM MY HOME

MODE OF TRANSPORTATION: (Circle all that apply)

VEHICLE   AIR   OTHER: ____________ (Please specify)

17. Was snowmobiling the ***primary*** purpose of your most recent trip to **<u>Yellowstone National Park</u>**? If no, what was the primary purpose of your trip?

_____ YES, snowmobiling was the primary purpose of the trip.
_____ NO, snowmobiling was not the primary purpose of the trip.
The primary purpose was not snowmobiling, it was
____.

18. Circle the state where your most recent snowmobile trip into Yellowstone National Park originated from: WY   MT   ID

Table A.8 Survey Instrument (continued).

19. Please indicate the number of ***total days*** you spent ***on your last snowmobiling trip to Yellowstone National Park*** as well as the number of ***nights you spent away from home*** on this trip. Please also indicate the number of ***days spent snowmobiling***.

______ TOTAL NIGHTS AWAY FROM HOME ON MOST RECENT TRIP
______ TOTAL DAYS *IN YELLOWSTONE* ON MOST RECENT TRIP
______ TOTAL NIGHTS *IN YELLOWSTONE* MOST RECENT TRIP
______ DAYS SPENT SNOWMOBILING ON MOST RECENT TRIP

20. Please give an estimate of the ***miles you traveled on your snowmachine per day*** during your most recent trip to **Yellowstone National Park**. Also, please indicate the ***number of hours you spent on your machine per day*** during the same trip.

______ MILES TRAVELED ON SNOWMACHINE PER DAY
______ HOURS SPENT ON SNOWMACHINE PER DAY

21. Please give your best estimate on the number of gallons of gasoline you purchased per day for your snowmobile during your most recent snowmobiling trip to **Yellowstone National Park**.

______ NUMBER OF GALLONS PURCHASED PER DAY

SECTION 4: *Expenditure Information*
***Please note that the following information is to help us gain a better understanding of the amount of money spent in the region around Yellowstone National Park for private snowmobile operations. Please be as accurate as possible. All answers are CONFIDENTIAL.**

22. ***Variable Costs.*** Please list the total amounts spent by you and your family on the following snowmobile items during your ***most recent snowmobile trip*** to **Yellowstone National Park** where you agreed to complete this survey. Also, please estimate the amount of these expenditures that were made in Wyoming, Montana and/or Idaho.

Expenditures on items *during most recent snowmobile trip to Yellowstone National Park.*	**Total Spent on Trip**	**Total Spent *In WY, MT, ID***
Lodging		
Eating & Drinking (Restaurants & Bars)		
Grocery &/or Liquor Stores		
Gasoline		
Oil/Trip Repairs/Maintenance		
Retail Items (souvenirs, etc.)		
Snowmobile Rental		
Guided Snowmobile Tour Packages		
Other Recreation: (movies, ski areas, etc.)		
Other Purchases: (please list below)		

Please indicate the number of people who were represented in these expenditures:

______ NUMBER OF PEOPLE

Table A.8 Survey Instrument (continued).

23. ***Fixed Costs.*** Please list the total amounts spent by you and your family on the following snowmobile items ***during the last twelve months***. Also, please estimate the amount of these expenditures made in Wyoming, Montana and Idaho. Please try to include any purchases made outside of the snowmobile season (December 2001 – April 2002).

Expenditures on snowmobile items *during the last twelve months.*	**Total Spent**	**Total Spent *In WY, MT, ID***
New/Used Snowmobile		
Snowmobile Trailer		
Safety Equipment (Helmet, Tools, First Aid Kits, etc.)		
Avalanche Equipment		
Clothing (Suit, Gloves, etc.)		
Annual Repairs/Parts(Belts, Sparkplugs, etc.)		
Registration/Licenses/Taxes		
Club Dues/Expenses		
Other Purchases: (please list below)		

Please indicate the number of people who were represented in these expenditures:

______ NUMBER OF PEOPLE

SECTION 5: ***Yellowstone National Park Snowmobile Phase Out Questions***
***This section will allow you to give us your perspective on the proposed Yellowstone National Park snowmobile phase out.**

24. Are you aware of the issues surrounding the Yellowstone Park snowmobile phase out that has recently been proposed? (If no, please move on to question 25.)

______ YES
______ NO

25. In your opinion, what is the best solution for the snowmobile conflict within the National Parks? (Please check the single most appropriate response)

______ COMPLETE BAN OF BOTH SNOWMOBILES AND SNOW COACHES.
______ COMPLETE SNOWMOBILE BAN WITH SNOW COACH ALLOWED.
______ PARTIAL SNOWMOBILE BAN IN HIGHLY SENSITIVE AREAS.
______ ROTATION OF SNOWMOBILE ALLOWANCE AREAS IN PARK EVERY SEASON.
______ LOTTERY OR PERMIT SYSTEM SIMILAR TO HUNTING PRIVILEGES.
______ LIMITED SNOWMOBILE ACCESS PER DAY OR PER SEASON.
______ NO BAN BUT REQUIREMENT OF CLEANER, QUIETER MACHINES.
______ NO BAN AND NO ADDITIONAL REQUIREMENTS.
______ NO OPINION ABOUT THIS ISSUE
______ OTHER (Please Specify):

____
____
____

Table A.8 Survey Instrument (continued).

SECTION 6: ***Rating Region's Snowmobile Sites***

26. Please list your **most frequently visited** snowmobiling site. (Please refer to your trip record or question 7 for identification number.)

_____ MOST FREQUENTLY VISITED SNOWMOBILE TRAIL

27. Please indicate your satisfaction level regarding the man-made features that makes an area your **most frequently visited site** (as listed in the previous question). Please place a check mark in the box stating your satisfaction level for each of the characteristics described below based on your experience at your most preferred site.

MAN-MADE FEATURE	Extremely Satisfied	Satisfied	Neither Satisfied or Dissatisfied	Not Satisfied	Extremely Dissatisfied
Availability of Fuel Services					
Trail Management (locations of trails – close to home, etc.)					
Miles of Groomed Trails					
Law Enforcement					
Available Shelters					
Trail Grooming and Maintenance					
Trail Signing					
Trail Map Availability					
Trail Map Quality					
Parking Availability					
Other: (please specify)					

28. Please rank the **top three** natural features that make an area your **most frequently visited site**. Please place the appropriate number from the list on the line that best corresponds with your opinion.

_____ MOST IMPORTANT

_____ SECOND MOST IMPORTANT

_____ THIRD MOST IMPORTANT

1. WILDLIFE VIEWING OPPORTUNITY
2. SOLITUDE
3. RUGGED TERRAIN
4. SCENIC VIEWS
5. GOOD SNOW CONDITIONS
6. OPEN AREAS
7. OFF-TRAIL POWDER
8. TRAIL AVAILABILITY/QUALITY
9. OTHER: ____________________
   ____

Table A.8 Survey Instrument (continued).

SECTION 7: ***Basic Information***

*These last few questions will help us understand your responses by knowing some basic information about you. All responses are ***CONFIDENTIAL***. Your answers to these questions are critical for analyses which may affect future management decisions by state Snowmobile Recreation and Trails Programs.

29. In what zip code is your residence?

_____________________ ZIP CODE

30. Please indicate your gender below by checking the appropriate response.

_____ MALE _____ FEMALE

31. Please check the category that represents your age.

_____ UNDER 21 YEARS _____ 41-50 YEARS
_____ 21-30 YEARS _____ 51-64 YEARS
_____ 31-40 YEARS _____ 65 YEARS AND OLDER

32. Please check the highest year of formal education you completed.

_____ GRADES 1 THROUGH 8 _____ OBTAINED A COLLEGE DEGREE
_____ SOME HIGH SCHOOL _____ SOME POSTGRADUATE WORK
_____ FINISHED HIGH SCHOOL _____ OBTAINED GRADUATE DEGREE
_____ SOME COLLEGE

33. Please check the most appropriate response describing your employment during the last twelve months.

_____ EMPLOYED FULL TIME (40hrs/wk) _____ RETIRED
_____ EMPLOYED PART TIME (less than 40 hrs/wk) _____ HOMEMAKER
_____ OTHER (PLEASE SPECIFY BELOW): _____ UNEMPLOYED

____

34. Please list the number of people in your household who are working outside of the home.

_____ NUMBER OF PEOPLE WORKING OUTSIDE OF HOME

35. Please check the most representative range of your household's income before taxes last year. ***PLEASE NOTE: This question is absolutely vital to the economic analysis portion of our study. We strongly encourage you to answer this question and remind you that all of your answers are completely CONFIDENTIAL.***

_____ Under $5,000 _____ $25,000 – $29,999 _____ $75,000 – $99,999
_____ $5,000 – $9,999 _____ $30,000 – $34,999 _____ $100,000 – $149,999
_____ $10,000 – $14,999 _____ $35,000 – $39,999 _____ $150,000 – $199,999
_____ $15,000 – $19,999 _____ $40,000 – $49,999 _____ $200,000 – $300,000
_____ $20,000 – $24,999 _____ $50,000 – $74,999 _____ Over $300,000

Table A.8 Survey Instrument (continued).

Thank you very much for your help. Is there anything else you would like to tell us about snowmobiling in and around Yellowstone National Park? We would appreciate any comments. Please use the space below if you would like to provide any additional information. **Once you are done, please mail this completed questionnaire back to us in the postage-paid return envelope**. Thanks again!

COMMENTS:

Appendix B:

SAS AND GAUSS CODE USED FOR ANALYSIS

Table B.1 SAS Code Used in Analysis for Chapter 1.

```
PROC IMPORT OUT= WORK.surv
DATAFILE= "C:\FILES\DATFILES\YNP\ynp gauss\ynp survey sas mod.xls"
            DBMS=EXCEL2000 REPLACE;
            RANGE="Sheet1$";
            GETNAMES=YES;

PROC IMPORT OUT= WORK.snow
DATAFILE= "C:\FILES\DATFILES\YNP\ynp gauss\YNP snow data.xls"
            DBMS=EXCEL2000 REPLACE;
            RANGE="Sheet1$";
            GETNAMES=YES;

PROC IMPORT OUT= WORK.travel
DATAFILE= "C:\FILES\DATFILES\YNP\ynp gauss\YNP travel time and distance
values.xls"
            DBMS=EXCEL2000 REPLACE;
            RANGE="Sheet1$";
            GETNAMES=YES;

PROC IMPORT OUT= WORK.trips
DATAFILE= "C:\FILES\DATFILES\YNP\ynp gauss\ynp trips sas.xls"
            DBMS=EXCEL2000 REPLACE;
            RANGE="Sheet1$";
            GETNAMES=YES;

PROC IMPORT OUT= WORK.sitechar
DATAFILE= "C:\FILES\DATFILES\YNP\ynp gauss\YNP site characteristics.xls"
            DBMS=EXCEL2000 REPLACE;
            RANGE="Sheet1$";
            GETNAMES=YES;
data alldata;
merge work.surv work.snow work.travel work.trips work.sitechar;
by id;

data modall;
set alldata;

if q35=16 then q35=.;
if id = 639 then delete;
if id=76 then delete;
if id=148 then delete;
if id=1081 then delete;
if id=453 then delete;

proc means data=modall printalltypes mean sum;
class singmult;
var tottrips choiceoc rps13t rps13d ynpdytp tripswy dayswy dyprtpwy
tripsid daysid dyprtpid tripsmt daysmt dyprtpmt
Q1 Q2 Q5A Q15A Q15B Q15C Q16A Q16B Q19A Q19B Q19C Q19D
Q20A Q20B Q21 Q22A1 Q22B1 Q22C1 Q22D1 Q22E1 Q22F1
Q22G1 Q22H1 Q22I1 Q22J1 Q22A2 Q22B2 Q22C2 Q22D2 Q22E2 Q22F2
Q22G2 Q22H2 Q22I2 Q22J2 Q23A1 Q23A2 Q23B2 Q23C2 Q23D2 Q23E2 Q23F2
```

Table B.1 SAS Code Used in Analysis for Chapter 1 (continued).

```
Q23G2 Q23H2 Q23I2 Q23K rps1t rps2at rps2bt rps3t rps4t rps5t rps6t rps7t
rps8t rps9at rps9bt rps9ct rps10t rps11at rps11bt rps11ct rps11dt
rps11et rps12t rps13t rps30t rps31t rps32t rps33t rps34at rps34bt
rps34ct rps34dt rps34et rps34ft rps34gt rps34ht rps34it rps40t rps41t
rps42t rps43t rps44at rps44bt rps44ct rps44dt rps44et rps44ft rps44gt
rps44ht rps44it rps44jt rps44kt sp1trips sp1nonpt sp1s1t sp1s2at sp1s2bt
sp1s3t sp1s4t sp1s5t sp1s6t sp1s7t sp1s8t sp1s9at sp1s9bt sp1s9ct
sp1s10t sp1s11at sp1s11bt sp1s11ct sp1s11dt sp1s11et sp1s12t sp1s13t
sp1s30t sp1s31t   sp1s32t sp1s33t sp1s34at sp1s34bt sp1s34ct
sp1s34dt sp1s34et sp1s34ft sp1s34gt sp1s34ht sp1s34it sp1s40t sp1s41t
sp1s42t sp1s43t sp1s44at sp1s44bt sp1s44ct sp1s44dt sp1s44et sp1s44ft
sp1s44gt sp1s44ht sp1s44it sp1s44jt sp1s44kt sp2trips sp2nonpt sp2s1t
sp2s2at sp2s2bt sp2s3t sp2s4t sp2s5t sp2s6t sp2s7t sp2s8t sp2s9at
sp2s9bt sp2s9ct sp2s10t sp2s11at sp2s11bt sp2s11ct sp2s11dt sp2s11et
sp2s12t sp2s13t sp2s30t sp2s31t sp2s32t sp2s33t sp2s34at sp2s34bt
sp2s34ct sp2s34dt sp2s34et sp2s34ft sp2s34gt sp2s34ht sp2s34it sp2s40t
sp2s41t sp2s42t sp2s43t sp2s44at sp2s44bt sp2s44ct sp2s44dt sp2s44et
sp2s44ft sp2s44gt sp2s44ht sp2s44it sp2s44jt sp2s44kt s1de s1te s2ade
s2ate s2bde s2bte s3de s3te s4de s4te s5de s5te s6de s6te s7de s7te s8de
s8te s9ade s9ate s9bde s9bte s9cde s9cte s10de s10te s11ade
s11ate s11bde s11bte s11cde s11cte s11dde s11dte s11ede s11ete s12de
s12te s13de s13te s30de s30te s31de s31te s32de s32te s33de s33te s34ade
s34ate s34bde s34bte s34cde s34cte s34dde s34dte s34ede s34ete s34fde
s34fte s34gde s34gte s34hde s34hte s34ide s34ite s40de s40te s41de s41te
s42de s42te s43de s43te s44ade s44ate s44bde s44bte s44cde s44cte s44dde
s44dte s44ede s44ete s44fde s44fte s44gde s44gte s44hde s44hte s44ide
s44ite s44jde s44jte s44kde s44kte;

proc ttest data=modall alpha=0.05;
class singmult;
var tottrips choiceoc rps13t rps13d ynpdytp tripswy dayswy dyprtpwy
tripsid daysid dyprtpid tripsmt daysmt dyprtpmt Q1 Q2 Q5A Q15A Q15B Q15C
Q16A Q16B Q19A Q19B Q19C Q19D Q20A Q20B Q21 Q22A1 Q22B1 Q22C1 Q22D1
Q22E1 Q22F1 Q22G1 Q22H1 Q22I1 Q22J1 Q22A2 Q22B2 Q22C2 Q22D2 Q22E2 Q22F2
Q22G2 Q22H2 Q22I2 Q22J2 Q23A1 Q23A2 Q23B2 Q23C2 Q23D2 Q23E2 Q23F2
Q23G2 Q23H2 Q23I2 Q23K rps1t rps2at rps2bt rps3t rps4t rps5t rps6t rps7t
rps8t rps9at rps9bt rps9ct rps10t rps11at rps11bt rps11ct rps11dt
rps11et rps12t rps13t rps30t rps31t rps32t rps33t rps34at rps34bt
rps34ct rps34dt rps34et rps34ft rps34gt rps34ht rps34it rps40t rps41t
rps42t rps43t rps44at rps44bt rps44ct rps44dt rps44et rps44ft rps44gt
rps44ht rps44it rps44jt rps44kt sp1trips sp1nonpt sp1s1t sp1s2at sp1s2bt
sp1s3t sp1s4t sp1s5t sp1s6t sp1s7t sp1s8t sp1s9at sp1s9bt sp1s9ct
sp1s10t sp1s11at sp1s11bt sp1s11ct sp1s11dt sp1s11et sp1s12t sp1s13t
sp1s30t sp1s31t   sp1s32t sp1s33t sp1s34at sp1s34bt sp1s34ct
sp1s34dt sp1s34et sp1s34ft sp1s34gt sp1s34ht sp1s34it sp1s40t sp1s41t
sp1s42t sp1s43t sp1s44at sp1s44bt sp1s44ct sp1s44dt sp1s44et sp1s44ft
sp1s44gt sp1s44ht sp1s44it sp1s44jt sp1s44kt sp2trips sp2nonpt sp2s1t
sp2s2at sp2s2bt sp2s3t sp2s4t sp2s5t sp2s6t sp2s7t sp2s8t sp2s9at
sp2s9bt sp2s9ct sp2s10t sp2s11at sp2s11bt sp2s11ct sp2s11dt sp2s11et
sp2s12t sp2s13t sp2s30t sp2s31t sp2s32t sp2s33t sp2s34at sp2s34bt
sp2s34ct sp2s34dt sp2s34et sp2s34ft sp2s34gt sp2s34ht sp2s34it sp2s40t
sp2s41t sp2s42t sp2s43t sp2s44at sp2s44bt sp2s44ct sp2s44dt sp2s44et
sp2s44ft sp2s44gt sp2s44ht sp2s44it sp2s44jt sp2s44kt s1de s1te s2ade
```

Table B.1 SAS Code Used in Analysis for Chapter 1 (continued).

```
s2ate s2bde s2bte s3de s3te s4de s4te s5de s5te s6de s6te s7de s7te s8de
s8te s9ade s9ate s9bde s9bte s9cde s9cte s10de s10te s11ade
s11ate s11bde s11bte s11cde s11cte s11dde s11dte s11ede s11ete s12de
s12te s13de s13te s30de s30te s31de s31te s32de s32te s33de s33te s34ade
s34ate s34bde s34bte s34cde s34cte s34dde s34dte s34ede s34ete s34fde
s34fte s34gde s34gte s34hde s34hte s34ide s34ite s40de s40te s41de s41te
s42de s42te s43de s43te s44ade s44ate s44bde s44bte s44cde s44cte s44dde
s44dte s44ede s44ete s44fde s44fte s44gde s44gte s44hde s44hte s44ide
s44ite s44jde s44jte s44kde s44kte;

proc freq data=modall;
tables singmult*Q4 singmult*Q6 singmult*Q8 singmult*Q9 singmult*Q13
singmult*Q13A singmult*Q16C1 singmult*Q16C2 singmult*Q16C3
singmult*Q16C4 singmult*Q16CC singmult*Q17 singmult*Q18 singmult*Q24
singmult*Q25 singmult*Q27A singmult*Q27B singmult*Q27C singmult*Q27D
singmult*Q27E singmult*Q27F singmult*Q27G singmult*Q27H singmult*Q27I
singmult*Q27J singmult*Q27K singmult*Q28A singmult*Q28B singmult*Q28C
singmult*Q30 singmult*Q31 singmult*Q32 singmult*Q33 singmult*Q33A
singmult*Q34 singmult*Q35/ chisq;

data expdata;
set alldata;
if q22a1 =. then delete;
if q22a2 =. then delete;
if q22b1=. then delete;
if q22c1=. then delete;
if q22d1=. then delete;
if q22e1=. then delete;
if q22f1=. then delete;
if q22g1=. then delete;
if q22h1=. then delete;
if q22i1=. then delete;
if q22j1=. then delete;
if q22b2=. then delete;
if q22c2=. then delete;
if q22d2=. then delete;
if q22e2=. then delete;
if q22f2=. then delete;
if q22g2=. then delete;
if q22h2=. then delete;
if q22i2=. then delete;
if q22j2=. then delete;
ttexpns = q22a1+q22b1+q22c1+q22d1+q22e1+q22f1+q22g1+q22h1+q22I1+q22j1;
ttexprgn = q22a2+q22b2+q22c2+q22d2+q22e2+q22f2+q22g2+q22h2+q22I2+q22j2;


if ttexpns=0 then ttexpd=1;
else ttexpd= ttexpns;
pcexpregn = (ttexprgn/ttexpd)*100;

proc means data=expdata printalltypes mean sum;
class singmult;
var ttexpns ttexprgn q22k;
```

Table B.1 SAS Code Used in Analysis for Chapter 1 (continued).

```
proc ttest data=expdata alpha=0.05;
class singmult;
var ttexpns ttexprgn q22k;

data sxpdata;
set alldata;
if q23a1 =. then delete;
if q23a2 =. then delete;
if q23b1=. then delete;
if q23c1=. then delete;
if q23d1=. then delete;
if q23e1=. then delete;
if q23f1=. then delete;
if q23g1=. then delete;
if q23h1=. then delete;
if q23i1=. then delete;
if q23b2=. then delete;
if q23c2=. then delete;
if q23d2=. then delete;
if q23e2=. then delete;
if q23f2=. then delete;
if q23g2=. then delete;
if q23h2=. then delete;
if q23i2=. then delete;

ttsexpn = q23a1+q23b1+q23c1+q23d1+q23e1+q23f1+q23g1+q23h1+q23I1;
ttsexrgn = q23a2+q23b2+q23c2+q23d2+q23e2+q23f2+q23g2+q23h2+q23I2;

proc means data=sxpdata printalltypes mean sum;
class singmult;
var ttsexpn ttsexrgn q23k;

proc ttest data=sxpdata alpha=0.05;
class singmult;
var ttsexpn ttsexrgn q23k;

RUN;
```

Table B.2 Gauss Code Used in for Data Transformation for Random Utility Model for Multiple Trip – Single Destination Per Trip Segment Reported in Chapter 2.

```
dataloop alldata multmod;

/* Note: must turn on dataloop translator via the configure portion of
menu or edit gauss.cfg and turn translator to on via notepad or some
ascii editor.  This should not be left on for model runs. The translator
should be turned off for that, particularly big models. */

/* Note: normal logic statements do not work in dataloop.  Must use
statements supported by dataloop. See Gauss User Guide for some clue on
statements supported. */

/* The number of choice occasions for multiple trip people were
estimated as days park was open until end of February.  Making choiceoc
= 76.  */


make nonpt = 76 - tottrips;
recode nonpt with
0 for nonpt < 0;

recode Q32 with
0 for Q32 == 7;

recode Q31 with
0 for Q31 ==7;

/* code for estimating non-participation based on 76 choice occasions
for stated preference data */

make sp1non = 76 - sp1trips;
recode sp1non with
0 for sp1non < 0;

make sp2non = 76 - sp2trips;
recode sp2non with
0 for sp2non < 0;

/* deleting invalid observations for multmod run */

delete id == 639;
delete id == 76;
delete id == 148;
delete id == 1081;
delete id == 167;
delete singmult == 1;
delete Q35 == 16;

/* converting question 35 to midpoint annual income /10000 for scaling
purposes */
    code income default 0 with
    0.2500 for Q35 == 1,
    0.7500 for Q35 == 2,
    1.2500 for Q35 == 3,
```

Table B.2 Gauss Code Used in for Data Transformation for Random Utility Model for Multiple Trip – Single Destination Per Trip Segment Reported in Chapter 2 (continued).

```
 1.7500 for Q35 == 4,
    2.2500 for Q35 == 5,
    2.7500 for Q35 == 6,
    3.2500 for Q35 == 7,
    3.7500 for Q35 == 8,
    4.5000 for Q35 == 9,
    6.2500 for Q35 == 10,
    8.7500 for Q35 == 11,
    12.5000 for Q35 == 12,
    17.5000 for Q35 == 13,
    25.0000 for Q35 == 14,
    35.0000 for Q35 == 15;

/* estimating two types of travel cost variables. TC1= individual costs
such as lodging, gas-snowmobile gas, trip repairs and airfare if
traveled by air; Summed and divided by 2 and then YNP distance to get
rate/mile for roundtrip then multiplied by roundtrip site distance;
TC2=roundtrip distance to site multiplied by $0.2185/mile both TC
variables are /100 for scaling purposes in estimation */
/* NOTE: See Morey 1999 for effect of scaling on marginal utility of
money and effect on compensating variation calculation (CV).  If scale
all prices by double then CV doubled. If halve all prices then CV
halved.  The expected maximum utility and maximum likelihood unchanged
but mu is scaled and ultimately affects CV calculation. */

/* Estimate expenditure on gas for snowmobiles to be subtracted from
total gas expenditures */

recode Q21 with
0 for Q21 == 999999;

make rps13tg = rps13t;
recode rps13tg with
1 for rps13t <= 0;
make snogas = Q21*(rps13d/rps13tg)*1.35;
recode snogas with
0 for snogas > Q22D1;

delete Q22A1 == 999999;

/* including "other" category if flew on plane and snowmobile rental
costs */

make snowrnt = Q22G2;
recode snowrnt with
0 for Q22G2 == 999999;

make airtckt=Q22J1;
recode airtckt with
0 for Q22J1 == 999999,
0 for Q16C2 == 0;

/* making # of people variable to divide into costs */
```

Table B.2 Gauss Code Used in for Data Transformation for Random Utility Model for Multiple Trip – Single Destination Per Trip Segment Reported in Chapter 2 (continued).

```
make pepl=Q22K;
recode pepl with
1 for Q22K == 999999,
1 for Q22K == 0,
1 for Q22K == 2500;

/* estimating trip costs to be used in TC1 less snogas */
make tpcst=(((Q22A1+(Q22D1-snogas)+Q22E1+snowrnt+airtckt)./ pepl)./ 2);

/* estimating tc1 and tc2 for each site */

make tc1s1=((tpcst ./ s13de) .* s1de .* 2) .* 0.01;
make tc2s1=((s1de .* 2 .* 0.2185) ./ pepl) .* 0.01;
.
.
(repeat for rest of sites)
.
.
make tc1s44k=((tpcst ./ s13de) .* s44kde .* 2) .* 0.01;
make tc2s44k=((s44kde .* 2 .* 0.2185) ./ pepl) .* 0.01;

/* Estimate used for travel time taking into account air travel vs
vehicle travel */

recode Q16C2 with
0 for Q16C2 == 999999;

/* Estimating air travel time if not given or else use respondent's air
travel time make airtime=Q16A; */
code airtrav1 default 0 with
    1 for Q16A > 0 and Q16A < 999999;
code airtrav2 default 1 with
    0 for airtrav1 == 1;
    make airtime=((4+(s13de ./ 600)) .* airtrav2)+(Q16A .* airtrav1);
code airpln default 0 with
    1 for Q16C2 == 1;
code nopln default 1 with
    0 for airpln == 1;

/* estimating travel time as air travel or estimated vehicle time to
site from PC miler - travel time is scaled by /10 for estimation
purposes Note: must use . in front of operations to do item by item
calculations */

make s1hr=((s1te .* 2 .* nopln)+((airtime ./ s13de) .* s1de .* 2 .*
airpln)) .* 0.1;
.
.
(repeat for rest of sites)
.
.
make s44khr=((s44kte .* 2 .* nopln)+((airtime ./ s13de) .* s44kde .* 2
.* airpln)) .* 0.1;
```

Table B.2 Gauss Code Used in for Data Transformation for Random Utility Model for Multiple Trip – Single Destination Per Trip Segment Reported in Chapter 2 (continued).

```
/* investment in snowmobile equipment scaled by /1000 */

delete Q23A1 == 999999;
make snoinvst=(Q23A1+Q23B1+Q23C1+Q23D1+Q23G1) .* 0.001;

/* create elevation difference for each site scaled by /1000 */

make s1eldf=(s1evh-s1evl) .* 0.001;
.
.
(repeat for rest of sites)
.
.
make s44keldf=(s44kevh-s44kevl) .* 0.001;

/* creating scaled length of trail variable ex. s1lng/10 = ss1lng */

make ss1lng=(s1lng) .* 0.1;
.
.
(repeat for rest of sites)
.
.
make ss44klng=(s44klng) .* 0.1;

/* creating interaction variable between miles of trail and groom (at
least 50%) or not */

make s1tlgm = ss1lng .* s1grm;
.
.
(repeat for rest of sites)
.
.

make s44ktlgm = ss44klng .* s44kgrm;

/* creating variable as sum of top two features for snowmobiling */

code feat1 default 0 with
    1 for Q28A == 1,
    2 for Q28A == 2,
    3 for Q28A == 3,
    4 for Q28A == 4,
    5 for Q28A == 5,
    6 for Q28A == 6,
    7 for Q28A == 7,
    8 for Q28A == 8,
    9 for Q28A == 9;
code feat2 default 0 with
    1 for Q28B == 1,
    2 for Q28B == 2,
    3 for Q28B == 3,
```

Table B.2 Gauss Code Used in for Data Transformation for Random Utility Model for Multiple Trip – Single Destination Per Trip Segment Reported in Chapter 2 (continued).

```
    4 for Q28B == 4,
    5 for Q28B == 5,
    6 for Q28B == 6,
    7 for Q28B == 7,
    8 for Q28B == 8,
    9 for Q28B == 9;
make topfeat=feat1+feat2;
make yrssnow=Q1;
recode yrssnow with
0 for yrssnow == 999999;

/*creating a dummy variable for snowmobile club */

    code club default 0 with
    1 for Q6 == 2;

/* creating a dummy variable for snowmobiling only on weekend (weeknd)
or week days (weekd) */

    code weeknd default 0 with
    1 for Q5A > 0 and Q5A < 999999;
    code weekd default 0 with
    1 for Q5B > 0 and Q5B < 999999;

keep id, origin, s1lng, ss1lng, s1grm, s1srv, s1evl, s1evh, s2alng,
ss2alng, s2agrm, s2asrv, s2aevl, s2aevh, s2blng, ss2blng, s2bgrm,
s2bsrv, s2bevl, s2bevh, s3lng, ss3lng, s3grm, s3srv, s3evl, s3evh,
s4lng, ss4lng, s4grm, s4srv, s4evl, s4evh, s5lng, ss5lng, s5grm, s5srv,
s5evl, s5evh, s6lng, ss6lng, s6grm, s6srv, s6evl, s6evh, s7lng, ss7lng,
s7grm, s7srv, s7evl, s7evh, s8lng, ss8lng, s8grm, s8srv, s8evl, s8evh,
s9alng, ss9alng, s9agrm, s9asrv, s9aevl, s9aevh, s9blng, ss9blng,
s9bgrm, s9bsrv, s9bevl, s9bevh, s9clng, ss9clng, s9cgrm, s9csrv, s9cevl,
s9cevh, s10lng, ss10lng, s10grm, s10srv, s10evl, s10evh, s11alng,
ss11alng, s11agrm, s11asrv, s11aevl, s11aevh, s11blng,
ss11blng, s11bgrm, s11bsrv, s11bevl, s11bevh, s11clng, ss11clng,
s11cgrm, s11csrv, s11cevl, s11cevh, s11dlng, ss11dlng, s11dgrm, s11dsrv,
s11devl, s11devh, s11elng, ss11elng, s11egrm, s11esrv, s11eevl, s11eevh,
s12lng, ss12lng, s12grm, s12srv, s12evl, s12evh, s13lng, ss13lng,
s13grm, s13srv, s13evl, s13evh, s30lng, ss30lng, s30grm, s30srv, s30evl,
s30evh, s31lng, ss31lng, s31grm, s31srv, s31evl, s31evh, s32lng,
ss32lng, s32grm, s32srv, s32evl, s32evh, s33lng, ss33lng, s33grm,
s33srv, s33evl, s33evh, s34alng, ss34alng, s34agrm, s34asrv, s34aevl,
s34aevh, s34blng, ss34blng, s34bgrm, s34bsrv, s34bevl, s34bevh, s34clng,
ss34clng, s34cgrm, s34csrv, s34cevl, s34cevh, s34dlng, ss34dlng,
s34dgrm, s34dsrv, s34devl, s34devh, s34elng, ss34elng, s34egrm, s34esrv,
s34eevl, s34eevh, s34flng, ss34flng, s34fgrm, s34fsrv, s34fevl, s34fevh,
s34glng, ss34glng, s34ggrm, s34gsrv, s34gevl, s34gevh, s34hlng,
ss34hlng, s34hgrm, s34hsrv, s34hevl, s34hevh, s34ilng, ss34ilng,
s34igrm, s34isrv, s34ievl, s34ievh, s40lng,    ss40lng, s40grm, s40srv,
s40evl, s40evh, s41lng, ss41lng, s41grm, s41srv, s41evl, s41evh, s42lng,
ss42lng, s42grm, s42srv, s42evl, s42evh, s43lng, ss43lng, s43grm,
s43srv, s43evl, s43evh, s44alng, ss44alng, s44agrm, s44asrv, s44aevl,
```

Table B.2 Gauss Code Used in for Data Transformation for Random Utility Model for Multiple Trip – Single Destination Per Trip Segment Reported in Chapter 2 (continued).

```
s44aevh, s44blng, ss44blng, s44bgrm, s44bsrv, s44bevl, s44bevh, s44clng,
ss44clng, s44cgrm, s44csrv, s44cevl, s44cevh, s44dlng, ss44dlng,
s44dgrm, s44dsrv, s44devl, s44devh, s44elng, ss44elng, s44egrm, s44esrv,
s44eevl, s44eevh, s44flng, ss44flng, s44fgrm, s44fsrv, s44fevl, s44fevh,
s44glng, ss44glng, s44ggrm, s44gsrv, s44gevl, s44gevh, s44hlng,
ss44hlng, s44hgrm, s44hsrv, s44hevl,
s44hevh, s44ilng, ss44ilng, s44igrm, s44isrv, s44ievl, s44ievh, s44jlng,
ss44jlng, s44jgrm, s44jsrv, s44jevl, s44jevh, s44klng, ss44klng,
s44kgrm, s44ksrv, s44kevl, s44kevh, sn01s1, sn01s2a, sn01s2b, sn01s3,
sn01s4, sn01s5,   sn01s6, sn01s7, sn01s8, sn01s9a, sn01s9b, sn01s9c,
sn01s10, sn01s11a, sn01s11b, sn01s11c, sn01s11d, sn01s11e, sn01s12,
sn01s13, sn01s30, sn01s31, sn01s32, sn01s33, sn01s34a, sn01s34b,
sn01s34c, sn01s34d, sn01s34e, sn01s34f, sn01s34g, sn01s34h,
sn01s34i, sn01s40, sn01s41, sn01s42, sn01s43, sn01s44a, sn01s44b,
sn01s44c, sn01s44d, sn01s44e, sn01s44f, sn01s44g, sn01s44h, sn01s44i,
sn01s44j, sn01s44k, jsns1, jsns2a, jsns2b, jsns3, jsns4, jsns5, jsns6,
jsns7, jsns8, jsns9a, jsns9b, jsns9c, jsns10, jsns11a, jsns11b, jsns11c,
jsns11d, jsns11e, jsns12, jsns13, jsns30, jsns31, jsns32, jsns33,
jsns34a, jsns34b, jsns34c, jsns34d, jsns34e, jsns34f, jsns34g, jsns34h,
jsns34i, jsns40, jsns41, jsns42, jsns43, jsns44a, jsns44b, jsns44c,
jsns44d, jsns44e, jsns44f, jsns44g, jsns44h, jsns44i, jsns44j,
jsns44k, fsns1, fsns2a, fsns2b, fsns3, fsns4, fsns5, fsns6, fsns7,
fsns8, fsns9a, fsns9b, fsns9c, fsns10, fsns11a, fsns11b, fsns11c,
fsns11d, fsns11e, fsns12, fsns13, fsns30, fsns31, fsns32, fsns33,
fsns34a, fsns34b, fsns34c, fsns34d, fsns34e, fsns34f, fsns34g, fsns34h,
fsns34i, fsns40, fsns41, fsns42, fsns43, fsns44a, fsns44b, fsns44c,
fsns44d, fsns44e, fsns44f, fsns44g, fsns44h, fsns44i, fsns44j, fsns44k,
msns1, msns2a, msns2b, msns3, msns4, msns5, msns6, msns7, msns8, msns9a,
msns9b, msns9c, msns10, msns11a, msns11b, msns11c, msns11d, msns11e,
msns12, msns13, msns30, msns31, msns32, msns33, msns34a, msns34b,
msns34c, msns34d, msns34e, msns34f, msns34g, msns34h, msns34i,
msns40, msns41, msns42, msns43, msns44a, msns44b, msns44c,  msns44d,
msns44e, msns44f, msns44g, msns44h, msns44i, msns44j, msns44k, sn02s1,
sn02s2a, sn02s2b, sn02s3, sn02s4, sn02s5, sn02s6, sn02s7, sn02s8,
sn02s9a, sn02s9b, sn02s9c, sn02s10, sn02s11a, sn02s11b, sn02s11c,
sn02s11d, sn02s11e, sn02s12, sn02s13, sn02s30, sn02s31, sn02s32,
sn02s33, sn02s34a, sn02s34b, sn02s34c, sn02s34d, sn02s34e, sn02s34f,
sn02s34g, sn02s34h, sn02s34i, sn02s40, sn02s41, sn02s42, sn02s43,
sn02s44a, sn02s44b, sn02s44c, sn02s44d, sn02s44e, sn02s44f, sn02s44g,
sn02s44h, sn02s44i, sn02s44j, sn02s44k, s1de, s1te, s2ade, s2ate, s2bde,
s2bte, s3de, s3te, s4de, s4te, s5de, s5te, s6de, s6te, s7de, s7te, s8de,
s8te, s9ade, s9ate, s9bde, s9bte, s9cde, s9cte, s10de, s10te, s11ade,
s11ate, s11bde, s11bte, s11cde, s11cte, s11dde, s11dte, s11ede, s11ete,
s12de, s12te, s13de, s13te, s30de, s30te, s31de, s31te, s32de, s32te,
s33de, s33te, s34ade, s34ate, s34bde, s34bte, s34cde, s34cte, s34dde,
s34dte, s34ede, s34ete, s34fde, s34fte, s34gde, s34gte, s34hde, s34hte,
s34ide, s34ite, s40de, s40te, s41de, s41te, s42de, s42te, s43de, s43te,
s44ade, s44ate, s44bde, s44bte, s44cde, s44cte, s44dde, s44dte, s44ede,
s44ete, s44fde, s44fte, s44gde, s44gte, s44hde,
s44hte, s44ide, s44ite, s44jde, s44jte, s44kde, s44kte, singmult,
choiceoc, tottrips, nonpart, nonpt, rps1t, rps2at, rps2bt, rps3t,
rps4t, rps5t, rps6t, rps7t, rps8t, rps9at, rps9bt, rps9ct, rps10t,
rps11at, rps11bt, rps11ct, rps11dt, rps11et, rps12t, rps13t, rps30t,
```

Table B.2 Gauss Code Used in for Data Transformation for Random Utility Model for Multiple Trip – Single Destination Per Trip Segment Reported in Chapter 2 (continued).

```
rps31t, rps32t, rps33t, rps34at, rps34bt, rps34ct, rps34dt, rps34et,
rps34ft, rps34gt, rps34ht, rps34it, rps40t, rps41t, rps42t, rps43t,
rps44at, rps44bt, rps44ct, rps44dt, rps44et, rps44ft, rps44gt, rps44ht,
rps44it, rps44jt, rps44kt, rps1d, rps2ad, rps2bd, rps3d, rps4d, rps5d,
rps6d, rps7d, rps8d, rps9ad, rps9bd, rps9cd, rps10d, rps11ad, rps11bd,
rps11cd, rps11dd, rps11ed, rps12d, rps13d, rps30d, rps31d, rps32d,
rps33d, rps34ad, rps34bd, rps34cd, rps34dd, rps34ed, rps34fd, rps34gd,
rps34hd, rps34id, rps40d, rps41d, rps42d, rps43d, rps44ad, rps44bd,
rps44cd, rps44dd, rps44ed, rps44fd, rps44gd, rps44hd, rps44id, rps44jd,
rps44kd, sp1trips, sp1non, sp1s1t, sp1s2at, sp1s2bt, sp1s3t, sp1s4t,
sp1s5t, sp1s6t, sp1s7t, sp1s8t, sp1s9at, sp1s9bt, sp1s9ct, sp1s10t,
sp1s11at, sp1s11bt, sp1s11ct, sp1s11dt, sp1s11et, sp1s12t, sp1s13t,
sp1s30t, sp1s31t, sp1s32t, sp1s33t, sp1s34at, sp1s34bt, sp1s34ct,
sp1s34dt, sp1s34et, sp1s34ft, sp1s34gt, sp1s34ht, sp1s34it, sp1s40t,
sp1s41t, sp1s42t, sp1s43t, sp1s44at, sp1s44bt, sp1s44ct, sp1s44dt,
sp1s44et, sp1s44ft, sp1s44gt, sp1s44ht, sp1s44it, sp1s44jt, sp1s44kt,
sp2trips, sp2non, sp2s1t, sp2s2at, sp2s2bt, sp2s3t, sp2s4t, sp2s5t,
sp2s6t, sp2s7t, sp2s8t, sp2s9at, sp2s9bt, sp2s9ct, sp2s10t, sp2s11at,
sp2s11bt, sp2s11ct, sp2s11dt, sp2s11et, sp2s12t, sp2s13t, sp2s30t,
sp2s31t, sp2s32t, sp2s33t, sp2s34at, sp2s34bt, sp2s34ct, sp2s34dt,
sp2s34et, sp2s34ft, sp2s34gt, sp2s34ht, sp2s34it, sp2s40t, sp2s41t,
sp2s42t, sp2s43t, sp2s44at, sp2s44bt, sp2s44ct, sp2s44dt, sp2s44et,
sp2s44ft, sp2s44gt, sp2s44ht, sp2s44it, sp2s44jt, sp2s44kt, sp2s1d,
sp2s2ad, sp2s2bd, sp2s3d, sp2s4d, sp2s5d, sp2s6d, sp2s7d,
sp2s8d,sp2s9ad, sp2s9bd, sp2s9cd, sp2s10d, sp2s11ad, sp2s11bd, sp2s11cd,
sp2s11dd, sp2s11ed, sp2s12d, sp2s13d, sp2s30d, sp2s31d, sp2s32d,
sp2s33d, sp2s34ad, sp2s34bd, sp2s34cd, sp2s34dd, sp2s34ed, sp2s34fd,
sp2s34gd, sp2s34hd, sp2s34id, sp2s40d, sp2s41d, sp2s42d, sp2s43d,
sp2s44ad, sp2s44bd, sp2s44cd, sp2s44dd, sp2s44ed, sp2s44fd, sp2s44gd,
sp2s44hd, sp2s44id, sp2s44jd, sp2s44kd, Q1, Q2, Q3A, Q3B, Q3C, Q4, Q5A,
Q5B, Q5C, Q6, Q8, Q9, Q10, Q11, Q13, Q13A, Q14A, Q14B,
Q14C, Q15A, Q15B, Q15C, Q16A, Q16B, Q16C1, Q16C2, Q16C3, Q16C4, Q16CC,
Q17, Q17A, Q18, Q19A, Q19B, Q19C, Q19D, Q20A, Q20B, Q21, Q22A1, Q22A2,
Q22B1, Q21B2, Q22C1, Q22C2, Q22D1, Q22D2, Q22E1, Q22E2, Q22F1, Q22F2,
Q22G1, Q22G2, Q22H1, Q22H2, Q22I1, Q22I2, Q22J1, Q22J2, Q22J3, Q22K,
Q23A1, Q23A2, Q23B1, Q23B2, Q23C1, Q23C2, Q23D1, Q23D2, Q23E1, Q23E2,
Q23F1, Q23F2, Q23G1, Q23G2, Q23H1, Q23H2, Q23I1, Q23I2, Q23I3, Q23K,
Q24, Q25, Q25A, Q26, Q27A, Q27B, Q27C, Q27D, Q27E, Q27F, Q27G, Q27H,
Q27I, Q27J, Q27K, Q27K1, Q28A, Q28A1, Q28B, Q28B1, Q28C, Q28C1, Q29,Q30,
Q31, Q32, Q33, Q33A, Q34, Q35, income, tc1s1, tc2s1, tc1s2a, tc2s2a,
tc1s2b, tc2s2b, tc1s3, tc2s3, tc1s4, tc2s4, tc1s5, tc2s5, tc1s6, tc2s6,
tc1s7, tc2s7, tc1s8, tc2s8, tc1s9a, tc2s9a, tc1s9b, tc2s9b, tc1s9c,
tc2s9c, tc1s10, tc2s10, tc1s11a, tc2s11a, tc1s11b, tc2s11b, tc1s11c,
tc2s11c, tc1s11d, tc2s11d, tc1s11e, tc2s11e, tc1s12, tc2s12, tc1s13,
tc2s13, tc1s30, tc2s30, tc1s31, tc2s31, tc1s32, tc2s32, tc1s33, tc2s33,
tc1s34a, tc2s34a, tc1s34b, tc2s34b, tc1s34c, tc2s34c, tc1s34d, tc2s34d,
tc1s34e, tc2s34e, tc1s34f, tc2s34f, tc1s34g, tc2s34g, tc1s34h, tc2s34h,
tc1s34i, tc2s34i, tc1s40, tc2s40, tc1s41, tc2s41, tc1s42, tc2s42,
tc1s43, tc2s43, tc1s44a, tc2s44a, tc1s44b, tc2s44b, tc1s44c, tc2s44c,
tc1s44d, tc2s44d, tc1s44e, tc2s44e, tc1s44f, tc2s44f, tc1s44g, tc2s44g,
tc1s44h, tc2s44h, tc1s44i, tc2s44i, tc1s44j, tc2s44j, tc1s44k, tc2s44k,
s1hr, s2ahr, s2bhr, s3hr, s4hr, s5hr, s6hr, s7hr, s8hr, s9ahr, s9bhr,
```

```
s9chr, s10hr, s11ahr, s11bhr, s11chr, s11dhr, s11ehr, s12hr, s13hr,
s30hr, s31hr, s32hr, s33hr, s34ahr, s34bhr,
s34chr, s34dhr, s34ehr, s34fhr, s34ghr, s34hhr, s34ihr, s40hr, s41hr,
s42hr, s43hr, snoinvst, s44ahr, s44bhr, s44chr, s44dhr, s44ehr, s44fhr,
s44ghr, s44hhr, s44ihr, s44jhr, s44khr, s1eldf, s2aeldf, s2beldf,
s3eldf, s4eldf, s5eldf, s6eldf, s7eldf, s8eldf, s9aeldf, s9beldf,
s9celdf, s10eldf, s11aeldf, s11beldf, s11celdf, s11deldf, s11eeldf,
s12eldf, s13eldf, s30eldf, s31eldf, s32eldf, s33eldf, s34aeldf,
s34beldf, s34celdf, s34deldf, s34eeldf, s34feldf, s34geldf, s34heldf,
s34ieldf, s40eldf, s41eldf, s42eldf, s43eldf, s44aeldf, s44beldf,
s44celdf, s44deldf, s44eeldf, s44feldf, s44geldf, s44heldf, s44ieldf,
s44jeldf, s44keldf, topfeat, yrssnow, club, weeknd, weekd s1tlgm,
s2atlgm, s2btlgm, s3tlgm, s4tlgm, s5tlgm, s6tlgm, s7tlgm, s8tlgm,
s9atlgm, s9btlgm, s9ctlgm, s10tlgm, s11atlgm, s11btlgm, s11ctlgm,
s11dtlgm, s11etlgm, s12tlgm, s13tlgm, s30tlgm, s31tlgm, s32tlgm,
s33tlgm, s34atlgm, s34btlgm, s34ctlgm, s34dtlgm, s34etlgm, s34ftlgm,
s34gtlgm, s34htlgm, s34itlgm, s40tlgm, s41tlgm, s42tlgm, s43tlgm,
s44atlgm, s44btlgm, s44ctlgm, s44dtlgm, s44etlgm, s44ftlgm, s44gtlgm,
s44htlgm, s44itlgm, s44jtlgm, s44ktlgm;

endata;
```

Table B.3 Gauss Code Used for Estimation of 3 Nested Logit Random Utility Model for Multiple Trip – Single Destination Per Trip Segment Reported in Chapter 2.

```
/* x=loadd("multmod");
nm=getname("multmod");
call makevars(x,0,nm); */

/* The above statements are executed prior to activating model file.
This uses variable names in dataset so variables do not have to be
referred to in matrix form /*

library maxlik;
#include maxlik.ext;
maxset;

output file=tc13nla.out reset;

/* Following dataloop, this is YNP 3 level nested logit model - October,
2003 */

/* Loading maximum likelihood module */

dataset="multmod";

/* data set created in data loop "dattrans" and stored as gauss set
"multmod"  sing the above so that variable names can be used in the
model statements */

proc li(b, x);

x=loadd("multmod");
nm=getname("multmod");
call makevars(x,0,nm);

/* Gauss procedure used to generate the ln of the likelihood function */

local evs1, evs2a, evs2b, evs3, evs4, evs5, evs6, evs7, evs8, evs9a,
evs9b, evs9c, evs10, evs11a, evs11b, evs11c, evs11d, evs11e, evs12,
evs13, evs30, evs31, evs32, evs33, evs34a, evs34b, evs34c, evs34d,
evs34e, evs34f, evs34g, evs34h, evs34i, evs40, evs41, evs42, evs43,
evs44a, evs44b, evs44c, evs44d, evs44e, evs44f, evs44g, evs44h, evs44i,
evs44j, evs44k, evnonp, vs1, vs2a, vs2b, vs3, vs4, vs5, vs6, vs7, vs8,
vs9a, vs9b, vs9c, vs10, vs11a, vs11b, vs11c, vs11d, vs11e, vs12, vs13,
vs30, vs31, vs32, vs33, vs34a, vs34b, vs34c, vs34d, vs34e, vs34f, vs34g,
vs34h, vs34i, vs40, vs41, vs42, vs43, vs44a, vs44b, vs44c, vs44d, vs44e,
vs44f, vs44g, vs44h, vs44i, vs44j, vs44k, vnonp, inclpart, inclden,
linclden, lsumpart, inclynp, lsumynp, inclros, lsumros;

/* local statement is used to declare variables local to the procedure.
See 12-3 in Gauss User Guide */
```

Table B.3 Gauss Code Used for Estimation of 3 Nested Logit Random Utility Model for Multiple Trip – Single Destination Per Trip Segment Reported in Chapter 2 (continued).

```
/* the following are the conditional indirect utility functions raised
to e (exp) for the site alternatives multiplied by s, i.e., b[16].  Note
that the conditional indirect utility function for non-participation
does not include multiplication by s as it cancels out.  See Morey "Two
Rums Uncloaked" in Herriges and Kling (1999)for equations that
derivations can be made from for both 2 level and 3 level nested logit
models */

/* The following defines the parameters and variables used in the model:
b[1] through b[8] are parameter estimates for travel cost (tc#s#),
travel time (s#hrs), miles of trail (ss#lng) scaled /100, interaction
between miles of trail and grooming 50% or more of trail (s#tlgm), 50%
or more groomed trails (s#grm), presence of services on or near trail
(s#srv), elevation difference between high and low point on trail
(s#eldf) scaled /1000, average inches of snowpack on trail for 2001-02
(sn02s#), b[9] is parameter estimate for whether respondent belongs to
snowmobile club (club), b[10] is a constant, b[11] estimate on
respondent's annual investment in snowmobile equipment from survey
(snoinvst), b[12] and b[13] are parameters for binary variables on
whether respondents snowmobiled on weekend (weeknd) or week days (weekd)
with base being snowmobiling only on holidays,  b[14] is parameter for
response to question 32 in survey regarding respondent's education level
(q32), b[15] is parameter for number of years snowmobiled by respondent
(yrssnow) */

/* Nest for all Wyoming, Idaho, and Montana Sites in choice set except
YNP, GTNP, Mesa Falls, Big Springs,
 and Two Top */

evs1=exp(b[16]*(b[1]*tc1s1 + b[2]*s1hr + b[3]*ss1lng + b[4]*s1tlgm +
b[5]*s1grm + b[6]*s1srv + b[7]*s1eldf + b[8]*sn02s1));
evs2a=exp(b[16]*(b[1]*tc1s2a + b[2]*s2ahr + b[3]*ss2alng + b[4]*s2atlgm
+ b[5]*s2agrm + b[6]*s2asrv + b[7]*s2aeldf + b[8]*sn02s2a));
evs2b=exp(b[16]*(b[1]*tc1s2b + b[2]*s2bhr + b[3]*ss2blng + b[4]*s2btlgm
+ b[5]*s2bgrm + b[6]*s2bsrv + b[7]*s2beldf + b[8]*sn02s2b));
evs3=exp(b[16]*(b[1]*tc1s3 + b[2]*s3hr + b[3]*ss3lng + b[4]*s3tlgm +
b[5]*s3grm + b[6]*s3srv + b[7]*s3eldf + b[8]*sn02s3));
evs4=exp(b[16]*(b[1]*tc1s4 + b[2]*s4hr + b[3]*ss4lng + b[4]*s4tlgm +
b[5]*s4grm + b[6]*s4srv + b[7]*s4eldf + b[8]*sn02s4));
evs5=exp(b[16]*(b[1]*tc1s5 + b[2]*s5hr + b[3]*ss5lng + b[4]*s5tlgm +
b[5]*s5grm + b[6]*s5srv + b[7]*s5eldf + b[8]*sn02s5));
evs6=exp(b[16]*(b[1]*tc1s6 + b[2]*s6hr + b[3]*ss6lng + b[4]*s6tlgm +
b[5]*s6grm + b[6]*s6srv + b[7]*s6eldf + b[8]*sn02s6));
evs7=exp(b[16]*(b[1]*tc1s7 + b[2]*s7hr + b[3]*ss7lng + b[4]*s7tlgm +
b[5]*s7grm + b[6]*s7srv + b[7]*s7eldf + b[8]*sn02s7));
evs8=exp(b[16]*(b[1]*tc1s8 + b[2]*s8hr + b[3]*ss8lng + b[4]*s8tlgm +
b[5]*s8grm + b[6]*s8srv + b[7]*s8eldf + b[8]*sn02s8));
evs9a=exp(b[16]*(b[1]*tc1s9a + b[2]*s9ahr + b[3]*ss9alng + b[4]*s9atlgm
+ b[5]*s9agrm + b[6]*s9asrv + b[7]*s9aeldf + b[8]*sn02s9a));
evs9b=exp(b[16]*(b[1]*tc1s9b + b[2]*s9bhr + b[3]*ss9blng + b[4]*s9btlgm
+ b[5]*s9bgrm + b[6]*s9bsrv + b[7]*s9beldf + b[8]*sn02s9b));
evs9c=exp(b[16]*(b[1]*tc1s9c + b[2]*s9chr + b[3]*ss9clng + b[4]*s9ctlgm
+ b[5]*s9cgrm + b[6]*s9csrv + b[7]*s9celdf + b[8]*sn02s9c));
```

Table B.3 Gauss Code Used for Estimation of 3 Nested Logit Random Utility Model for Multiple Trip – Single Destination Per Trip Segment Reported in Chapter 2 (continued).

```
evs10=exp(b[16]*(b[1]*tcls10 + b[2]*s10hr + b[3]*ss10lng + b[4]*s10tlgm
+ b[5]*s10grm + b[6]*s10srv + b[7]*s10eldf + b[8]*sn02s10));
evs11a=exp(b[16]*(b[1]*tcls11a + b[2]*s11ahr + b[3]*ss11alng +
b[4]*s11atlgm + b[5]*s11agrm + b[6]*s11asrv + b[7]*s11aeldf +
b[8]*sn02s11a));
evs11b=exp(b[16]*(b[1]*tcls11b + b[2]*s11bhr + b[3]*ss11blng +
b[4]*s11btlgm + b[5]*s11bgrm + b[6]*s11bsrv + b[7]*s11beldf +
b[8]*sn02s11b));
evs11c=exp(b[16]*(b[1]*tcls11c + b[2]*s11chr + b[3]*ss11clng +
b[4]*s11ctlgm + b[5]*s11cgrm + b[6]*s11csrv + b[7]*s11celdf +
b[8]*sn02s11c));
evs11d=exp(b[16]*(b[1]*tcls11d + b[2]*s11dhr + b[3]*ss11dlng +
b[4]*s11dtlgm + b[5]*s11dgrm + b[6]*s11dsrv + b[7]*s11deldf +
b[8]*sn02s11d));
evs11e=exp(b[16]*(b[1]*tcls11e + b[2]*s11ehr + b[3]*ss11elng +
b[4]*s11etlgm + b[5]*s11egrm + b[6]*s11esrv + b[7]*s11eeldf +
b[8]*sn02s11e));

evs30=exp(b[16]*(b[1]*tcls30 + b[2]*s30hr + b[3]*ss30lng + b[4]*s30tlgm
+ b[5]*s30grm + b[6]*s30srv + b[7]*s30eldf +
b[8]*sn02s30));
evs31=exp(b[16]*(b[1]*tcls31 + b[2]*s31hr + b[3]*ss31lng + b[4]*s31tlgm
+ b[5]*s31grm + b[6]*s31srv + b[7]*s31eldf +
b[8]*sn02s31));
evs32=exp(b[16]*(b[1]*tcls32 + b[2]*s32hr + b[3]*ss32lng + b[4]*s32tlgm
+ b[5]*s32grm + b[6]*s32srv + b[7]*s32eldf +
b[8]*sn02s32));
evs33=exp(b[16]*(b[1]*tcls33 + b[2]*s33hr + b[3]*ss33lng + b[4]*s33tlgm
+ b[5]*s33grm + b[6]*s33srv + b[7]*s33eldf +
b[8]*sn02s33));
evs34a=exp(b[16]*(b[1]*tcls34a + b[2]*s34ahr + b[3]*ss34alng +
b[4]*s34atlgm + b[5]*s34agrm + b[6]*s34asrv + b[7]*s34aeldf +
b[8]*sn02s34a));
evs34b=exp(b[16]*(b[1]*tcls34b + b[2]*s34bhr + b[3]*ss34blng +
b[4]*s34btlgm + b[5]*s34bgrm + b[6]*s34bsrv + b[7]*s34beldf +
b[8]*sn02s34b));
evs34c=exp(b[16]*(b[1]*tcls34c + b[2]*s34chr + b[3]*ss34clng +
b[4]*s34ctlgm + b[5]*s34cgrm + b[6]*s34csrv + b[7]*s34celdf +
b[8]*sn02s34c));
evs34d=exp(b[16]*(b[1]*tcls34d + b[2]*s34dhr + b[3]*ss34dlng +
b[4]*s34dtlgm + b[5]*s34dgrm + b[6]*s34dsrv + b[7]*s34deldf +
b[8]*sn02s34d));
evs34e=exp(b[16]*(b[1]*tcls34e + b[2]*s34ehr + b[3]*ss34elng +
b[4]*s34etlgm + b[5]*s34egrm + b[6]*s34esrv + b[7]*s34eeldf +
b[8]*sn02s34e));
evs34f=exp(b[16]*(b[1]*tcls34f + b[2]*s34fhr + b[3]*ss34flng +
b[4]*s34ftlgm + b[5]*s34fgrm + b[6]*s34fsrv + b[7]*s34feldf +
b[8]*sn02s34f));
evs34g=exp(b[16]*(b[1]*tcls34g + b[2]*s34ghr + b[3]*ss34glng +
b[4]*s34gtlgm + b[5]*s34ggrm + b[6]*s34gsrv + b[7]*s34geldf +
b[8]*sn02s34g));
evs34h=exp(b[16]*(b[1]*tcls34h + b[2]*s34hhr + b[3]*ss34hlng +
```

Table B.3 Gauss Code Used for Estimation of 3 Nested Logit Random Utility Model for Multiple Trip – Single Destination Per Trip Segment Reported in Chapter 2 (continued).

```
b[4]*s34htlgm + b[5]*s34hgrm + b[6]*s34hsrv + b[7]*s34heldf +
b[8]*sn02s34h));
evs34i=exp(b[16]*(b[1]*tcls34i + b[2]*s34ihr + b[3]*ss34ilng +
b[4]*s34itlgm + b[5]*s34igrm + b[6]*s34isrv + b[7]*s34ieldf +
b[8]*sn02s34i));
evs40=exp(b[16]*(b[1]*tcls40 + b[2]*s40hr + b[3]*ss40lng + b[4]*s40tlgm
+ b[5]*s40grm + b[6]*s40srv + b[7]*s40eldf +
b[8]*sn02s40));

evs44a=exp(b[16]*(b[1]*tcls44a + b[2]*s44ahr + b[3]*ss44alng +
b[4]*s44atlgm + b[5]*s44agrm + b[6]*s44asrv + b[7]*s44aeldf +
b[8]*sn02s44a));
evs44b=exp(b[16]*(b[1]*tcls44b + b[2]*s44bhr + b[3]*ss44blng +
b[4]*s44btlgm + b[5]*s44bgrm + b[6]*s44bsrv + b[7]*s44beldf +
b[8]*sn02s44b));
evs44c=exp(b[16]*(b[1]*tcls44c + b[2]*s44chr + b[3]*ss44clng +
b[4]*s44ctlgm + b[5]*s44cgrm + b[6]*s44csrv + b[7]*s44celdf +
b[8]*sn02s44c));
evs44d=exp(b[16]*(b[1]*tcls44d + b[2]*s44dhr + b[3]*ss44dlng +
b[4]*s44dtlgm + b[5]*s44dgrm + b[6]*s44dsrv + b[7]*s44deldf +
b[8]*sn02s44d));
evs44e=exp(b[16]*(b[1]*tcls44e + b[2]*s44ehr + b[3]*ss44elng +
b[4]*s44etlgm + b[5]*s44egrm + b[6]*s44esrv + b[7]*s44eeldf +
b[8]*sn02s44e));
evs44f=exp(b[16]*(b[1]*tcls44f + b[2]*s44fhr + b[3]*ss44flng +
b[4]*s44ftlgm + b[5]*s44fgrm + b[6]*s44fsrv + b[7]*s44feldf +
b[8]*sn02s44f));
evs44g=exp(b[16]*(b[1]*tcls44g + b[2]*s44ghr + b[3]*ss44glng +
b[4]*s44gtlgm + b[5]*s44ggrm + b[6]*s44gsrv + b[7]*s44geldf +
b[8]*sn02s44g));
evs44h=exp(b[16]*(b[1]*tcls44h + b[2]*s44hhr + b[3]*ss44hlng +
b[4]*s44htlgm + b[5]*s44hgrm + b[6]*s44hsrv + b[7]*s44heldf +
b[8]*sn02s44h));
evs44i=exp(b[16]*(b[1]*tcls44i + b[2]*s44ihr + b[3]*ss44ilng +
b[4]*s44itlgm + b[5]*s44igrm + b[6]*s44isrv + b[7]*s44ieldf +
b[8]*sn02s44i));
evs44j=exp(b[16]*(b[1]*tcls44j + b[2]*s44jhr + b[3]*ss44jlng +
b[4]*s44jtlgm + b[5]*s44jgrm + b[6]*s44jsrv + b[7]*s44jeldf +
b[8]*sn02s44j));
evs44k=exp(b[16]*(b[1]*tcls44k + b[2]*s44khr + b[3]*ss44klng +
b[4]*s44ktlgm + b[5]*s44kgrm + b[6]*s44ksrv + b[7]*s44keldf +
b[8]*sn02s44k));

/* Nest consisting of GTNP, YNP, Mesa Falls, Two Top, and Big Springs */

evs12=exp(b[16]*(b[1]*tcls12 + b[2]*s12hr + b[3]*ss12lng + b[4]*s12tlgm
+ b[5]*s12grm + b[6]*s12srv + b[7]*s12eldf + b[8]*sn02s12));
evs13=exp(b[16]*(b[1]*tcls13 + b[2]*s13hr + b[3]*ss13lng + b[4]*s13tlgm
+ b[5]*s13grm + b[6]*s13srv + b[7]*s13eldf + b[8]*sn02s13));
evs41=exp(b[16]*(b[1]*tcls41 + b[2]*s41hr + b[3]*ss41lng + b[4]*s41tlgm
+ b[5]*s41grm + b[6]*s41srv + b[7]*s41eldf + b[8]*sn02s41));
```

Table B.3 Gauss Code Used for Estimation of 3 Nested Logit Random Utility Model for Multiple Trip – Single Destination Per Trip Segment Reported in Chapter 2 (continued).

```
evs42=exp(b[16]*(b[1]*tcls42 + b[2]*s42hr + b[3]*ss42lng + b[4]*s42tlgm
+ b[5]*s42grm + b[6]*s42srv + b[7]*s42eldf + b[8]*sn02s42));
evs43=exp(b[16]*(b[1]*tcls43 + b[2]*s43hr + b[3]*ss43lng + b[4]*s43tlgm
+ b[5]*s43grm + b[6]*s43srv + b[7]*s43eldf + b[8]*sn02s43));

/* the next line is the conditional indirect utility for non-
participation (e raised to the vnonp) */

evnonp=exp(b[9]*club + b[10] + b[11]*snoinvst + b[12]*weeknd +
b[13]*weekd + b[14]*Q32 + b[15]*yrssnow);

/* taking ln of above equations */

vs1=ln(evs1); vs2a=ln(evs2a); vs2b=ln(evs2b); vs3=ln(evs3);
vs4=ln(evs4); vs5=ln(evs5); vs6=ln(evs6); vs7=ln(evs7); vs8=ln(evs8);
vs9a=ln(evs9a); vs9b=ln(evs9b); vs9c=ln(evs9c); vs10=ln(evs10);
vs11a=ln(evs11a); vs11b=ln(evs11b); vs11c=ln(evs11c); vs11d=ln(evs11d);
vs11e=ln(evs11e); vs12=ln(evs12); vs13=ln(evs13); vs30=ln(evs30);
vs31=ln(evs31); vs32=ln(evs32); vs33=ln(evs33); vs34a=ln(evs34a);
vs34b=ln(evs34b); vs34c=ln(evs34c); vs34d=ln(evs34d); vs34e=ln(evs34e);
vs34f=ln(evs34f); vs34g=ln(evs34g); vs34h=ln(evs34h); vs34i=ln(evs34i);
vs40=ln(evs40); vs41=ln(evs41); vs42=ln(evs42); vs43=ln(evs43);
vs44a=ln(evs44a); vs44b=ln(evs44b); vs44c=ln(evs44c); vs44d=ln(evs44d);
vs44e=ln(evs44e); vs44f=ln(evs44f); vs44g=ln(evs44g); vs44h=ln(evs44h);
vs44i=ln(evs44i); vs44j=ln(evs44j); vs44k=ln(evs44k); vnonp=ln(evnonp);

/* two nests for sites - inclynp = nest with YNP, GTNP, Two Top, Big
Springs and Mesa Falls inclros = nest with rest of other sites in choice
set NOTE: b[17]=t, b[16]=s */

inclynp=(evs12 + evs13 + evs41 + evs42 + evs43)^(b[17]/b[16]);
inclros=(evs1 + evs2a + evs2b + evs3 + evs4 + evs5 + evs6 + evs7 + evs8
+ evs9a + evs9b + evs9c + evs10 + evs11a + evs11b + evs11c + evs11d +
evs11e + evs30 + evs31 + evs32 + evs33 + evs34a + evs34b + evs34c +
evs34d + evs34e + evs34f + evs34g + evs34h + evs34i + evs40 + evs44a +
evs44b + evs44c + evs44d + evs44e + evs44f + evs44g + evs44h + evs44i +
evs44j + evs44k)^(b[17]/b[16]);
inclpart=(inclynp + inclros)^(1/b[17]);

/* inclden is denominator in all of the probabilities see Morey as
referenced above */

inclden= evnonp + inclpart;
linclden=ln(inclden);

/* numerator of probabilities*/

lsumpart=((1/b[17])-1)*ln(inclynp +inclros);
lsumynp=((b[17]/b[16])-1)*ln(evs12 + evs13 + evs41 + evs42 + evs43);
lsumros=((b[17]/b[16])-1)*ln(evs1 + evs2a + evs2b + evs3 + evs4 + evs5 +
evs6 + evs7 + evs8 + evs9a + evs9b + evs9c + evs10 + evs11a + evs11b +
evs11c + evs11d + evs11e + evs30 + evs31 + evs32 + evs33 + evs34a +
evs34b + evs34c + evs34d + evs34e + evs34f + evs34g + evs34h + evs34i +
```

Table B.3 Gauss Code Used for Estimation of 3 Nested Logit Random Utility Model for Multiple Trip – Single Destination Per Trip Segment Reported in Chapter 2 (continued).

```
evs40 + evs44a + evs44b + evs44c + evs44d + evs44e + evs44f +
evs44g + evs44h + evs44i + evs44j + evs44k);

/* the next command calculates the contribution to the log of the
likelihood function for each individual in the sample */

retp(rps1t .* (vs1 + lsumpart + lsumros - linclden) + rps2at .* (vs2a +
lsumpart + lsumros - linclden) + rps2bt .* (vs2b + lsumpart + lsumros -
linclden) + rps3t .* (vs3 + lsumpart + lsumros - linclden) + rps4t .*
(vs4 + lsumpart + lsumros - linclden) + rps5t .* (vs5 + lsumpart +
lsumros - linclden) + rps6t .* (vs6 + lsumpart + lsumros - linclden) +
rps7t .* (vs7 + lsumpart + lsumros - linclden) + rps8t .* (vs8 +
lsumpart + lsumros - linclden) + rps9at .* (vs9a + lsumpart + lsumros -
linclden) + rps9bt .* (vs9b + lsumpart + lsumros - linclden) + rps9ct .*
(vs9c + lsumpart + lsumros - linclden) + rps10t .* (vs10 + lsumpart +
lsumros - linclden) +   rps11at .* (vs11a + lsumpart + lsumros -
linclden) + rps11bt .* (vs11b + lsumpart + lsumros - linclden) + rps11ct
.* (vs11c + lsumpart + lsumros - linclden) + rps11dt .* (vs11d +
lsumpart + lsumros - linclden) +    rps11et .* (vs11e + lsumpart +
lsumros - linclden) + rps12t .* (vs12 + lsumpart + lsumynp - linclden) +
rps13t .* (vs13 + lsumpart + lsumynp - linclden) + rps30t .* (vs30 +
lsumpart + lsumros - linclden) + rps31t .* (vs31 + lsumpart + lsumros -
linclden) + rps32t .* (vs32 + lsumpart + lsumros - linclden) + rps33t .*
(vs33 + lsumpart + lsumros - linclden) + rps34at .* (vs34a + lsumpart +
lsumros - linclden) + rps34bt .* (vs34b + lsumpart + lsumros - linclden)
+ rps34ct .* (vs34c + lsumpart + lsumros - linclden) + rps34dt .* (vs34d
+ lsumpart + lsumros - linclden) + rps34et .* (vs34e + lsumpart +
lsumros -linclden) + rps34ft .* (vs34f + lsumpart + lsumros - linclden)
+ rps34gt .* (vs34g + lsumpart + lsumros - linclden) + rps34ht .* (vs34h
+ lsumpart + lsumros - linclden) + rps34it .* (vs34i + lsumpart +
lsumros - linclden) + rps40t .* (vs40 + lsumpart + lsumros - linclden) +
      rps41t .* (vs41 + lsumpart + lsumynp - linclden) + rps42t .* (vs42
+ lsumpart + lsumynp -linclden) + rps43t .* (vs43 + lsumpart + lsumynp -
linclden) + rps44at .* (vs44a + lsumpart + lsumros - linclden) + rps44bt
.* (vs44b + lsumpart + lsumros - linclden) + rps44ct .* (vs44c +
lsumpart + lsumros - linclden) + rps44dt .* (vs44d + lsumpart + lsumros
- linclden) + rps44et .* (vs44e + lsumpart + lsumros - linclden) +
rps44ft .* (vs44f + lsumpart + lsumros - linclden) + rps44gt .* (vs44g +
lsumpart + lsumros - linclden) + rps44ht .* (vs44h + lsumpart + lsumros
- linclden) + rps44it .* (vs44i + lsumpart + lsumros - linclden) +
rps44jt .* (vs44j + lsumpart + lsumros - linclden) + rps44kt .* (vs44k +
lsumpart + lsumros - linclden) + nonpt .* (vnonp - linclden));
endp;

/* starting values*/

start = { -.0131, -.5921, -.0188, .0162, -0.0863, 0.1739, .1089, -.0013,
-.3370, 5.5026, -.0689,     -.4018, -.6732, .0336, -.0227, 3.4645,
0.5000 };

_title="nstl-3 rp Yellowstone National Park";
_max_MaxIters=2000;
```

Table B.3 Gauss Code Used for Estimation of 3 Nested Logit Random Utility Model for Multiple Trip – Single Destination Per Trip Segment Reported in Chapter 2 (continued).

```
_max_GradTol=0.0001;
```

```
_max_Active= { 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1 };

/* maxlik format for estimation procedure, output and input where maxprt
formats and prints the output from a call to maxlik.  See pgs 62-74 & 93
in Maximum Likelihood 5.0 module reference guide.  Note: _max_Active
command is used to fix parameter estimates at start values or not -
useful for model building and model testing - 0 fixes
parameter at start value and 1 allows parameter estimate to be estimated
via gradient search */

{ bs,f0,g,h,retcode }=MAXPrt(MAXLIK("multmod", 0, &li, start));

brpynp=bs; save brpynp; output off;
```

Table B.4 Gauss Code Used in for Data Transformation for Random Utility Model for Single Trip to Region – Multiple Destination Segment Reported in Chapter 3.

```
dataloop sngdata singmult;

/* Note: must turn on dataloop translator via the configure portion of
menu or edit gauss.cfg and turn translator to on via notepad or some
ascii editor.  This should not be left on for model runs. The translator
should be turned off for that, particularly big models. */

/* Note: normal logic statements do not work in dataloop.  Must use
statements supported by dataloop. See Gauss User Guide for some clue on
statements supported. */

/* singmult data transformation file is to create data file for single
trip to region - multiple destination segment for analysis from data set
named sngdata. Nonparticipation is entered in survey data as choice
occasions - trips = nonparticipation */

/* code for estimating non-participation based on choice occasions
while in region for stated preference data */

make sp1choic = sp1trips + nonpart;
recode sp1choic with
0 for sp1trips == 0;

make sp1nonp = sp1choic - sp1trips;
recode sp1nonp with
0 for sp1nonp < 0;

make sp2choic = sp2trips + nonpart;
recode sp2choic with
0 for sp2trips == 0;

make sp2nonp = sp2choic - sp2trips;
recode sp2nonp with
0 for sp2nonp < 0;

/* Q32 deals with level of education of survey respondent.  A seven
response means no response in numbered categories. */

recode Q32 with
0 for Q32 == 7;

/* Q31 deals with age category of respondent.  A seven response means no
response in numbered categories. */

recode Q31 with
0 for Q31 ==7;

/* deleting invalid observations for run */

delete id == 639;
delete id == 76;
delete id == 148;
delete id == 1081;
```

Table B.4 Gauss Code Used in for Data Transformation for Random Utility Model for Single Trip to Region – Multiple Destination Segment Reported in Chapter 3 (continued).

```
delete id == 167;
delete Q35 == 16;
delete singmult == 0;
delete choiceoc > 30;

/* converting question 35 to midpoint annual income /10000 for scaling
purposes */

code income default 0 with
    0.2500 for Q35 == 1,
    0.7500 for Q35 == 2,
    1.2500 for Q35 == 3,
    1.7500 for Q35 == 4,
    2.2500 for Q35 == 5,
    2.7500 for Q35 == 6,
    3.2500 for Q35 == 7,
    3.7500 for Q35 == 8,
    4.5000 for Q35 == 9,
    6.2500 for Q35 == 10,
    8.7500 for Q35 == 11,
    12.5000 for Q35 == 12,
    17.5000 for Q35 == 13,
    25.0000 for Q35 == 14,
    35.0000 for Q35 == 15;

/* Estimating two types of site cost variables. SC stands for site cost.
This deals with the estimation of multiple destination costs.  There is
a total trip cost to get to region including, lodging,
repairs, gas and airfare divided by days in region (choiceoc). Cost to a
site equal fixed cost plus variable cost. Estimating two types of
variable travel cost variables. VC1 = individual costs such as lodging,
gas minus snowmobile gas, and trip repairs within region.  These are
summed and divided by YNP distance to get a rate/mile then multiplied by
site distance; VC2= roundtrip distance multiplied by 0.2185. As
proportion of costs spent outside region go down, fixed costs become
proportionally less of total site cost. */

/* Estimate expenditure on gas for snowmobiles to be subtracted from
total gas expenditures */

recode Q21 with
0 for Q21 == 999999;

make rps13tg = rps13t;
recode rps13tg with
1 for rps13t <= 0;
make snogas = Q21*(rps13d/rps13tg)*1.35;
recode snogas with
0 for snogas > Q22D2;

/* including "other" category if flew on plane and snowmobile rental
costs */
```

Table B.4 Gauss Code Used in for Data Transformation for Random Utility Model for Single Trip to Region – Multiple Destination Segment Reported in Chapter 3 (continued).

```
make snowrnt = Q22G2;
recode snowrnt with
0 for Q22G2 == 999999;

make airtckt=Q22J1;
recode airtckt with
0 for Q22J1 == 999999,
0 for Q16C2 == 0;

/* making # of people variable to divide into costs */

make pepl=Q22K;
recode pepl with
1 for Q22K == 999999,
1 for Q22K == 0,
1 for Q22K == 2500;

/* estimating trip costs in and out of region including airfare */

delete Q22A1 == 999999;
delete Q22D1 == 999999;
delete Q22E1 == 999999;
delete Q22A2 == 999999;
delete Q22D2 == 999999;
delete Q22E2 == 999999;

/* total trip cost */

make totpcst=(Q22A1+Q22D1+Q22E1+airtckt+snowrnt) ./ pepl;
delete totpcst == 0;

/* trip costs within WY, ID, MT */

make retpcst=(Q22A2+Q22D2+Q22E2+snowrnt-snogas)./ pepl;

/* trip costs outside of region for fixed cost estimate.  Observed in
data that if total trip cost is less than regional trip cost respondents
are most likely separating trip costs into costs within WY, MT, ID and
outside that region.  Thus, when outcost is negative do transformation
to account for that */

make outcost = totpcst - retpcst;
code outpos default 0 with
1 for outcost >= 0;

code outneg default 0 with
1 for outcost < 0;
make outpcst  = (outcost .* outpos) + (((totpcst + retpcst) - retpcst)
.* outneg);

code outzro default 0 with
1 for outcost == 0;
make dynp = (s13te ./ 10);
```

Table B.4 Gauss Code Used in for Data Transformation for Random Utility Model for Single Trip to Region – Multiple Destination Segment Reported in Chapter 3 (continued).

```
make fxcost = ((outpcst ./ choiceoc) + ((totpcst ./ choiceoc) .*dynp .*
outzro));

make g13dist=g13de;
recode g13dist with
1 for g13de == 0;

/* variable cost rate to YNP from gateway community using
expenditures data = VC1.  VC1 is based on regional trip expenditures
apportioned by total days at YNP site/ total days within region
on most recent trip.  That figure is divided by round trip
distance figures from gateway community to YNP to get rate per
mile used in VC1 figures. Variable Cost 2 is standard mileage
rate of 0.2185/mi * roundtrip distance from gateway community
= VC2 */

make vc1 = ((retpcst/choiceoc)*(rps13d/rps13tg))/(g13dist*2);
code vc1zro default 0 with
1 for vc1 == 0;
make vc1rate = vc1 + (0.2185*vc1zro);

/* coding days per trip for a site to estimate fixed cost to site */

make s1d = (g1te ./ 10)*2;
code s1ntp default 0 with
1 for rps1t == 0;
code s1tp default 0 with
1 for rps1t > 0;
make s1dtp = ((1 .* s1ntp) + (s1tp .* (rps1d ./ (rps1t + s1ntp))));


/* fcs1 = fixed cost for site 1 where fixed costs are based on trip
costs to region divided by days in region * times days to get to site
from YNP and time on site. sc1s1 = site cost for site 1 where it is fcs1
plus vc1 for site1 and sc2s1 = site cost for site 1 where it is fcs1
plus vc2 for site 1.  All other site costs follow this pattern. */

make fcs1 =(s1d .* fxcost) + (s1dtp .* fxcost);
make vc1s1 = (vc1rate .* g1de .* 2);
make vc2s1 = (0.2185 .* g1de .* 2);

/* scaling site costs by 100 */

make sc1s1 = (fcs1 + vc1s1) .* 0.01;
make sc2s1 = (fcs1 + vc2s1) .* 0.01;

/* site cost coding for sites 2 through 44k */

.
.
(repeat for rest of sites)
.
```

Table B.4 Gauss Code Used in for Data Transformation for Random Utility Model for Single Trip to Region – Multiple Destination Segment Reported in Chapter 3 (continued).

```
.
make s44kd = (g44kte/10)*2;
code s44kntp default 0 with
1 for rps44kt == 0;
code s44ktp default 0 with
1 for rps44kt > 0;
make s44kdtp = ((1 .* s44kntp) + (s44ktp .* (rps44kd ./ (rps44kt +
s44kntp))));
make fcs44k =(s44kd .* fxcost) + (s44kdtp .* fxcost);
make vc1s44k = (vc1rate .* g44kde .* 2);
make vc2s44k = (0.2185 .* g44kde .* 2);
make sc1s44k = (fcs44k + vc1s44k) .* 0.01;
make sc2s44k = (fcs44k + vc2s44k) .* 0.01;

/* investment in snowmobile equipment scaled by /1000 */

recode Q23A1 with
0 for Q23A1 == 999999;
recode Q23B1 with
0 for Q23B1 == 999999;
recode Q23C1 with
0 for Q23C1 == 999999;
recode Q23D1 with
0 for Q23D1 == 999999;
recode Q23G1 with
0 for Q23G1 == 999999;

make snoinvst=(Q23A1+Q23B1+Q23C1+Q23D1+Q23G1) .* 0.001;

/* create elevation difference for each site scaled by /1000 */

make s1eldf=(s1evh-s1evl) .* 0.001;
.
.
(repeat for rest of sites)
.
.

make s44keldf=(s44kevh-s44kevl) .* 0.001;

/* creating scaled length of trail variable ex. s1lng/10 = ss1lng */

make ss1lng=(s1lng) .* 0.1;
.
.
(repeat for rest of sites)
.
.

make ss44klng=(s44klng) .* 0.1;

/* creating interaction variable between miles of trail and groom (at
least 50%) or not */
```

Table B.4 Gauss Code Used in for Data Transformation for Random Utility Model for Single Trip to Region – Multiple Destination Segment Reported in Chapter 3 (continued).

```
make s1tlgm = ss1lng .* s1grm;
.
.
(repeat for rest of sites)
.
.

make s44ktlgm = ss44klng .* s44kgrm;


/* creating variable as sum of top two features for snowmobiling */

 code feat1 default 0 with
    1 for Q28A == 1,
    2 for Q28A == 2,
    3 for Q28A == 3,
    4 for Q28A == 4,
    5 for Q28A == 5,
    6 for Q28A == 6,
    7 for Q28A == 7,
    8 for Q28A == 8,
    9 for Q28A == 9;
code feat2 default 0 with
    1 for Q28B == 1,
    2 for Q28B == 2,
    3 for Q28B == 3,
    4 for Q28B == 4,
    5 for Q28B == 5,
    6 for Q28B == 6,
    7 for Q28B == 7,
    8 for Q28B == 8,
    9 for Q28B == 9;
make topfeat=feat1+feat2;
make yrssnow=Q1;
recode yrssnow with
0 for yrssnow == 999999;
/*creating a dummy variable for snowmobile club */

    code club default 0 with
    1 for Q6 == 2;

/* creating a dummy variable for snowmobiling only on weekend (weeknd)
or week days (weekd) */

    code weeknd default 0 with
    1 for Q5A > 0 and Q5A < 999999;
    code weekd default 0 with
    1 for Q5B > 0 and Q5B < 999999;

keep id, origin, s1lng, ss1lng, s1grm, s1srv, s1evl, s1evh, s2alng,
ss2alng, s2agrm, s2asrv, s2aevl, s2aevh, s2blng, ss2blng, s2bgrm,
s2bsrv, s2bevl, s2bevh, s3lng, ss3lng, s3grm, s3srv, s3evl, s3evh,
s4lng, ss4lng, s4grm, s4srv, s4evl, s4evh, s5lng, ss5lng, s5grm, s5srv,
```

Table B.4 Gauss Code Used in for Data Transformation for Random Utility Model for Single Trip to Region – Multiple Destination Segment Reported in Chapter 3 (continued).

```
s5evl, s5evh, s6lng, ss6lng, s6grm, s6srv, s6evl, s6evh, s7lng, ss7lng,
s7grm, s7srv, s7evl, s7evh, s8lng, ss8lng, s8grm, s8srv, s8evl, s8evh,
s9alng, ss9alng, s9agrm, s9asrv, s9aevl, s9aevh, s9blng, ss9blng,
s9bgrm, s9bsrv, s9bevl, s9bevh, s9clng, ss9clng, s9cgrm, s9csrv, s9cevl,
s9cevh, s10lng, ss10lng, s10grm, s10srv, s10evl, s10evh, s11alng,
ss11alng, s11agrm, s11asrv, s11aevl, s11aevh, s11blng, ss11blng,
s11bgrm, s11bsrv, s11bevl, s11bevh, s11clng, ss11clng, s11cgrm, s11csrv,
s11cevl, s11cevh, s11dlng, ss11dlng, s11dgrm, s11dsrv, s11devl, s11devh,
s11elng, ss11elng, s11egrm, s11esrv, s11eevl, s11eevh, s12lng, ss12lng,
s12grm, s12srv, s12evl, s12evh, s13lng, ss13lng, s13grm, s13srv, s13evl,
s13evh, s30lng, ss30lng, s30grm, s30srv, s30evl, s30evh, s31lng,
ss31lng, s31grm, s31srv, s31evl, s31evh, s32lng, ss32lng, s32grm,
s32srv, s32evl, s32evh, s33lng, ss33lng, s33grm, s33srv, s33evl, s33evh,
s34alng, ss34alng, s34agrm, s34asrv, s34aevl, s34aevh, s34blng,
ss34blng, s34bgrm, s34bsrv, s34bevl, s34bevh, s34clng, ss34clng,
s34cgrm, s34csrv, s34cevl, s34cevh, s34dlng, ss34dlng, s34dgrm, s34dsrv,
s34devl, s34devh, s34elng, ss34elng, s34egrm, s34esrv, s34eevl, s34eevh,
s34flng, ss34flng, s34fgrm, s34fsrv, s34fevl, s34fevh, s34glng,
ss34glng, s34ggrm, s34gsrv, s34gevl, s34gevh, s34hlng, ss34hlng,
s34hgrm, s34hsrv, s34hevl, s34hevh, s34ilng, ss34ilng, s34igrm, s34isrv,
s34ievl, s34ievh, s40lng,     ss40lng, s40grm, s40srv, s40evl, s40evh,
s41lng, ss41lng, s41grm, s41srv, s41evl, s41evh, s42lng, ss42lng,
s42grm, s42srv, s42evl, s42evh, s43lng, ss43lng, s43grm, s43srv, s43evl,
s43evh,     s44alng, ss44alng, s44agrm, s44asrv, s44aevl,
s44aevh, s44blng, ss44blng, s44bgrm, s44bsrv, s44bevl, s44bevh, s44clng,
ss44clng, s44cgrm, s44csrv, s44cevl, s44cevh, s44dlng, ss44dlng,
s44dgrm, s44dsrv, s44devl, s44devh, s44elng, ss44elng, s44egrm, s44esrv,
s44eevl, s44eevh, s44flng, ss44flng, s44fgrm, s44fsrv, s44fevl, s44fevh,
s44glng, ss44glng, s44ggrm, s44gsrv, s44gevl, s44gevh, s44hlng,
ss44hlng, s44hgrm, s44hsrv, s44hevl,
s44hevh, s44ilng, ss44ilng, s44igrm, s44isrv, s44ievl, s44ievh, s44jlng,
ss44jlng, s44jgrm, s44jsrv, s44jevl, s44jevh, s44klng, ss44klng,
s44kgrm, s44ksrv, s44kevl, s44kevh, sn01s1, sn01s2a, sn01s2b, sn01s3,
sn01s4, sn01s5,   sn01s6, sn01s7, sn01s8, sn01s9a, sn01s9b, sn01s9c,
sn01s10, sn01s11a, sn01s11b, sn01s11c, sn01s11d, sn01s11e, sn01s12,
sn01s13, sn01s30, sn01s31, sn01s32, sn01s33, sn01s34a, sn01s34b,
sn01s34c, sn01s34d, sn01s34e, sn01s34f, sn01s34g, sn01s34h,
sn01s34i, sn01s40, sn01s41, sn01s42, sn01s43, sn01s44a, sn01s44b,
sn01s44c, sn01s44d, sn01s44e, sn01s44f, sn01s44g, sn01s44h, sn01s44i,
sn01s44j, sn01s44k, sn02s1, sn02s2a, sn02s2b, sn02s3, sn02s4, sn02s5,
sn02s6, sn02s7, sn02s8, sn02s9a, sn02s9b, sn02s9c, sn02s10, sn02s11a,
sn02s11b, sn02s11c, sn02s11d, sn02s11e, sn02s12, sn02s13, sn02s30,
sn02s31, sn02s32, sn02s33, sn02s34a, sn02s34b, sn02s34c, sn02s34d,
sn02s34e, sn02s34f, sn02s34g, sn02s34h, sn02s34i, sn02s40, sn02s41,
sn02s42, sn02s43, sn02s44a, sn02s44b, sn02s44c, sn02s44d, sn02s44e,
sn02s44f, sn02s44g, sn02s44h, sn02s44i, sn02s44j, sn02s44k, s13de,
s13te, g1de, g1te, g2ade, g2ate, g2bde, g2bte, g3de, g3te,  g4de, g4te,
g5de, g5te, g6de, g6te, g7de, g7te, g8de, g8te, g9ade, g9ate, g9bde,
g9bte, g9cde, g9cte, g10de, g10te, g11ade, g11ate, g11bde, g11bte,
g11cde, g11cte, g11dde, g11dte, g11ede, g11ete, g12de, g12te, g13de,
g13te, g30de, g30te, g31de, g31te, g32de, g32te, g33de, g33te, g34ade,
g34ate, g34bde, g34bte, g34cde, g34cte, g34dde, g34dte, g34ede, g34ete,
```

Table B.4 Gauss Code Used in for Data Transformation for Random Utility Model for Single Trip to Region – Multiple Destination Segment Reported in Chapter 3 (continued).

```
g34fde, g34fte, g34gde, g34gte, g34hde, g34hte, g34ide, g34ite, g40de,
g40te, g41de, g41te, g42de, g42te, g43de, g43te, g44ade, g44ate, g44bde,
g44bte, g44cde, g44cte, g44dde, g44dte, g44ede, g44ete, g44fde, g44fte,
g44gde, g44gte, g44hde, g44hte, g44ide, g44ite, g44jde, g44jte, g44kde,
g44kte, singmult, choiceoc, tottrips, nonpart, rps1t, rps2at, rps2bt,
rps3t, rps4t, rps5t, rps6t, rps7t, rps8t, rps9at, rps9bt, rps9ct,
rps10t, rps11at, rps11bt, rps11ct, rps11dt, rps11et, rps12t, rps13t,
rps30t, rps31t, rps32t, rps33t, rps34at, rps34bt, rps34ct,rps34dt,
rps34et, rps34ft, rps34gt, rps34ht, rps34it, rps40t, rps41t, rps42t,
rps43t, rps44at, rps44bt, rps44ct, rps44dt, rps44et, rps44ft, rps44gt,
rps44ht, rps44it, rps44jt, rps44kt, rps1d, rps2ad,
rps2bd, rps3d, rps4d, rps5d, rps6d, rps7d, rps8d, rps9ad, rps9bd,
rps9cd, rps10d, rps11ad, rps11bd, rps11cd, rps11dd, rps11ed,
rps12d, rps13d, rps30d, rps31d, rps32d, rps33d, rps34ad, rps34bd,
rps34cd, rps34dd, rps34ed, rps34fd, rps34gd, rps34hd, rps34id,
rps40d, rps41d, rps42d, rps43d, rps44ad, rps44bd, rps44cd, rps44dd,
rps44ed, rps44fd, rps44gd, rps44hd, rps44id, rps44jd, rps44kd, sp1trips,
sp1nonp, sp1s1t, sp1s2at, sp1s2bt, sp1s3t, sp1s4t, sp1s5t, sp1s6t,
sp1s7t, sp1s8t, sp1s9at, sp1s9bt, sp1s9ct, sp1s10t, sp1s11at, sp1s11bt,
sp1s11ct, sp1s11dt,     sp1s11et, sp1s12t, sp1s13t, sp1s30t, sp1s31t,
sp1s32t, sp1s33t, sp1s34at, sp1s34bt, sp1s34ct, sp1s34dt, sp1s34et,
sp1s34ft, sp1s34gt, sp1s34ht, sp1s34it, sp1s40t, sp1s41t, sp1s42t,
sp1s43t, sp1s44at, sp1s44bt, sp1s44ct, sp1s44dt, sp1s44et, sp1s44ft,
sp1s44gt, sp1s44ht, sp1s44it, sp1s44jt, sp1s44kt, sp2trips, sp2nonp,
sp2s1t, sp2s2at, sp2s2bt, sp2s3t, sp2s4t, sp2s5t, sp2s6t,
sp2s7t, sp2s8t, sp2s9at, sp2s9bt, sp2s9ct, sp2s10t, sp2s11at, sp2s11bt,
sp2s11ct, sp2s11dt, sp2s11et, sp2s12t, sp2s13t, sp2s30t, sp2s31t,
sp2s32t, sp2s33t, sp2s34at, sp2s34bt, sp2s34ct, sp2s34dt, sp2s34et,
sp2s34ft, sp2s34gt, sp2s34ht, sp2s34it, sp2s40t, sp2s41t, sp2s42t,
sp2s43t, sp2s44at, sp2s44bt,  sp2s44ct, sp2s44dt, sp2s44et, sp2s44ft,
sp2s44gt, sp2s44ht, sp2s44it, sp2s44jt, sp2s44kt, sp2s1d, sp2s2ad,
sp2s2bd, sp2s3d, sp2s4d, sp2s5d, sp2s6d, sp2s7d, sp2s8d, sp2s9ad,
sp2s9bd, sp2s9cd, sp2s10d, sp2s11ad, sp2s11bd, sp2s11cd, sp2s11dd,
sp2s11ed, sp2s12d, sp2s13d, sp2s30d, sp2s31d, sp2s32d, sp2s33d,
sp2s34ad, sp2s34bd, sp2s34cd, sp2s34dd, sp2s34ed, sp2s34fd, sp2s34gd,
sp2s34hd, sp2s34id, sp2s40d, sp2s41d, sp2s42d, sp2s43d, sp2s44ad,
sp2s44bd, sp2s44cd, sp2s44dd, sp2s44ed, sp2s44fd, sp2s44gd, sp2s44hd,
sp2s44id, sp2s44jd, sp2s44kd, Q1, Q2, Q3A, Q3B, Q3C, Q4, Q5A, Q5B, Q5C,
Q6, Q8, Q9, Q10, Q11, Q13, Q13A, Q14A, Q14B, Q14C, Q15A, Q15B, Q15C,
Q16A, Q16B, Q16C1, Q16C2, Q16C3, Q16C4, Q16CC, Q17, Q17A, Q18, Q19A,
Q19B, Q19C, Q19D, Q20A, Q20B, Q21, Q22A1, Q22A2, Q22B1, Q21B2, Q22C1,
Q22C2, Q22D1, Q22D2, Q22E1, Q22E2, Q22F1, Q22F2, Q22G1, Q22G2, Q22H1,
Q22H2, Q22I1, Q22I2, Q22J1, Q22J2, Q22J3, Q22K, Q23A1, Q23A2, Q23B1,
Q23B2, Q23C1, Q23C2, Q23D1, Q23D2, Q23E1, Q23E2, Q23F1, Q23F2, Q23G1,
Q23G2, Q23H1, Q23H2, Q23I1, Q23I2, Q23I3, Q23K, Q24, Q25, Q25A, Q26,
Q27A, Q27B, Q27C, Q27D, Q27E, Q27F, Q27G, Q27H, Q27I, Q27J, Q27K, Q27K1,
Q28A, Q28A1, Q28B, Q28B1, Q28C, Q28C1, Q29, Q30, Q31, Q32, Q33, Q33A,
Q34, Q35, income, vclrate, fxcost, totpcst, outpcst, retpcst, sc1s1,
sc2s1, sc1s2a, sc2s2a, sc1s2b, sc2s2b, sc1s3, sc2s3, sc1s4,
sc2s4, sc1s5, sc2s5, sc1s6, sc2s6, sc1s7, sc2s7, sc1s8, sc2s8, sc1s9a,
sc2s9a, sc1s9b, sc2s9b, sc1s9c, sc2s9c, sc1s10, sc2s10, sc1s11a,
sc2s11a, sc1s11b, sc2s11b, sc1s11c, sc2s11c, sc1s11d, sc2s11d, sc1s11e,
```

Table B.4 Gauss Code Used in for Data Transformation for Random Utility Model for Single Trip to Region – Multiple Destination Segment Reported in Chapter 3 (continued).

```
sc2s11e, sc1s12, sc2s12, sc1s13, sc2s13, sc1s30, sc2s30, sc1s31, sc2s31,
sc1s32, sc2s32, sc1s33, sc2s33, sc1s34a, sc2s34a, sc1s34b,
sc2s34b, sc1s34c, sc2s34c, sc1s34d, sc2s34d, sc1s34e, sc2s34e, sc1s34f,
sc2s34f, sc1s34g, sc2s34g, sc1s34h, sc2s34h, sc1s34i, sc2s34i, sc1s40,
sc2s40, sc1s41, sc2s41, sc1s42, sc2s42, sc1s43, sc2s43, sc1s44a,
sc2s44a, sc1s44b, sc2s44b, sc1s44c, sc2s44c, sc1s44d, sc2s44d, sc1s44e,
sc2s44e, sc1s44f, sc2s44f, sc1s44g, sc2s44g, sc1s44h, sc2s44h, sc1s44i,
sc2s44i, sc1s44j, sc2s44j, sc1s44k, sc2s44k, snoinvst, s1eldf, s2aeldf,
s2beldf, s3eldf, s4eldf, s5eldf, s6eldf, s7eldf, s8eldf, s9aeldf,
s9beldf, s9celdf, s10eldf, s11aeldf, s11beldf, s11celdf, s11deldf,
s11eeldf, s12eldf, s13eldf, s30eldf, s31eldf, s32eldf, s33eldf,
s34aeldf, s34beldf, s34celdf, s34deldf, s34eeldf, s34feldf, s34geldf,
s34heldf, s34ieldf, s40eldf, s41eldf, s42eldf, s43eldf, s44aeldf,
s44beldf, s44celdf, s44deldf, s44eeldf, s44feldf, s44geldf, s44heldf,
s44ieldf, s44jeldf, s44keldf, topfeat, yrssnow, club, weeknd, weekd
s1tlgm, s2atlgm, s2btlgm, s3tlgm, s4tlgm, s5tlgm, s6tlgm, s7tlgm,
s8tlgm, s9atlgm, s9btlgm, s9ctlgm, s10tlgm, s11atlgm, s11btlgm,
s11ctlgm, s11dtlgm, s11etlgm, s12tlgm, s13tlgm, s30tlgm, s31tlgm,
s32tlgm, s33tlgm, s34atlgm, s34btlgm, s34ctlgm, s34dtlgm, s34etlgm,
s34ftlgm, s34gtlgm, s34htlgm, s34itlgm, s40tlgm, s41tlgm, s42tlgm,
s43tlgm, s44atlgm, s44btlgm, s44ctlgm, s44dtlgm, s44etlgm, s44ftlgm,
s44gtlgm, s44htlgm, s44itlgm, s44jtlgm, s44ktlgm;

endata;
```

Table B.5 Gauss Code Used for Estimation of 2 Nested Logit (with Quadratic Term on Site Cost Variable) Random Utility Model for Single Trip to Region – Multiple Destination Segment Reported in Chapter 3.

```
/* x=loadd("singmult");
nm=getname("singmult");
call makevars(x,0,nm); */

/* The above statements are executed prior to activating model file.
This uses variable names in dataset so variables do not have to be
referred to in matrix form /*

library maxlik;
#include maxlik.ext
maxset;

output file=sc2q2nlb.out reset;

/* Following dataloop, this is YNP 2 level nested logit model for
multiple destination participants  - January, 2004 */

/* Loading maximum likelihood module */

dataset="singmult";

/* data set created in data loop "datsing" and stored as gauss set
"singmult" using the above so that variable names can be used in the
model statements */

proc li(b, x);

x=loadd("singmult");
nm=getname("singmult");
call makevars(x,0,nm);

/* Gauss procedure used to generate the ln of the likelihood function */

local evs1, evs2a, evs2b, evs3, evs4, evs5, evs6, evs7, evs8, evs9a,
evs9b, evs9c, evs10, evs11a, evs11b, evs11c, evs11d, evs11e, evs12,
evs13, evs30, evs31, evs32, evs33, evs34a, evs34b, evs34c, evs34d,
evs34e, evs34f, evs34g, evs34h, evs34i, evs40, evs41, evs42, evs43,
evs44a, evs44b, evs44c, evs44d, evs44e, evs44f, evs44g, evs44h, evs44i,
evs44j, evs44k, evnonp, vs1, vs2a, vs2b, vs3, vs4, vs5, vs6, vs7, vs8,
vs9a, vs9b, vs9c, vs10, vs11a, vs11b, vs11c, vs11d, vs11e, vs12, vs13,
vs30, vs31, vs32, vs33, vs34a, vs34b, vs34c, vs34d, vs34e, vs34f, vs34g,
vs34h, vs34i, vs40, vs41, vs42, vs43, vs44a, vs44b, vs44c, vs44d, vs44e,
vs44f, vs44g, vs44h, vs44i, vs44j, vs44k, vnonp, inclpart, inclden,
lincl den, lsumpart;

/* local statement is used to declare variables local to the procedure.
See 12-3 in Gauss User Guide */
```

Table B.5 Gauss Code Used for Estimation of 2 Nested Logit (with Quadratic Term on Site Cost Variable) Random Utility Model for Single Trip to Region – Multiple Destination Segment Reported in Chapter 3 (continued).

```
/* the following are the conditional indirect utility functions raised
to e (exp) for the site alternatives multiplied by s, i.e., b[12].  Note
that the conditional indirect utility function for non-participation
does not include multiplication by s as it cancels out.  See Morey "Two
Rums Uncloaked" in Herriges and Kling (1999)for equations that
derivations can be made from for both 2 level and 3 level nested logit
models */

/* The following defines the parameters and variables used in the model:
b[1] through b[8] are parameter estimates for site travel cost (sc#s#),
quadratic site cost, miles of trail (ss#lng) scaled /100, interaction
between miles of trail and grooming 50% or more of trail (s#tlgm), 50%
or more groomed trails (s#grm), presence of services on or near trail
(s#srv), elevation difference between high and low point on trail
(s#eldf) scaled /1000, average inches of snowpack on trail for 2001-02
(sn02s#), b[9] is a constant, b[10] is parameter for response to
question 32 in survey regarding respondent's education level (q32),
b[11] is parameter for number of years snowmobiled by respondent
(yrssnow) */

evs1=exp(b[12]*(b[1]*sc2s1 + b[2]*sc2s1^2 + b[3]*ss1lng + b[4]*s1tlgm +
b[5]*s1grm + b[6]*s1srv + b[7]*s1eldf + b[8]*sn02s1));
evs2a=exp(b[12]*(b[1]*sc2s2a + b[2]*sc2s2a^2 + b[3]*ss2alng +
b[4]*s2atlgm + b[5]*s2agrm + b[6]*s2asrv + b[7]*s2aeldf +
b[8]*sn02s2a));
.
.
(repeat for rest of sites)
.
.
evs44k=exp(b[12]*(b[1]*sc2s44k + b[2]*sc2s44k^2 + b[3]*ss44klng +
b[4]*s44ktlgm + b[5]*s44kgrm + b[6]*s44ksrv + b[7]*s44keldf +
b[8]*sn02s44k));

/* the next line is the conditional indirect utility for non-
participation (e raised to the vnonp) */

evnonp=exp(b[9] + b[10]*Q32 + b[11]*yrssnow);

/* taking ln of above equations */

vs1=ln(evs1); vs2a=ln(evs2a); vs2b=ln(evs2b); vs3=ln(evs3);
vs4=ln(evs4); vs5=ln(evs5); vs6=ln(evs6); vs7=ln(evs7); vs8=ln(evs8);
vs9a=ln(evs9a); vs9b=ln(evs9b); vs9c=ln(evs9c); vs10=ln(evs10);
vs11a=ln(evs11a); vs11b=ln(evs11b); vs11c=ln(evs11c); vs11d=ln(evs11d);
vs11e=ln(evs11e); vs12=ln(evs12); vs13=ln(evs13); vs30=ln(evs30);
vs31=ln(evs31); vs32=ln(evs32); vs33=ln(evs33); vs34a=ln(evs34a);
vs34b=ln(evs34b); vs34c=ln(evs34c); vs34d=ln(evs34d); vs34e=ln(evs34e);
vs34f=ln(evs34f); vs34g=ln(evs34g); vs34h=ln(evs34h); vs34i=ln(evs34i);
vs40=ln(evs40); vs41=ln(evs41); vs42=ln(evs42); vs43=ln(evs43);
vs44a=ln(evs44a); vs44b=ln(evs44b); vs44c=ln(evs44c); vs44d=ln(evs44d);
```

Table B.5 Gauss Code Used for Estimation of 2 Nested Logit (with Quadratic Term on

Site Cost Variable) Random Utility Model for Single Trip to Region – Multiple Destination Segment Reported in Chapter 3 (continued).

```
vs44e=ln(evs44e); vs44f=ln(evs44f); vs44g=ln(evs44g); vs44h=ln(evs44h);
vs44i=ln(evs44i); vs44j=ln(evs44j); vs44k=ln(evs44k); vnonp=ln(evnonp);

/* note b[12]=s */

inclpart=(evs1 + evs2a + evs2b + evs3 + evs4 + evs5 + evs6 + evs7 + evs8
+ evs9a + evs9b + evs9c + evs10 + evs11a + evs11b + evs11c + evs11d +
evs11e + evs12 + evs13 + evs30 + evs31 + evs32 + evs33 + evs34a + evs34b
+ evs34c + evs34d + evs34e + evs34f + evs34g + evs34h + evs34i + evs40 +
evs41 + evs42 + evs43 + evs44a + evs44b + evs44c + evs44d + evs44e +
evs44f + evs44g + evs44h + evs44i + evs44j + evs44k)^(1/b[12]);

/* inclden is denominator in all of the probabilities see Morey as
referenced above */

inclden= evnonp + inclpart;
lninclden=ln(inclden);

/* numerator of probabilities */

lsumpart=((1/b[12])-1)*ln(evs1 + evs2a + evs2b + evs3 + evs4 + evs5 +
evs6 + evs7 + evs8 + evs9a + evs9b + evs9c + evs10 + evs11a + evs11b +
evs11c + evs11d + evs11e + evs12 + evs13 + evs30 + evs31 + evs32 +
evs33 + evs34a + evs34b + evs34c + evs34d + evs34e + evs34f + evs34g +
evs34h + evs34i + evs40 + evs41 + evs42 + evs43 + evs44a + evs44b +
evs44c + evs44d + evs44e + evs44f + evs44g + evs44h + evs44i + evs44j +
evs44k);

/* the next command calculates the contribution to the log of the
likelihood function for each individual in the sample - rps#t equals
number of trips taken to site during period YNP was open for
snowmobiling according to survey (choice occasions for this group is
equal to the number of days in the region) - sp#t were stated preference
responses used in log likelihood calculation */

retp(rps1t .* (vs1 + lsumpart-lninclden) + rps2at .* (vs2a + lsumpart-
lninclden) + rps2bt .* (vs2b + lsumpart-lninclden) + rps3t .* (vs3 +
lsumpart-lninclden) + rps4t .* (vs4 + lsumpart-lninclden) + rps5t .* (vs5
+ lsumpart-lninclden) + rps6t .* (vs6 + lsumpart-lninclden) + rps7t .*
(vs7 + lsumpart-lninclden) + rps8t .* (vs8 + lsumpart-lninclden) +
rps9at .* (vs9a + lsumpart-lninclden) + rps9bt .* (vs9b + lsumpart-
lninclden) + rps9ct .* (vs9c + lsumpart-lninclden) + rps10t .* (vs10 +
lsumpart-lninclden) +    rps11at .* (vs11a + lsumpart-lninclden) + rps11bt
.* (vs11b + lsumpart-lninclden) + rps11ct .* (vs11c + lsumpart-lninclden)
+ rps11dt .* (vs11d + lsumpart-lninclden) +      rps11et .* (vs11e +
lsumpart-lninclden) + rps12t .* (vs12 + lsumpart-lninclden) + rps13t .*
(vs13 + lsumpart-lninclden) +  rps30t .* (vs30 + lsumpart-lninclden) +
rps31t .* (vs31 + lsumpart-lninclden) + rps32t .* (vs32 + lsumpart-
lninclden) + rps33t .* (vs33 + lsumpart-lninclden) + rps34at .* (vs34a +
lsumpart-lninclden) + rps34bt .* (vs34b + lsumpart-lninclden) + rps34ct .*
(vs34c + lsumpart-lninclden) + rps34dt .* (vs34d + lsumpart-lninclden) +
rps34et .* (vs34e + lsumpart-lninclden) + rps34ft .* (vs34f +
```

Table B.5 Gauss Code Used for Estimation of 2 Nested Logit (with Quadratic Term on Site Cost

Variable) Random Utility Model for Single Trip to Region – Multiple Destination Segment Reported in Chapter 3 (continued).

```
lsumpart-lincIden) + rps34gt .* (vs34g + lsumpart-lincIden) + rps34ht .*
(vs34h + lsumpart-lincIden) + rps34it .* (vs34i + lsumpart-lincIden) +
rps40t .* (vs40 + lsumpart-lincIden) +    rps41t .* (vs41 + lsumpart-
lincIden) + rps42t .* (vs42 + lsumpart-lincIden) + rps43t .* (vs43 +
lsumpart-lincIden) +    rps44at .* (vs44a + lsumpart-lincIden) + rps44bt
.* (vs44b + lsumpart-lincIden) + rps44ct .* (vs44c + lsumpart-lincIden)
+ rps44dt .* (vs44d + lsumpart-lincIden) + rps44et .* (vs44e + lsumpart-
lincIden) + rps44ft .* (vs44f + lsumpart-lincIden) + rps44gt .* (vs44g +
lsumpart-lincIden) + rps44ht .* (vs44h + lsumpart-lincIden) + rps44it .*
(vs44i + lsumpart-lincIden) + rps44jt .* (vs44j + lsumpart-lincIden) +
      rps44kt .* (vs44k + lsumpart-lincIden) +     nonpart .* (vnonp -
lincIden));

endp;

/* starting values*/

start = { -.8782, .0375, .1115, -.1515, 1.6322, 2.0832, -0.2646, .0170,
5.5413, -.0840, -.0137, 1 };

_title="nstl-2 rp for multiple destination visitors to Yellowstone
National Park";
_max_MaxIters=2000;
_max_GradTol=0.0001;
_max_Active= { 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1 };

/* maxlik format for estimation procedure, output and input where maxprt
formats and prints the output from a call to maxlik.  See pgs 62-74 & 93
in Maximum Likelihood 5.0 module reference guide. Note: _max_Active
command is used to fix parameter estimates at start values or not -
useful for model building and model testing - 0 fixes parameter at start
value and 1 allows parameter estimate to be estimated via gradient
search */

{ bs,f0,g,h,retcode }=MAXPrt(MAXLIK("singmult", 0, &li, start));

brpynp=bs; save brpynp; output off;
```

Table B.6 Gauss Code Used for Estimation of Lambda Adjusted, Pooled Revealed Preference – Stated Preference (SP1) Data for Estimation and Testing of Preference Homogeneity Reported in Chapter 2.

```
dataloop palldat pclassp1;

/* Note: must turn on dataloop translator via the configure portion of
menu or edit gauss.cfg
and turn translator to on via notepad or some ascii editor.  This should
not be left on for model
runs. The translator should be turned off for that, particularly big
models. */

/* Note: normal logic statements do not work in dataloop.  Must use
statements supported by dataloop.
See Gauss User Guide for some clue on statements supported. */

/* Reducing the number of choice occasions for multiple trip people as
days per trip were
found to be on average greater than 1.  Making choiceoc = 38 rather than
76.  This should also reduce nonparticipation frequency which may
be causing problems in repeated nested logit model, given joint
probabilities to be estimated may
be too small for individual sites. */

/*code multip default 1 with
0 for singmult == 1;
make chtwo = ((choiceoc ./ 2) .* multip) + (choiceoc .* singmult); */

make nonpt = 76 - tottrips;
recode nonpt with
0 for nonpt < 0;


/* code for estimating non-participation based on 76 choice occasions
for
stated preference data */

make sp1non = 76 - sp1trips;
recode sp1non with
0 for sp1non < 0;

make sp2non = 76 - sp2trips;
recode sp2non with
0 for sp2non < 0;

recode Q32 with
0 for Q32 == 7;

recode Q31 with
0 for Q31 ==7;

/* deleting invalid observations for pooled rp-sp data */
delete id == 639;
delete id == 76;
delete id == 148;
```

Table B.6 Gauss Code Used for Estimation of Lambda Adjusted, Pooled Revealed Preference – Stated Preference (SP1) Data for Estimation and Testing of Preference Homogeneity Reported in Chapter 2 (continued).

```
delete id == 1081;
delete id == 167;

/* delete obnum == 362;
delete obnum == 1063;
delete obnum == 1764;
delete obnum == 36;
delete obnum == 737;
delete obnum == 1438;
delete obnum == 73;
delete obnum == 774;
delete obnum == 1475;
delete obnum == 645;
delete obnum == 1346;
delete obnum == 2047;
delete obnum == 87;
delete obnum == 788;
delete obnum == 1489; */

delete singmult == 1;
delete Q35 == 16;

 /* deleting sp2 observations */

delete sp2dum == 1;

/* creating scalar for pooled rp and sp data theta = 1/s from models,
lambda = thetarp/thetasp as per
Louviere et. al "Stated Choice Methods"; */

vector srp = 7.0167;
vector ssp1 = 5.3720;
vector ssp2 = 4.3974;

make thetarp = (1 ./ srp );
make thetasp1 = (1 ./ ssp1);
make thetasp2 = (1 ./ ssp2);

make lmdasp1 = (thetarp ./ thetasp1);
make lmdasp2 = (thetarp ./ thetasp2);

/* creating lambda adjusted nonparticipation variable for pooled rp-sp
data - sp1  */

make lnonpt = ((nonpt .* rpdum) + (sp1non .* sp1dum .* lmdasp1));


/* converting question 35 to midpoint annual income /10000 for scaling
purposes */
  code income default 0 with
    0.2500 for Q35 == 1,
    0.7500 for Q35 == 2,
```

Table B.6 Gauss Code Used for Estimation of Lambda Adjusted, Pooled Revealed Preference – Stated Preference (SP1) Data for Estimation and Testing of Preference Homogeneity Reported in Chapter 2 (continued).

```
    1.2500 for Q35 == 3,
    1.7500 for Q35 == 4,
    2.2500 for Q35 == 5,
    2.7500 for Q35 == 6,
    3.2500 for Q35 == 7,
    3.7500 for Q35 == 8,
    4.5000 for Q35 == 9,
    6.2500 for Q35 == 10,
    8.7500 for Q35 == 11,
    12.5000 for Q35 == 12,
    17.5000 for Q35 == 13,
    25.0000 for Q35 == 14,
    35.0000 for Q35 == 15;

/* estimating two types of travel cost variables. TC1= individual costs
such as lodging,
 gas-snowmobile gas, trip repairs and airfare if traveled by air; Summed
and divided by 2 and then
YNP distance to get rate/mile for roundtrip then multiplied by roundtrip
site distance;
TC2=roundtrip distance to site multiplied by $0.2185/mile both TC
variables are /100 for scaling purposes in estimation */
/* NOTE: See Morey 1999 for effect of scaling on marginal utility of
money and effect on compensating
variation calculation (CV).  If scale all prices by double then CV
doubled. If halve all prices then CV
halved.  The expected maximum utility and maximum likelihood unchanged
but mu is scaled and ultimately
affects CV calculation. */

/* Estimate expenditure on gas for snowmobiles to be subtracted from
total gas expenditures */

recode Q21 with
0 for Q21 == 999999;

make rps13tg = rps13t;
recode rps13tg with
1 for rps13t <= 0;
make snogas = Q21*(rps13d/rps13tg)*1.35;
recode snogas with
0 for snogas > Q22D1;

delete Q22A1 == 999999;

/* including "other" category if flew on plane and snowmobile rental
costs */

make snowrnt = Q22G2;
recode snowrnt with
0 for Q22G2 == 999999;
```

Table B.6 Gauss Code Used for Estimation of Lambda Adjusted, Pooled Revealed Preference – Stated Preference (SP1) Data for Estimation and Testing of Preference Homogeneity Reported in Chapter 2 (continued).

```
make airtckt=Q22J1;
recode airtckt with
0 for Q22J1 == 999999,
0 for Q16C2 == 0;

/* making # of people variable to divide into costs */

make pepl=Q22K;
recode pepl with
1 for Q22K == 999999,
1 for Q22K == 0,
1 for Q22K == 2500;

/* estimating trip costs to be used in TC1 less snogas */
make tpcst=(((Q22A1+(Q22D1-snogas)+Q22E1+snowrnt+airtckt) ./ pepl) ./
2);

/* estimating tc1 and tc2 for each site */

make tc1s1=((tpcst ./ s13de) .* s1de .* 2) .* 0.01;
make tc2s1=((s1de .* 2 .* 0.2185) ./ pepl) .* 0.01;
.
.
(repeat for rest of sites)
.
.

make tc1s44k=((tpcst ./ s13de) .* s44kde .* 2) .* 0.01;
make tc2s44k=((s44kde .* 2 .* 0.2185) ./ pepl) .* 0.01;

/* Make lambda adjusted travel cost variables for pooled rp-sp data set
*/

make ltc1s1= ((tc1s1 .* rpdum) + (tc1s1 .* sp1dum .* lmdasp1));
make ltc2s1=((tc2s1 .* rpdum) + (tc2s1 .* sp1dum .* lmdasp1));
.
.
(repeat for rest of sites)
.
.

make ltc1s44k=((tc1s44k .* rpdum) + (tc1s44k .* sp1dum .* lmdasp1));
make ltc2s44k=((tc2s44k .* rpdum) + (tc2s44k .* sp1dum .* lmdasp1));

/* Estimate used for travel time taking into account air travel vs
vehicle travel */
recode Q16C2 with
0 for Q16C2 == 999999;

/* Estimating air travel time if not given or else use respondent's air
travel time
make airtime=Q16A; */
```

Table B.6 Gauss Code Used for Estimation of Lambda Adjusted, Pooled Revealed Preference – Stated Preference (SP1) Data for Estimation and Testing of Preference Homogeneity Reported in Chapter 2 (continued).

```
code airtrav1 default 0 with
    1 for Q16A > 0 and Q16A < 999999;
code airtrav2 default 1 with
    0 for airtrav1 == 1;
    make airtime=((4+(s13de ./ 600)) .* airtrav2)+(Q16A .* airtrav1);
code airpln default 0 with
    1 for Q16C2 == 1;
code nopln default 1 with
    0 for airpln == 1;
/* estimating travel time as air travel or estimated vehicle time to
site from PC miler -
 travel time is scaled by /10 for estimation purposes
    Note: must use . in front of operations to do item by item
calculations */
make s1hr=((s1te .* 2 .* nopln)+((airtime ./ s13de) .* s1de .* 2 .*
airpln)) .* 0.1;
.
.
(repeat for rest of sites)
.
.

make s44khr=((s44kte .* 2 .* nopln)+((airtime ./ s13de) .* s44kde .* 2
.* airpln)) .* 0.1;

/* make lamda adjusted time variables for rp-sp pooled data */

make ls1hr=((s1hr .* rpdum) + (s1hr .* sp1dum .* lmdasp1));
.
.
(repeat for rest of sites)
.
.
make ls44khr=((s44khr .* rpdum) + (s44khr .* sp1dum .* lmdasp1));

/* investment in snowmobile equipment scaled by /1000 */
delete Q23A1 == 999999;
make snoinvst=(Q23A1+Q23B1+Q23C1+Q23D1+Q23G1) .* 0.001;

/* make lamda adjusted snoinvest variable for pooled rp-sp data */
make lsnoinvs = ((snoinvst .* rpdum) + (snoinvst .* sp1dum .* lmdasp1));

/* create elevation difference for each site scaled by /1000 */
make s1eldf=(s1evh-s1evl) .* 0.001;
.
.
(repeat for rest of sites)
.
.

make s44keldf=(s44kevh-s44kevl) .* 0.001;
```

Table B.6 Gauss Code Used for Estimation of Lambda Adjusted, Pooled Revealed Preference – Stated Preference (SP1) Data for Estimation and Testing of Preference Homogeneity Reported in Chapter 2 (continued).

```
/* creating lamda adjusted elevation difference variable for pooled rp-
sp data */

make ls1eld=((s1eldf .* rpdum) + (s1eldf .* sp1dum .* lmdasp1));
.
.
(repeat for rest of sites)
.
.
make ls44keld=((s44keldf .* rpdum) + (s44keldf .* sp1dum .* lmdasp1));

/* creating scaled length of trail variable ex. s1lng/10 = ss1lng */
make ss1lng=(s1lng) .* 0.1;
.
.
(repeat for rest of sites)
.
.
make ss44klng=(s44klng) .* 0.1;

/* creating lambda adjusted trail length variable and grm variable for
rp-sp pooled data set */

make ls1lng=((ss1lng .* rpdum) + (ss1lng .* sp1dum .* lmdasp1));
.
.
(repeat for rest of sites)
.
.
make ls44klng=((ss44klng .* rpdum) + (ss44klng .* sp1dum .* lmdasp1));

make ls1grm=((s1grm .* rpdum) + (s1grm .* sp1dum .* lmdasp1));
.
.
(repeat for rest of sites)
.
.
make ls44kgrm=((s44kgrm .* rpdum) + (s44kgrm .* sp1dum .* lmdasp1));

/* creating lambda adjusted interaction variable between miles of trail
and groom (at least 50%) or not lambda adjusted
for pooled rp-sp data */

make ls1tlg = ls1lng .* ls1grm;
.
.
(repeat for rest of sites)
.
.

make ls44ktlg = ls44klng .* ls44kgrm;
```

Table B.6 Gauss Code Used for Estimation of Lambda Adjusted, Pooled Revealed Preference – Stated Preference (SP1) Data for Estimation and Testing of Preference Homogeneity Reported in Chapter 2 (continued).

```
/* creating lambda adjusted services variable for rp-sp pooled data */

make ls1srv=((s1srv .* rpdum) + (s1srv .* sp1dum .* lmdasp1));
.
.
(repeat for rest of sites)
.
.

make ls44ksrv=((s44ksrv .* rpdum) + (s44ksrv .* sp1dum .* lmdasp1));

/* creating variable as sum of top two features for snowmobiling */
code feat1 default 0 with
    1 for Q28A == 1,
    2 for Q28A == 2,
    3 for Q28A == 3,
    4 for Q28A == 4,
    5 for Q28A == 5,
    6 for Q28A == 6,
    7 for Q28A == 7,
    8 for Q28A == 8,
    9 for Q28A == 9;
code feat2 default 0 with
    1 for Q28B == 1,
    2 for Q28B == 2,
    3 for Q28B == 3,
    4 for Q28B == 4,
    5 for Q28B == 5,
    6 for Q28B == 6,
    7 for Q28B == 7,
    8 for Q28B == 8,
    9 for Q28B == 9;
make topfeat=feat1+feat2;
make yrssnow=Q1;
recode yrssnow with
0 for yrssnow == 999999;

/* create lamda adjusted yrssnow variable for pooled rp-sp data */
make lyrssnow = ((yrssnow .* rpdum) + (yrssnow .* sp1dum .* lmdasp1));

/*creating a dummy variable for snowmobile club */
code club default 0 with
    1 for Q6 == 2;

/* create lamda adjusted snowmobile club variable for pooled rp-sp data
*/
make lclub = ((club .* rpdum) + (club .* sp1dum .* lmdasp1));

/* creating a dummy variable for snowmobiling only on weekend (weeknd)
or week days (weekd) */
 code weeknd default 0 with
```

Table B.6 Gauss Code Used for Estimation of Lambda Adjusted, Pooled Revealed Preference – Stated Preference (SP1) Data for Estimation and Testing of Preference Homogeneity Reported in Chapter 2 (continued).

```
    1 for Q5A > 0 and Q5A < 999999;
 code weekd default 0 with
    1 for Q5B > 0 and Q5B < 999999;

/* create lamda adjusted snowmobiling only on weeknd (lweeknd) or week
days (lweekd) for pooled rp-sp data */
make lweeknd = ((weeknd .* rpdum) + (weeknd .* sp1dum .* lmdasp1));
make lweekd = ((weekd .* rpdum) + (weekd .* sp1dum .* lmdasp1));

/* create lamda adjusted intercept and q32 varaiable for pooled rp-sp
data */
make leduc = ((q32 .* rpdum) + (q32 .* sp1dum .* lmdasp1));
make lintcept = ((intcept .* rpdum) + (intcept .* sp1dum .* lmdasp1));

/* creating lambda adjusted variable for average snowpack for each site
*/

make lsn2s1= ((sn02s1 .* rpdum) + (sn02s1 .* sp1dum .* lmdasp1));
.
.
(repeat for rest of sites)
.
.
make lsn2s44k=((sn02s44k .* rpdum) + (sn02s44k .* sp1dum .* lmdasp1));

/* creating lambda adjusted dependent variable for number of trips to
each site */

make lrss1t= ((rss1t .* rpdum) + (rss1t .* sp1dum .* lmdasp1));
.
.
(repeat for rest of sites)
.
.
make lrss44kt=((rss44kt .* rpdum) + (rss44kt .* sp1dum .* lmdasp1));


keep obnum, id, origin, lmdasp1, lmdasp2, rpdum, sp1dum, sp2dum,
ls1lng, ss1lng, ls1grm, s1grm, ls1srv, s1srv, s1eldf, ls1eld, ls2alng,
ls2agrm, ls2asrv, ls2aeld,
ls2blng, ls2bgrm, ls2bsrv, ls2beld, ls3lng, ls3grm,   ls3srv,
      ls3eld,     ls4lng, ls4grm,
ls4srv,     ls4eld,     ls5lng,     ls5grm,     ls5srv,     ls5eld,
      ls6lng, ls6grm,   ls6srv,     ls6eld,
ls7lng,     ls7grm,     ls7srv,     ls7eld,     ls8lng,     ls8grm,
      ls8srv,     ls8eld,     ls9alng,
ls9agrm, ls9asrv, ls9aeld, ls9blng, ls9bgrm, ls9bsrv, ls9beld, ls9clng,
ls9cgrm, ls9csrv,
ls9celd, ls10lng, ls10grm, ls10srv, ls10eld, ls11alng, ls11agrm,
ls11asrv, ls11aeld,
ls11blng, ls11bgrm, ls11bsrv, ls11beld, ls11clng, ls11cgrm, ls11csrv,
ls11celd,
```

Table B.6 Gauss Code Used for Estimation of Lambda Adjusted, Pooled Revealed Preference – Stated Preference (SP1) Data for Estimation and Testing of Preference Homogeneity Reported in Chapter 2 (continued).

```
ls11dlng, ls11dgrm, ls11dsrv, ls11deld, ls11elng, ls11egrm, ls11esrv,
ls11eeld, ls12lng,
ls12grm, ls12srv, ls12eld,    ls13lng, ls13grm, ls13srv, ls13eld,
ls30lng, ls30grm, ls30srv, ls30eld,
ls31lng, ls31grm, ls31srv, ls31eld, ls32lng, ls32grm, ls32srv, ls32eld,
ls33lng,
ls33grm, ls33srv, ls33eld, ls34alng, ls34agrm, ls34asrv, ls34aeld,
ls34blng,
ls34bgrm, ls34bsrv, ls34beld, ls34clng, ls34cgrm, ls34csrv, ls34celd,
ls34dlng,
ls34dgrm, ls34dsrv, ls34deld, ls34elng, ls34egrm, ls34esrv, ls34eeld,
ls34flng, ls34fgrm, ls34fsrv,
ls34feld, ls34glng, ls34ggrm, ls34gsrv, ls34geld, ls34hlng, ls34hgrm,
ls34hsrv, ls34held,
ls34ilng, ls34igrm, ls34isrv, ls34ield, ls40lng, ls40grm, ls40srv,
ls40eld,
ls41lng, ls41grm, ls41srv, ls41eld, ls42lng, ls42grm, ls42srv, ls42eld,
ls43lng,
ls43grm, ls43srv, ls43eld, ls44alng, ls44agrm, ls44asrv, ls44aeld,
ls44blng,
ls44bgrm, ls44bsrv, ls44beld, ls44clng, ls44cgrm, ls44csrv, ls44celd,
ls44dlng, ls44dgrm,
ls44dsrv, ls44deld, ls44elng, ls44egrm, ls44esrv, ls44eeld, ls44flng,
ls44fgrm, ls44fsrv,
ls44feld, ls44glng, ls44ggrm, ls44gsrv, ls44geld, ls44hlng, ls44hgrm,
ls44hsrv, ls44held,
ls44ilng, ls44igrm, ls44isrv, ls44ield, ls44jlng, ls44jgrm, ls44jsrv,
ls44jeld,
ls44klng, ls44kgrm, ls44ksrv, ls44keld, lsn2s1, sn02s1, lsn2s2a,
lsn2s2b, lsn2s3, lsn2s4, lsn2s5, lsn2s6, lsn2s7,
lsn2s8, lsn2s9a, lsn2s9b,
lsn2s9c, lsn2s10, lsn2s11a, lsn2s11b, lsn2s11c, lsn2s11d, lsn2s11e,
lsn2s12, lsn2s13, lsn2s30, lsn2s31, lsn2s32,
lsn2s33, lsn2s34a, lsn2s34b, lsn2s34c, lsn2s34d, lsn2s34e, lsn2s34f,
lsn2s34g, lsn2s34h, lsn2s34i, lsn2s40, lsn2s41,
lsn2s42, lsn2s43, lsn2s44a, lsn2s44b, lsn2s44c, lsn2s44d, lsn2s44e,
lsn2s44f, lsn2s44g, lsn2s44h, lsn2s44i, lsn2s44j, lsn2s44k,
singmult, choiceoc, tottrips, nonpart, nonpt, lnonpt, leduc, lintcept,
lrss1t, rss1t, lrss2at, lrss2bt, lrss3t,
lrss4t, lrss5t, lrss6t, lrss7t,     lrss8t, lrss9at, lrss9bt, lrss9ct,
lrss10t, lrss11at, lrss11bt, lrss11ct, lrss11dt, lrss11et, lrss12t,
lrss13t,
lrss30t, lrss31t, lrss32t, lrss33t, lrss34at, lrss34bt, lrss34ct,
      lrss34dt, lrss34et, lrss34ft, lrss34gt,   lrss34ht, lrss34it,
lrss40t, lrss41t,
lrss42t, lrss43t, lrss44at, lrss44bt, lrss44ct, lrss44dt, lrss44et,
lrss44ft, lrss44gt, lrss44ht, lrss44it, lrss44jt, lrss44kt,
sp1trips, sp1non, sp1s1t, sp1s2at, sp1s2bt, sp1s3t, sp1s4t, sp1s5t,
sp1s6t, sp1s7t, sp1s8t, sp1s9at, sp1s9bt, sp1s9ct, sp1s10t,
sp1s11at, sp1s11bt, sp1s11ct, sp1s11dt,   sp1s11et, sp1s12t, sp1s13t,
sp1s30t, sp1s31t, sp1s32t, sp1s33t, sp1s34at, sp1s34bt,
```

Table B.6 Gauss Code Used for Estimation of Lambda Adjusted, Pooled Revealed Preference – Stated Preference (SP1) Data for Estimation and Testing of Preference Homogeneity Reported in Chapter 2 (continued).

```
sp1s34ct, sp1s34dt, sp1s34et, sp1s34ft,   sp1s34gt, sp1s34ht, sp1s34it,
sp1s40t, sp1s41t, sp1s42t, sp1s43t, sp1s44at,   sp1s44bt,
sp1s44ct, sp1s44dt, sp1s44et, sp1s44ft,   sp1s44gt, sp1s44ht, sp1s44it,
sp1s44jt,   sp1s44kt, sp2trips, sp2non, sp2s1t, sp2s2at,
sp2s2bt, sp2s3t, sp2s4t, sp2s5t, sp2s6t, sp2s7t, sp2s8t, sp2s9at,
sp2s9bt, sp2s9ct, sp2s10t, sp2s11at, sp2s11bt, sp2s11ct, sp2s11dt,
sp2s11et, sp2s12t, sp2s13t, sp2s30t, sp2s31t, sp2s32t, sp2s33t,
sp2s34at, sp2s34bt, sp2s34ct, sp2s34dt, sp2s34et, sp2s34ft, sp2s34gt,
sp2s34ht, sp2s34it, sp2s40t, sp2s41t, sp2s42t, sp2s43t, sp2s44at,
sp2s44bt,   sp2s44ct, sp2s44dt, sp2s44et, sp2s44ft,   sp2s44gt,
sp2s44ht,
sp2s44it, sp2s44jt, sp2s44kt, sp2s1d, sp2s2ad, sp2s2bd, sp2s3d, sp2s4d,
      sp2s5d, sp2s6d, sp2s7d, sp2s8d,     sp2s9ad, sp2s9bd, sp2s9cd,
sp2s10d, sp2s11ad, sp2s11bd, sp2s11cd, sp2s11dd, sp2s11ed, sp2s12d,
sp2s13d, sp2s30d, sp2s31d, sp2s32d, sp2s33d, sp2s34ad, sp2s34bd,
sp2s34cd, sp2s34dd, sp2s34ed, sp2s34fd,   sp2s34gd, sp2s34hd, sp2s34id,
sp2s40d, sp2s41d, sp2s42d, sp2s43d, sp2s44ad,   sp2s44bd, sp2s44cd,
sp2s44dd, sp2s44ed, sp2s44fd, sp2s44gd,   sp2s44hd, sp2s44id, sp2s44jd,
sp2s44kd, Q1, Q2, Q3A, Q3B, Q3C, Q4, Q5A, Q5B, Q5C, Q6, Q8, Q9, Q10,
Q11,
Q13, Q13A, Q14A, Q14B, Q14C, Q15A, Q15B, Q15C, Q16A, Q16B, Q16C1, Q16C2,
Q16C3, Q16C4, Q16CC, Q17, Q17A, Q18, Q19A, Q19B, Q19C, Q19D, Q20A, Q20B,
Q21, Q22A1, Q22A2, Q22B1, Q22B2, Q22C1, Q22C2, Q22D1, Q22D2, Q22E1,
Q22E2, Q22F1, Q22F2, Q22G1, Q22G2, Q22H1, Q22H2, Q22I1, Q22I2, Q22J1,
Q22J2,
Q22J3, Q22K, Q23A1, Q23A2, Q23B1, Q23B2, Q23C1, Q23C2, Q23D1, Q23D2,
Q23E1, Q23E2, Q23F1, Q23F2, Q23G1, Q23G2, Q23H1, Q23H2, Q23I1, Q23I2,
Q23I3,
Q23K, Q24, Q25, Q25A, Q26, Q27A, Q27B, Q27C, Q27D, Q27E, Q27F, Q27G,
Q27H, Q27I, Q27J, Q27K, Q27K1, Q28A, Q28A1, Q28B, Q28B1, Q28C, Q28C1,
Q29,  Q30,
Q31, Q32, Q33, Q33A, Q34, Q35, income, lclub, lweeknd, lweekd, lyrssnow,
tc1s1, ltc1s1, tc2s1, ltc2s1, ltc1s2a, ltc2s2a, ltc1s2b, ltc2s2b,
ltc1s3,
ltc2s3, ltc1s4, ltc2s4, ltc1s5, ltc2s5, ltc1s6, ltc2s6, ltc1s7,
ltc2s7, ltc1s8, ltc2s8, ltc1s9a, ltc2s9a, ltc1s9b, ltc2s9b, ltc1s9c,
ltc2s9c, ltc1s10, ltc2s10, ltc1s11a, ltc2s11a, ltc1s11b, ltc2s11b,
ltc1s11c, ltc2s11c, ltc1s11d,
ltc2s11d, ltc1s11e, ltc2s11e, ltc1s12, ltc2s12, ltc1s13, ltc2s13,
ltc1s30, ltc2s30, ltc1s31, ltc2s31, ltc1s32, ltc2s32, ltc1s33, ltc2s33,
ltc1s34a, ltc2s34a, ltc1s34b,
ltc2s34b, ltc1s34c, ltc2s34c, ltc1s34d, ltc2s34d, ltc1s34e, ltc2s34e,
ltc1s34f, ltc2s34f, ltc1s34g, ltc2s34g, ltc1s34h, ltc2s34h, ltc1s34i,
ltc2s34i, ltc1s40,
ltc2s40, ltc1s41, ltc2s41, ltc1s42, ltc2s42, ltc1s43, ltc2s43, ltc1s44a,
ltc2s44a, ltc1s44b, ltc2s44b, ltc1s44c, ltc2s44c, ltc1s44d, ltc2s44d,
ltc1s44e, ltc2s44e,
ltc1s44f, ltc2s44f, ltc1s44g, ltc2s44g, ltc1s44h, ltc2s44h, ltc1s44i,
ltc2s44i, ltc1s44j, ltc2s44j, ltc1s44k, ltc2s44k, ls1hr, ls2ahr, ls2bhr,
ls3hr, ls4hr, ls5hr,
```

Table B.6 Gauss Code Used for Estimation of Lambda Adjusted, Pooled Revealed Preference – Stated Preference (SP1) Data for Estimation and Testing of Preference Homogeneity Reported in Chapter 2 (continued).

```
ls6hr, ls7hr, ls8hr, ls9ahr, ls9bhr, ls9chr, ls10hr, ls11ahr, ls11bhr,
ls11chr, ls11dhr, ls11ehr, ls12hr, ls13hr, ls30hr, ls31hr, ls32hr,
ls33hr, ls34ahr, ls34bhr,
ls34chr, ls34dhr, ls34ehr, ls34fhr, ls34ghr, ls34hhr, ls34ihr, ls40hr,
ls41hr, ls42hr, ls43hr, snoinvst, lsnoinvs,
ls44ahr, ls44bhr, ls44chr, ls44dhr, ls44ehr, ls44fhr, ls44ghr, ls44hhr,
ls44ihr, ls44jhr, ls44khr,
topfeat, yrssnow, club, weeknd, weekd ls1tlg, ls2atlg, ls2btlg, ls3tlg,
ls4tlg, ls5tlg, ls6tlg, ls7tlg, ls8tlg, ls9atlg, ls9btlg, ls9ctlg,
ls10tlg, ls11atlg, ls11btlg, ls11ctlg, ls11dtlg, ls11etlg, ls12tlg,
ls13tlg, ls30tlg, ls31tlg, ls32tlg, ls33tlg, ls34atlg, ls34btlg,
ls34ctlg,
ls34dtlg, ls34etlg, ls34ftlg, ls34gtlg, ls34htlg, ls34itlg, ls40tlg,
ls41tlg, ls42tlg, ls43tlg, ls44atlg, ls44btlg, ls44ctlg, ls44dtlg,
ls44etlg,
ls44ftlg, ls44gtlg, ls44htlg, ls44itlg, ls44jtlg, ls44ktlg, s1amn,
s2aamn, s2bamn, s3amn, s4amn, s5amn, s6amn, s7amn, s8amn, s9aamn,
s9bamn, s9camn,
s10amn, s11aamn, s11bamn, s11camn, s11damn, s11eamn, s12amn, s13amn,
s30amn, s31amn, s32amn, s33amn, s34aamn, s34bamn, s34camn,
s34damn, s34eamn, s34famn, s34gamn, s34hamn, s34iamn, s40amn, s41amn,
s42amn, s43amn, s44aamn, s44bamn, s44camn, s44damn, s44eamn,
s44famn, s44gamn, s44hamn, s44iamn, s44jamn, s44kamn;

endata;
```

Table B.7 Gauss Code Used for Estimation of Lambda Adjusted, Pooled Revealed Preference – Stated Preference (SP1) Model for Testing of Preference Homogeneity Reported in Chapter 2.

```
/* x=loadd("pclassp1");
nm=getname("pclassp1");
call makevars(x,0,nm); */

library maxlik;
#include maxlik.ext;
maxset;

output file=ptclq3nd.out reset;
/* Following dataloop, this is YNP 3 level nested logit model - October,
2003 */
/* The following model uses pooled rp-sp1 data "pclass1" */
/* Loading maximum likelihood module */

dataset="pclassp1";

/* data set created in data loop "ptransp1" and stored as gauss set
"pclass1"
 using the above so that variable names can be used in the model
statements */

proc li(b, x);

x=loadd("pclassp1");
nm=getname("pclassp1");
call makevars(x,0,nm);

/* Gauss procedure used to generate the ln of the likelihood function */

local evs1, evs2a, evs2b, evs3, evs4, evs5, evs6, evs7, evs8, evs9a,
evs9b, evs9c,
evs10, evs11a, evs11b, evs11c, evs11d, evs11e, evs12, evs13, evs30,
evs31, evs32,
evs33, evs34a, evs34b, evs34c, evs34d, evs34e, evs34f, evs34g, evs34h,
evs34i,
evs40, evs41, evs42, evs43, evs44a, evs44b, evs44c, evs44d, evs44e,
evs44f,
evs44g, evs44h, evs44i, evs44j, evs44k, evnonp, vs1, vs2a, vs2b, vs3,
vs4, vs5, vs6,
vs7, vs8, vs9a, vs9b, vs9c, vs10, vs11a, vs11b, vs11c, vs11d, vs11e,
vs12, vs13, vs30,
vs31, vs32, vs33, vs34a, vs34b, vs34c, vs34d, vs34e, vs34f, vs34g,
vs34h,
vs34i, vs40, vs41, vs42, vs43, vs44a, vs44b, vs44c, vs44d, vs44e, vs44f,
vs44g, vs44h, vs44i, vs44j, vs44k, vnonp, inclpart, inclden, linclden,
lsumpart,
inclynp, lsumynp, inclros, lsumros;

/* local statement is used to declare variables local to the procedure.
See 12-3
```

Table B.7 Gauss Code Used for Estimation of Lambda Adjusted, Pooled Revealed Preference – Stated Preference (SP1) Model for Testing of Preference Homogeneity Reported in Chapter 2 (continued).

```
in Gauss User Guide */

/* the following are the conditional indirect utility functions raised
to e (exp) for the site alternatives
multiplied by s, i.e., b[16].  Note that the conditional indirect
utility function for non-participation
does not include multiplication by s as it cancels out.  See Morey "Two
Rums Uncloaked" in Herriges and
Kling (1999)for equations that derivations can be made from for both 2
level and 3 level nested logit models */

/* The following defines the parameters and variables used in the model
lambda adjusted for pooled rp-sp1 data: b[1] through b[9] are parameter
estimates
for travel cost (ltc#s#), travel cost squared (ltc#s#^2), travel time
(ls#hrs), miles of trail (ls#lng) scaled /100, interaction between miles
of trail
and grooming 50% or more of trail (ls#tlg), 50% or more groomed trails
(ls#grm), presence
of services on or near trail (ls#srv), elevation difference between high
and low point on trail (ls#eld) scaled /1000, average
inches of snowpack on trail for 2001-02 (lsn2s#), b[10] is parameter
estimate for whether respondent belongs to
snowmobile club (lclub), b[11]*intcept is a lambda adjusted constant,
b[12] estimate on respondent's annual investment in snowmobile equipment
from survey (lsnoinvs), b[13] and b[14] are parameters for binary
variables on whether respondents snowmobiled on weekend
(lweeknd) or week days (lweekd) with base being snowmobiling only on
holidays,  b[15] is parameter for response to
question 32 in survey regarding respondent's education level (leduc),
b[16] is parameter for number of years snowmobiled
by respondent (lyrssnow) */

/* Nest for all Wyoming, Idaho, and Montana Sites in choice set except
YNP, GTNP, Mesa Falls, Big Springs,
 and Two Top */
evs1=exp(b[17]*(b[1]*ltc1s1 + b[2]*ltc1s1^2 + b[3]*ls1hr + b[4]*ls1lng +
b[5]*ls1tlg + b[6]*ls1grm + b[7]*ls1srv + b[8]*ls1eld +
    b[9]*lsn2s1));
.
.
(repeat for rest of sites)
.
.

evs44k=exp(b[17]*(b[1]*ltc1s44k + b[2]*ltc1s44k^2 + b[3]*ls44khr +
b[4]*ls44klng + b[5]*ls44ktlg + b[6]*ls44kgrm + b[7]*ls44ksrv +
        b[8]*ls44keld + b[9]*lsn2s44k));

/* Nest consisting of GTNP, YNP, Mesa Falls, Two Top, and Big Springs */
```

Table B.7 Gauss Code Used for Estimation of Lambda Adjusted, Pooled Revealed Preference – Stated Preference (SP1) Model for Testing of Preference Homogeneity Reported in Chapter 2 (continued).

```
evs12=exp(b[17]*(b[1]*ltcls12 + b[2]*ltcls12^2 + b[3]*ls12hr +
b[4]*ls12lng + b[5]*ls12tlg + b[6]*ls12grm + b[7]*ls12srv + b[8]*ls12eld
+
    b[9]*lsn2s12));
evs13=exp(b[17]*(b[1]*ltcls13 + b[2]*ltcls13^2 + b[3]*ls13hr +
b[4]*ls13lng + b[5]*ls13tlg + b[6]*ls13grm + b[7]*ls13srv + b[8]*ls13eld
+
    b[9]*lsn2s13));
evs41=exp(b[17]*(b[1]*ltcls41 + b[2]*ltcls41^2 + b[3]*ls41hr +
b[4]*ls41lng + b[5]*ls41tlg + b[6]*ls41grm + b[7]*ls41srv + b[8]*ls41eld
+
    b[9]*lsn2s41));
evs42=exp(b[17]*(b[1]*ltcls42 + b[2]*ltcls42^2 + b[3]*ls42hr +
b[4]*ls42lng + b[5]*ls42tlg + b[6]*ls42grm + b[7]*ls42srv + b[8]*ls42eld
+
    b[9]*lsn2s42));
evs43=exp(b[17]*(b[1]*ltcls43 + b[2]*ltcls43^2 + b[3]*ls43hr +
b[4]*ls43lng + b[5]*ls43tlg + b[6]*ls43grm + b[7]*ls43srv + b[8]*ls43eld
+
    b[9]*lsn2s43));

/* the next line is the conditional indirect utility for non-
participation (e raised to the vnonp) */

evnonp=exp(b[10]*lclub + b[11]*lintcept + b[12]*lsnoinvs + b[13]*lweeknd
+ b[14]*lweekd + b[15]*leduc + b[16]*lyrssnow);

/* taking ln of above equations */

vs1=ln(evs1); vs2a=ln(evs2a); vs2b=ln(evs2b); vs3=ln(evs3);
vs4=ln(evs4); vs5=ln(evs5); vs6=ln(evs6);
vs7=ln(evs7); vs8=ln(evs8); vs9a=ln(evs9a); vs9b=ln(evs9b);
vs9c=ln(evs9c); vs10=ln(evs10); vs11a=ln(evs11a);
vs11b=ln(evs11b); vs11c=ln(evs11c); vs11d=ln(evs11d); vs11e=ln(evs11e);
vs12=ln(evs12); vs13=ln(evs13); vs30=ln(evs30);
vs31=ln(evs31); vs32=ln(evs32); vs33=ln(evs33); vs34a=ln(evs34a);
vs34b=ln(evs34b); vs34c=ln(evs34c);
vs34d=ln(evs34d); vs34e=ln(evs34e); vs34f=ln(evs34f); vs34g=ln(evs34g);
vs34h=ln(evs34h); vs34i=ln(evs34i);
vs40=ln(evs40); vs41=ln(evs41); vs42=ln(evs42); vs43=ln(evs43);
vs44a=ln(evs44a); vs44b=ln(evs44b); vs44c=ln(evs44c);
vs44d=ln(evs44d); vs44e=ln(evs44e); vs44f=ln(evs44f); vs44g=ln(evs44g);
vs44h=ln(evs44h); vs44i=ln(evs44i);
vs44j=ln(evs44j); vs44k=ln(evs44k); vnonp=ln(evnonp);

/* two nests for sites - inclynp = nest with YNP, GTNP, Two Top, Big
Springs and Mesa Falls
 inclros = nest with rest of other sites in choice set NOTE: b[18]=t,
b[17]=s */

inclynp=(evs12 + evs13 + evs41 + evs42 + evs43)^(b[18]/b[17]);
```

Table B.7 Gauss Code Used for Estimation of Lambda Adjusted, Pooled Revealed Preference – Stated Preference (SP1) Model for Testing of Preference Homogeneity Reported in Chapter 2 (continued).

```
inclros=(evs1 + evs2a + evs2b + evs3 + evs4 + evs5 + evs6 + evs7 + evs8
+ evs9a + evs9b + evs9c +
evs10 + evs11a + evs11b + evs11c + evs11d + evs11e + evs30 + evs31 +
evs32 +
evs33 + evs34a + evs34b + evs34c + evs34d + evs34e + evs34f + evs34g +
evs34h + evs34i +
evs40 + evs44a + evs44b + evs44c + evs44d + evs44e + evs44f +
evs44g + evs44h + evs44i + evs44j + evs44k)^(b[18]/b[17]);
inclpart=(inclynp + inclros)^(1/b[18]);

/* inclden is denominator in all of the probabilities see Morey as
referenced above */

inclden= evnonp + inclpart;
linclden=ln(inclden);

/* numerator of probabilities*/

lsumpart=((1/b[18])-1)*ln(inclynp +inclros);
lsumynp=((b[18]/b[17])-1)*ln(evs12 + evs13 + evs41 + evs42 + evs43);
lsumros=((b[18]/b[17])-1)*ln(evs1 + evs2a + evs2b + evs3 + evs4 + evs5 +
evs6 + evs7 + evs8 + evs9a + evs9b + evs9c +
evs10 + evs11a + evs11b + evs11c + evs11d + evs11e + evs30 + evs31 +
evs32 +
evs33 + evs34a + evs34b + evs34c + evs34d + evs34e + evs34f + evs34g +
evs34h + evs34i +
evs40 + evs44a + evs44b + evs44c + evs44d + evs44e + evs44f +
evs44g + evs44h + evs44i + evs44j + evs44k);

/* the next command calculates the contribution to the log of the
likelihood function for each individual in
the sample */

retp(lrss1t .* (vs1 + lsumpart + lsumros - linclden) + lrss2at .* (vs2a
+ lsumpart + lsumros - linclden) + lrss2bt .* (vs2b + lsumpart + lsumros
- linclden) +
      lrss3t .* (vs3 + lsumpart + lsumros - linclden) + lrss4t .* (vs4 +
lsumpart + lsumros - linclden) + lrss5t .* (vs5 + lsumpart + lsumros -
linclden) +
    lrss6t .* (vs6 + lsumpart + lsumros - linclden) + lrss7t .* (vs7 +
lsumpart + lsumros - linclden) +    lrss8t .* (vs8 + lsumpart + lsumros
- linclden) +
    lrss9at .* (vs9a + lsumpart + lsumros - linclden) +     lrss9bt .*
(vs9b + lsumpart + lsumros - linclden) +  lrss9ct .* (vs9c + lsumpart +
lsumros - linclden) + lrss10t .* (vs10 + lsumpart + lsumros - linclden)
+     lrss11at .* (vs11a + lsumpart + lsumros - linclden) + lrss11bt .*
(vs11b + lsumpart + lsumros - linclden) +
      lrss11ct .* (vs11c + lsumpart + lsumros - linclden) + lrss11dt .*
(vs11d + lsumpart + lsumros - linclden) + lrss11et .* (vs11e + lsumpart
+ lsumros - linclden) +
```

Table B.7 Gauss Code Used for Estimation of Lambda Adjusted, Pooled Revealed Preference – Stated Preference (SP1) Model for Testing of Preference Homogeneity Reported in Chapter 2 (continued).

```
lrss12t .* (vs12 + lsumpart + lsumynp - linclden) +   lrss13t .* (vs13 +
lsumpart + lsumynp - linclden) +    lrss30t .* (vs30 + lsumpart +
lsumros - linclden) + lrss31t .* (vs31 + lsumpart + lsumros - linclden)
+ lrss32t .* (vs32 + lsumpart + lsumros - linclden) +  lrss33t .* (vs33
+ lsumpart + lsumros - linclden) + lrss34at .* (vs34a + lsumpart +
lsumros - linclden) + lrss34bt .* (vs34b + lsumpart + lsumros -
linclden) + lrss34ct .* (vs34c + lsumpart + lsumros - linclden) +
lrss34dt .* (vs34d + lsumpart + lsumros - linclden) + lrss34et .* (vs34e
+ lsumpart + lsumros -linclden) + lrss34ft .* (vs34f + lsumpart +
lsumros - linclden) + lrss34gt .* (vs34g + lsumpart + lsumros -
linclden) + lrss34ht .* (vs34h + lsumpart + lsumros - linclden) +
lrss34it .* (vs34i + lsumpart + lsumros - linclden) + lrss40t .* (vs40 +
lsumpart + lsumros - linclden) +    lrss41t .* (vs41 + lsumpart +
lsumynp - linclden) + lrss42t .* (vs42 + lsumpart + lsumynp -linclden) +
lrss43t .* (vs43 + lsumpart + lsumynp -linclden) +    lrss44at .* (vs44a
+ lsumpart + lsumros - linclden) +  lrss44bt .* (vs44b + lsumpart +
lsumros - linclden) + lrss44ct .* (vs44c + lsumpart + lsumros -
linclden) + lrss44dt .* (vs44d + lsumpart + lsumros - linclden) +
lrss44et .* (vs44e + lsumpart + lsumros - linclden) + lrss44ft .* (vs44f
+ lsumpart + lsumros - linclden) + lrss44gt .* (vs44g + lsumpart +
lsumros - linclden) +  lrss44ht .* (vs44h + lsumpart + lsumros -
linclden) + lrss44it .* (vs44i + lsumpart + lsumros - linclden) +
lrss44jt .* (vs44j + lsumpart + lsumros - linclden) +  lrss44kt .*
(vs44k + lsumpart + lsumros - linclden) + lnonpt .* (vnonp - linclden));
endp;

/* starting values*/

start = { -.0094, .0001, -.2516, -.0089, .0081, -.0436, 0.0590, 0.0438,
-.0003, -.2922, 4.6336, -.0627, -.4144, -.6424, .0210, -.0231, 9.7602,
0.9693 };

_title="nstl-3 rp Yellowstone National Park sp1";
_max_MaxIters=2000;
_max_GradTol=0.0001;
_max_Active= { 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1 };
_cn_Precision=6;

/* maxlik format for estimation procedure, output and input where maxprt
formats and prints the output from a
call to maxlik.  See pgs 62-74 & 93 in Maximum Likelihood 5.0 module
reference guide */

{ bs,f0,g,h,retcode }=MAXPrt(MAXLIK("pclassp1", 0, &li, start));

brpynp=bs; save brpynp; output off;
```

Table B.8 SAS Code Used for Estimation of Means Used in Regional Impact Analysis for Region One Reported in Chapter 5.

```
PROC IMPORT OUT= WORK.surv
            DATAFILE= "C:\FILES\DATFILES\YNP\ynp gauss\ynp survey sas
mod.xls"
            DBMS=EXCEL2000 REPLACE;
             RANGE="Sheet1$";
         GETNAMES=YES;


PROC IMPORT OUT= WORK.snow
            DATAFILE= "C:\FILES\DATFILES\YNP\ynp gauss\YNP snow
data.xls"
            DBMS=EXCEL2000 REPLACE;
     RANGE="Sheet1$";
     GETNAMES=YES;


PROC IMPORT OUT= WORK.travel
            DATAFILE= "C:\FILES\DATFILES\YNP\ynp gauss\YNP travel time
and distance values.xls"
            DBMS=EXCEL2000 REPLACE;
     RANGE="Sheet1$";
     GETNAMES=YES;

PROC IMPORT OUT= WORK.trips
            DATAFILE= "C:\FILES\DATFILES\YNP\ynp gauss\ynp trips
sas.xls"
            DBMS=EXCEL2000 REPLACE;
     RANGE="Sheet1$";
     GETNAMES=YES;

PROC IMPORT OUT= WORK.sitechar
            DATAFILE= "C:\FILES\DATFILES\YNP\ynp gauss\YNP site characte
ristics.xls"
            DBMS=EXCEL2000 REPLACE;
     RANGE="Sheet1$";
     GETNAMES=YES;
data alldata;
merge work.surv work.snow work.travel work.trips work.sitechar;
by id;
data modall;
set alldata;

nonpt = 76 - tottrips;
if nonpt < 0 then nonpt=0;

/* nonparticipation for each segment and stated preference question */
/* multiple trips / single site per trip */
sp1non = 76 - sp1trips;
if sp1non < 0 then sp1non = 0;
sp2non = 76 -sp1trips;
if sp2non < 0 then sp2non =0;
```

Table B.8 SAS Code Used for Estimation of Means Used in Regional Impact Analysis for Region One Reported in Chapter 5 (continued).

```
/* single trip to region multiple destinations */
if sp1trips=0 then sp1choic=0;
else sp1choic=sp1trips + nonpart;
sp1nonp = sp1choic - sp1trips;
if sp1nonp < 0 then sp1nonp = 0;

if sp2trips=0 then sp2choic=0;
else sp2choic=sp2trips + nonpart;
sp2nonp = sp2choic - sp2trips;
if sp2nonp < 0 then sp2nonp =0;


if Q32 = 7 then q32 = 0;

if Q31 = 7 then Q31 = 0;

if id = 639 then delete;
if id = 76 then delete;
if id = 148 then delete;
if id = 1081 then delete;
if id = 167 then delete;
if q35=16 then delete;
/* if singmult=1 then delete; */

proc means data = modall n mean min max sum;
var origin tottrips sp1trips sp2trips nonpt sp1non sp2non
q22a2 q22b2 q22c2 q22d2 q22e2 q22f2 q22g2 q22h2 q22i2 q22j2 q22k;

proc means data = modall n mean min max sum;
class singmult;
var origin tottrips sp1trips sp2trips nonpt sp1non sp2non
choiceoc sp1choic sp2choic sp1nonp sp2nonp q22a2 q22b2
q22c2 q22d2 q22e2 q22f2 q22g2 q22h2 q22i2 q22j2 q22k;

data regone;
set modall;

/* zipcodes in region 1 - 6 counties surrounding YNP & GTNP */

/* Teton County, Wyoming zipcodes */
if origin = 83001 then delete;
if origin = 83013 then delete;
if origin = 83012 then delete;
if origin = 83011 then delete;
if origin = 83025 then delete;
if origin = 83014 then delete;

/* Park County, Wyoming zipcodes */

if origin = 82435 then delete;
if origin = 82414 then delete;
if origin = 82440 then delete;
if origin = 82433 then delete;
```

Table B.8 SAS Code Used for Estimation of Means Used in Regional Impact Analysis for Region One Reported in Chapter 5 (continued).

```
if origin = 82450 then delete;

/* Fremont Cty, Idaho zipcodes */

if origin = 83433 then delete;
if origin = 83429 then delete;
if origin = 83420 then delete;
if origin = 83445 then delete;
if origin = 83421 then delete;
if origin = 83436 then delete;
if origin = 83438 then delete;
if origin = 83447 then delete;
if origin = 83451 then delete;

/* Teton County, Idaho zipcodes */

if origin = 83422 then delete;
if origin = 83455 then delete;
if origin = 83452 then delete;
if origin = 83424 then delete;

/* Gallatin County, MT zipcodes */

if origin = 59758 then delete;
if origin = 59716 then delete;
if origin = 59715 then delete;
if origin = 59714 then delete;
if origin = 59741 then delete;
if origin = 59717 then delete;
if origin = 59718 then delete;
if origin = 59719 then delete;
if origin = 59730 then delete;
if origin = 59771 then delete;
if origin = 59772 then delete;
if origin = 59773 then delete;
if origin = 59752 then delete;
if origin = 59760 then delete;

/* Park County, MT zipcodes */

if origin = 59020 then delete;
if origin = 59018 then delete;
if origin = 59027 then delete;
if origin = 59030 then delete;
if origin = 59047 then delete;
if origin = 59065 then delete;
if origin = 59081 then delete;
if origin = 59082 then delete;
if origin = 59086 then delete;

proc means data = regone mean min max sum;
var tottrips sp1trips sp2trips nonpt sp1non sp2non q22a2 q22b2
q22c2 q22d2 q22e2 q22f2 q22g2 q22h2 q22i2 q22j2 q22k;
```

Table B.8 SAS Code Used for Estimation of Means Used in Regional Impact Analysis for Region One Reported in Chapter 5 (continued).

```
proc means data = regone mean min max sum;
class singmult;
var origin tottrips sp1trips sp2trips nonpt sp1non sp2non
choiceoc sp1choic sp2choic sp1nonp sp2nonp q22a2 q22b2
q22c2 q22d2 q22e2 q22f2 q22g2 q22h2 q22i2 q22j2 q22k;

data ronesp1;
set regone;
if sp1trips=0 then delete;

proc means data = ronesp1 mean min max sum;
class singmult;
var origin tottrips sp1trips sp2trips nonpt sp1non sp2non
choiceoc sp1choic sp2choic sp1nonp sp2nonp q22a2 q22b2
q22c2 q22d2 q22e2 q22f2 q22g2 q22h2 q22i2 q22j2 q22k;

data ronesp2;
set regone;
if sp2trips=0 then delete;

proc means data = ronesp2 mean min max sum;
class singmult;
var origin tottrips sp1trips sp2trips nonpt sp1non sp2non
choiceoc sp1choic sp2choic sp1nonp sp2nonp q22a2 q22b2
q22c2 q22d2 q22e2 q22f2 q22g2 q22h2 q22i2 q22j2 q22k;

RUN;
```

Table B.9. Gauss Code Used for Estimation of Lambda Adjusted, Pooled Revealed Preference – Stated Preference (SP2) Data for Estimation and Testing of Preference Homogeneity for Multiple Destination Segment Reported in Chapter 5.

```
dataloop psngdat psngmtsp2;

/* Note: must turn on dataloop translator via the configure portion of
menu or edit gauss.cfg
and turn translator to on via notepad or some ascii editor.  This should
not be left on for model
runs. The translator should be turned off for that, particularly big
models. */

/* Note: normal logic statements do not work in dataloop.  Must use
statements supported by dataloop.
See Gauss User Guide for some clue on statements supported. */

/* singmult data transformation file is to create data file for single
trip to region - multiple destination
segment for analysis.  Nonparticipation is entered in survey data as
choice occasions - trips = nonparticipation */

/* code for estimating non-participation based on choice occasions
while in region for stated preference data */

make nonrate = (nonpart ./ tottrips);
make nonsp1 = (nonrate .* sp1trips);
make nonsp2 = (nonrate .* sp2trips);

make sp1choic = sp1trips + nonsp1;
recode sp1choic with
0 for sp1trips == 0;

make sp1nonp = sp1choic - sp1trips;
recode sp1nonp with
0 for sp1nonp < 0;

make sp2choic = sp2trips + nonsp2;
recode sp2choic with
0 for sp2trips == 0;

make sp2nonp = sp2choic - sp2trips;
recode sp2nonp with
0 for sp2nonp < 0;

/* Q32 deals with level of education of survey respondent.  A seven
response means no response in numbered categories. */
recode Q32 with
0 for Q32 == 7;

/* Q31 deals with age category of respondent.  A seven response means no
response in numbered categories. */
recode Q31 with
0 for Q31 ==7;

/* deleting invalid observations for pooled rp-sp data */
```

Table B.9. Gauss Code Used for Estimation of Lambda Adjusted, Pooled Revealed Preference – Stated Preference (SP2) Data for Estimation and Testing of Preference Homogeneity for Multiple Destination Segment Reported in Chapter 5 (continued).

```
delete id == 639;
delete id == 76;
delete id == 148;
delete id == 1081;
delete id == 167;
delete Q35 == 16;
delete singmult == 0;
delete choiceoc > 30;

/* deleting sp1 observations */

delete sp1dum == 1;

/* converting question 35 to midpoint annual income /10000 for scaling
purposes */
    code income default 0 with
    0.2500 for Q35 == 1,
    0.7500 for Q35 == 2,
    1.2500 for Q35 == 3,
    1.7500 for Q35 == 4,
    2.2500 for Q35 == 5,
    2.7500 for Q35 == 6,
    3.2500 for Q35 == 7,
    3.7500 for Q35 == 8,
    4.5000 for Q35 == 9,
    6.2500 for Q35 == 10,
    8.7500 for Q35 == 11,
    12.5000 for Q35 == 12,
    17.5000 for Q35 == 13,
    25.0000 for Q35 == 14,
    35.0000 for Q35 == 15;

/* creating scalar for pooled rp and sp data theta = 1/s from models,
lambda = thetarp/thetasp as per
Louviere et. al "Stated Choice Methods"; */

vector srp = 11.5906;
vector ssp1 = 5.9386;
vector ssp2 = 7.6753;

make thetarp = (1 ./ srp );
make thetasp1 = (1 ./ ssp1);
make thetasp2 = (1 ./ ssp2);

make lmdasp1 = (thetarp ./ thetasp1);
make lmdasp2 = (thetarp ./ thetasp2);

/* creating lambda adjusted nonparticipation variable for pooled rp-sp
data - sp1  */

make lnonpt = ((nonpart .* rpdum) + (sp2nonp .* sp2dum .* lmdasp2));
```

Table B.9. Gauss Code Used for Estimation of Lambda Adjusted, Pooled Revealed Preference – Stated Preference (SP2) Data for Estimation and Testing of Preference Homogeneity for Multiple Destination Segment Reported in Chapter 5 (continued).

```
/* Estimating two types of site cost variables. SC stands for site cost.
This deals with the estimation
of multiple destination costs.  There is a total trip cost to get to
region including, lodging,
repairs, gas and airfare divided by days in region (choiceoc). Cost to a
site equal fixed cost plus
variable cost. Estimating two types of variable travel cost variables.
VC1 = individual costs such
as lodging, gas minus snowmobile gas, and trip repairs within region.
These are summed and divided
by YNP distance to get a rate/mile then multiplied by site distance;
VC2= roundtrip distance multiplied
by 0.2185. As proportion of costs spent outside region go down, fixed
costs become proportionally
less of total site cost. */

/* Estimate expenditure on gas for snowmobiles to be subtracted from
total gas expenditures */

recode Q21 with
0 for Q21 == 999999;

make rps13tg = rps13t;
recode rps13tg with
1 for rps13t <= 0;
make snogas = Q21*(rps13d/rps13tg)*1.35;
recode snogas with
0 for snogas > Q22D2;

/* including "other" category if flew on plane and snowmobile rental
costs */

make snowrnt = Q22G2;
recode snowrnt with
0 for Q22G2 == 999999;

make airtckt=Q22J1;
recode airtckt with
0 for Q22J1 == 999999,
0 for Q16C2 == 0;

/* making # of people variable to divide into costs */

make pepl=Q22K;
recode pepl with
1 for Q22K == 999999,
1 for Q22K == 0,
1 for Q22K == 2500;

/* estimating trip costs in and out of region including airfare */
delete Q22A1 == 999999;
delete Q22D1 == 999999;
```

Table B.9. Gauss Code Used for Estimation of Lambda Adjusted, Pooled Revealed Preference – Stated Preference (SP2) Data for Estimation and Testing of Preference Homogeneity for Multiple Destination Segment Reported in Chapter 5 (continued).

```
delete Q22E1 == 999999;
delete Q22A2 == 999999;
delete Q22D2 == 999999;
delete Q22E2 == 999999;

/* total trip cost */
make totpcst=(Q22A1+Q22D1+Q22E1+airtckt+snowrnt) ./ pepl;
delete totpcst == 0;

/* trip costs within WY, ID, MT */
make retpcst=(Q22A2+Q22D2+Q22E2+snowrnt-snogas)./ pepl;

/* trip costs outside of region for fixed cost estimate.  Observed in
data that if total trip cost is less than regional trip cost respondents
are most likely separating trip costs into costs within WY, MT, ID and
outside
that region.  Thus, when outcost is negative do transformation to
account for that */
make outcost = totpcst - retpcst;

code outpos default 0 with
1 for outcost >= 0;
code outneg default 0 with
1 for outcost < 0;
make outpcst  = (outcost .* outpos) + (((totpcst + retpcst) - retpcst)
.* outneg);

code outzro default 0 with
1 for outcost == 0;
make dynp = (s13te ./ 10);
make fxcost = ((outpcst ./ choiceoc) + ((totpcst ./ choiceoc) .*dynp .*
outzro));

make g13dist=g13de;
recode g13dist with
1 for g13de == 0;

/* variable cost rate to YNP from gateway community using
expenditures data = VC1.  VC1 is based on regional trip expenditures
apportioned by total days at YNP site/ total days within region
on most recent trip.  That figure is divided by round trip
distance figures from gateway community to YNP to get rate per
mile used in VC1 figures. Variable Cost 2 is standard mileage
rate of 0.2185/mi * roundtrip distance from gateway community
= VC2 */

make vc1 = ((retpcst/choiceoc)*(rps13d/rps13tg))/(g13dist*2);
code vc1zro default 0 with
1 for vc1 == 0;
make vc1rate = vc1 + (0.2185*vc1zro);
```

Table B.9. Gauss Code Used for Estimation of Lambda Adjusted, Pooled Revealed Preference – Stated Preference (SP2) Data for Estimation and Testing of Preference Homogeneity for Multiple Destination Segment Reported in Chapter 5 (continued).

```
/* coding days per trip for a site to estimate fixed cost to site */

make s1d = (g1te ./ 10)*2;
code s1ntp default 0 with
1 for rps1t == 0;
code s1tp default 0 with
1 for rps1t > 0;
make s1dtp = ((1 .* s1ntp) + (s1tp .* (rps1d ./ (rps1t + s1ntp))));


/* fcs1 = fixed cost for site 1 where fixed costs
are based on trip costs to region divided by days
in region * times days to get to site from YNP and time on site.
sc1s1 = site cost for site 1 where it is fcs1 plus vc1 for site1
and sc2s1 = site cost for site 1 where it is fcs1 plus vc2 for
site 1.  All other site costs follow this pattern. */

make fcs1 =(s1d .* fxcost) + (s1dtp .* fxcost);
make vc1s1 = (vc1rate .* g1de .* 2);
make vc2s1 = (0.2185 .* g1de .* 2);

/* scaling site costs by 100 */
make sc1s1 = (fcs1 + vc1s1) .* 0.01;
make sc2s1 = (fcs1 + vc2s1) .* 0.01;

/* site cost coding for sites 2 through 44k */
.
.
(repeat for rest of sites)
.
.
make s44kd = (g44kte/10)*2;
code s44kntp default 0 with
1 for rps44kt == 0;
code s44ktp default 0 with

1 for rps44kt > 0;
make s44kdtp = ((1 .* s44kntp) + (s44ktp .* (rps44kd ./ (rps44kt +
s44kntp))));
make fcs44k =(s44kd .* fxcost) + (s44kdtp .* fxcost);
make vc1s44k = (vc1rate .* g44kde .* 2);
make vc2s44k = (0.2185 .* g44kde .* 2);
make sc1s44k = (fcs44k + vc1s44k) .* 0.01;
make sc2s44k = (fcs44k + vc2s44k) .* 0.01;

/* Make lambda adjusted site cost variables for pooled rp-sp data set */

make lsc1s1= ((sc1s1 .* rpdum) + (sc1s1 .* sp2dum .* lmdasp2));
make lsc2s1=((sc2s1 .* rpdum) + (sc2s1 .* sp2dum .* lmdasp2));
.
.
```

Table B.9. Gauss Code Used for Estimation of Lambda Adjusted, Pooled Revealed Preference – Stated Preference (SP2) Data for Estimation and Testing of Preference Homogeneity for Multiple Destination Segment Reported in Chapter 5 (continued).

```
(repeat for rest of sites)
.
.

make lscls44k=((scls44k .* rpdum) + (scls44k .* sp2dum .* lmdasp2));
make lsc2s44k=((sc2s44k .* rpdum) + (sc2s44k .* sp2dum .* lmdasp2));


/* investment in snowmobile equipment scaled by /1000 */
recode Q23A1 with
0 for Q23A1 == 999999;
recode Q23B1 with
0 for Q23B1 == 999999;
recode Q23C1 with
0 for Q23C1 == 999999;
recode Q23D1 with
0 for Q23D1 == 999999;
recode Q23G1 with
0 for Q23G1 == 999999;

make snoinvst=(Q23A1+Q23B1+Q23C1+Q23D1+Q23G1) .* 0.001;

/* make lamda adjusted snoinvest variable for pooled rp-sp data */
make lsnoinvs = ((snoinvst .* rpdum) + (snoinvst .* sp2dum .* lmdasp2));

/* create elevation difference for each site scaled by /1000 */
make sleldf=(slevh-slevl) .* 0.001;
.
.
(repeat for rest of sites)
.
.
make s44keldf=(s44kevh-s44kevl) .* 0.001;

/* creating lamda adjusted elevation difference variable for pooled rp-
sp data */

make lsleld=((sleldf .* rpdum) + (sleldf .* sp2dum .* lmdasp2));
.
.
(repeat for rest of sites)
.
.
make ls44keld=((s44keldf .* rpdum) + (s44keldf .* sp2dum .* lmdasp2));

/* creating scaled length of trail variable ex. sllng/10 = ssllng */

make ssllng=(sllng) .* 0.1;
.
.
(repeat for rest of sites)
```

Table B.9. Gauss Code Used for Estimation of Lambda Adjusted, Pooled Revealed Preference – Stated Preference (SP2) Data for Estimation and Testing of Preference Homogeneity for Multiple Destination Segment Reported in Chapter 5 (continued).

```
.
.
make ss44klng=(s44klng) .* 0.1;

/* creating lambda adjusted trail length variable and grm variable for
rp-sp pooled data set */

make ls1lng=((ss1lng .* rpdum) + (ss1lng .* sp2dum .* lmdasp2));
.
.
(repeat for rest of sites)
.
.
make ls44klng=((ss44klng .* rpdum) + (ss44klng .* sp2dum .* lmdasp2));

make ls1grm=((s1grm .* rpdum) + (s1grm .* sp2dum .* lmdasp2));
.
.
(repeat for rest of sites)
.
.
make ls44kgrm=((s44kgrm .* rpdum) + (s44kgrm .* sp2dum .* lmdasp2));

/* creating lambda adjusted interaction variable between miles of trail
and groom (at least 50%) or not lambda adjusted
for pooled rp-sp data */

make ls1tlg = ls1lng .* ls1grm;
.
.
(repeat for rest of sites)
.
.
make ls44ktlg = ls44klng .* ls44kgrm;

/* creating lambda adjusted services variable for rp-sp pooled data */

make ls1srv=((s1srv .* rpdum) + (s1srv .* sp2dum .* lmdasp2));
.
.
(repeat for rest of sites)
.
.
make ls44ksrv=((s44ksrv .* rpdum) + (s44ksrv .* sp2dum .* lmdasp2));


/* creating variable as sum of top two features for snowmobiling */
 code feat1 default 0 with
    1 for Q28A == 1,
    2 for Q28A == 2,
    3 for Q28A == 3,
    4 for Q28A == 4,
```

Table B.9. Gauss Code Used for Estimation of Lambda Adjusted, Pooled Revealed Preference – Stated Preference (SP2) Data for Estimation and Testing of Preference Homogeneity for Multiple Destination Segment Reported in Chapter 5 (continued).

```
    5 for Q28A == 5,
    6 for Q28A == 6,
    7 for Q28A == 7,
    8 for Q28A == 8,
    9 for Q28A == 9;
code feat2 default 0 with
    1 for Q28B == 1,
    2 for Q28B == 2,
    3 for Q28B == 3,
    4 for Q28B == 4,
    5 for Q28B == 5,
    6 for Q28B == 6,
    7 for Q28B == 7,
    8 for Q28B == 8,
    9 for Q28B == 9;
make topfeat=feat1+feat2;
make yrssnow=Q1;
recode yrssnow with
0 for yrssnow == 999999;

/* create lamda adjusted yrssnow variable for pooled rp-sp data */
make lyrssnow = ((yrssnow .* rpdum) + (yrssnow .* sp2dum .* lmdasp2));

/*creating a dummy variable for snowmobile club */
    code club default 0 with
    1 for Q6 == 2;

/* create lamda adjusted snowmobile club variable for pooled rp-sp data
*/
make lclub = ((club .* rpdum) + (club .* sp2dum .* lmdasp2));


/* creating a dummy variable for snowmobiling only on weekend (weeknd)
or week days (weekd) */
    code weeknd default 0 with
    1 for Q5A > 0 and Q5A < 999999;
    code weekd default 0 with
    1 for Q5B > 0 and Q5B < 999999;

/* create lamda adjusted intercept and q32 varaiable for pooled rp-sp
data */
make leduc = ((q32 .* rpdum) + (q32 .* sp2dum .* lmdasp2));
make lintcept = ((intcept .* rpdum) + (intcept .* sp2dum .* lmdasp2));

/* creating lambda adjusted variable for average snowpack for each site
*/

make lsn2s1= ((sn02s1 .* rpdum) + (sn02s1 .* sp2dum .* lmdasp2));
.
.
(repeat for rest of sites)
.
```

Table B.9. Gauss Code Used for Estimation of Lambda Adjusted, Pooled Revealed Preference – Stated Preference (SP2) Data for Estimation and Testing of Preference Homogeneity for Multiple Destination Segment Reported in Chapter 5 (continued).

```
.
make lsn2s44k=((sn02s44k .* rpdum) + (sn02s44k .* sp2dum .* lmdasp2));

/* creating lambda adjusted dependent variable for number of trips to
each site */

make lrss1t= ((rss1t .* rpdum) + (rss1t .* sp2dum .* lmdasp2));
.
.
(repeat for rest of sites)
.
.
make lrss44kt=((rss44kt .* rpdum) + (rss44kt .* sp2dum .* lmdasp2));

/* creating lambda adjusted amenities variable for pooled rp-sp data*/
make ls1amn=((s1amn .* rpdum) + (s1amn .* sp2dum .* lmdasp2));
.
.
(repeat for rest of sites)
.
.

make ls44kamn=((s44kamn .* rpdum) + (s44kamn .* sp2dum .* lmdasp2));

keep obnum, id, origin, lmdasp1, lmdasp2, rpdum, sp1dum, sp2dum,
ls1lng, ss1lng, ls1grm, s1grm, ls1srv, s1srv, s1eldf, ls1eld, ls2alng,
ls2agrm, ls2asrv, ls2aeld, ls2blng, ls2bgrm, ls2bsrv, ls2beld, ls3lng,
ls3grm,ls3srv,ls3eld,ls4lng, ls4grm, ls4srv,    ls4eld,     ls5lng,
      ls5grm,     ls5srv,     ls5eld,     ls6lng, ls6grm,   ls6srv,
      ls6eld, ls7lng,   ls7grm,     ls7srv,     ls7eld,     ls8lng,
      ls8grm,ls8srv,    ls8eld,     ls9alng,
ls9agrm, ls9asrv, ls9aeld, ls9blng, ls9bgrm, ls9bsrv, ls9beld, ls9clng,
ls9cgrm, ls9csrv, ls9celd, ls10lng, ls10grm, ls10srv, ls10eld, ls11alng,
ls11agrm, ls11asrv, ls11aeld, ls11blng, ls11bgrm, ls11bsrv, ls11beld,
ls11clng, ls11cgrm, ls11csrv, ls11celd, ls11dlng, ls11dgrm, ls11dsrv,
ls11deld, ls11elng, ls11egrm, ls11esrv, ls11eeld, ls12lng,
ls12grm, ls12srv, ls12eld,    ls13lng, ls13grm, ls13srv, ls13eld,
ls30lng, ls30grm, ls30srv, ls30eld, ls31lng, ls31grm, ls31srv, ls31eld,
ls32lng, ls32grm, ls32srv, ls32eld, ls33lng, ls33grm, ls33srv, ls33eld,
ls34alng, ls34agrm, ls34asrv, ls34aeld, ls34blng, ls34bgrm, ls34bsrv,
ls34beld, ls34clng, ls34cgrm, ls34csrv, ls34celd, ls34dlng, ls34dgrm,
ls34dsrv, ls34deld, ls34elng, ls34egrm, ls34esrv, ls34eeld, ls34flng,
ls34fgrm, ls34fsrv, ls34feld, ls34glng, ls34ggrm, ls34gsrv, ls34geld,
ls34hlng, ls34hgrm, ls34hsrv, ls34held, ls34ilng, ls34igrm, ls34isrv,
ls34ield, ls40lng, ls40grm, ls40srv, ls40eld, ls41lng, ls41grm, ls41srv,
ls41eld, ls42lng, ls42grm, ls42srv, ls42eld, ls43lng,
ls43grm, ls43srv, ls43eld, ls44alng, ls44agrm, ls44asrv, ls44aeld,
ls44blng, ls44bgrm, ls44bsrv, ls44beld, ls44clng, ls44cgrm, ls44csrv,
ls44celd, ls44dlng, ls44dgrm, ls44dsrv, ls44deld, ls44elng, ls44egrm,
ls44esrv, ls44eeld, ls44flng, ls44fgrm, ls44fsrv,
```

Table B.9. Gauss Code Used for Estimation of Lambda Adjusted, Pooled Revealed Preference – Stated Preference (SP2) Data for Estimation and Testing of Preference Homogeneity for Multiple Destination Segment Reported in Chapter 5 (continued).

```
ls44feld, ls44glng, ls44ggrm, ls44gsrv, ls44geld, ls44hlng, ls44hgrm,
ls44hsrv, ls44held, ls44ilng, ls44igrm, ls44isrv, ls44ield, ls44jlng,
ls44jgrm, ls44jsrv, ls44jeld,  ls44klng, ls44kgrm, ls44ksrv, ls44keld,
lsn2s1, sn02s1, lsn2s2a, lsn2s2b, lsn2s3, lsn2s4, lsn2s5, lsn2s6,
lsn2s7, lsn2s8, lsn2s9a, lsn2s9b, lsn2s9c, lsn2s10, lsn2s11a, lsn2s11b,
lsn2s11c, lsn2s11d, lsn2s11e, lsn2s12, lsn2s13, lsn2s30, lsn2s31,
lsn2s32, lsn2s33, lsn2s34a, lsn2s34b, lsn2s34c, lsn2s34d, lsn2s34e,
lsn2s34f, lsn2s34g, lsn2s34h, lsn2s34i, lsn2s40, lsn2s41,
lsn2s42, lsn2s43, lsn2s44a, lsn2s44b, lsn2s44c, lsn2s44d, lsn2s44e,
lsn2s44f, lsn2s44g, lsn2s44h, lsn2s44i, lsn2s44j, lsn2s44k,
singmult, choiceoc, tottrips, nonpart, nonpart, lnonpt, leduc, lintcept,
lrss1t, rss1t, lrss2at, lrss2bt, lrss3t, lrss4t, lrss5t, lrss6t, lrss7t,
      lrss8t, lrss9at, lrss9bt, lrss9ct, lrss10t, lrss11at, lrss11bt,
lrss11ct, lrss11dt, lrss11et, lrss12t, lrss13t, lrss30t, lrss31t,
lrss32t, lrss33t, lrss34at, lrss34bt, lrss34ct, lrss34dt, lrss34et,
lrss34ft, lrss34gt,     lrss34ht, lrss34it, lrss40t, lrss41t,
lrss42t, lrss43t, lrss44at, lrss44bt, lrss44ct, lrss44dt, lrss44et,
lrss44ft, lrss44gt, lrss44ht, lrss44it, lrss44jt, lrss44kt,
sp1trips, sp1nonp, sp1s1t, sp1s2at, sp1s2bt, sp1s3t, sp1s4t, sp1s5t,
sp1s6t, sp1s7t, sp1s8t, sp1s9at, sp1s9bt, sp1s9ct, sp1s10t,
sp1s11at, sp1s11bt, sp1s11ct, sp1s11dt,   sp1s11et, sp1s12t, sp1s13t,
sp1s30t, sp1s31t, sp1s32t, sp1s33t, sp1s34at, sp1s34bt, sp1s34ct,
sp1s34dt, sp1s34et, sp1s34ft, sp1s34gt, sp1s34ht, sp1s34it, sp1s40t,
sp1s41t, sp1s42t, sp1s43t, sp1s44at,      sp1s44bt, sp1s44ct, sp1s44dt,
sp1s44et, sp1s44ft, sp1s44gt, sp1s44ht, sp1s44it, sp1s44jt, sp1s44kt,
sp2trips, sp2nonp, sp2s1t, sp2s2at, sp2s2bt, sp2s3t, sp2s4t, sp2s5t,
sp2s6t, sp2s7t, sp2s8t, sp2s9at, sp2s9bt, sp2s9ct, sp2s10t, sp2s11at,
sp2s11bt, sp2s11ct, sp2s11dt, sp2s11et, sp2s12t, sp2s13t, sp2s30t,
sp2s31t, sp2s32t, sp2s33t, sp2s34at, sp2s34bt, sp2s34ct, sp2s34dt,
sp2s34et, sp2s34ft, sp2s34gt, sp2s34ht, sp2s34it, sp2s40t, sp2s41t,
sp2s42t, sp2s43t, sp2s44at, sp2s44bt, sp2s44ct, sp2s44dt, sp2s44et,
sp2s44ft,   sp2s44gt, sp2s44ht, sp2s44it, sp2s44jt, sp2s44kt, sp2s1d,
sp2s2ad, sp2s2bd, sp2s3d, sp2s4d, sp2s5d, sp2s6d, sp2s7d, sp2s8d,
sp2s9ad, sp2s9bd, sp2s9cd, sp2s10d, sp2s11ad, sp2s11bd, sp2s11cd,
sp2s11dd, sp2s11ed, sp2s12d, sp2s13d, sp2s30d, sp2s31d, sp2s32d,
sp2s33d, sp2s34ad, sp2s34bd, sp2s34cd, sp2s34dd, sp2s34ed,
sp2s34fd,sp2s34gd, sp2s34hd, sp2s34id, sp2s40d, sp2s41d, sp2s42d,
sp2s43d, sp2s44ad, sp2s44bd, sp2s44cd, sp2s44dd, sp2s44ed, sp2s44fd,
sp2s44gd,   sp2s44hd, sp2s44id, sp2s44jd, sp2s44kd, Q1, Q2, Q3A, Q3B,
Q3C, Q4, Q5A, Q5B, Q5C, Q6, Q8, Q9, Q10, Q11, Q13, Q13A, Q14A, Q14B,
Q14C, Q15A, Q15B, Q15C, Q16A, Q16B, Q16C1, Q16C2, Q16C3, Q16C4, Q16CC,
Q17, Q17A, Q18, Q19A, Q19B, Q19C, Q19D, Q20A, Q20B, Q21, Q22A1, Q22A2,
Q22B1, Q22B2, Q22C1, Q22C2, Q22D1, Q22D2, Q22E1, Q22E2, Q22F1, Q22F2,
Q22G1, Q22G2, Q22H1, Q22H2, Q22I1, Q22I2, Q22J1, Q22J2, Q22J3, Q22K,
Q23A1, Q23A2, Q23B1, Q23B2, Q23C1, Q23C2, Q23D1, Q23D2, Q23E1, Q23E2,
Q23F1, Q23F2, Q23G1, Q23G2, Q23H1, Q23H2, Q23I1, Q23I2, Q23I3,
Q23K, Q24, Q25, Q25A, Q26, Q27A, Q27B, Q27C, Q27D, Q27E, Q27F, Q27G,
Q27H, Q27I, Q27J, Q27K, Q27K1, Q28A, Q28A1, Q28B, Q28B1, Q28C, Q28C1,
Q29,  Q30, Q31, Q32, Q33, Q33A, Q34, Q35, income, lclub, vc1rate,
fxcost, outpcst, retpcst, lyrssnow, sc1s1, lsc1s1, sc2s1, lsc2s1,
lsc1s2a, lsc2s2a, lsc1s2b, lsc2s2b, lsc1s3, lsc2s3, lsc1s4, lsc2s4,
lsc1s5, lsc2s5, lsc1s6, lsc2s6, lsc1s7, lsc2s7, lsc1s8, lsc2s8,
```

Table B.9. Gauss Code Used for Estimation of Lambda Adjusted, Pooled Revealed Preference – Stated Preference (SP2) Data for Estimation and Testing of Preference Homogeneity for Multiple Destination Segment Reported in Chapter 5 (continued).

```
lsc1s9a, lsc2s9a, lsc1s9b, lsc2s9b, lsc1s9c, lsc2s9c, lsc1s10, lsc2s10,
lsc1s11a, lsc2s11a, lsc1s11b, lsc2s11b, lsc1s11c, lsc2s11c, lsc1s11d,
lsc2s11d, lsc1s11e, lsc2s11e, lsc1s12, lsc2s12, lsc1s13, lsc2s13,
lsc1s30, lsc2s30, lsc1s31, lsc2s31, lsc1s32, lsc2s32, lsc1s33, lsc2s33,
lsc1s34a, lsc2s34a, lsc1s34b, lsc2s34b, lsc1s34c, lsc2s34c, lsc1s34d,
lsc2s34d, lsc1s34e, lsc2s34e, lsc1s34f, lsc2s34f, lsc1s34g, lsc2s34g,
lsc1s34h, lsc2s34h, lsc1s34i, lsc2s34i, lsc1s40, lsc2s40, lsc1s41,
lsc2s41, lsc1s42, lsc2s42, lsc1s43, lsc2s43, lsc1s44a, lsc2s44a,
lsc1s44b, lsc2s44b, lsc1s44c, lsc2s44c, lsc1s44d, lsc2s44d, lsc1s44e,
lsc2s44e, lsc1s44f, lsc2s44f, lsc1s44g, lsc2s44g, lsc1s44h, lsc2s44h,
lsc1s44i, lsc2s44i, lsc1s44j, lsc2s44j, lsc1s44k, lsc2s44k, snoinvst,
lsnoinvs, topfeat, yrssnow, club, ls1tlg, ls2atlg, ls2btlg, ls3tlg,
ls4tlg, ls5tlg, ls6tlg, ls7tlg, ls8tlg, ls9atlg, ls9btlg, ls9ctlg,
ls10tlg, ls11atlg, ls11btlg, ls11ctlg, ls11dtlg, ls11etlg, ls12tlg,
ls13tlg, ls30tlg, ls31tlg, ls32tlg, ls33tlg, ls34atlg, ls34btlg,
ls34ctlg, ls34dtlg, ls34etlg, ls34ftlg, ls34gtlg, ls34htlg, ls34itlg,
ls40tlg, ls41tlg, ls42tlg, ls43tlg, ls44atlg, ls44btlg, ls44ctlg,
ls44dtlg, ls44etlg, ls44ftlg, ls44gtlg, ls44htlg, ls44itlg, ls44jtlg,
ls44ktlg, ls1amn, ls2aamn, ls2bamn, ls3amn, ls4amn, ls5amn, ls6amn,
ls7amn, ls8amn, ls9aamn, ls9bamn, ls9camn, ls10amn, ls11aamn, ls11bamn,
ls11camn, ls11damn, ls11eamn, ls12amn, ls13amn, ls30amn, ls31amn,
ls32amn, ls33amn, ls34aamn, ls34bamn, ls34camn, ls34damn, ls34eamn,
ls34famn, ls34gamn, ls34hamn, ls34iamn, ls40amn, ls41amn, ls42amn,
ls43amn, ls44aamn, ls44bamn, ls44camn, ls44damn, ls44eamn, ls44famn,
ls44gamn, ls44hamn, ls44iamn, ls44jamn, ls44kamn;

endata;
```

Table B.10. Gauss Code Used for Krinsky-Robb Estimation of 95 Percent Confidence Interval for Compensating Variation Estimate – Multiple Destination Segment.

```
/* Confidence interval estimation for
YNP Multiple Destination segment */

/* This uses output from sc2q2amn.gss - which is the 2nl model for
the multiple destination model with the amenities variable for YNP and
GTNP.
You must first run the model program to save out the bhat vector and the
variance-covariance matrix to run this program. */

output file = krmltdst.out reset;

load bhat;
load cov;

/* cholesky decomposition of covariance matrix */
srcov=chol(cov);


/* estimating Do and D1 */

/* site cost means */

sc2s1 = 2.4817;
.
.
(repeat for rest of sites)
.
.
sc2s44k = 2.36408;
avgsc2 = 2.20113;

/* site length of trail means */

ss1lng = 6.6;
.
.
(repeat for rest of sites)
.
.
ss44klng = 22.5;

/* interaction of grooming and trail length */

s1tlgm = 0;
.
.
(repeat for rest of sites)
.
.
s44ktlgm = 22.5;

/* trail grooming */
```

Table B.10. Gauss Code Used for Krinsky-Robb Estimation of 95 Percent Confidence Interval for Compensating Variation Estimate – Multiple Destination Segment (continued).

```
s1grm = 0;
.
.
(repeat for rest of sites)
.
.
s44kgrm = 1;

/* services on trail or near trailhead */

s1srv = 1;
.
.
(repeat for rest of sites)
.
.
s44ksrv = 0;

/* elevation difference from high to low on trail */
s1eldf = 3.5;
.
.
(repeat for rest of sites)
.
.
s44keldf = 8.2;

/* site amenities variable */

s1amn = 0;
.
.
(repeat for rest of sites)
.
.
s44kamn = 0;

/* average snowpack on trail for Jan, Feb, Mar, 02 */

sn02s1 = 49.73333;
.
.
(repeat for rest of sites)
.
.
sn02s44k = 17.66667;

/* non-participation equation variables */

q32 = 4.57087;
yrssnow = 15.43307;
```

Table B.10. Gauss Code Used for Krinsky-Robb Estimation of 95 Percent Confidence Interval for Compensating Variation Estimate – Multiple Destination Segment (continued).

```
/* equations evaluated at means - esv */

evs1=exp(bhat[13, .]*(bhat[1, .]*sc2s1 + bhat[2, .]*sc2s1^2 + bhat[3,
.]*ss1lng + bhat[4, .]*s1tlgm + bhat[5, .]*s1grm + bhat[6, .]*s1srv +
bhat[7, .]*s1eldf +
    bhat[8, .]*s1amn + bhat[9, .]*sn02s1));
.
.
(repeat for rest of sites)
.
.
evs44k=exp(bhat[13, .]*(bhat[1, .]*sc2s44k + bhat[2, .]*sc2s44k^2 +
bhat[3, .]*ss44klng + bhat[4, .]*s44ktlgm + bhat[5, .]*s44kgrm + bhat[6,
.]*s44ksrv +
        bhat[7, .]*s44keldf + bhat[8, .]*s44kamn + bhat[9,
.]*sn02s44k));

/* the next line is the conditional indirect utility for non-
participation (e raised to the vnonp) */

evnonp=exp(bhat[10, .] + bhat[11, .]*Q32 + bhat[12, .]*yrssnow);

/* estimating expected maximum utility d0 */

d0= (evnonp)+((evs1 + evs2a + evs2b + evs3 + evs4 + evs5 + evs6 + evs7 +
evs8 + evs9a + evs9b + evs9c +
evs10 + evs11a + evs11b + evs11c + evs11d + evs11e + evs12 + evs13 +
evs30 + evs31 + evs32 +
evs33 + evs34a + evs34b + evs34c + evs34d + evs34e + evs34f + evs34g +
evs34h + evs34i +
evs40 + evs41 + evs42 + evs43 + evs44a + evs44b + evs44c + evs44d +
evs44e + evs44f +
evs44g + evs44h + evs44i + evs44j + evs44k)^(1/bhat[13, .]));

/* estimating expected maximum utility after closure esv */

cevs1=exp(bhat[13, .]*(bhat[1, .]*sc2s1 + bhat[2, .]*sc2s1^2 + bhat[3,
.]*ss1lng + bhat[4, .]*s1tlgm + bhat[5, .]*s1grm + bhat[6, .]*s1srv +
bhat[7, .]*s1eldf + bhat[8, .]*s1amn + bhat[9, .]*sn02s1));
.
.
(repeat for rest of sites)
.
.
cevs13=exp(bhat[13, .]*(bhat[1, .]*9999 + bhat[2, .]*sc2s13^2 + bhat[3,
.]*ss13lng + bhat[4, .]*s13tlgm + bhat[5, .]*s13grm + bhat[6, .]*s13srv
+ bhat[7, .]*s13eldf + bhat[8, .]*s13amn + bhat[9, .]*sn02s13));
.
.
(repeat for rest of sites)
.
.
```

Table B.10. Gauss Code Used for Krinsky-Robb Estimation of 95 Percent Confidence Interval for Compensating Variation Estimate – Multiple Destination Segment (continued).

```
cevs44k=exp(bhat[13, .]*(bhat[1, .]*sc2s44k + bhat[2, .]*sc2s44k^2 +
bhat[3, .]*ss44klng + bhat[4, .]*s44ktlgm + bhat[5, .]*s44kgrm + bhat[6,
.]*s44ksrv +
bhat[7, .]*s44keldf + bhat[8, .]*s44kamn + bhat[9, .]*sn02s44k));

/* the next line is the conditional indirect utility for non-
participation (e raised to the vnonp) */

cevnonp=exp(bhat[10, .] + bhat[11, .]*Q32 + bhat[12, .]*yrssnow);

/* estimating expected maximum utility d1 */

d1= (cevnonp)+((cevs1 + cevs2a + cevs2b + cevs3 + cevs4 + cevs5 + cevs6
+ cevs7 + cevs8 + cevs9a + cevs9b + cevs9c +
cevs10 + cevs11a + cevs11b + cevs11c + cevs11d + cevs11e + cevs12 +
cevs13 + cevs30 + cevs31 + cevs32 + cevs33 + cevs34a + cevs34b + cevs34c
+ cevs34d + cevs34e + cevs34f + cevs34g + cevs34h + cevs34i +
cevs40 + cevs41 + cevs42 + cevs43 + cevs44a + cevs44b + cevs44c +
cevs44d + cevs44e + cevs44f + cevs44g + cevs44h + cevs44i + cevs44j +
cevs44k)^(1/bhat[13, .]));

/* estimating mu for quadratic */
mu = abs(bhat[1, .] + 2*bhat[2, .]*avgsc2);
invmu = (1 ./ mu);

/* estimating mean compensating variation per choice occasion and
annually */
cv = ((invmu)*(ln(d1) - ln(d0))*100);
anncv = cv * 6.74016;

print;
" cv estimate and CI for multiple destination model";
print;
"cv =";
cv';
print;
"anncv =";
anncv';

/* computing mean E(CV)for all new beta vectors after random draw */
/* number of repetitions for random draw */

  reps = 10000;

/* 95 percent confidence interval endpoints */

let kk[2,1] = 251,9751;

/* for loop to create column vector for cv and annual cv estimates */

z = zeros(reps,2);
for ii(1, reps, 1);
```

Table B.10. Gauss Code Used for Krinsky-Robb Estimation of 95 Percent Confidence Interval for Compensating Variation Estimate – Multiple Destination Segment (continued).

```
/* new parameters from random draw */
nbhat = (srcov' * rndn(rows(bhat), 1)) + bhat;


/* equations evaluated at means - esv */

aevs1=exp(nbhat[13, .]*(nbhat[1, .]*sc2s1 + nbhat[2, .]*sc2s1^2 +
nbhat[3, .]*ss1lng + nbhat[4, .]*s1tlgm + nbhat[5, .]*s1grm + nbhat[6,
.]*s1srv + nbhat[7, .]*s1eldf + nbhat[8, .]*s1amn + nbhat[9,
.]*sn02s1));
.
.
(repeat for rest of sites)
.
.
aevs44k=exp(nbhat[13, .]*(nbhat[1, .]*sc2s44k + nbhat[2, .]*sc2s44k^2 +
nbhat[3, .]*ss44klng + nbhat[4, .]*s44ktlgm + nbhat[5, .]*s44kgrm +
nbhat[6, .]*s44ksrv +  nbhat[7, .]*s44keldf + nbhat[8, .]*s44kamn +
nbhat[9, .]*sn02s44k));

/* the next line is the conditional indirect utility for non-
participation (e raised to the vnonp) */

aevnonp=exp(nbhat[10, .] + nbhat[11, .]*Q32 + nbhat[12, .]*yrssnow);

/* estimating expected maximum utility d0 */

ed0= (aevnonp)+((aevs1 + aevs2a + aevs2b + aevs3 + aevs4 + aevs5 + aevs6
+ aevs7 + aevs8 + aevs9a + aevs9b + aevs9c + aevs10 + aevs11a + aevs11b
+ aevs11c + aevs11d + aevs11e + aevs12 + aevs13 + aevs30 + aevs31 +
aevs32 +  aevs33 + aevs34a + aevs34b + aevs34c + aevs34d + aevs34e +
aevs34f + aevs34g + aevs34h + aevs34i + aevs40 + aevs41 + aevs42 +
aevs43 + aevs44a + aevs44b + aevs44c + aevs44d + aevs44e + aevs44f +
aevs44g + aevs44h + aevs44i + aevs44j + aevs44k)^(1/nbhat[13, .]));

/* estimating expected maximum utility after closure with new parameter
vectors esv */
bevs1=exp(nbhat[13, .]*(nbhat[1, .]*sc2s1 + nbhat[2, .]*sc2s1^2 +
nbhat[3, .]*ss1lng + nbhat[4, .]*s1tlgm + nbhat[5, .]*s1grm + nbhat[6,
.]*s1srv + nbhat[7, .]*s1eldf + nbhat[8, .]*s1amn + nbhat[9,
.]*sn02s1));
.
.
(repeat for rest of sites)
.
.
bevs12=exp(nbhat[13, .]*(nbhat[1, .]*9999 + nbhat[2, .]*sc2s12^2 +
nbhat[3, .]*ss12lng + nbhat[4, .]*s12tlgm + nbhat[5, .]*s12grm +
nbhat[6, .]*s12srv + nbhat[7, .]*s12eldf + nbhat[8, .]*s12amn + nbhat[9,
.]*sn02s12));
```

Table B.10. Gauss Code Used for Krinsky-Robb Estimation of 95 Percent Confidence Interval for Compensating Variation Estimate – Multiple Destination Segment (continued).

```
bevs13=exp(nbhat[13, .]*(nbhat[1, .]*9999 + nbhat[2, .]*sc2s13^2 +
nbhat[3, .]*ss13lng + nbhat[4, .]*s13tlgm + nbhat[5, .]*s13grm +
nbhat[6, .]*s13srv + nbhat[7, .]*s13eldf +  nbhat[8, .]*s13amn +
nbhat[9, .]*sn02s13));
.
.
(repeat for rest of sites)
.
.
bevs44k=exp(nbhat[13, .]*(nbhat[1, .]*sc2s44k + nbhat[2, .]*sc2s44k^2 +
nbhat[3, .]*ss44klng + nbhat[4, .]*s44ktlgm + nbhat[5, .]*s44kgrm +
nbhat[6, .]*s44ksrv + nbhat[7, .]*s44keldf + nbhat[8, .]*s44kamn +
nbhat[9, .]*sn02s44k));

/* the next line is the conditional indirect utility for non-
participation (e raised to the vnonp) */

bevnonp=exp(nbhat[10, .] + nbhat[11, .]*Q32 + nbhat[12, .]*yrssnow);

/* estimating expected maximum utility d0 */

ed1= (bevnonp)+((bevs1 + bevs2a + bevs2b + bevs3 + bevs4 + bevs5 + bevs6
+ bevs7 + bevs8 + bevs9a + bevs9b + bevs9c + bevs10 + bevs11a + bevs11b
+ bevs11c + bevs11d + bevs11e + bevs12 + bevs13 + bevs30 + bevs31 +
bevs32 + bevs33 + bevs34a + bevs34b + bevs34c + bevs34d + bevs34e +
bevs34f + bevs34g + bevs34h + bevs34i + bevs40 + bevs41 + bevs42 +
bevs43 + bevs44a + bevs44b + bevs44c + bevs44d + bevs44e + bevs44f +
bevs44g + bevs44h + bevs44i + bevs44j + bevs44k)^(1/nbhat[13, .]));

/* estimating mu for quadratic */
nmu = abs(nbhat[1, .] + 2*nbhat[2, .]*avgsc2);
invnmu = (1 ./ nmu);

/* estimating mean compensating variation per choice occasion and
annually */
ecv = ((invnmu)*(ln(ed1) - ln(ed0))*100);
eanncv = ecv * 6.74016;
z[ii, 1] = ecv;
z[ii, 2] = eanncv;

endfor;

/* print;
z; */

sortecv=sortc(z, 1);
/* print;
sortecv; */
print;
"repetitions used to form CIs ="; reps;
print;
```

Table B.10. Gauss Code Used for Krinsky-Robb Estimation of 95 Percent Confidence Interval for Compensating Variation Estimate – Multiple Destination Segment (continued).

```
"95 percent confidence interval for cv & annual cv";
sortecv[kk, .]';

output off; end;
```

Appendix C:

RESULTS OF ALTERNATIVE MODEL SPECIFICATIONS USING REVEALED PREFERENCE DATA AND ADDITIONAL IMPACT ANALYSES

Table C.1. Model Results for Multiple Trips and Single Site Per Trip Segment – Travel Cost Estimated Using Expenditure Data (TC1) N=328.

Variable	2 NL	2 NL Quadratic	3 NL	3 NL Quadratic
TC1	-0.0129	-0.0208	-0.0086	-0.0139
	(0.0001)*	(0.0000)	(0.0060)	(0.0021)
$TC1^2$		0.0001		0.0001
		(0.0011)		(0.0422)
Stehr	-0.3469	-0.3488	-0.3444	-0.3445
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Stelng	0.0008	0.0008	-0.0123	-0.0125
	(0.7689)	(0.7686)	(0.0000)	(0.0000)
Stetlgm	-0.0066	-0.0067	0.0112	0.0114
	(0.0146)	(0.0145)	(0.0000)	(0.0000)
Stegrm	0.2273	0.2335	-0.0643	-0.0650
	(0.0000)	(0.0000)	(0.0160)	(0.0165)
Stesrv	0.2289	0.2346	0.0792	0.0812
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Steeldf	-0.0082	-0.0087	0.0607	0.0617
	(0.0388)	(0.0317)	(0.0000)	(0.0000)
Sn02ste	0.0020	0.0020	-0.0005	-0.0005
	(0.0000)	(0.0000)	(0.0394)	(0.0376)
Club	-0.2945	-0.2978	-0.3048	-0.3057
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Constant	4.5167	4.5250	6.8771	6.8406
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Snoinvst	-0.0640	-0.0639	-0.0645	-0.0644
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Weeknd	-0.4114	-0.4112	-0.4107	-0.4117
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Weekd	-0.6528	-0.6539	-0.6514	-0.6523
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Educ	0.0241	0.0249	0.0246	0.0251
	(0.0877)	(0.0784)	(0.0816)	(0.0753)
Yrssnow	-0.0230	-0.0230	-0.0229	-0.0229
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
s – scale	5.1287	5.0043	7.1705	7.0167
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
t – scale			0.2356	0.2384
			(0.0532)	(0.0332)
McFaddens R^2	0.1237	0.1240	0.1877	0.1878
LL	-11454.6456	-11451.3328	-10618.0488	-10616.7368
LL – Constant	-13071.5872	-13071.5872	-13071.5872	-13071.5872
Model χ^2	3233.8832	3240.5088	4907.0768	4909.7008
Critical $\chi^2_{\alpha=0.05}$	24.996	26.296	26.296	27.587

* Probabilities reported in parentheses for asymptotic t-statistics.

Table C.2. Model Results for Multiple Trips and Single Site Per Trip Segment – Travel Cost Estimated Using Standard Mileage Rate $0.2185/mile (TC2) N=328.

Variable	2 NL	2 NL Quadratic	3 NL	3 NL Quadratic
TC2	-0.0172	-0.3311	-0.0306	-0.3180
	(0.1203)*	(0.0000)	(0.0092)	(0.0000)
$TC2^2$		0.0322		0.0308
		(0.0000)		(0.0000)
Stehr	-0.3391	-0.3150	-0.3256	-0.3075
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Stelng	0.0009	0.0011	-0.0115	-0.0140
	(0.7029)	(0.7228)	(0.0000)	(0.0000)
Stetlgm	-0.0063	-0.0088	0.0105	0.0126
	(0.0122)	(0.0068)	(0.0000)	(0.0000)
Stegrm	0.2129	0.2765	-0.0611	-0.0798
	(0.0000)	(0.0000)	(0.0156)	(0.0138)
Stesrv	0.2134	0.2823	0.0729	0.1022
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Steeldf	-0.0072	-0.0117	0.0576	0.0702
	(0.0514)	(0.0135)	(0.0000)	(0.0000)
Sn02ste	0.0019	0.0019	-0.0004	-0.0007
	(0.0000)	(0.0000)	(0.0850)	(0.0091)
Club	-0.2813	-0.2793	-0.2951	-0.2949
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Constant	4.4758	4.4576	6.7288	8.0465
	(0.0000)	(0.0000)	(0.0000)	(0.0107)
Snoinvst	-0.0629	-0.0577	-0.0627	-0.0583
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Weeknd	-0.4218	-0.4110	-0.4199	-0.4103
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Weekd	-0.6437	-0.6565	-0.6396	-0.6577
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Educ	0.0215	0.0320	0.0229	0.0325
	(0.1266)	(0.0238)	(0.1041)	(0.0216)
Yrssnow	-0.0229	-0.0212	-0.0226	-0.0210
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
s – scale	5.4868	4.2049	7.6050	5.8923
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
t – scale			0.2455	0.1622
			(0.0415)	(0.1755)
McFaddens R^2	0.1229	0.1293	0.1875	0.1922
LL	-11465.6992	-11381.2064	-10620.0496	-10559.5336
LL – Constant	-13071.5872	-13071.5872	-13071.5872	-13071.5872
Model χ^2	3211.7760	3380.7616	4903.0752	5024.1072
Critical $\chi^2_{\alpha=0.05}$	24.996	26.296	26.296	27.587

* Probabilities reported in parentheses for asymptotic t-statistics.

Table C.3. Model Results for Single Trip to Region and Multiple Sites Visited Segment – Site Cost Was Estimated Using Expenditure Data for Costs to Region and Mileage Rate from Gateway Community to Site based on expenditures for the Site Cost 1 Variable (SC1), and the Site Cost 2 (SC2) Variable Was Based Expenditures to Region plus Standard Mileage Rate ($0.2185/mi.) for Travel from Gateway Community to Site N=254.

Variable	SC1 2NL	SC1 2 NL Quadratic [a]	SC2 2NL	SC2 2NL Quadratic
SC#	-0.0614		-0.0868	-0.1259
	(0.0001)*		(0.0144)	(0.0076)
$SC\#^2$				0.0042
				(0.0079)
Stelng	0.0299		0.0091	0.0082
	(0.0008)		(0.0233)	(0.0147)
Stetlgm	-0.0395		-0.0116	-0.0095
	(0.0040)		(0.2050)	(0.0131)
Stegrm	0.4468		0.1318	0.1137
	(0.0006)		(0.0224)	(0.0145)
Stesrv	0.5187		0.1693	0.1459
	(0.0002)		(0.0164)	(0.0091)
Steeldf	-0.0678		-0.2130	-0.0182
	(0.0004)		(0.0190)	(0.0117)
Sn02ste	0.0038		0.0012	0.0009
	(0.0006)		(0.0214)	(0.0161)
Constant	1.4697		0.4345	0.3426
	(0.0004)		(0.0549)	(0.0760)
Educ	-0.0772		-0.0773	-0.0772
	(0.0135)		(0.0145)	(0.0147)
Yrssnow	-0.0145		-0.0151	-0.0149
	(0.0006)		(0.0000)	(0.0004)
s - scale	3.8664		11.7995	13.0509
	(0.0000)		(0.0145)	(0.0079)
McFaddens R^2	0.1653		0.1664	0.1955
LL	-4419.0920		-4413.4024	-4259.3768
LL – Constant	-5294.5030		-5294.5030	-5294.5030
Model χ^2	1750.8220		1762.2012	2070.2524
Critical $\chi^2_{\alpha=0.05}$	24.996		24.996	26.296

* Probabilities reported in parentheses for asymptotic t-statistics.

[a] Attempts were made to estimate both the SC1 quadratic and the above models in a 3 nested logit specification. In each case after allowing maximum number of iterations (2000) with different restrictions and start values (3 tries per model) no convergence was obtained. It was deemed these specifications were inappropriate for this segment of the data. It is likely the trip data are not dense enough for the non-YNP nest in the 3 NL formulation of the model.

Table C.4. Model Results for Both Sample Segments Incorporating a Binary Variable for Unique Site Characteristics (YNP & GTNP = 1, Other Sites =0).

Variable	3 NL Quadratic	Variable	2 NL Quadratic
TC1	-0.0134	SC2	-0.1288
	(0.0031)		(0.0055)
$TC1^2$	0.0001	$SC2^2$	0.0043
	(0.0662)		(0.0058)
Stehr	-0.3447		
	(0.0000)		
Stelng	-0.0122	Stelng	0.0034
	(0.0000)		(0.0664)
Stetlgm	0.0105	Stetlgm	-0.0068
	(0.0000)		(0.0165)
stegrm	-0.0486	Stegrm	0.0677
	(0.0740)		(0.0303)
Stesrv	0.0732	Stesrv	0.0939
	(0.0000)		(0.0093)
Steeldf	0.0597	Steeldf	0.0061
	(0.0000)		(0.0882)
Steamn	0.0547	Steamn	0.1946
	(0.0001)		(0.0062)
Sn02ste	0.0000	Sn02ste	0.0027
	(0.9599)		(0.0071)
Club	-0.3055	Constant	0.4587
	(0.0000)		(0.0362)
Constant	6.6289	Educ	-0.0775
	(0.0000)		(0.0144)
Snoinvst	-0.0645	Yrssnow	-0.0150
	(0.0000)		(0.0004)
Weeknd	-0.4112		
	(0.0000)		
Weekd	-0.6519		
	(0.0000)		
Educ	0.0251		
	(0.0747)		
Yrssnow	-0.0229		
	(0.0000)		
s - scale	7.0011	*s* - scale	11.5906
	(0.0000)		(0.0058)
t – scale	0.2603		
	(0.0361)		
McFaddens R^2	0.1885	McFaddens R^2	0.2533
LL	-10607.9792	LL	-3953.3830
Model χ^2	4927.2160	Model χ^2	2682.2400
Critical $\chi^2_{\alpha=0.05}$	28.869	Critical $\chi^2_{\alpha=0.05}$	21.026

* Probabilities reported in parentheses for asymptotic t-statistics.

Table C.5. Estimated Concentration of Economic Impacts of YNP and GTNP Site Closure Assuming Substitution But Not Visitor Heterogeneity on the Six Counties Surrounding the Parks (assuming all site visits are from single destination visitors).

Description	RP	RP-SP2	SP2
Estimated Change In Counties' Visitation from Outside Three State Region	-20,009	-33,093	-223,733
% of Estimated Total Change Expenditures*	87.7 %	87.5 %	53.8%
Grocery/Liquor	$365,916	$605,181	$4,091,530
Gasoline	$720,838	$1,192,178	$8,060,113
Retail Items	$832,006	$1,376,037	$9,303,155
Other Purchases	$504,126	$833,763	$5,636,933
Snowmobile Rental	$1,782,149	$2,947,457	$19,927,265
Guided Tour Package	$404,209	$668,512	$4,519,696
Other Recreation	$596,372	$986,327	$6,668,393
Lodging	$3,624,580	$5,994,614	$40,528,589
Eating & Drinking	$2,050,066	$3,390,559	$22,923,003
Oil/Trip Repairs/Maintenance	$237,616	$392,987	$2,656,921
Total for Six Counties	$11,117,878	$18,387,615	$124,315,599
% of Estimated Total Economic Impacts	87.7 %	87.5 %	53.8%
Labor (# of jobs) – Counties	253.8	419.8	2,838.2
% of Estimated Total	72.7 %	72.6 %	44.6 %
Income – Counties	$5,359,260	$8,863,562	$59,925,067
% of Estimated Total	82.4 %	82.2 %	50.5 %

* Rounded to Nearest Dollar.

Table C.6. Estimated Concentration of Economic Impacts of YNP and GTNP Site Closure Assuming Substitution and Visitor Heterogeneity on the Six Counties Surrounding the Parks (assuming all site visits are from single destination visitors).

Description	RP	RP-SP2	SP2
Estimated Change In Counties' Visitation from Outside Three State Region			
Single Destination Visitors	-10,045	-16,613	-112,320
Multiple Destination Visitors	-12,222	-66,181	-56,170
Total Change in Visitors	-22,267	-82,794	-168,490
% of Estimated Total Change	174.0 %	90.7 %	60.5 %
Expenditures*			
Grocery/Liquor	$224,207	$573,482	$2,152,117
Gasoline	$411,799	$1,116,006	$3,842,987
Retail Items	$564,846	$1,329,474	$5,623,735
Other Purchases	$431,002	$846,682	$4,584,904
Snowmobile Rental	$1,089,208	$2,791,959	$10,444,650
Guided Tour Package	$356,549	$683,955	$3,821,730
Other Recreation	$494,584	$995,138	$5,220,040
Lodging	$2,403,913	$5,765,753	$23,745,328
Eating & Drinking	$1,234,639	$3,203,196	$11,771,864
Oil/Trip Repairs/Maintenance	$108,095	$355,052	$900,013
Total for Six Counties	$7,318,842	$17,660,697	$72,107,368
% of Estimated Total	106.5 %	78.5 %	54.4%
Economic Impacts			
Labor (# of jobs) – Counties	166.7	403.0	1,641.2
% of Estimated Total	88.3 %	65.1 %	45.1%
Income – Counties	$3,525,364	$8,512,004	$34,723,906
% of Estimated Total	100.0 %	73.7 %	51.1%

* Rounded to Nearest Dollar.