Measuring Preferences for Congestion Management at Rocky Mountain National Park

Abstract

National parks are faced with contradicting missions that make management of congestion issues difficult. The public believes national parks are a commons, meant for all to enjoy, and therefore stand firmly against any management strategies that have the ability to keep others from visiting. In order for national parks to effectively manage congestion they must have public approval. One solution would be to raise the entrance fee price, though this has already received negative public feedback. Another potential solution is the implementation of reservation systems to replace entrance fees during peak season. A choice experiment with three attributes and two levels per is used to measure a sample of Colorado residents' preferences for congestion management at Rocky Mountain National Park. Results suggest the public has a desire to lower congestion, but is not willing to pay a price above $65 to achieve this. Instead, the public indicated they would be favorable to the implementation of a reservation system that limited access to the Park but achieved lowered congestion. Varying individual specific characteristics were further measured to determine particular group preferences. Indication of the publics' preference to reduce congestion through a reservation system provides insight into a potential candidate to manage congestion at Rocky Mountain National Park.

By: Nicholas Keim

Undergraduate Honors Thesis for

University of Colorado Economics Department

Advisor: Nicholas Flores, Department of Economics

Additional Committee Members:

Martin Boileau, Department of Economics

Lori Hunter, Department of Sociology

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I.   Introduction

Background

Rocky Mountain National Park (RMNP) was established in 1915 with the purpose "to preserve the high-elevation ecosystems and wilderness characters of the southern Rocky Mountains within its borders and to provide the freest recreational use of and access." Celebrating its 100th year anniversary in 2015, RMNP has been undoubtedly successful in accomplishing its original mission. Hosting a wide variety of alpine vegetation and wildlife, as well as a staggering 355 miles of hiking trails, RMNP is a true curiosity with no shortage of ways to explore its vast landscapes. On top of that, 92 miles of paved roads weave through the Park, including the world-famous Trail Ridge Road, the highest paved highway in North America. The Park's utter uniqueness makes it a major Colorado destination with accompanying economic impact. The park attracts people from around the world to visit Colorado and encourages locals to leave their homes on weekends. Located just 66 miles from Denver and adjacent to the town of Estes Park, it stands among one of the easiest Park's to access in the country. These characteristics help to explain why RMNP is the 4th most visited National Park in the US (Rocky Mountain National Park, 2018).

In fact, while annual visitation has increased since the Park's creation, it skyrocketed beyond any previous expectations in recent years. In 1948, 33 years after its creation, the Park had achieved 1 million annual visitors. It took 50 years later, in 1998, for the Park to gradually triple its visitation to 3 million annual visitors. The Park remained at this level up until 2013, when in just 3 years the Park took a drastic jump from 3 million annual visitors to a record breaking 4.5 million (Rocky Mountain National Park, 2018). A 150% increase in visitation in

just a mere 3 years was unanticipated, and management has been slow to react though visitation

will likely continue to increase. Most of this visitation takes place in between the months of June

and September, with the month of July alone seeing almost 1 million visitors. Visiting on a

summer weekend can include sitting in traffic, struggling to find parking, and trail hiking that

feels more like walking through the crowded streets of New York. When visitors experience

severe congestion like this their overall experience can deteriorate, detracting from the utility

received from outdoor recreation (Manning, Anderson, & Pettengill, 2017). There have been

times where if Park officials believe crowding has reached unsafe levels, then access may be

restricted at the entrance gates, but this is the only strategy to account for these crowds. That, and

the requirement of entrance fees.

With three entrance gates into the Park, one seldom used on the Western slope and two

outside of Estes Park on the Eastern side, visitors are required to pay a use/entrance fee before

being allowed in. RMNP began using entrance fees in 1939 at $2 per vehicle for a 7-day pass.

The first increase occurred 50 years later in 1989, to $5 per vehicle. From 1989 to 2015 the fee

steadily increased up to $20, until 2015 when the 7-day pass was increased to $30 and a 1-day

pass was introduced at $20 per vehicle. Most recently in 2018, the 7-day pass increased to $35

and the 1-day to $25 which stands as the current entrance fees (Rocky Mountain National Park,

2018). These entrance fees were always meant to serve two purposes, one being to lessen

crowding and the other to provide a large portion of the funding for the Park and the National

Park Service. As the previous visitation numbers indicate, the current entrance fees are largely

unsuccessful in their capacity to control crowds. Standard supply and demand economics would

suggest the best way to control for the excess in demand would be to increase the fee, however,

national parks are often seen as common property resources, making fee increases unpopular to the public.

National parks were established with dual contradicting missions as is defined in RMNP's founding mission, presented at the beginning of this paper. The first of which is to protect and preserve important natural resources. Whereas the second seeks to offer opportunities for the public to use and enjoy. When the public is given free and unrestricted access to recreation at parks, the ecosystems of the parks often suffer. Vegetation along trails and roads deteriorate, wildlife is disturbed, and pollution becomes problematic exemplifying the issue of "tragedy of the commons" proposed by Hardin (1968). However, efforts to restrict access in order to preserve the first mission, interferes with achieving the second mission (Manning, Anderson & Pettengill, 2017).

The public fully supports the ideal of access for all. In 2017 the National Park Service proposed a drastic fee hike for 17 of the most popular National Parks in an effort to address maintenance back logs. The proposal sought to increase the fee for the 7-day pass up to $70 per vehicle from its original cost of $30 (NPS.gov, 2017). While seeming likely to be implemented, large public backlash led to the proposal being scratched and instead only the $5 increase was implemented in 2018. Opponents cited that the dramatic increase would inhibit certain low-income groups from being able to experience public lands, which was a violation of the National Park's purpose. Whether this argument is valid, however, remains unclear.

Some research has proposed the idea of use fees negatively impacting the ability of low-income groups to access outdoor recreation resources. Ostergen, Solop, and Hagen (2005) conclude that low-income groups are less likely to use recreation resources when use fees are raised, therefore use fees defeat the purpose of public lands. More and Stevens (2000)

hypothesize that use fees alone are not contributors to barriers of visitation at National Parks. Instead the overall costs of visiting National Parks, including travel costs, lodging, food, and equipment on top of the use fees prevent low-income groups from visiting National Parks. The conflicting findings on use fees being barriers to visitation have had little influence on the public changing their perceptions or their support for their implementation and increases. When low-income groups are unable to visit National Parks, the public will always identify the more direct use fees as being the cause, regardless of whether there are additional underlying causes. Furthermore, use fees that are raised by small-scale proportions have little impact on crowding levels and only large increases have the ability to reduce crowds, to which only the upper-income groups appear to be in favor of (Schroeder & Louviere, 2017).

Since the issue of overcrowding at RMNP is unlikely to disappear and raising the price of entrance fees conflicts with national park's mission statement and is unpopular with the general public, RMNP must consider alternative congestion management strategies for entering the Park.

Research Question

This paper proposes the idea of using reservation systems as an alternative management strategy to address congestion at Rocky Mountain National Park. It takes into consideration that any national park congestion management strategy must have public approval to succeed due to the open access nature of national parks. With this necessary condition in mind the research presented in this paper seeks to answer the question of whether the public would be favorable to implementing a reservation system for entering RMNP if it meant reducing congestion and not having to pay a higher use fee. Though reservation systems have been used and assessed in other

outdoor recreation settings with positive responses, they have seldom been considered as replacements for entrance fees to enter national parks. Therefore, the results presented in this study help to begin the discussion of the feasibility for their implementation by addressing the largest concern for Park management: is the public receptive towards it? To address this question, this study uses a choice experiment conducted with a sample of Colorado residents. From the results of this experiment a conditional logit model is estimated to measure preferences between management policies that differ by type of restriction, price, and level of congestion. This estimation will aim to provide a better understanding of public preferences for policies that effect RMNP visitation experiences.

II.   Literature Review

Recreators Perspectives on Access Restriction

Environmental management researchers have become increasingly focused on evaluating attitudes towards using access restrictions in outdoor recreation. Access restrictions are typically defined as using capacity constraint methods like permits, day passes, reservations, or entrance limits, as well as some indirect methods that make access more difficult and thus an unappealing process. These methods all share a common goal: limit the number of people in a particular area when congestion is a problem. Though typically viewed as negative characteristics of a site, they have the potential to be seen more favorably than other negative attributes, like congestion. In most cases, research findings indicate recreators of varying backgrounds would prefer access restrictions over other management strategies (Newman et al., 2005; Pettebone et al., 2011; Lawson et al., 2003; Jakus & Shaw, 1997). Wilderness backpackers in Yosemite National Park

were particularly favorable towards a lower chance of getting a permit if it meant improvements

in particular characteristics effected by congestion (Newman et al., 2005). This same study

further calculated that 60% of visitors preferred a scenario with little to no freedom if it resulted

in a greater degree of solitude, with the other 40% preferring an opposite scenario. Jakus and

Shaw (1997) came to a similar conclusion when studying a recreation site in New York. Their

findings indicated that individuals of all recreation groups preferred a strict limit on day entry

passes over a price increase to reduce congestion. It is important to note, however, that the two

studies mentioned above deal with backpackers and a local recreation site. Therefore, it should

be considered that backpackers might be more willing to go to greater lengths to achieve solitude

and local recreators could be less concerned with restrictions because they have greater

possibility to visit other sites. So, it is possible that the individuals included in their studies

would prefer access restriction in those scenarios but not for a wider national park.

Pettebone et al. (2011) on the other hand studies the use of an indirect access restriction

method for the greater Rocky Mountain National Park. Their study examines the preferences and

effectiveness of using shuttles and limited parking to control congestion. Visitors exhibited a

higher preference for modes of transportation that led to a higher probability of solitude and thus

were more likely to take shuttles if it meant not having to sit in traffic or wait for parking, though

they would still prefer not taking shuttles at all. Although they find a preference for access

restrictions to reduce congestion, they also find that limits to parking in the Park lead visitors to

park on road sides destroying vegetation, and while shuttles can often reduce congestion on

roads, they increase congestion on trails. An additional study of access restriction at a national

park was conducted by Lawson et al. (2003), who used computer simulations to determine

carrying capacities at sites in Arches National Park. After finding a carrying capacity less than

the current level of visitation, they conclude it would be both more preferable for visitors and easier for management to restrict access at the entrance, rather than attempting to limit particular site visitation. Overall the studies examined above suggest a necessity for national park management to implement a direct access restriction at the entrance to parks to which support might be expected, as long as congestion can be reduced. Though, as we will see, other studies have found access restrictions do not have uniform support from the public.

Some research has grown to indicate forms of access restriction, like permits and carrying capacities, detract from the benefits received from recreation (McCool & Stankey, 2001). Though this same study does not consider whether the reduction in benefits from restricted access outweigh the reduction from experiencing congestion. Additional studies have indicated that in some situations individuals are not willing to give up their freedom of access for less congestion but would instead prefer indirect management strategies to mitigate congestion impacts. Bullock and Lawson (2008) in particular find that individuals at Cadillac Mountain in Acadia National Park perceived "visitors on trails" as the least important factor effecting their experience. While "visitor-caused damage to vegetation and soil" was the most important. Similarly, these same individuals preferred better site management over limited use by implementing physical barriers on trails over barring visitation. The individuals examined in this study were clearly less concerned about experiencing nature in solitude than with experiencing nature in general, regardless of having to walk on paved trails or being surrounded by fences and people. While findings for this study are significant it is important to consider the individuals in this study were peak season visitors and as Moyle and Croy (2007) find, peak-season visitors of popular national parks are typically the least sensitive to crowding since highly sensitive visitors are displaced to visit in off-season.

Further research has begun the next step of examining preferences for the different forms of how access restrictions can take shape. Permit hikers at Grand Canyon National Park were found to, on average, apply for their permits 81 days in advance and were not willing to pay more to be able to apply earlier. However, individuals were willing to pay more for a real-time web-based service since typically half of all permit applications for the season were denied (Schwartz, Stewarts, & Backlund, 2012). Siderelis and Moore (2006) similarly found in a case of white-water rafting permits, advance application permits were heavily preferred over a first-come first serve scenario. Reigner et al. (2012) further advances the understanding of access restriction methods by analyzing the implication of permits at Half Dome in Yosemite National Park. Their results indicate permits are effective when they are applied using an adaptive management strategy that assesses use patterns and limits, applies preliminary permit for only weekends, and lastly implements a full permit for the full 7-day week. These findings provide insight for the optimal design of a reservation system that would increase public supportiveness.

Recreators Perspectives Towards Use Fees

An appropriate use fee for public lands should account for revenue, maintaining access, fairness, equity, and congestion (Richer & Christensen, 1999). A multitude of research has aimed to study preferences associated with the application of use fees, i.e. entrance fees, at outdoor recreation sites. In general attitudes towards use fees are negative, though the magnitude varies based on the size of the fee and background of the individual. At two Chicago recreation sites, lower use fees were typically preferred across sites, regardless of varying site attributes. That is until a use fee was raised high enough to cause a significant decrease in congestion at which point some individuals shifted their attitudes. These particular individuals, however, were found

to be those with higher incomes (Schroeder & Louviere, 2017). Alternatively, low-income individuals are found to typically prefer lower use fees or even for the recreation sites to be paid for by taxes instead of fees (More & Stevens, 2000). Although attitudes toward use fees tend to be negative, Lee and Han (2002) find that use fees at Korean National Parks were significantly less than the use values expressed by recreators. An indication that although recreators attach a high value to getting to experience a national park they still have strongly negative attitudes towards an increase in the fee to use these parks. These negative attitudes primarily emanate from low-income individuals and can become positive for high income individuals when congestion is significantly reduced.

Application of Choice Experiments in Outdoor Recreation

Choice experiments, a form of stated choice modeling, have long been used in the study of environmental, recreation, and leisure economics. Their particular function derives from their ability to effectively measure tradeoffs. Choice experiments also provide more information than other forms of the stated choice method, can better avoid elicitation of responses, are able to measure more attributes than revealed methods, and are better at avoiding collinearity (Hanley, Moucato, & Wright, 2001; Adomowicz, Louviere, & Williams, 1993). Though beginning in market research and health economics, choice experiments are now seen as a very flexible and widely accepted means of valuing outdoor recreation and assessing site characteristics. Chaminuka et al. (2002) for example, uses a choice experiment in Kruger National Park, South Africa to study tourist preferences and willingness to pay for ecotourism in the adjacent area. Since consumers derive their utility from the attributes of a good, rather than the good itself, their study was better able to identify particular characteristics of ecotourism destinations that were of

the most interest to tourists. This information helps locals to make better decisions as to what amenities to provide to their visitors. Alternatively, many of the studies on preferences for access restriction, use fees, and congestion listed in previous sections use choice experiments to identify the attitudes exhibited by outdoor recreators that provide motivation for this study (Newman et al., 2005; Pettebone et al., 2011; Bullock & Lawson, 2008; Schroeder & Louviere, 2017; Lee & Han, 2002). Both Newman et al. (2005) and Pettebone et al. (2011) use choice experiments in relation to access restrictions and congestion, and therefore were particularly influential in the research design used in this paper, serving as useful guides in the process of developing the methods used to answer this study's main research question.

While past research has indicated outdoor recreators exhibit a preference for access restriction strategies over use fees to lower the impacts of congestion, they are very case specific. Whether they deal with wilderness backpacking, parking/shuttle strategies, or smaller regional parks, there is little consideration for the attitudes towards a direct capacity constraint strategy at the entrance of a greater national park. Since national parks are receiving the bulk of outdoor recreation and demand for them is growing well past their carrying capacity, attention must be shifted in their direction. The research presented in this paper addresses this lack of information in solving this problem. Choice experiments are the norm in previous literature and well suited for addressing these questions. Given this fact, this study uses a choice experiment to consider public attitudes towards reservation systems replacing entrance fees to reduce congestion at Rocky Mountain National Park.

III.   Methods

Selecting Attributes & Levels

The type of choice experiment used in this study requires individuals to indicate which of two specifically defined alternatives they would prefer. These two alternatives are largely similar in their contents and should draw positive or negative interest depending on a particular individual's preferences. The contents of alternatives are specified by attributes and varying levels of those attributes that individuals would find particularly desirable or undesirable. For this study alternatives share identical attributes that may vary in levels across the alternatives, though they can also be similar (see Figure 1 for reference). Due to the contrasts across attributes, individuals are forced to make trade-offs in deciding the alternative they prefer most. These trade-offs become the primary interest, as they indicate the attributes and levels of those attributes that most influence choices (e.g. trading off a low price with high congestion for high price, low congestion). This information provides clarity as to why individuals may prefer one scenario over an opposing one when these scenarios are defined by contrasting characteristics. As a result, these studies are highly influenced by the attributes and respective levels assigned to the design and therefore require significant consideration by the researcher (Holmes, Adamowicz, & Carlsson, 2017).

The research presented here uses 3 attributes, each with 2 corresponding levels. This was largely decided with consideration of limited research budget. This experiment design is relatively basic, yet sufficiently informative, though an expanded design may potentially provide additional insights. However, for this study the number of levels will provide a clear distinction of high and low that indicate a broader attitude towards a particular attribute, rather than

particular degrees of attitudes. With this in mind, the attributes decided upon were type of

restriction, price, and crowding/congestion level, with Table 1 indicating their respective levels.

The alternatives of this experiment represent two options for what an individual would

experience if they planned on visiting Rocky Mountain National Park on a July weekend. First

and foremost, individuals face some kind of barrier to access that they are required to engage

with before being allowed to enter to the park, indicating a type of restriction. Type of restriction

can either take the form of the current entrance fee, or the proposed reservation system. Since

prior research has not provided a clear indication of attitudes towards use fees or congestion

levels for the entire park this study includes type of restriction as its own attribute rather than as

labels for the alternatives. Therefore, it is possible to experience choice sets with both

alternatives as only entrance fees or only reservation systems.

Table 1: Choice experiment attributes and levels

Price
1) $25
2) $65
Type of Restriction
1) Entrance Fee – always allowed in
2) Reservation – possibility of not being allowed in
Crowding Levels

1) Hiking Encounter – every 5 minutes.
      Traffic – speed limit.
      Parking – takes 2 minutes

2) Hiking Encounter – every 1 minute.
      Traffic – slower than usual.
      Parking – takes 10 minutes

If an entrance fee is indicated then the type of restriction in place is the currently used

system at RMNP. This means that there exists no entrance capacity constraint and therefore,

individuals can decide at any time to visit the Park and always expect to get in. Alternatively, if a reservation system is indicated as the respective level for type of restriction then a capacity constraint is implemented for entrance into the Park. Individuals would be required to go onto a real-time reservation website in hopes of there being availability for the day they wish to go, though this means there is a probability that by the time they attempt to make the reservation all spots will have been taken for that day. It is assumed that reservations for weekend days will always fill up, and therefore if too late, individuals would have to reserve another day, or go somewhere else/stay home.

Regardless of type of restriction, visitors always have to pay a price. This price represents the fee of being able to access RMNP that ultimately helps fund the park. When an entrance fee is in place, the price is paid at the entrance gate the day of visiting. Whereas for a reservation, the price is paid upon making the reservation. The levels decided upon are based on existing and proposed fees at RMNP. While the fee of $25 is the existing entrance fee for a 1-day vehicle, the fee of $65 is based upon the 2017 proposed fee of $70 for a 1-day vehicle (NPS.gov, 2017). However, due to the heavy public disapproval that was associated with this proposal, this study aims to avoid the negative connotations that $70 now has on the public. Therefore, a fee of $65 is used instead in an attempt to resemble a large increase but not seem related to the 2017 proposal.

Crowding level is an indication of the unavoidable amount of people an individual will have to encounter while in the park. Crowding can take three forms: hiking encounters, traffic, and time to park. Forms were chosen based on the most influential attributes found in similar recreation studies that also use choice experiments. Pettebone et al. (2011) in particular finds traffic levels and time to wait for a parking spot at Rocky Mountain National Park to have the largest influence on visitor's preferences. The study presented in this paper defines traffic level

as the speed all cars travel while in the park, and time to park as how long one would have to

wait at parking lots and pull offs for a spot to become available. Congestion while hiking, on the

other hand, tends to vary in how it is parameterized depending on the context of the particular

study. Studies have defined it as people in view at any time, daily encounters, or broad estimates

of people on the trail, while occasionally using photos to provide better clarity for respondents

(Pettebone et al., 2011; Newman et. al., 2005; Bullock & Lawson, 2008). In all studies these

measurements presented significant findings but are not as applicable for the context of this

particular study and instead hiking congestion is estimated as the number of minutes before one

would encounter another individual or group. The three forms of congestion are combined into

one attribute, rather than three separate attributes, because it is presumed that a capacity

constraint like the reservation system would affect all aspects of congestion, including the three

specified here. Levels were determined with consideration that any management strategy for the

park could not fully eliminate congestion, only reduce it. Verification of adequate difference in

the congestion levels were tested with focus groups and tweaked to ensure clarity.

Experimental Design

A full factorial design is utilized with a possible of eight alternatives. These designs

require the use of all possible alternatives derived from the number of attributes and number of

levels per attribute. Full factorial designs can become increasingly difficult to use for larger

designs with more attributes and/or levels. However, since this study utilizes only three attributes

with two levels each, only eight possible alternatives are generated ($L^A=2^3$) making use of a full

factorial design more feasible. Full factorial designs are typically preferred over fractional

designs because they allow for all main and interaction effects to be statistically independent

(Holmes, Adamowicz, & Carlsson, 2017).

Figure 1: One of twelve choice sets used in experiment

	A	B
Type of Restriction	Entrance Fee	Reservation System
Price	$25	$25
Crowding Level	Hiking Encounter – every 1 minute. Traffic – slower than usual. Parking – takes 10 minutes	Hiking Encounter – every 5 minutes. Traffic – speed limit Parking – takes 2 minutes

By using a full factorial design, 28 possible paired choice sets are generated to represent

the maximum number of combinations between the eight alternatives. Many choice sets included

comparisons with only one attribute differing across alternatives. These choice sets were

assumed to then have dominating alternatives that individuals would always choose, lacking any

trade-offs. As a result, these choice sets were eliminated from the design along with other

presumably dominating choice sets. This narrowed the number of viable choice sets exhibiting

adequate tradeoffs to a total of 12. Figure 1 indicates one of these 12. The 12 choice sets were

then divided into two versions containing six each. Allocation across the versions was designed

to ensure all eight alternatives were seen in both versions equally and neither version was

considered easier or harder than the other.

A simulation was used to further ensure a proper experimental design was created.

Choice set answers were simulated using a total of 144 choices, 12 choices per choice set, where

coefficients were created by the researcher and error terms were randomly generated to

formulate random choice behavior. After running a statistical analysis on the choice sets and

their randomly generated choice answers, the analysis successfully estimated the coefficients created by the researcher. This simulation provided validation that the experimental design would be able to identify the effects important to this research.

Survey Administration

The survey was designed and distributed online through the survey software Qualtrics with a sample size of n=521 responses collected over a 6-day period from February 20-26, 2019. Survey subjects were recruited by Qualtrics through their online survey panel and approval was obtained from the IRB human research committee (protocol #: 18-0719). A pilot survey was initially distributed to 50 individuals to ensure adequate survey design and clarity in choice sets. Respondents had to be over the age of 18, Colorado residents, and distributed equally across the Front Range cities of Denver, Boulder, Fort Collins, and Colorado Springs. These constraints attempt to maximize the number of respondents who have visited RMNP and visit the most frequently. This means, however, that the out-of-state visitors who make up a large proportion of annual visits to RMNP are excluded from this study. The study is further limited by the time of year it was conducted and could have benefited more from taking place during RMNP peak season. There is potential that respondents' answers could be influenced from being displaced to the time of year the survey is concerned with. These two limitations are results of time constraints and could be overcome by administering the survey in person at RMNP during peak season.

Respondents could take the survey on their own time, in their own locations, and on a cell phone or computer. Upon beginning the survey, they were given a short briefing describing the

purpose of the study, a detailed explanation of attributes, and an example choice set. Along with the clarification of choice sets, reservation systems were particularly highlighted due to being a relatively alien concept in the context of Rocky Mountain National Park (see Appendix A for how reservation systems were defined, as well as the entire survey template). A final reminder indicating the study was being conducted independent of RMNP management aimed to prevent strategic bias attempting to alter or keep certain proposed management strategies. Respondents were then randomly given one of the two versions and presented the 6 choice sets in a random order. Versions were distributed equally across respondents, with 266 taking version 1 and the other 255 taking version 2. Random ordering of choice sets ensured that no particular choice sets were always seen first or last. Furthermore, respondents were not able to switch back and forth between choice sets and viewed only one at a time. For each choice set they would view a side by side comparison of the two alternatives labeled A & B and asked which of the two they would prefer the most. Following completion of the choice sets respondents were asked to answer demographic questions about their age, gender, race/ethnicity, education, and income. They were also asked RMNP visitation questions regarding whether they had ever been to RMNP, how many times had they visited in the last 12 months, what their favorite activities in the park are, and whether they owned an annual parks pass. If they answered yes to owning an annual pass, a follow up question was given to determine how they interpreted using their pass in the choice sets and if it influenced their answers at all.

Statistical Analysis

As frequently done in choice experiment literature, responses from the choice sets were analyzed using a conditional logit model based on random utility theory. Since individuals make

trade-offs between attributes when indicating their preferred alternative, it is assumed they know

their own utility. Their utility, U_i , is defined as the sum of the observable components, V_i ,

consisting of a vector of attributes, Z_i, within alternative i, plus the unobservable components,

ε_i , that reflect random choice behavior not explained by the attributes, expressed as:

$$U_i = V_i(Z_i) + \varepsilon_i$$

Since individuals are assumed to know their utility, it is assumed they will always attempt to

maximize it. Given this, the probability that an individual will choose alternative i over some

alternative j is defined as:

$$P_i = P[\,V_i(Z_i) + \varepsilon_i > V_j(Z_j) + \varepsilon_j]$$

The above equation demonstrates that an individual will chose alternative i if and only if the

utility experienced from i is greater than the utility experienced from alternative j. As a result,

choices are made based on the differences in utility across alternatives which are defined by their

specific attributes. This is better demonstrated by taking the difference across the observable

components of utility, rearranged as:

$$P_i = P[\,V_i(Z_i) - V_j(Z_j) > \varepsilon_j - \varepsilon_i]$$

where only differences across alternatives are included in the model, highlighting trade-offs

exhibited. The conditional logit model further rearranges this model as a log odds ratio, assuming

the unobservable component of utility is independently and identically Gumbel distributed

(Holmes, Adamowicz, & Carlsson, 2017; Bullock & Lawson, 2008).

$$P_i = \frac{1}{1 + \exp -[V_i(Z_i) - V_j(Z_j)]}$$

Utility for an alternative is defined as a linear function of its attributes. For this study the observable utility is composed of the three attributes: type of restriction, congestion level, and price. Expressed as the base model:

$$U_i = V_i(Z_i) + \varepsilon_i = \beta_R Restriction_i + \beta_C Congestion_i + \beta_P Price_i + \varepsilon_i$$

Both restriction and congestion are coded as dummy variables where Restriction==1 if the type of restriction indicated is a reservation system and Restriction==0 if indicated as an entrance fee. Congestion is coded where congestion high is coded as Congestion==1 and congestion low as Congestion==0. Dummy coding is used ("0's" & "1's") as opposed to effects coding, ("-1's" & "1's") which would be more useful if there were more than two levels. As a result of using dummy coding the β coefficients of Restriction and Congestion represent the marginal utility of moving from one level (entrance fee/congestion low) to the second level (reservation system/congestion high).

Price on the other hand is coded as a continuous variable (i.e., as 25 and 65) and therefore β_P is the marginal utility of a per dollar increase, rather than the difference in utility of the two levels like how restriction and congestion are measured. Marginal utility per dollar can then be divided under the marginal utilities of congestion and restriction to transform those values into dollar terms or more precisely their marginal willingness to pay (Holmes, Adamowicz, & Carlsson, 2017). This was done so utility functions measured in dollars could be calculated for each of the eight alternatives. Measuring utility in dollars gives results that are more easily interpreted since utility values are relative and without tangible value. The eight utility functions were then ranked to determine scenarios that would be more preferable on average compared to other scenarios.

Individual demographic and visitation variables were also estimated in multiple models to understand if particular groups exhibited a difference in preferences for the attributes compared to their counterpart groups. Besides income, age, and education, each variable was estimated in separate models with interaction effects on all three of the attributes expressed as:

$$U_{ik} = \beta_R Restriction_i + \beta_C Congestion_i + \beta_P Price_i + \beta_{RX} Restriction_i \cdot (X_k)$$
$$+ \beta_{CX} Congestion_i \cdot (X_k) + \beta_{PX} Price_i \cdot (X_k) + \varepsilon_i$$

Where X_k represents some dummy variable specific to individual k (i.e., gender, income, preferred activity, etc.) interacted with Restriction, Congestion, and Price. $\beta_{(R,C,P)X}$ is the difference in marginal utility for the X group compared to their related omitted group for each of the three attributes. Backpacking, for example, is coded as X=1 if individuals indicated they enjoyed backpacking while in RMNP and X=0 otherwise. In this case the coefficients of the interaction effects indicate the difference in marginal utility from an attribute for backpackers versus non-backpackers, but not their total marginal utility. Income on the other hand includes two X variables as income less than $60k and income greater than $120k. In this case the coefficients for the two levels of income are measured as the difference in marginal utility for i.e., income less than $60k compared to the omitted income level, income between $60k and $120k. Education and age are measured in similar fashions.

Wald chi square tests were then calculated to determine if being part of certain groups within characteristics effected choice behavior. Each of the three interaction term coefficients were tested to be statistically different than zero, simultaneously, post-regression. Wald tests are similar in their function to R-squared tests for linear regressions in testing the overall goodness of fit of a regression. For logit models a Wald test is estimating the improvement in predicting choice behavior from including specified variables in the regression. Wald tests that do not

suggest statistically significant results indicate that being a part of a particular group within the sample does not immediately impact choice behavior and observed preferences. This information provides further insight as to how particular groups may exhibit separate preferences in the context of this choice experiment to better explain behavior (Bullock & Lawson, 2008).

Both a probit and linear probability model were considered to examine potential differences in results across models. While the probit and logit models yielded similar results, the results of the linear probability model were noticeably different compared to the former two. After testing to determine if the linear probability was mis-specified it was concluded that it was not an accurate model for this study (see appendix B for more detail on this conclusion). Since the linear probability model was concluded to be mis-specified, the probit produced near similar results as the logit, and the logit is the frequently used model in choice experiment literature, the logit was concluded to be the model to use.

IV.   Results

Choice Set Answer Distributions

Answer distributions from each of the 12 paired choice sets are presented in Table 2. A sample size of n=521 divided among two versions lead to each choice set being seen 268 times, and with 12 choice sets a total of 3,126 choices were made. Alternatives A and B are both defined by their attributes and given a percentage as to how many respondents chose that particular alternative as being preferable over the counter alternative. Immediately results of some choice sets stand out. Choice sets 1 and 9 are the two most dominant choice sets in the sense that there is a dominantly uniform distribution of answers. This was expected however, as

the researcher planted one in each of the two versions as a test to respondents' attentiveness. An

indication that Alterative B of choice set 9 was chosen 91% of the time even though the two

alternatives only differed in congestion shows that respondents were reading the alternatives

carefully and most were able to spot that there existed only one difference making B the obvious

choice.

Table 2: Answer distribution of the 12 choice sets with 3,126 choices

Choice Set	Alternative A	% Chose A	% Chose B	Alternative B
1	(8) Reservation, Congestion High, Price=65	9%	91%	(1) Entrance Fee, Congestion Low, Price=25
2	(5) Entrance Fee, Congestion Low, Price=65	16%	84%	(2) Reservation, Congestion Low, Price=25
3	(5) Entrance Fee, Congestion Low, Price=65	35%	65%	(3) Entrance Fee, Congestion High, Price=25
4	(6) Reservation, Congestion Low, Price=65	33%	68%	(5) Entrance Fee, Congestion Low, Price=65
5	(4) Reservation, Congestion High, Price=25	60%	40%	(5) Entrance Fee, Congestion Low, Price=65
6	(2) Reservation, Congestion Low, Price=25	69%	31%	(3) Entrance Fee, Congestion High, Price=25
7	(2) Reservation, Congestion Low, Price=25	86%	14%	(7) Entrance Fee, Congestion High, Price=65
8	(3) Entrance Fee, Congestion High, Price=25	68%	32%	(6) Reservation, Congestion Low, Price=65
9	(3) Entrance Fee, Congestion High, Price=25	9%	91%	(1) Entrance Fee, Congestion Low, Price=25
10	(6) Reservation, Congestion Low, Price=65	38%	62%	(4) Reservation, Congestion High, Price=25
11	(7) Entrance Fee, Congestion High, Price=65	21%	79%	(6) Reservation, Congestion Low, Price=65
12	(4) Reservation, Congestion High, Price=25	82%	18%	(7) Entrance Fee, Congestion High, Price=65

After the planted choice sets, choice set 2 is among the next most dominated in answer

distribution. This is surprising, as the researcher expected this particular choice set to have

somewhat indifferent responses. The alternatives in choice set 2 represent a comparison in the two management scenarios of the most interest to this paper. Alternative A is described as the strategy to reduce congestion through an increased entrance fee, while Alternative B indicates the proposed reservation system to reduce congestion. Though it was believed there may be some favorability towards the reservation system over the increased entrance fee, it was unexpected that responses would be relatively dominant towards the reservation system. These preliminary findings will have further weight after results from the logit model are discussed.

On the other end of the spectrum, the choice set with the closest answer distribution was choice set 5. Results here suggest respondents were relatively indifferent and had a more difficult time choosing between the two types of restriction when the reservation system maintained a low price at the cost of high congestion, and the entrance fee achieved lower congestion at the cost of an increased fee. Though not uniform, respondents still mostly indicated they would prefer the reservation system that was unsuccessful in its purpose (i.e. achieving low congestion) over a price of $65. The conditional logit model provides further information on the results we see here in its effort to explain how the differences in attributes determined choice behavior.

Conditional Logit Model Results

Results from the base conditional logit model are presented in Table 3. It is important to note that due to the nature of estimating utility, the values of coefficients are relative and possess no tangible value. Instead the researcher is most concerned with the signs, significance, and comparisons of the magnitude across coefficients. Furthermore, coefficients are measurements in the difference in utility received from one level compared to another, not the effect of a

particular level on overall utility. More specifically, coefficients are measurements of the

marginal utility from experiencing the specified level versus its counterpart.

Table 3: Coefficients for attributes from conditional logit model

Variable	β	s.e.	z-score
Reservation	-0.268***	.059	-4.51
Congestion High	-1.197***	.068	-17.62
Price *per dollar*	-0.0421***	.0018	-22.78
Price∆40 [a]	-1.684	n./a	n./a

*** p < .01.   a: (price per dollar x 40) or difference in utility of price=25 to price=65.

The coefficient for reservation systems suggests that as expected moving from an

entrance fee to a reservation system has a negative effect on utility. That is individuals would

prefer on average an entrance fee over a reservation system if they wished to maximize utility.

While still being statistically significant from zero (i.e. 0 indicating being indifferent between the

two types of restriction) the coefficient for reservation is the smallest of the three attributes.

Therefore, while reservation systems have a negative effect on utility compared to entrance fees,

their effect is less than that of moving across the levels of congestion and price.

Congestion high produces similar results as the reservation, in that high amounts of

congestion have a negative effect on utility compared to having lowered congestion. However,

the corresponding coefficient pertains to a much larger magnitude than that of reservation

systems. This suggests individuals have a stronger preference to move from high congestion to

low congestion than they do to have an entrance fee instead of a reservation system.

Lastly, price is shown to have the largest effect on utility, though the price per dollar coefficient is small, priceΔ40 is given to show the marginal utility of moving across the two price levels. Like congestion and reservations, it is significant at the .01 level, but its status as having the largest magnitude (priceΔ40=-1.684) of the three shows that price, on average, has the largest effect on individuals' choices. With congestion then having the second greatest effect, and reservation versus entrance fee having the least.

This helps to explain the answer distribution of choice set 2 in Table 2, as the difference in price was seemingly much more influential in choice behavior than difference in restrictions. Indication that the three attributes are significant at the .01 level strongly suggests choices were influenced by each of three attributes, though not equally. While the results presented here carry weight, they do not answer the questions of this paper clearly. Whether the public would prefer a reservation system to an increased entrance fee to reduce congestion is examined in the following section.

Ranking the Alternatives

The objective of the study presented in this paper is to determine if the public would prefer a reservation system over an increased entrance fee to reduce congestion in RMNP. In addition, whether either of the two above scenarios would be preferred over the current status of the park, i.e., entrance fee of $25 but with high levels of congestion. To best answer these questions the 8 alternatives, which from here on will be referred to as scenarios, used in the choice experiment were ranked according to estimated preferences presented in Table 4. Rankings are established after converting the base logit model coefficients into dollar terms in

which the congestion and reservation coefficients are divided by the price per dollar coefficients,

detailed more in the *statistical analysis* section. Converting to dollars does not change the

rankings but does make interpretations and comparisons easier. The values estimated indicate the

reduction in utility in dollars a particular scenario has when compared to a scenario in which

there was an entrance fee, low congestion, and a price of $0. More importantly, they do not

represent the overall utility from visiting RMNP, only the reduction in utility from having to

experience particular attributes. For example, scenario (1) has an estimated utility reduction of

$25 because that is the price being payed, and there exists an entrance fee and low congestion

which do not cause utility reduction. Therefore, there is only a reduction when a scenario is

characterized by a reservation system, high congestion, or a price greater than $0.

Table 4: Ranking choice alternatives based on their utility reduction in dollars

Scenario	Utility Reduction ($)	Preference Ranking
(1) Entrance Fee, Congestion Low, Price=25	-25.00	1st
(2) Reservation System, Congestion Low, Price=25	-31.37	2nd
(3) Entrance Fee, Congestion High, Price=25	-53.43	3rd
(4) Reservation System, Congestion High, Price=25	-59.80	4th
(5) Entrance Fee, Congestion Low, Price=65	-65.00	5th
(6) Reservation System, Congestion Low, Price=65	-71.37	6th
(7) Entrance Fee, Congestion High, Price=65	-93.43	7th
(8) Reservation System, Congestion High, Price=65	-99.80	8th

Upon quick glance of the scenarios order of ranking, a few trends quickly stand out. First

of all, all scenarios with price=25 are ranked higher than scenarios with price=65 regardless of

the level of the other attributes. Following price, congestion low is always ranked higher than

congestion high, regardless of type of restriction, however, congestion high and price=25 is still

ranked higher than congestion low and price=65. Lastly, reservation systems are always ranked below entrance fees when two scenarios are similar in congestion and price. These trends should come as no surprise as they are consistent with the ranking of magnitudes from the conditional logit model. Furthermore, rankings are consistent with the choice set answer distributions in Table 2.

To best address the research question proposed, particular attention is drawn to scenarios (2), (3), and (5). Scenario (3) represents the current status at RMNP, with an entrance fee of $25 and high congestion. Scenario (5) indicates the proposed increase in entrance fee to reduce congestion, and scenario (3) represents the proposed reservation system to also reduce congestion. As the rankings show, on average, the public is expected to prefer the current status of high congestion over a scenario that achieves low congestion at the cost of having to pay a higher fee. Suggesting the public would not be in favor of a higher entrance fee even if it meant less congestion, which is consistent with the outcome of the 2017 proposed fee hike mentioned in the *introduction*. Although, the public would not prefer increased fees to reduce congestion, the rankings suggest a stronger favorability towards reducing congestion through a reservation system. Furthermore, using a reservation system to reduce congestion is also more preferable over the current status of RMNP. Results from this study suggest that a reservation system is preferred over an increased entrance fee to reduce congestion at RMNP, as well as also being preferred over the Park's current status. This is consistent with answers to the question: "would you prefer a reservation system over an increased entrance fee to reduce congestion at RMNP?" asked at the end of the survey. In which 61% stated yes, 23% stated no, and the rest indicated they were indifferent.

Variation in Sample Specific Characteristics

If it is the case that the public is more favorable to a reservation system over high

congestion and price increases, then attention should be drawn to understand which members of

the public express these preferences. Table 5 describes the sample population from the survey

based on their answers to the demographic and visitation questions asked at the end of the

survey. There exist a few notable characteristics. A large majority of respondents indicated they

had been to RMNP at some point in their life (82.5%), however half of respondents had not been

in the past year. Furthermore, nearly a third of respondents indicated they possessed an annual

Park pass. This is concerning since annual passes are means of getting around the typical

entrance fees to Parks and the study in this paper does not fully address how annual passes would

Table 5: Descriptive statistics for sample n=521

Age	Mean = 43 , Std. Dev. = 15.36
Gender	Male = 49.5% , Female = 50.1%
Days visited in last 12 months	Mean = 2.5 , Median = 0.5 , min = 0 , max = 80
Ever Visited RMNP	Yes = 82.5% , No = 17.5%
Annual Pass holder	Yes = 31.3% , No = 68.7%
Preferred Activities	Backpacking = 12% , Camping = 24% , Driving = 76% , Hiking = 69%
Income	Less than 60k = 51% , 60k to 120k = 36% , Larger than 120k = 13%
Education	HS or less = 17% , some college = 25% , Associate/Bachelors = 44% , Masters or higher = 14%
Race/Ethnicity	White = 76% , Black = 4.5% , Latino = 9.6% , Asian/Islander = 3.2% , Native = 2.7%

change in the context of a reservation system or increased entrance fee. Lastly, there are considerable differences across the samples population's indication of income, education, preferred activities, age, and to some degree race/ethnicity. This variation allows for an estimation as to whether being a part of any particular group in these categories has any implication on stated preferences.

A conditional logit model with interaction effects is used to determine variation in preferences depending on individual differences across demographic and visitation characteristics. Results of some of the characteristics are presented in Table 6. Characteristics are estimated and reported as separate models to avoid multicollinearity issues and provide direct comparisons for characteristic groups. Dummy variables are used to define the characteristics where a variable is equal to 1 if the specified group characteristic under row *variable* was indicated by the individual. Incidentally coefficients are thus an indication of the difference in utility received by the specified group compared to the omitted group from the indicated attribute level. More so, coefficients are not an indication of the overall utility received from the attribute for the specified group, only the difference in utility for the specified group compared to the omitted. For all groups indicated in Table 6 it can be assumed that the utility received from reservation systems, congestion high, and price increases is still negative and similar to results from Table 3. The primary concern of this section is how magnitudes change for being part of a particular group. In the discussion that follows phrases like "more opposed" and "less opposed" are used to report results, and simply indicate negative and positive coefficients being expressed.

Table 6a: Coefficients for interaction of attributes and sample population characteristics

Model Variable	(1) Visited_ no	(2) Annual_ yes	(3) Income >120k	(3) Income <60k	(4) Age>45	(4) Age<30	(5) Female	(6) 3 or more Days	(7) 0 Days
% of sample	17.47%	31.29%	12.67%	51.06%	44.34%	25.34%	50%	26.49%	42.61%
Reservation	0.30**	-0.11	0.06	0.23*	-0.36**	-0.25	-0.04	-0.12	0.20*
	(.14)	(.13)	(.20)	(.13)	(.14)	(.16)	(.12)	(.13)	(.12)
Congestion High	0.27*	0.13	0.03	0.46***	-0.02	-0.36**	<0.00	0.39***	-0.08
	(.16)	(.14)	(.22)	(.16)	(.16)	(.19)	(.14)	(.14)	(.14)
Price	0.012***	< 0.000	0.009**	0.013**	0.002	-0.001	-0.004	0.013***	0.007*
	(.00)	(.00)	(.01)	(.00)	(.00)	(.00)	(.003)	(.00)	(.00)
Wald Test	8.32**	3.40	5.92	9.03**	10.38**	6.52*	2.78	21.29***	11.73***

* p<.1; ** p<.05; *** p<.01

Table 6b: Coefficients for interaction of attributes and sample population characteristics

Model Variable	(8) Backpacking	(9) Driving	(10) Camping	(11) Black	(12) Latino	(13) No_college	(14) Associate/ Bachelors	(14) Masters/ higher
% of sample	12.09%	76.39%	24.38%	4.61%	9.60%	16.51%	43.76%	14.40%
Reservation	-0.23	-0.26**	0.21	0.50**	0.034*	0.08	-0.15	-0.18
	(.21)	(.13)	(.14)	(.25)	(.19)	(.15)	(.13)	(.19)
Congestion High	-0.69***	-0.31**	0.18	0.62**	0.08	0.25	-0.05	-0.37*
	(.25)	(.15)	(.15)	(.27)	(.22)	(.17)	(.15)	(.22)
Price per $	-0.012*	-0.015***	0.005	0.006	0.005	0.013***	-0.010***	-0.014**
	(.01)	(.00)	(.00)	(.00)	(.00)	(.00)	(.00)	(.01)
Wald Test	8.50**	15.00***	2.93	6.85*	3.99	10.23**	10.41**	5.07

Owning an annual pass for starters was of particular interest, as nearly a third of respondents indicated owning one and planning to renew it. Since the study in this paper did not specify the use of annual passes in the choice sets or how the reservation system would change annual passes if implemented, it was unclear if pass holders would exhibit different responses to non-pass holders. Results of model (2) suggest that annual pass owners are more opposed to the reservation system (-0.11) and less opposed to higher congestion (0.13) than non-pass holders. Though these results are not statistically significant from zero and therefore a conclusion can not be drawn on whether or not owning an annual pass influenced preferences exhibited in the choice sets and so the concern presented here is resolved. When asked how owning an annual

pass influenced answers to choice sets, most annual pass holders indicated it did not influence at all, or they were thinking of families.

Further concern arises from the group within the sample population that indicated they had never been to RMNP at any point in their lives (17.5%). Model (1) indicates how those who had never visited differed in preference than those who had. Results suggest those who had never been are less opposed to reservation systems, higher congestion, and price increase. Since all three coefficients were statistically significant, we can reject the idea that having never visited RMNP had no effect on preferences and choice behavior. Furthermore, model (7) looks at how preferences change for those who had not been to RMNP in the last 12 months compared to those who had. With this group representing nearly half the sample population, results suggest those that have not been in the last year are significantly less opposed to both price increases and reservation systems than those that visited at least one day. Furthermore, they did not exhibit significant difference in preference for high congestion, leading to a possible explanation that individuals did not visit in the last year because they believed RMNP to be too crowded and would thus prefer efforts to reduce that congestion. Alternatively, results from model (6) suggest those that visited 3 or more days in the past year are significantly less opposed to higher congestion and price increases, which can be expected as these individuals already choose to frequently visit RMNP even though there exists high congestion.

RMNP hosts a variety of activities for visitors to engage in and therefore attracts a wide range of recreational backgrounds. Survey respondents were asked which of the available activities they preferred most to engage with and were allowed to choose all that applied to them, of these activities backpacking, scenic driving, and camping stood out as the most interesting. While model (10) suggests those who prefer to camp in the Park are less opposed to reservation

systems, higher congestion, and price increases, models (8) and (9) suggest backpackers and scenic drivers expressed more opposing preferences to the three attributes. Backpackers larger opposition to congestion can be expected since these groups tend to prefer solitude and is consistent with findings from Newman et al. (2005). Notably those who prefer to engage in scenic drives in the Park are particularly more opposed to reservation systems than those who preferred other activities. Scenic drivers are among one of the few groups looked at that expressed statistically significant negative coefficients for reservation systems. Possible explanation for this is that scenic drivers tend to spend less time in the Park and therefore, would not want to go through the hassle of a reservation system for only a short trip. Alternatively, since scenic drivers make up a large portion of the sample population (76.4%) it is also possible that those who do not prefer scenic drives are more indifferent to reservation systems than scenic drivers. Age is the only other statistically significant characteristic that helps to explain negative preferences for the reservation system. Results of model (4) suggest those over the approximate mean age of 45 years old are more opposed to the reservation systems than younger groups. It appears these two are related considering 84% of those over the age of 45 indicated enjoying scenic drives. While being younger than 30 years old also indicated a negative coefficient for reservation systems, it was not statistically significant. Alternatively, those under the age of 30 are far more opposed to higher congestion than other age groups.

Income was expected to produce the most interesting results as it serves as a premise for the necessity of this study to address the public's concerns for access to all. Model (3) presents the results for both income >120k (income high) and income <60k (income low) compared to income between 60k and 120k. While results suggest income high is less opposed to price increases, surprisingly income low expresses similar preferences (0.013) and of a larger positive

magnitude than income high (0.009). This suggests that on average individuals in the lower income tier were the least opposed to price increases, as well as being the least opposed to higher congestion and reservation systems than the two other income tiers. Upon using an aggregate model with most of the characteristic variables, the income low coefficient for price increases was no longer statistically significant and therefore low-income groups being less opposed to price increases is likely explained by members of that group also being members of other groups. Lastly, it appears an increase in income has a positive effect on preferences for lower congestion, and therefore, individuals with higher incomes are likely to desire reductions in congestion more than those of lower incomes. While it is typically expected that education would have similar results as income, considering income typically has a positive relationship with education, this study does not see this trend. Instead models (13) and (14) suggests higher education leads to being more opposed to price increases, as well as to a lesser degree reservation systems and higher congestion.

Wald tests were used to determine the overall influence on choice behavior of individuals being members of particular groups. That is Wald tests measured how including the specified variables improved the model's accuracy in estimating choice behavior. Larger Wald test values indicate a variable being better at helping to explain observed preferences. Results of the Wald tests suggest that frequency of visits in the last 12 months is the best explanation for choice behavior and preference indication. Members of the group "visited more than 3 days in last 12 months" were estimated to have the most explanatory difference in preference when compared to those that visited less often. Preferred activities, education, and age characteristics also produce significant results in the Wald test suggesting different groups within these characteristics are likely to exhibit different preferences than their counter parts.

V.   Discussion

Key Findings

As Rocky Mountain National Park continues to see increasing annual visitation, accompanied with heavy crowding on summer weekends, this paper attempts to observe the publics' preferences for congestion management strategies. Results from this study suggest the public would be favorable to a reservation system implemented at RMNP if it was accompanied with lowered congestion and avoided a substantial increase in price. Respondents of this paper's research indicated they had a desire to lower congestion in most cases, but also indicated they would be willing to tolerate high amounts of congestion rather than pay $65 to lower it. Furthermore, it is likely individuals are willing to pay slightly more than $25 to achieve lower congestion with the reservation system considering the estimated utility reduction from increased congestion is approximately $28.00 and reduction from using a reservation system is only $6.00. Previous studies have found similar results that indicated public favorability for implementation of capacity constraints as congestion management tools. Most studies indicated individuals came to increasingly prefer strategies to limit the number of people the better they became at reducing congestion (Newman et al., 2005; Jakus & Shaw, 1997; Lawson et al., 2003). Furthermore, Pettebone et al. (2011) also found visitors of RMNP are willing to make sacrifices when visiting in order to have a less congested experience when in the Park.

In comparing the two proposed congestion management strategies, results indicate strong preferences. In three different cases, individuals indicated they would prefer a reservation system to reduce congestion over an increased entrance fee at RMNP. Not only did respondents appear to prefer reservations over increased entrance fees but results also suggest they would prefer the

reservation system over the current status of the Park. The impact of congestion on visitor utility has reached a point to which visitors are willing to sacrifice some freedom of access for a marginal decrease in it. It is important to keep in mind congestion was not eliminated in the choice sets, only certain elements of congestion were reduced to a more reasonable level. The indication that individuals are willing to embrace a system that requires more advanced planning and occasional inconvenience for marginal reductions is a big step for research into this issue. The goal of this study was to determine if the public would be more favorable to a reservation system over an increased entrance fee but did not expect reservations to also be more favorable than the current status. There is a clear desire for visitors of RMNP to both reduce congestion and avoid a higher price, influencing a willingness to make sacrifices in other areas, like the ability to visit spontaneously. These findings provide a contradiction to the work of Bullock and Lawson (2008) who found recreators of Acadia NP would not prefer limiting use even if it meant less people, though they focused on a particular sight that includes individuals mostly from the North-Eastern US.

Though there was an indication of the public being more favorable to reservation systems when compared to high congestion and a large price increase, there still exists a reduction in utility from their implementation. Those over the age of 45 and those who indicated preferring scenic drives in the Park were found to have the most influence on negative preference for reservation systems. Reasons for why these two groups are particularly more opposed to reservations is unclear, and further research could examine the preferences of these two group. In addition, while there was a strong consensus for desire to reduce congestion, the group that was significantly less concerned with this issue are those that frequent more than average. Understandably, individuals who currently visit more than three days a year are less sensitive to

congestion issues and choose to still visit, while more congestion sensitive individuals choose to go less or not at all, as reinforced by findings of Moyle and Croy (2007).

The primary motivation of this paper is driven by the publics' concern that price increases prevent low income groups from being able to access public lands. Income characteristics of this study, however, do not necessarily produce expected results to support this claim. Instead, results suggest the lowest income group has the least opposition to price increases compared to higher income groups. Results here could be impacted by omitted variable bias and could be a potential focus for future research as to determine other factors contributing to the indication that low income groups prefer price increases. One possible explanation could be that this study used the median household income as the threshold for the lowest income group. A lower standard could produce more expected results, i.e. a larger opposition to price increases.

Limitations and Considerations

Although the research presented in this paper posts significant findings in the context of measuring public favorability towards the implementation of reservation systems at RMNP, there exist some limitations and considerations. Chief among them is how reservation systems were defined within the survey. Reservations were defined at the beginning of the survey in a brief highlighted section of the introduction. It is possible respondents could have glossed over their description without processing their true implications and magnitude. Furthermore, upon reaching choice sets respondents saw the type of restriction attribute as only "entrance fee" or "reservation system" without any numerical value or context, unlike congestion and price. Due to the above considerations, it is possible respondents did not fully grasp the true impact

reservation systems would have on their ability to visit RMNP and therefore indicated being more or less indifferent to them. Future studies may find it useful to include a numeric value to the type of restrictions, like a percentage of people turned away or a probability of not being able to go the desired day. These values are difficult to calculate, however, and require an understanding of the daily carrying capacity of RMNP that an actual reservation would attempt to achieve. With this in mind, it is also possible public favorability could shift if the number turned away increased and so it could be worth while to consider the threshold to which the public would no longer favor a reservation over high congestion or price increases.

Price also needs to be considered in how it was defined. This paper assumes the relationship of price increases and utility as a linear relationship, however this is likely not the case. While this study does determine that a price of $65 is determinately unfavorable compared to the current price, it is unclear how individuals' preferences may change for a price between $25 and $65. For example, a price of $45 could be much more favorable than $65 and only marginally less preferable than the price of $25. As a result, willingness to pay for certain attributes is a relatively crude estimate and this paper still believes it is not entirely clear what individuals would fully pay for reductions in congestion. Though it does conclude, individuals likely would not pay more than $65. Including more price levels would account for this consideration and provide clearer individual preference for price increases.

Congestion faces a similar levels problem as price does, in that lowered congestion was a level calculated without consulting Park officials. Whether or not the level of low congestion could actually be reached is unclear and therefore, favorability of reservation systems is dependent on their ability to achieve the specified level of congestion. Estimating if the public would still be favorable to the reservations for a less severe reduction in congestion requires the

use of more levels for the congestion attribute. The limitations considered above for each of the three attributes are primarily concerned with this studies choice to only use two levels. The main reason this study did not use more levels was because its main goal was to establish the overall favorability of each of these attributes to provide a gateway understanding of a relatively unresearched issue. The issues of two levels are primarily discussed here to make clear what can and can not be concluded from the results of this study and how this impacts the recommendations going forward.

Lastly, limitations that were previously mentioned in the *methods* section are given more discussion here. Most importantly, the sample population used consisted of only Colorado residents, whether or not out-of-state visitors may exhibit different preferences is unclear in this study. Results reported in this study are therefore not a full indication of the preferences exhibited by all RMNP visitors and it is possible one would see different results if out-of-state visitors are considered. The primary purpose to only include Colorado residents was to secure a large percentage of the sample population that had been to RMNP. However, there were still some respondents that had never been to RMNP and analysis on these individuals indicated having never been, as well as not having been in the last year, had an influence on choice behavior and preferences that suggested a more positive attitude towards the negative levels of attributes. These limitations may have been overcome by conducting the survey on site within RMNP.

Recommendations for RMNP Management

This paper does not yet recommend the implementation of reservations to substitute entrance fees on busy weekends at RMNP. Instead it is the belief of this paper that reservations have been shown to be a legitimate alternative worth considering to control congestion, and therefore should be given more attention by outdoor recreation researchers. This paper is largely successful in establishing the public's attitude towards reservation systems and ultimately concludes they would be favorable to at least some form of their implementation. However, more research needs to be applied before any conclusion about whether they would be a better alternative to entrance fees to accomplish the missions of Rocky Mountain National Park. If the only goal was to reduce congestion and achieve the approval of the public in doing so than reservations look very promising. However, there is a large question as to how reservations may impact revenue for national parks and how that issue might be overcome, and therefore is something this paper believes to be a crucial next step for the literature. Potential next directions may address the degrees of favorability brought up in the previous section as to come to a better understanding as how reservations can reach the most efficient outcome.

Increasing flat fees has been shown to not be a viable solution to addressing congestion. National parks will always be a commons, meant for the public, in their entirety, to enjoy and access. As a result, without public approval a management strategy will fail to be implemented and problems will be left unsolved. If it is the desire of RMNP management to reduce congestion for not only the benefit of improved visitor experience but also increased ecological protection and likely easier management and enforcement within the Park, then reservation systems stand as a strong candidate to both achieve this purpose and have public support. Therefore, more research should be directed to their viability and potential implementation.

VI.   Conclusions

The research presented in this paper provides insight for measuring congestion management preferences at national parks that previously has been given little attention in existing literature. National parks face an overcrowding problem unseen before, and likely only to get worse. This paper is among the first to examine the feasibility of implementing a capacity constraint in the form of a reservation system to control congestion at Rocky Mountain Nation Park. Results suggest the public would prefer to reduce congestion at RMNP and would accept a capacity constraint that limited access to achieve this. Visitors are likely to have an enhanced experience if congestion can be reduced, and this paper believes reservation systems are a legitimate candidate to accomplish this. Furthermore, results suggest that while the public would prefer to have lower congestion, they would be willing to tolerate high amounts of congestion over paying $65. In summary, reservation systems are found to be a favorable alternative to entrance fees at Rocky Mountain National Park when they successfully reduce congestion and therefore should be given further consideration by RMNP management.

Bibliography

Adamowicz, W., Louviere, J., & Williams, M. (1994). Combining revealed and stated preference methods for valuing environmental amenities. *Journal of Environmental Economics and Management,* 26(1), 271-292.

Anderson, F.J., & Bonsor, N.C. (1974). Allocation, congestion, and the valuation of recreational resources. *Land Economics,* 50(1), 51-57.

Bullock, S.D., & Lawson, S.R. (2008). Managing the "Commons" on Cadillac Mountain: A stated choice analysis of Acadia National Park visitors' preferences. *Leisure Sciences,* 30(1), 71-86.

Chaminuka, P., Groeneveld, R.A., Selomane, A.O., & van Ireland, E.C. (2012). Tourist preferences for ecotourism in rural communities adjacent to Kruger National Park: A choice experiment approach. *Tourism Management*, 33(1), 168-176.

Chouinard, H., & Yoder, J. (2004). The political economy of river rats and Idaho's Four Rivers whitewater rafting lottery. *Western Economics Forum*, 3(1), 17-24.

Eagles, P.F.J. (2002). Trends in park tourism: economics, finance, and management. *Journal of Sustainable Tourism,* 10(2), 132-153.

Evans, M. F., Vossler, C. A., & Flores, N. E. (2009). Hybrid allocation mechanisms for publicly provided goods. *Journal of Public Economics*, 93, 311-325.

Hanley, N., Mourato, S., & Wright, R.E. (2001). Choice modelling approaches: A superior alternative for environmental valuation?. *Journal of Economic Surveys,* 15(3), 435-462.

Hardin, G. (1968). The tragedy of the commons. *Science,* 162(3859), 1243-1248.

Hindsley, P., Landry, C.E., Bin, O., & Vogelsong, H. (2007). Site congestion in recreation choice models: A generated regressors approach to beach site selection. *Document de travail.*

Holmes, T.P., Adamowicz, W.L., & Carlsson, F., (2017). Choice Experiments In P.A. Champ, K.J. Boyle, & T.C. Brown (Eds). *A primer on nonmarket valuation* (pp132-186). Dordrecht, The Netherlands: Springer.

Jakus, P., & Shaw, D.W. (1997). Congestion at recreation areas: Empirical evidence on perceptions, mitigating behavior and management preferences. *Journal of Environmental Management,* 50(1), 389-401.

Lawson, S. R., Manning, R. E., Valliere, W. A., & Wang, B. (2003). Proactive Monitoring and adaptive management of social carrying capacity in Arches National Park: an application of computer simulation modeling. *Journal of Environmental Management*, 68(3), 305-313.

Lee, C.K., & Han, S.Y. (2002). Estimating the use and preservation values of national parks' tourism resources using a contingent valuation method. *Tourism Management,* 23(1), 531-540.

Manning, R.E., Anderson, L.E., & Pettengill, P.R. (2017). *Managing outdoor recreation: Case studies in the national parks.* Boston, MA: CABI.

McCool, S.F., & Stankey, G.H. (2001). Managing access to wildlands for recreation in the USA: background and issues relevant to sustaining tourism. *Journal of Sustainable Tourism,* 9(5), 389-399.

More, T., & Stevens, T. (2000). Do user fees exclude low-income people from resource-based recreation?. *Journal of Leisure Research,* 32(3), 341-357.

Moyle, B., & Croy, G. (2007). Crowding and visitor satisfaction during the off-season: Port Campbell National Park. *Annals of Leisure Research,* 10(3-4), 518-531.

NPS.gov. (2017, October 24). *National Park Service proposes targeted fee increases at parks to address maintenance backlog.* Retrieved from https://www.nps.gov/orgs/1207/10-24-2017-fee-changes-proposal.htm.

Newman, P., Manning, R., Dennis, D., & McKonly, W. (2005). Informing Carrying Capacity Decision Making in Yosemite National Park, USA Using Stated Choice Modeling. *Journal of Park and Recreation Administration*, 23(1), 75-89.

Ostergren, D., Solop, F.I., & Hagen, K.K. (2005). National park service fees: Value for the money or a barrier to visitation?. *Journal of Park and Recreation Administration,* 23(1), 18-36.

Pettebone, D., Newman, P., Lawson, S.R., Hunt, L., Monz, C., & Zwiefka, J. (2011). Estimating visitors' travel mode choices along the Bear Lake Road in Rocky Mountain National Park. *Journal of Transport Geography,* 19(1), 1210-1221.

Reigner, N., Lawson, S., Meldrum, B., Pettebone, D., Newman, P., Gibson, A., & Kiser, B. (2012). Adaptive management of visitor use on Half Dome, an example of effectiveness. *Journal of Park and Recreation Administration,* 30(3), 64-78.

Richer, J. R., & Christensen, N. A. (1999). Appropriate fees for wilderness day use: Pricing decisions for recreation on public land. *Journal of Leisure Research*, 31(3), 269-280.

Rocky Mountain National Park (U.S. National Park Service). (2018, November 19). Retrieved from https://www.nps.gov/romo/index.htm

Schroeder, H.W., & Louviere, J. (2017). Stated choice models for predicting the impact of user fees at public recreation sites. *Journal of Leisure Research,* 31(3), 300-324.

Schwartz, Z., Stewart, W., & Backlund, E.A. (2012). Visitation at capacity-constrained tourism destinations: Exploring revenue management at a national park. *Tourism Management,* 33, 500-508

Siderelis, C., & Moore, R.L. (2006). Examining the effects of hypothetical modifications in permitting procedures and river conditions on whitewater boating behavior. *Journal of Leisure Research,* 38(4), 558-574.

Thiene, M., Swait, J., & Scarpa, R. (2016). Choice set formation for outdoor destinations: The role of motivations and preference discrimination in site selection for the management of public expenditures on protected areas. *Journal of Environmental Economics and Management,* 81, 152-173.

Timmins, C., & Murdock, J. (2007). A revealed preference approach to the measurement of congestion in travel cost models. *Journal of Environmental Economics*, 53, 230-249.

Appendix A: Survey Format Later Converted to Qualtrics

Rocky Mountain National Park

Congestion Management Survey

Rocky Mountain National Park (RMNP) is considered a treasure in both the nation and the state of Colorado. While National Park management hopes to protect the Park's beautiful landscapes, it also wants to provide those landscapes for the enjoyment of all. These two goals often conflict with each other and so the National Park is faced with making sure they can preserve the park for future generations while also ensuring that as many in the current generation can enjoy it too.

One solution would be to place restrictions on the number of people entering the park but by doing this RMNP can end up excluding certain groups from being able to experience the Park. On the other hand, when everyone is let in freely the large number of people can have a negative impact on the experiences of visitors. We call this problem congestion. In addition, congestion can also have a negative impact on the ecology of the Park.

With your help and participation in this 10-minute survey this study can attempt to find an alternative management strategy for entering RMNP that better addresses this problem.

Background

> At the moment RMNP charges $25 per vehicle at its entrance and there is no limit on the number of visitors allowed in for a day. As a result, RMNP sees huge crowds on Summer weekends. There have been many considerations as to how the Park can reduce these crowds. One option is to raise the price of the entrance fee well above $25 per vehicle for weekends. An increased entrance fee would make it less affordable to visit the Park on weekends and therefore reduce the number of people who visit.

Another option would be to use a reservation system.

What is a reservation system?

> Reservation systems have been used in many outdoor recreation settings including white water rafting, popular hiking trails, and wilderness backpacking areas. These reservation systems require you to reserve and purchase your day pass well before the actual day you plan on going and often have a limit to the number of reservations given for a particular day.
>
> This system could also be used for entering Rocky Mountain National Park on weekends.
>
> In this case if you planned on going to the Park on a weekend in July then your group would have to make a reservation at least a week or more in advance. This, however, would mean that there is a chance when you attempt to make a reservation that all reservations for the day you want to go are SOLD OUT. This would mean your group can NOT go that day and would either have to find another weekend day with open reservations, visit during the week, or do something else. The reservation system would not be applied to weekdays when there are less crowds.

Instructions

This study aims to see what you, the visitor of RMNP, prefer to experience when faced with different ways to enter the Park whether it be reservations or an entrance fee.

We ask you to <u>imagine</u> you and some friends or family are planning on heading up to Rocky Mountain National Park during a weekend in July, but you have two options to choose from. These two options represent the restrictions in place for how you and others are able to enter the Park and can either take the form of an ENTRANCE FEE or the RESERVATION SYSTEM. The options you must choose between may vary in three characteristics but also may have some characteristics in common. These three characteristics are **type of restriction, price, and crowding level.**

Type of restriction represents whether there is an entrance fee or reservation system.

- ENTRANCE FEE your group can go to the park anytime and is guaranteed to get in, no-one is ever turned away.
- RESERVATION SYSTEM would mean that day passes will eventually sell out and so your group might not be able to get a reservation for the day you want, and will have to go somewhere else or stay home. It will always be the case that either your group or other groups will be turned away though you would know if you can't get in well before the actual day you plan on going.

Price is the amount your group would always have to pay to enter the Park.

- ENTRANCE FEE would have your group pay the fee at the gate to the Park.
- RESERVATION SYSTEM would require your group to pay the fee upon making the reservation.

Crowding level is the unavoidable amount of people you will encounter while in the Park.

Crowding level will affect your group in three ways:

1) *Hiking Encounters* - how often you will encounter another group or person while hiking,
2) *Traffic* - the speed you will be driving at though the park due to traffic,
3) *Parking* - the amount of time it will take you to find a parking spot at certain pull offs and trail heads.

Let's Practice!

Below is an example of the choice sets you will encounter.

	A	B
Type of Restriction	Entrance Fee	Reservation System
Price	$25	$25
Crowding Level	Hiking Encounter – every 1 minute.	Hiking Encounter – every 5 minutes.

	Traffic – slower than usual. Parking – takes 10 minutes	Traffic – speed limit Parking – takes 2 minutes

Which scenario would you prefer?

A   B

In the survey that follows, you will be asked to make a decision like the one asked above six separate times. Following these choice questions, you will be asked several demographic questions. It is important to keep in my mind that the purpose of this study is to learn about the public's preferences for the types of restrictions considered in the study. Study results will be shared with Rocky Mountain National Park, but are by no means binding and will not have an immediate impact on how people enter Rocky Mountain National Park.

Once you feel ready and have a good understanding click the *next* button to continue with the choice experiments. You will not be able to go back through any of your answers after clicking *next.* You may exit the survey at any time.

Choice Sets

	A	B
Type of Restriction	*Level 1 or 2*	*Level 1 or 2*
Price	*Level 1 or 2*	*Level 1 or 2*
Crowding Level	*Level 1 or 2*	*Level 1 or 2*

Which scenario would you prefer?

A   B

	A	B
Type of Restriction	*Level 1 or 2*	*Level 1 or 2*
Price	*Level 1 or 2*	*Level 1 or 2*
Crowding Level	*Level 1 or 2*	*Level 1 or 2*

Which scenario would you prefer?

A   B

	A	B
Type of Restriction	*Level 1 or 2*	*Level 1 or 2*
Price	*Level 1 or 2*	*Level 1 or 2*
Crowding Level	*Level 1 or 2*	*Level 1 or 2*

Which scenario would you prefer?

A   B

	A	B
Type of Restriction	*Level 1 or 2*	*Level 1 or 2*
Price	*Level 1 or 2*	*Level 1 or 2*
Crowding Level	*Level 1 or 2*	*Level 1 or 2*

Which scenario would you prefer?

A   B

	A	B
Type of Restriction	*Level 1 or 2*	*Level 1 or 2*
Price	*Level 1 or 2*	*Level 1 or 2*
Crowding Level	*Level 1 or 2*	*Level 1 or 2*

Which scenario would you prefer?

A   B

	A	B
Type of Restriction	*Level 1 or 2*	*Level 1 or 2*
Price	*Level 1 or 2*	*Level 1 or 2*
Crowding Level	*Level 1 or 2*	*Level 1 or 2*

Which scenario would you prefer?

A   B

1) What is your age in years? _____

2) To which racial or ethnic group(s) do you most identify with?
   o American Indian or Alaska Native
   o Asian/Pacific Islanders
   o Black or African American (non-Hispanic)
   o Latino or Hispanic
   o Middle Eastern
   o White (non-Hispanic)

o Other

3) How would you identify yourself?
   A) Female
   B) Male
   C) Other/Not Listed

4) What is your annual household income?
   A) Less than $60,000
   B) $60,000 to $120,000
   C) Larger than $120,000

5) What is the highest degree or level of school you have completed?
   A) Less than a high school diploma
   B) High school degree or equivalent
   C) Some college, no degree
   D) Associate or Bachelor's Degrees
   E) Masters, Professional, or Doctorate Degrees

6) Have you ever visited Rocky Mountain National Park?
   A) Yes
   B) No

7) How many time have you been to RMNP in the last 12 months? _____

8) What do you prefer to do when visiting Rocky Mountain National Park? (check all that apply)
   o Hike
   o Scenic Drives, making small stops
   o Camp at Campgrounds
   o Wilderness Backpacking
   o Fishing
   o Climbing
   o Attend Ecological or Historical Programs

9) Do you possess either a "Rocky Mountain National Park Annual Pass," "America the Beautiful Pass," or a senior, military, or any other annual park pass and intend to renew it once it expires?
   A) Yes
   B) No

10) If answered "yes" to the above question, please indicate in the below comment box how owning a Park pass influenced your answers in the choice sets and how you interpreted being able to use your pass in those scenarios.

11) To what degree do you agree or disagree with the following statement about managing congestion at RMNP? "I would prefer a reservation system over an entrance fee to reduce congestion at RMNP"

Agree   Somewhat Agree   Neutral   Somewhat Disagree   Disagree

Appendix B: Results of Linear Probability Model and Probit Model

Table B. 1: Results of linear probability model

Variable	β	s.e.
Reservation	0.193***	.013
Congestion High	-0.072***	.013
Price *per dollar*	-0.005***	.0003

Table B. 2: Results of probit model

Variable	β	s.e.
Reservation	-0.125***	.033
Congestion High	-0.662***	.036
Price *per dollar*	-0.0238***	.0009

Table B. 3: Simulated results of linear probability model using logit estimated coefficients

Variable	β	s.e.
Reservation	0.195***	.024
Congestion High	-0.116***	.024
Price *per dollar*	-0.0076***	.0006

The probit model was able to successfully produce similar results to the conditional logit. While the coefficients are not identical, the ratio of coefficients are, Table B.2 shows the results from the probit model. Two ratios were calculated for both the probit and logit. The first divided the reservation by price per dollar: β_R/β_P. The logit model yielded a ratio equal to 6.37, while the probit yielded 5.26. The second ratio tested was congestion high divided by price per dollar: β_C/β_P. Results of the logit model were equal to 28.43 and the probit was 27.82. Similarity of the ratios indicate both models are equally capable in estimating preferences, however the logit is more widely used in existing literature and so this paper chose the logit as the best model.

The linear probability model, LPM, tells a different story. Table B.1 provides the resulting coefficients for the LPM using the same data as the probit. The results stand out as

being widely different than the results of the logit and probit models. Notably the magnitude of reservations is larger than that of congestion and also positive. As a result, the researcher attempted to simulate the results of the linear probability model using the estimated coefficients of the conditional logit model. That is choice behavior was ran through a simulation based on stated coefficients defined as those presented in Table 3. 844 choices were generated using the 12 choice sets and randomly generated error terms. Generated choices were then analyzed using a LPM. If the LPM was correct in its estimation than the same coefficients originally used to generate the coefficients would be estimated. Table B.3 demonstrates the results of this regression were unsuccessful in producing the original coefficients of the conditional logit model. As a result, the LPM was determined to be mis-specified and not fit for the purpose of this study.