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Modeling Long Overnight Trips by Chaining Recreation Sites

Min Chen

Michigan State University

chenmin5@msu.edu

Frank Lupi

Michigan State University

lupi@msu.edu

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1 Introduction

In recreation studies, valuation often applies to trips where the primary objective is recreation and only one site is visited, so day trip data is the most widely used as it normally meets the two requirements (Caulkins et al (1986), Lew and Larson (2005), Moeltner and Shonkwiler (2005), Scarpa and Thiene (2005), Smith (2005), von Haefen et al (2005), Kim et al (2007), Timmins and Murdock (2007), Parsons et al (2009)). Some studies, most of which are for fishing or hunting, do not explicitly provide complete trip detailsbut single-objective and single-site assumptions are still imposed (Englin and Shonkwiler (1995), Haab and Hicks (1997), Provencher and Bishop (1997), Schuhmann and Schwabe (2004), Morey et al (2006), Cutter et al (2007), Hynes et al (2007), Haab et al (2008), von Haefen and Phaneuf (2008)).

Nonetheless, a nontrivial portion of recreation trips, especially those lasting more than a day, either have multiple objectives, involve multiple sites, or both. Demand for recreation activities will be more accurately valued if these trips are accounted for. There have been studies investigating these issues directly or indirectly. For example, Kealy and Bishop (1986) included the total number of recreation days as the dependent variable in their travel cost demand model. The average number of days per recreation trip was assumed to be one exogenous independent variable. Other factors included individual characteristics, monetary travel cost, daily on-site costs, daily overnight expenditures, etc. Mendelsohn et al (1992) had major combinations of sites and treated one multiple-site trip as a trip to one of those site combinations. People could substitute across individual sites and site combinations. Hoehn et al (1996) proposed a four-level nested logit model for fishing trips to take into account trip duration as well as locations and target species.

Tay, McCarthy and Fletcher (1996) incorporated destination, duration and frequency of trips into one portfolio in the nested logit model. Parsons and Wilson (1997) proposed a theory to measure incidental and joint consumption of recreation in the single site demand model using dummy variables and their interactions with other explanatory variables. Shaw and Ozog (1999) introduced the choice of trip duration as one level in a repeated nested multinomial logit model. Loomis, Yorizane and Larson (2000) separated incidental consumption from joint consumption by putting two sets of dummy variables in Parsons and Wilson's model. Lupi et al (2003) and Kotchen et al (2006) separately nested single-day fishing trips and multiple-day fishing trips, and the estimated parameters were quite different for the two types. Yeh, Haab and Sohngen (2006) integrated multiple-objective trips and multiple-day trips into a two-level nested logit model where recreationists first decided whether to take a single-day trip or a multiple-day trip, and then chose the site. Only a fraction of the travel cost was included in the model for multiple-objective trips, which was determined by the proportion of trip time spent on the beach. They also set different parameters for single-day and multiple-day trips.

However, most papers keep the single-site assumption when dealing with multiple-day trips or the recreation part of multiple-objective trips. Even in the very few studies modeling multiple-site trips, sites are aggregated as composites and enter the model as a single site. Thus, multiple sites within a trip is still not clearly built into recreation demand models raising the need for models where people have the freedom to decide whether to visit more than one site and where to go.

We address the issue by modeling the demand for beach sites on multiple day trips that can include either one or two sites visited per trip. The data was obtained through two surveys, a screener mail survey and a follow-up web survey, which were conducted in 2011 and 2012 to Michigan residents asking about visitation to public Great Lakes beaches. In the web survey, we asked people to report up to three beaches on one randomly selected trip lasting four nights or more on which they spent the most/second most/third most amount of time. With this information, we are able to investigate whether the results of multi-site demand models are significantly different when modeling only the primary destination and allowing multiple destinations for overnight trips.

2 Survey and Data

2.1 Screener Mail Survey

The purpose of the screener survey was to recruit people who participated in beach recreation. The sample was drawn from the State of Michigan driver license list. People who live in the Upper Peninsula are excluded as the majority of population lives in the Lower Peninsula. The original sample size was 32,230, and the number goes down to 29,613 after removal of deceased people and those with bad mailing addresses.

The questionnaire had three parts. The first part asked people about their participation in various everyday activities, recreation activities and indoor activities. Only one screener question was about Great Lakes beaches in order to reduce self-selection bias. The second part of the screener was about participation obstacles, such as time or money constraints. The third part contained demographic questions like race, education, employment status, and household income.

From June, 2011 to November, 2011, three waves of survey packages were mailed out and two waves of automated phone calls were sent to household landlines as reminders. 11,028 people returned their questionnaires for a 37.24% response rate. 9,591 respondents were kept for data analysis according to the criteria of living in the Lower Peninsula and being the addressees, among which 5,556 said they have visited a Great Lakes beach since June 1, 2010.

2.2 Web Survey

The 5,476 respondents that participated[1] in beach recreation from the screener mail survey were invited to a follow-up web survey on Great Lakes beaches. There were an additional 85 participants (their responses were received after the mail survey was closed for data collection) chosen for a pilot survey, the purpose of which was to test the functionality and data storage of the web survey.

There were two sections in the web survey, the beach trip section and the choice experiment section. In the beach trip section, following the survey in Parsons et al (2009), trips were categorized into three types: trip lasting a day or less (day trip), overnight trip of less than four nights (short overnight trip), and overnight trip of four nights or more (long overnight trip). People were asked to report trip numbers of each type during the

[1] Due to some data manipulation errors, the sample size is less than the number of participants in beach recreation.

time frame from Memorial Day weekend, 2011 to September 30, 2011 (the primary beach-going season). For day and short overnight trips, detailed questions were asked for up to two randomly selected trips; for long overnight trips, information was collected on one randomly selected trip about where people go and how long they stay at each beach. In the choice experiment section, after information treatments, three pairs of hypothetical beaches with randomly drawn attributes were presented for people to choose (Weicksel (2012)). Questions on general perceptions of public beaches on each Great Lake follow the choice experiments. Demographic questions conclude the web survey.

Four waves of contacts were sent to potential web respondents. The first wave mail package included an invitation letter and a $1 cash incentive; postcard reminders were used in the second and third waves, differing in sizes. In the last wave, an incentive strategy based upon completion of the survey was implemented. Also, people without internet access were asked to return a small postcard mailed together with the letter. The survey started in April, 2012, and closed right after the Memorial Day weekend, 2012. In total, 3,197 people logged on the survey and answered our initial trip questions, giving a response rate of 58.38%.

2.3 Data

There are 588 public Great Lakes beaches in Michigan. To model trips with multiple destinations, it will be extremely computationally burdensome to construct the choice set with individual beaches. According to literature on site aggregation (Lupi and Feather (1998), Haener et al (2004), etc.), we aggregate the 588 public beaches into 49 beach areas, where the two key factors to consider are beach popularity and geographic distribution (see Figure 1 and Figure 2). A beach is more likely to stand on its own if many people go there. Beaches with no visits are dropped. Since the parameter estimate for travel cost is the denominator of all welfare estimates, to minimize the distance heterogeneity in all beach areas, we keep the average distance between two individual beaches under 18 miles within one area. Characteristics of these beach areas are averages of individual beach characteristics.

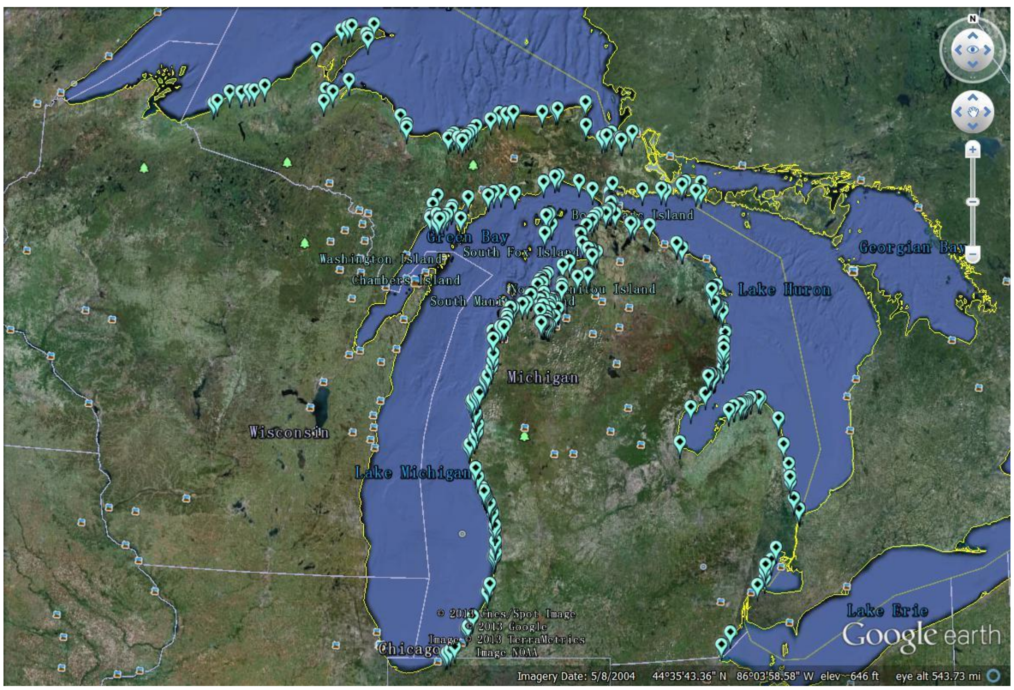

Figure 1: Public Great Lakes Beaches with Visits[2]

[2] Figure 1, 2 and 3 are google earth images. File conversion is through the website: http://www.earthpoint.us/ExcelToKml.aspx

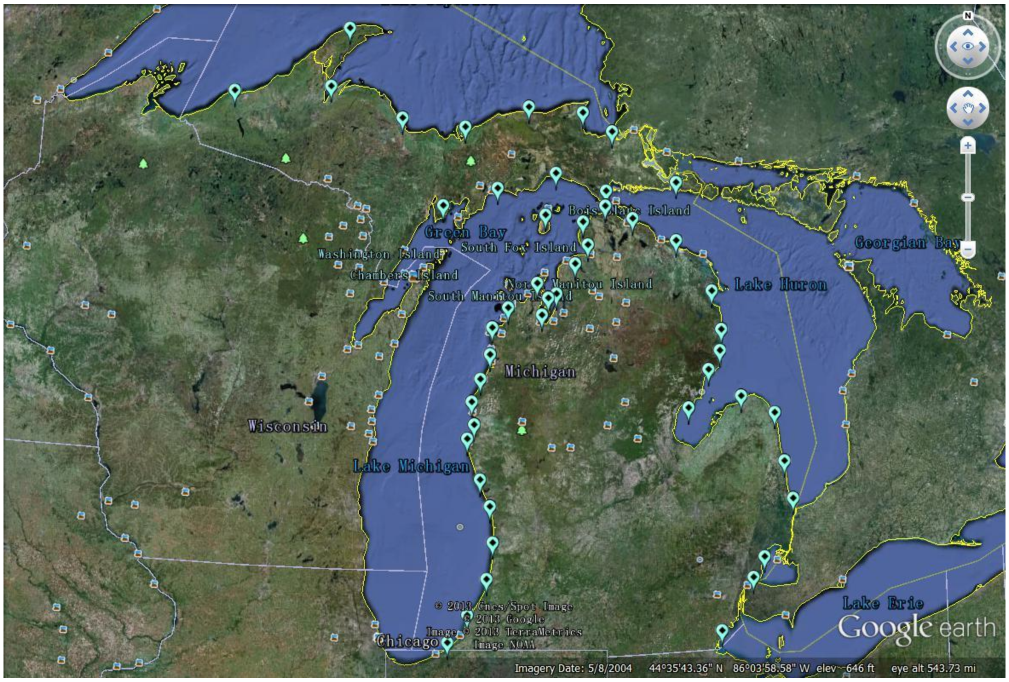

Figure 2: Aggregated Beach Areas in the Multiple Day Trip Models

Individual beach length information was provided by Michigan Department of Environmental Quality. Data on water surface temperature was obtained from the National Oceanic and Atmospheric Administration (NOAA) Great Lakes Environmental Research Laboratory (GLERL) using the Great Lakes Observing System (GLOS) Point Query tool[3]. 50 grid points were selected on Lake Superior along the coastline, 56 on Lake Huron, 79 on Lake Michigan and 2 on Lake Erie as in Figure 3. Daily temperatures were retrieved at these points and averaged into monthly temperatures. Monthly data was directly used for Lake St. Clair as its daily data is not available on-line. Individual beaches in the site choice models were matched to the nearest location with temperature data.

[3] http://glos.us/data-tools/point-query-tool-glcfs

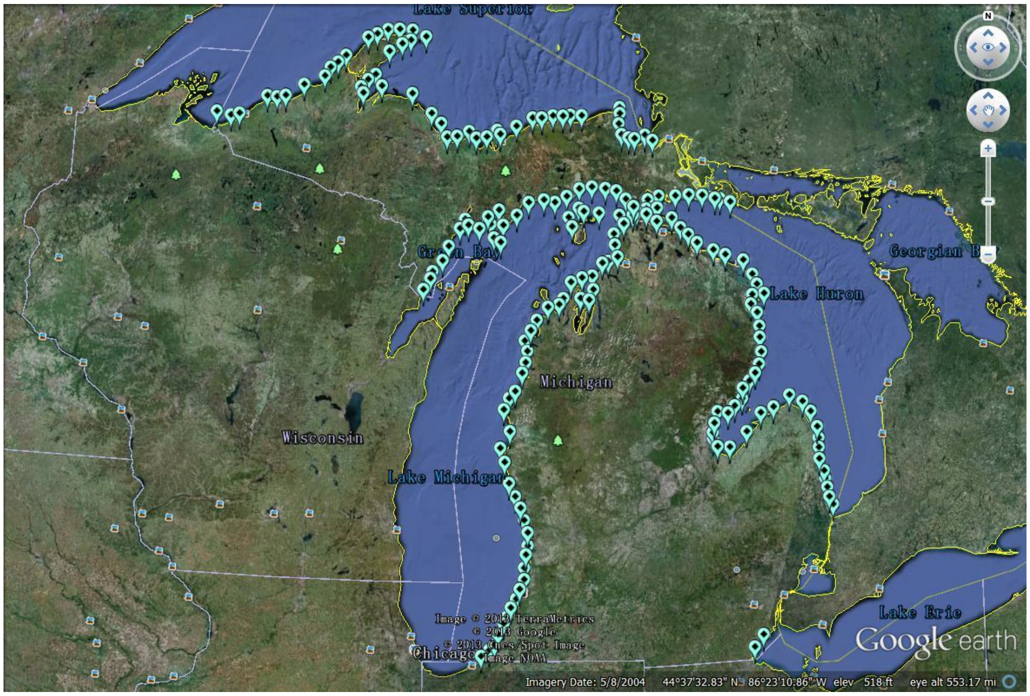

Figure 3 GLOS Points on Great Lakes in Michigan

We have 447 people who took long overnight trips, 355 visiting one beach area and 71 visiting two beach areas. For the remaining 21 that visited three beach areas, their third destinations was truncated, and they were pooled into people visiting two beach areas. Their descriptive statistics are shown in Table 1.

Table 1: Demographic Characteristics of Participants with Long Overnight Trips[4]

	Participants	Visiting One Beach Area	Visiting Two Beach Areas
Age (Mean)	45.5	45.7	44.9
Income (Mean, $1000)	95.7	95.1	98.3
Education Years (Mean)	15.2	15.2	15.5
Male (%)	44.7	45.3	42.4
White (%)	96.8	96.2	99.1
Employed Full-Time (%)	54.9	54.9	55.1
Retire (%)	18.1	18.6	16.3
Children under 17 (%)	39.6	38.4	44.1

[4] These are weighted by corresponding weights.

3 Models

A repeated nested logit model is used for seasonal visitation. Figure 4 shows the traditional approach to model overnight trips. In one choice occasion, a person either does not take a trip, or spends all the time on one beach.

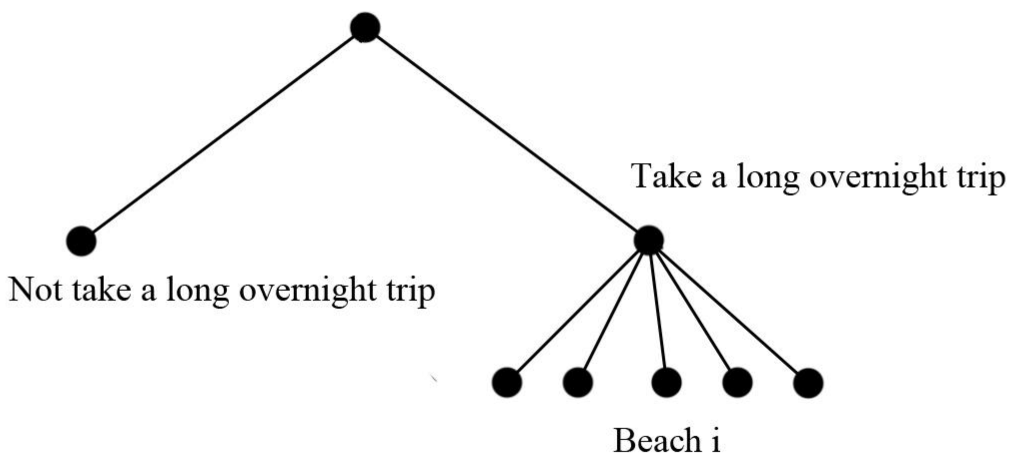

Figure 4: Decision Tree with Primary Destination

To incorporate multiple destinations in the trip, as illustrated in Figure 5, if taking a long overnight trip, a person can visit one beach or two beaches. In the nest of visiting two beaches, the first level of beaches represents the primary destination; the second level of beaches contains all other beaches in the choice set.

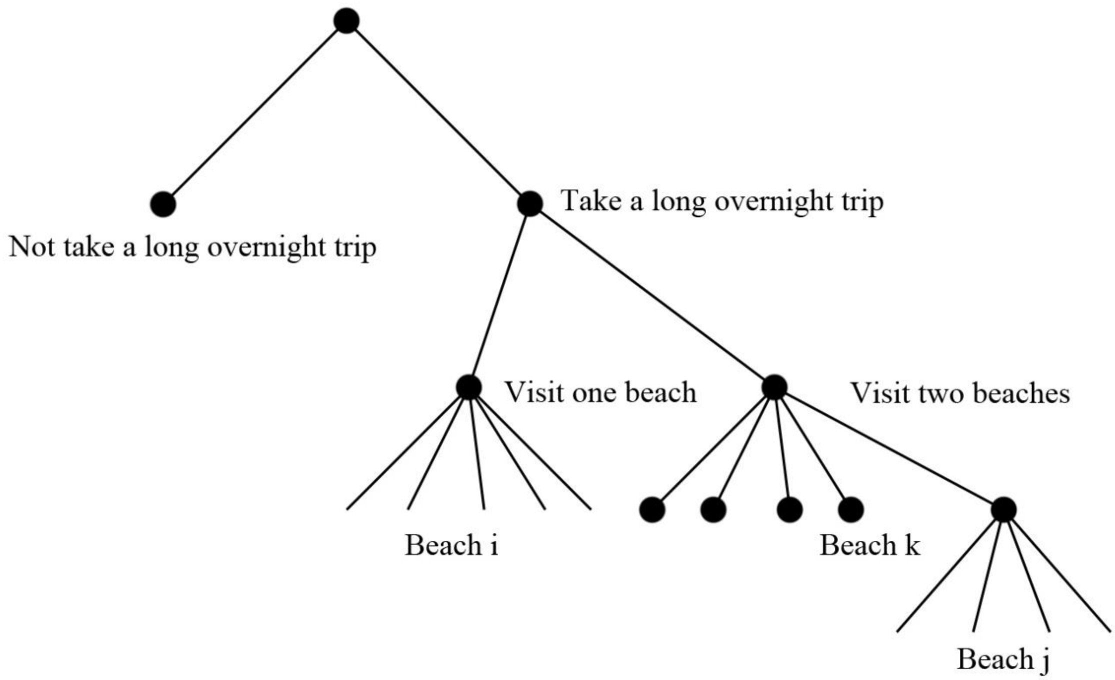

Figure 5: Decision Tree with Multiple Destinations

In occasion t, if a person n takes a long overnight trip and visits two beaches, the conditional probability to choose j as the secondary beach after visiting beach k is:

$$P_{nt}(j|k, visiting\ two\ beaches, take\ a\ trip) = \frac{e^{\frac{V_{njkt}}{\lambda_k}}}{\sum_{l=1}^{k-1} e^{\frac{V_{nlkt}}{\lambda_k}}}$$

k-1 means beach k is excluded from the choice set for the secondary beach.

The conditional probability that a person n chooses k as the primary beach is:

$$P_{nt}(k|visiting\ two\ beaches, take\ a\ trip) = \frac{(\sum_{l=1}^{k-1} e^{\frac{V_{nlkt}}{\lambda_k}})^{\lambda_k}}{\sum_{m=1}^{K}(\sum_{l=1}^{m-1} e^{\frac{V_{nlmt}}{\lambda_m}})^{\lambda_m}}$$

If a person n visits one beach, the conditional probability to choose beach i is:

$$P_{nt}(i|visiting\ one\ beach, take\ a\ trip) = \frac{e^{\frac{V_{nit}}{\sigma}}}{\sum_{m=1}^{K} e^{\frac{V_{nmt}}{\sigma}}}$$

The conditional probabilities of visiting two beaches and visiting one beach are:

$$P_{nt}(visiting\ two\ beaches|take\ a\ trip) = \frac{(\sum_{m=1}^{K}(\sum_{l=1}^{m-1} e^{\frac{V_{nlmt}}{\lambda_m}})^{\lambda_m})^{\sigma}}{(\sum_{m=1}^{K}(\sum_{l=1}^{m-1} e^{\frac{V_{nlmt}}{\lambda_m}})^{\lambda_m})^{\sigma} + (\sum_{m=1}^{K} e^{\frac{V_{nmt}}{\sigma}})^{\sigma}}$$

$$P_{nt}(visiting\ one\ beach|take\ a\ trip) = \frac{(\sum_{m=1}^{K} e^{\frac{V_{nmt}}{\sigma}})^{\sigma}}{(\sum_{m=1}^{K}(\sum_{l=1}^{m-1} e^{\frac{V_{nlmt}}{\lambda_m}})^{\lambda_m})^{\sigma} + (\sum_{m=1}^{K} e^{\frac{V_{nmt}}{\sigma}})^{\sigma}}$$

Denote the representative utility of not taking a long overnight trip as $V_{no\ trip}$, then the probabilities of taking a long overnight trip and not taking a long overnight trip are:

$$P_{nt}(take\ a\ trip) = \frac{((\sum_{m=1}^{K}(\sum_{l=1}^{m-1} e^{\frac{V_{nlmt}}{\lambda_m}})^{\lambda_m})^{\sigma} + (\sum_{m=1}^{K} e^{\frac{V_{nmt}}{\sigma}})^{\sigma})^{\rho}}{((\sum_{m=1}^{K}(\sum_{l=1}^{m-1} e^{\frac{V_{nlmt}}{\lambda_m}})^{\lambda_m})^{\sigma} + (\sum_{m=1}^{K} e^{\frac{V_{nmt}}{\sigma}})^{\sigma})^{\rho} + e^{V_{no\ trip}}}$$

$$P_{nt}(not\ take\ a\ trip) = \frac{e^{V_{no\ trip}}}{((\sum_{m=1}^{K}(\sum_{l=1}^{m-1} e^{\frac{V_{nlmt}}{\lambda_m}})^{\lambda_m})^{\sigma} + (\sum_{m=1}^{K} e^{\frac{V_{nmt}}{\sigma}})^{\sigma})^{\rho} + e^{V_{no\ trip}}}$$

Then the unconditional probabilities of choosing the pair of beach k and j and choosing beach i only are:

$$P_{nt}(j,k) = P_{nt}(j|k, visiting\ two\ beaches, take\ a\ trip)$$

$$* P_{nt}(k|visiting\ two\ beaches, take\ a\ trip)$$

$$* P_{nt}(visiting\ two\ beaches|take\ a\ trip) * P_{nt}(take\ a\ trip)$$

$$= \frac{e^{\frac{V_{njkt}}{\lambda_k}} * \left(\sum_{l=1}^{k-1} e^{\frac{V_{nlkt}}{\lambda_k}}\right)^{\lambda_k - 1} * \left(\sum_{m=1}^{K}\left(\sum_{l=1}^{m-1} e^{\frac{V_{nlmt}}{\lambda_m}}\right)^{\lambda_m}\right)^{\sigma-1}}{\left(\left(\sum_{m=1}^{K}\left(\sum_{l=1}^{m-1} e^{\frac{V_{nlmt}}{\lambda_m}}\right)^{\lambda_m}\right)^{\sigma} + \left(\sum_{m=1}^{K} e^{\frac{V_{nmt}}{\sigma}}\right)^{\sigma}\right)^{\rho} + e^{V_{no\ trip}}}$$

$$* ((\sum_{m=1}^{K}(\sum_{l=1}^{m-1} e^{\frac{V_{nlmt}}{\lambda_m}})^{\lambda_m})^{\sigma} + (\sum_{m=1}^{K} e^{\frac{V_{nmt}}{\sigma}})^{\sigma})^{\rho-1}$$

$$P_{nt}(i) = P_{nt}(i|visiting\ one\ beach, take\ a\ trip)$$

$$* P_{nt}(visiting\ one\ beach|take\ a\ trip) * P_{nt}(take\ a\ trip)$$

$$= \frac{e^{\frac{V_{nit}}{\sigma}} * \left(\sum_{m=1}^{K} e^{\frac{V_{nmt}}{\sigma}}\right)^{\sigma-1}}{\left(\left(\sum_{m=1}^{K}\left(\sum_{l=1}^{m-1} e^{\frac{V_{nlmt}}{\lambda_m}}\right)^{\lambda_m}\right)^{\sigma} + \left(\sum_{m=1}^{K} e^{\frac{V_{nmt}}{\sigma}}\right)^{\sigma}\right)^{\rho} + e^{V_{no\ trip}}}$$

$$* ((\sum_{m=1}^{K}(\sum_{l=1}^{m-1} e^{\frac{V_{nlmt}}{\lambda_m}})^{\lambda_m})^{\sigma} + (\sum_{m=1}^{K} e^{\frac{V_{nmt}}{\sigma}})^{\sigma})^{\rho-1}$$

We only know where people went on one randomly selected trip, but we have them report the numbers of long overnight trips taken in each month. Therefore, the likelihood function is:

$$L = \prod_{n_1=1}^{N_1} \prod_{i=1}^{K} P_{n_1 t}(i)^{y_{n_1}} * \prod_{n_2=1}^{N_2} \prod_{k=1}^{K} \prod_{\substack{j=1 \\ j \neq k}}^{k-1} P_{n_2 t}(j,k)^{y_{n_2}}$$

$$* \prod_{n=1}^{N} \prod_{t=2}^{T} (P_{nt}(taking\ a\ trip)^{w_{nt}} * P_{nt}(not\ taking\ a\ trip)^{1-w_{nt}})$$

Where T is the total number of choice occasions, 5 per month in our case; N is the total number of people who take long overnight trips, where N_1 people visit one beach only and N_2 people visit two beaches. y and w are binary indicators.

If one visits on beach, V_{nit} includes travel cost and time cost as the price variable, and beach length, monthly water temperature and regional dummies as the quality variable.

$$V_{nit} = \beta_p * Price + \beta_q * Quality$$

Based on Champ et al (2003). the computation of total trip cost is:

$$\begin{aligned} Trip\ cost &= travel\ cost + time\ cost \\ &= round\ trip\ travel\ distance * \$0.476\ per\ mile \\ &\quad + round\ trip\ travel\ time * (annual\ income/2{,}000) * (1/3) \end{aligned}$$

$0.476 per mile is the driving cost for an average size car. This number coms from annual report of the American Automobile Association (AAA), and excludes insurance and maintenance cost. Time cost is the opportunity cost. A person employed full-time works approximately 2,000 hours per year. The fraction of one third is determined empirically.

Travel distance and travel time are calculated in PC miler, the logistic software, and their measures are mile and hour.

If one visits two beaches, this person will enjoy characteristics of two beaches, and also divide recreation time between two beaches. In our data, for people visiting two beaches, the total number of days on primary beaches is 296, 139 on secondary beaches. Let the parameters on quality variables vary between the primary beach and secondary beach, we will have:

$$V_{njkt} = \beta_p * Price + \beta_{q1} * Quality\ on\ Primary\ Beach + \beta_{q2} * Quality\ on\ Secondary\ Beach$$

The round trip cost will be counted from permanent residence to the primary beach, the primary beach to the secondary beach, and the secondary beach back to permanent residence. $V_{no\ trip}$ is described by demographic variables listed in Table 1. The model described in Figure 1 is also estimated, so that we can compare the results to assess the impact of a more complicated overnight trip model structure.

4 Expected Contributions

This paper proposes a way to improve valuation of long overnight recreation trips with additional data on trips with multiple destinations. It is straightforward and easy to implement compared with other methods in previous studies because it just requires adding another level in the nested logit model. If the results of adding a secondary beach destination per trip to the model are significantly different from the traditional approach, it will be worth the effort to ask people to report where they went other than the primary destination. If the results are very similar, then it supports the practice of using the main destination of a multiple site trip since assuming only one beach is visited on overnight trips.

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