Recreational time allocation models by applying mobile phone data

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1. Introduction

In recent years, mobile phone networking data became available for researchers and draws growing attention for environmental economist. For example, Kubo *et al*. (2020) integrated mobile phone loaming data with zonal travel cost models and estimated nationwide coastal recreational value across Japan. Del Rossi *et al*. (2023) applied mobile phone trip date of New York state residents to conventional utility model and estimated the economic values of state parks. These studies allow researchers to explore wider-range of recreational value at the same time; however, few studies have paid attention to the duration time of the site visits, which might bias the estimation. This study employs mobile phone date to use the duration time of each recreational site visit in the Shiretoko national park, Japan and considers congestion impacts.

2. Methodology and Data

We employed mobile phone GPS tracking data of tourists in Shiretoko National Park during July and September, 2019. Figure 1 shows an example of the GPS tracking data of a tourist. The dataset composes of activity history of 9,194 tourists. This study designated 15 sites in Shiretoko National Park as the major attractions for tourists. The mobile phone date shows us whether the tourists visited these sites or not, and how long time they stayed in each site. In this study, utility function of a visitor *i* at site *j* is assumed as follows.

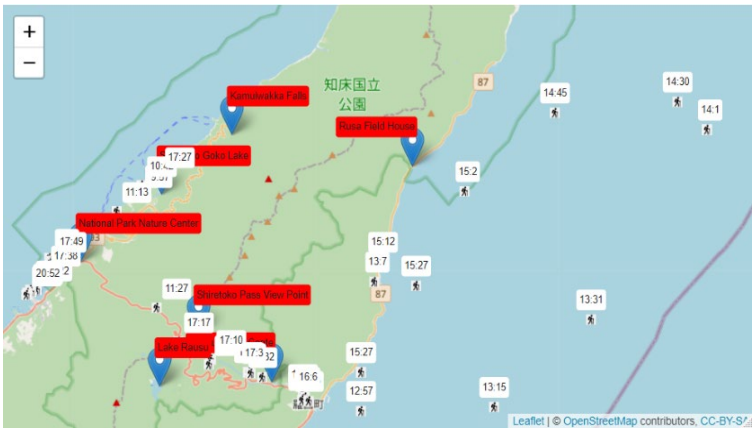

Figure 1　An Example of Mobile Phone data

$$U_{ji} = \beta_1 EF_j + \beta_2 HS_j + \beta_3 VC_j + \beta_4 HC_j + \beta_5 Boat_j + \beta_6 TT_{ji} + \beta_7 Conges_{ji} + \varepsilon_{ji}$$

In this function, the utility at site *j* depends on entrance fee of the site (*EF*), Hot Spring dummy (*HS*), Visitor centre dummy (*VC*), Hiking Course dummy (*HS*), Boat dummy (*Boat*), and travel time from the entrance of the park (*TT*) and Congestion of the site (*Conges*). We apply Repeated

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Random Utility model (Repeated RUM) to binary data indicating the site visits. In addition, fractional logit model is employed by using time ratio in each site out of total time in the park.

3. Results

Table 1 indicates the estimation results of parameters by Repeated RUM and Fractional logit model. The result shows that tourist prefer a Visitor Centre, a site close to the entrance of the park, and a site with lower fee. Moreover, a congested site is preferred to visitors.

Table1 Estimation Results

	Repeated RUM		Fractional Logit	
	Estimate	Z-value	Estimate	Z-value
Entrance Fee	-0.0905***	-24.777	-0.0700***	-11.730
Hot Spring	-0.275***	-4.672	1.276***	14.262
Visitor Centre	0.277***	8.262	0.752***	12.635
Hiking Course	-0.603***	-16.621	0.0113	0.179
Boat	-0.654***	-15.484	0.0830	1.223
Travel Time	-0.0365***	-56.195	-0.0470***	-42.582
Congestion	0.00466***	16.253	0.00627***	15.489
ASC for others	3.459***	104.08	3.273***	55.728
Log Likelihood	-75206.19		-12846.05	
N	82,746		9,194	

Significant level: “***” - 1%, “**” - 5%, “*” - 10%

4. Conclusion

This study uses duration time of site visits by employing mobile phone GPS tracking data. Interestingly, findings with two models implies that congestion can increase the likelihood to visit the recreational sites. This means the more congestion happens at a recreational site, a recreational site becomes popular, and vice versa. This is likely because of the endogeneity of congestion, since congestion is caused by visitor’s choice. This potential feedback loop shows difficulties of congestion management and requires further studies to explore the impact.

Reference

Kubo T, Uryu S, Yamano H, Tsuge T, Yamakita T and Shirayama Y (2020) Mobile phone network data reveal nationwide economic value of coastal tourism under climate change, *Tourism Management,* vol.77. 104010

Del Rossi G, Kling CL, and Ivan Rudik I (2023) The Economic Value of State Parks: Revealed Preference Estimates Using Cell Phone Data, *Agricultural and Applied Economics Association 2023 Annual Meeting.* No 335730,