Nationwide Recreation Travel Survey in Japan: Outline and Modeling Applicability

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The Nationwide Recreation Travel Survey (NRTS) was conducted by the Ministry of Construction in Japan in 1992. It covered the nine regions of Japan and collected more than 30,000 samples through home-based surveys and nearly 13,000 samples from recreation site surveys. Before the survey, recreational activities had been investigated by smaller-scale surveys (one-tenth the size of NRTS) every 2 years. The survey is expected to provide fundamental and useful information for suburban highway planning. Whereas road investment plans conventionally have been based on future weekday traffic volumes, several roads in suburban areas have become heavily congested on weekends. The prediction of weekend travel will have a more important role in road planning. The characteristics of recreational travel by car should be examined to gain valuable insight into highway planning in recreational areas. After survey profiles were summarized recreational travel demand models for trip generation and trip distribution were developed using an aggregated regression model and a disaggregate model. Finally, fruitful data sources and sufficient modeling applicabilities are provided.

The first large-scale survey for recreational travel in Japan is introduced in this paper. The Nationwide Recreation Travel Survey (NRTS) was conducted by the Ministry of Construction (MOC) in 1992 to understand the characteristics of recreation travel and the applicability of the survey data to demand modeling.

Every 5 years, MOC collects weekday vehicle trip data by roadside and car owner surveys entitled Road Traffic Census (RTC). Nearly 3 percent of car owners in Japan have been sampled in the RTC, and all vehicles that pass through interregional arterial roads have been intercepted by roadside surveyors. The RTC in 1990 also included a survey for weekend car trips using the same questionnaire sheet with the weekday survey. In both surveys, the trips that respondents were required to fill out were restricted to those within a specific 24-hr period.

Most weekday activities in a city, such as commuting or shopping, are completed within a day. However, recreational travel often exceeds 24 hr and characteristics of recreation travel, such as destinations, activities, and durations change by season. Additionally, a route choice behavior between two recreational facilities, which is not included in RTC questionnaires, is determined probably not only by minimum travel time but also by attraction of the route itself (e.g., road quality or scenic beauty) (*1*).

Although road investment plans in Japan have been based conventionally on future weekday traffic volumes, several roads in suburban areas are more heavily congested on weekends than on weekdays. This is because the low density of road networks radiating to recreational areas outside of cities provides fewer alternative routes for travelers. Additionally, substantial volumes of traffic by passenger vehicles often are higher than road capacities on weekends. The potential demand of recreational car travel is expected to be high in metropolitan regions because residents evidently have experiences of giving up a weekend drive because of heavily congested roads to or in suburban recreation areas.

Actually, the volumes of passenger vehicles for recreation traffic on weekends are equivalent to those of weekday commuter traffic. For example, according to RTC data, car trip generations in Kanto region amount to 3.1 million commuter vehicles on a weekday and 2.6 million recreational trip vehicles on a weekend. However, the average distance of recreational trips is twice as long as that of commuter trips, and total vehicle kilometers traveled per day of weekend recreational trips is much higher than that of commuter trips.

Consequently, after one understands recreational travel behavior, the prediction of weekend traffic, which is principally composed of recreational trips, and revision of highway planning in suburban areas are expected to resolve the traffic and environmental problems in those areas. A new survey was designed to collect individual histories of recreational activities during a year because characteristics of recreational trips change seasonally, and recreational trips often are not completed within a day. After several properties of recreational travel from home-based surveys are briefly summarized, trip generation models and destination choice models also are examined in this paper (*2*).

SURVEY SYSTEM AND QUESTIONNAIRES

Survey Method for Recreational Travel

Fundamental characteristics of recreational travel, which are concerned with survey system selections, are explained as follows: (*a*) recreation travel, in particular overnight travel, is generated infrequently for each household; (*b*) individual recreational activities differ with the seasons; and (*c*) a trip route depends on the attractiveness of the route, such as the landscaping as seen from the road. These cause the inefficiency of origin-destination trip surveys conducted on a specified day of a specific season. Considering these properties, home-based and choice-based surveys were conducted. To examine characteristics of recreation travel and to demonstrate the modeling applicability of trip generation and trip distribution, data of personal records of travel, which depend on memory, were collected using home-based surveys. Telephone surveys such as the National Personal Transportation Survey in the United States provided 1-year period data from 24-hr individual samples; however, the applicability of large-scale telephone surveys is still uncertain in Japan.

Choice-based sampling in the specific recreation sites can target a specified group in the whole population but cannot collect random

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samples from the population. Choice-based surveys were utilized; these were conducted in recreational sites to estimate trip chaining behaviors in recreational areas and combine the data with personal experience data of home-based surveys. Additionally, to estimate trip attraction volumes in the recreational areas, number plate surveys were conducted at several sites and access roads to the areas.

These surveys were conducted in nine regions by eight regional construction bureaus of MOC and the Hokkaido Development Agency in 1992 or 1993. Home-based surveys were conducted between July and October 1992 by random sampling of households in the selected areas. The areas cover 22 cities in 19 prefectures that belong to nine regions in Japan, as indicated in Figure 1. The surveyed areas are concentrated in large cities, including cities in every metropolitan region and several central cities in local areas such as Sapporo in the Hokkaido region, Sendai in the Tohoku region, Hiroshima in the Chugoku region, and Fukuoka in the Kyushu region. These indicate that home-based surveys in NRTS evidently represent characteristics of recreation activities of urban residents. The respondent of a survey is required to be more than 18 years old. Total individual samples exceed 30,000, encompassing 13,600 households. All except for three cities have more than 1,000 samples.

Choice-based surveys were conducted in nine specific popular sites corresponding to the nine regions in Japan. Most of the surveys were conducted on weekends in August during summer vacation, with the exception of Bandai in Tohoku region in October and Yuzawa in Hokuriku region in February 1993. These schedules were determined by the top reasons for and seasons of recreation: sightseeing of autumn foliage in Tohoku and skiing in Hokuriku. The sample size for all sites is nearly 13,000, and the response ratio is about 10 percent. The survey was distributed by hand and returned by mail.

Structure of Questionnaires in Both Surveys

The personal questionnaire for home-based surveys inquires of the respondents their annual travel records by mode, overseas travel experiences, and travel activities that correspond to the specific date of the choice-based survey in the region.

Because respondents for choice-based surveys are persons who drove by private car to a recreational region, most questionnaires are concerned with car travel. The major difference between the home-based and choice-based surveys is that in the choice-based survey questionnaire respondents are requested to explain their route patterns on the map of the recreational area. As mentioned earlier, this is distinctly a different questionnaire from that for urban transportation surveys, and such information should be collected for road planning in recreational areas.

Figure 2 presents a brief structure of surveyed items and primary goals in both surveys. The primary objective of home-based surveys

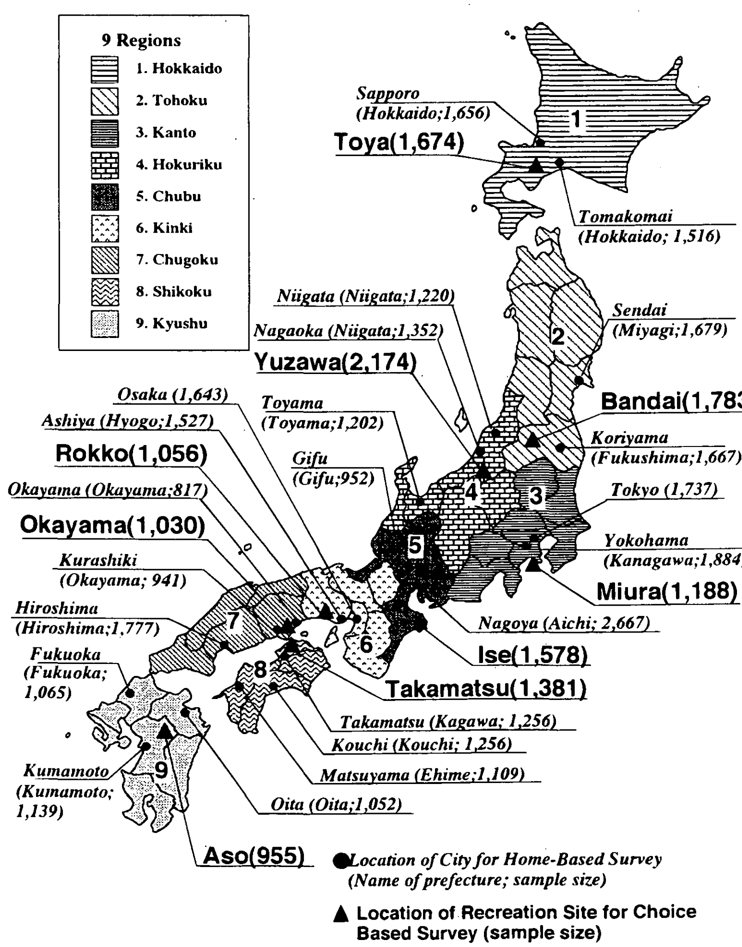

FIGURE 1 Locations of home-based and recreational site surveys.

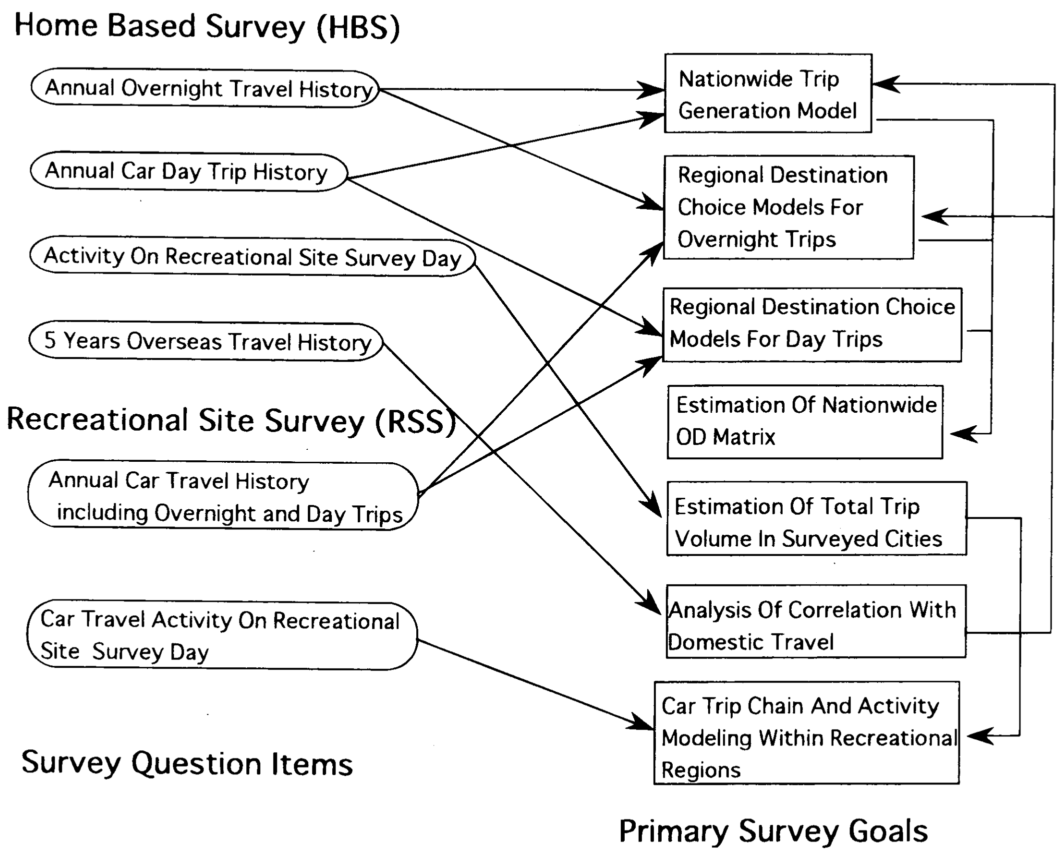

FIGURE 2 Surveyed items and primary goals in home-based and recreational site surveys.

is to collect data for the development of a nationwide trip generation model and regional destination choice models. On the other hand, the main purpose of choice-based recreation site surveys is to collect data for modeling of trip and activity chain behaviors within a recreational region. However, the questionnaires for both surveys supplement each other. Travel activity on the designated day of the recreational site survey was obtained from the home-based survey to examine the total travel volume from the city and portion of the total volume headed into the recreational region on that day. The annual car travel record was surveyed for recreational site survey respondents to combine them with home-based survey data to develop car travel destination choice models.

PROFILES OF RECREATIONAL TRAVEL IN JAPAN

Using survey results, various profiles of recreational travel have been examined. Particularly overnight travel, day trips, route choice, and trip chaining behaviors in recreation areas, and the correlation between domestic and overseas travel, are briefly investigated.

Because of lack of space, only the profile of overnight travel from home-based surveys is introduced in this paper. Although the recreational day trips exceed the overnight trips in volume in metropolitan suburban areas (the percentage of persons on day trips in the recreation site survey is 67 percent in Miura, Kanto region, and 74 percent in Rokko, Kinki region), principal recreational areas and most spa resorts in Japan often attract a larger percentage of overnight trips. (The percentage of overnight travelers in the recreation site survey is approximately 65 percent in Yuzawa in the Hokuriku region, Ise in the Chubu region, Okayama in the Chugoku region, and Aso in the Kyushu region.) An increase in overnight travel is expected in the future because of a long series of holidays and the growing need for recreational activities. As a result, an understanding of the mechanisms of overnight recreation travel and a comparison of them with day trips are required before examining the total weekend traffic and the system planning of suburban road networks (*3*).

PROFILES OF OVERNIGHT TRAVEL IN JAPAN

Average frequencies of overnight travel by age categories are shown in Figure 3. The frequency of those aged 70 or older is no more than half that of those aged 30 or older. Because this includes business travel, the categories for the 30 and 40 year olds have a somewhat larger frequency in total. Although recreation travel is the lowest in the 40s category among the working ages between 20 and 60, their business travel is possibly combined with recreation activities.

Average trip frequencies for individual income levels are shown in Figure 4. The total frequency increases in accordance with an increase in income level. The increasing trend is moderate for recreation travel. This is because business travel is highly generated in higher-income categories.

The modal choices for recreational trips are summarized in Figure 5. Car usage occupies the largest share in most of the categories of vacation period, and this share depends on the departure date and season. The reason why the share is largest during the summer vaca-

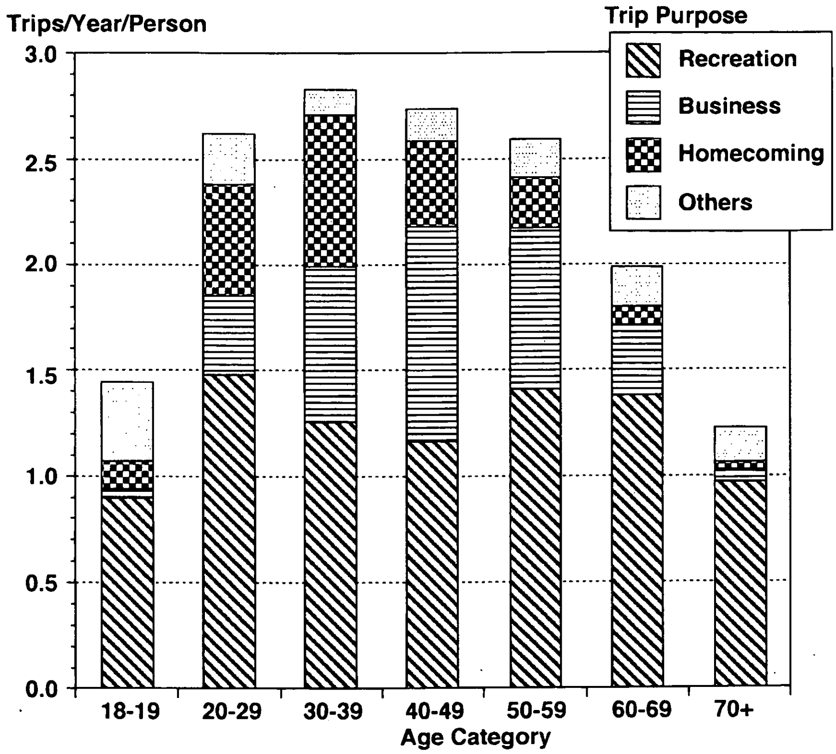

FIGURE 3 Annual overnight trip frequency per person by age category and trip purpose.

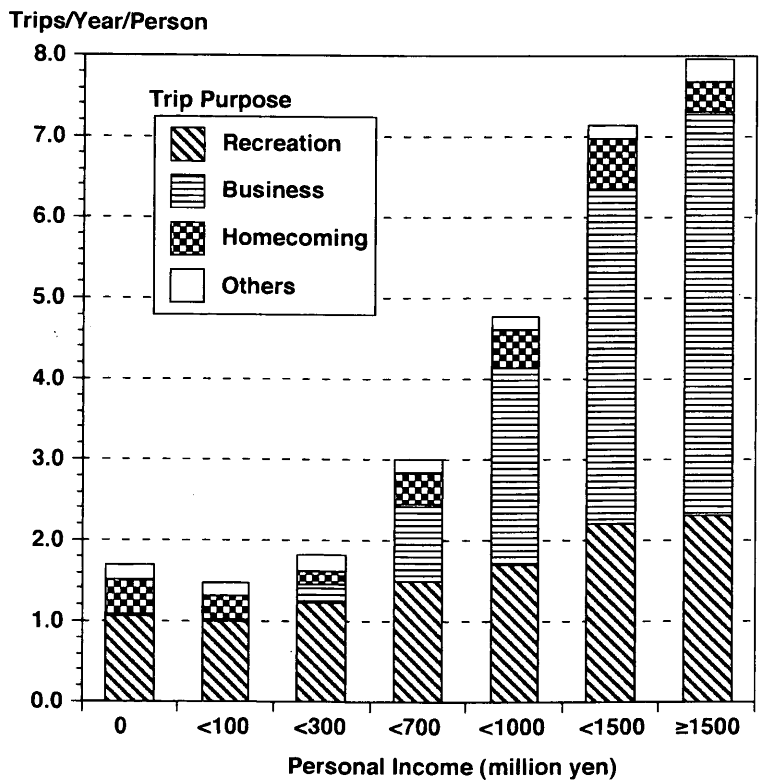

FIGURE 4 Annual overnight trip frequency per person by income category (personal) and trip purpose.

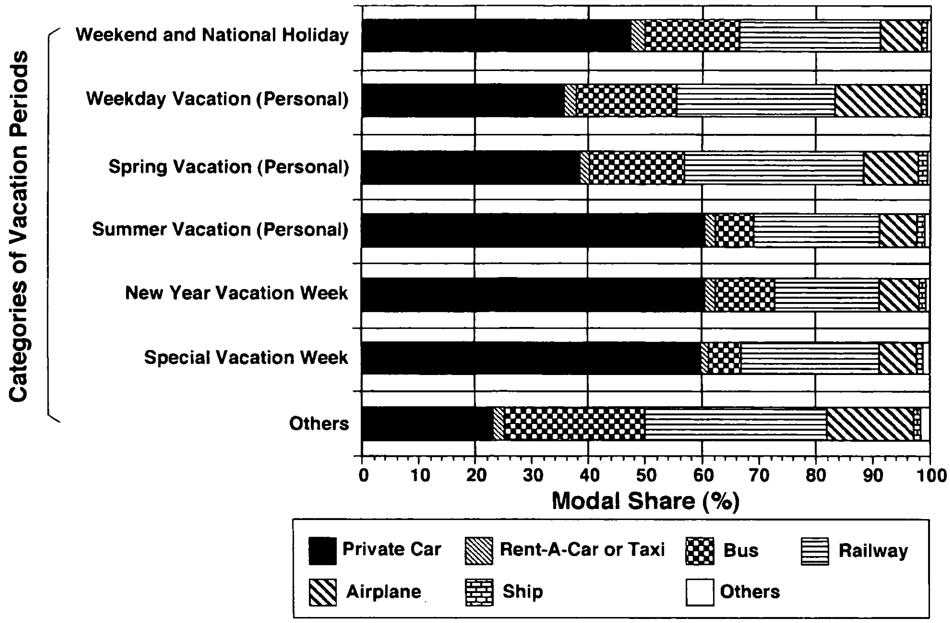

FIGURE 5 Modal shares of overnight recreational trips by vacation type.

tion in August or during the New Year holidays in late December and early January is that travelers prefer to drive cars with their families during those periods.

TRIP GENERATION MODELS

Regional Characteristics of Trip Generation

Modeling of trip frequency of recreational activities in Japan has been achieved by a disaggregated linear regression method, in which the objective variable is the individual travel frequency and the explanatory variables are personal demographic data, such as age and gender. Samples to estimate the linear function came from the former survey data by the Japan Tourist Association (JTA). Aggregate models using zonal average data could not be calibrated from JTA data because of the restriction in sample size. However, the coefficients of determination in the disaggregated linear functions were insufficient for the prediction of future trip generation (*2*).

Figure 6 shows regional differences in the recreation trip frequencies by prefecture. Japan is composed of 47 prefectures, in which the largest prefecture, Tokyo Metropolis, has a population of

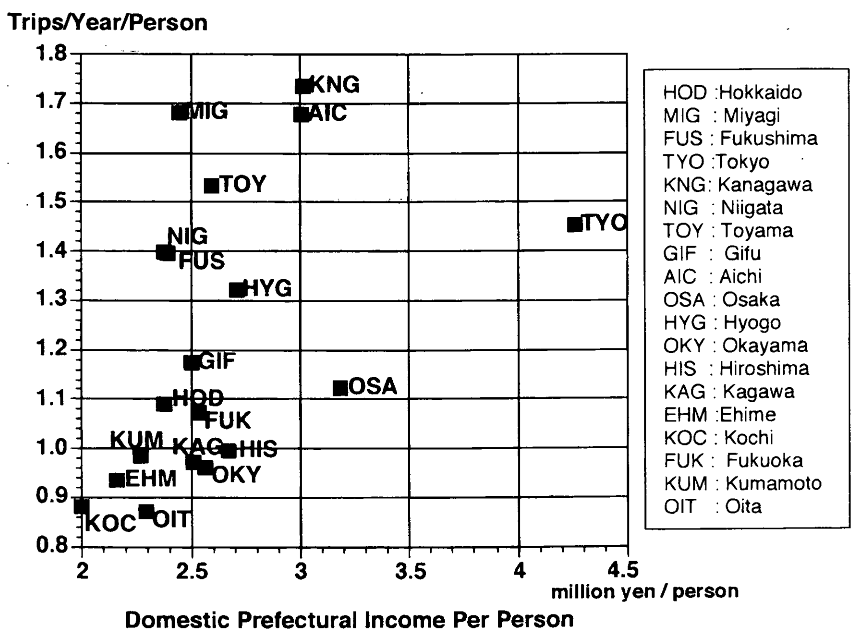

FIGURE 6 Correlation between overnight recreation trip frequency and domestic prefectural income for surveyed cities.

nearly 12 million and the smallest prefecture has a population of only 0.6 million population. Every surveyed city indicated in the figure corresponds to a prefecture described in Figure 1. Prefectural average frequencies from samples and income levels measured by domestic prefectural income statistics (thousand yen per capita) have a fairly strong correlation. This causes one to consider not only individual factors but also regional effects in trip frequency, such as regional income levels.

Regional differences in trip generation may depend on the difference of transportation facility conditions, such as the accessibility to expressways. Figure 7 shows the relationship between trip frequencies and general road densities (kilometers per square kilometers) in prefectures. A positive relation between these quantities is observable for prefectures whose trip frequencies exceed 1.0. However, the prefectures with a trip frequency lower than 1.0 are concentrated at the position of relatively higher road densities. Accordingly, the prefectures with lower frequency should be explained by factors other than road density. Because local prefectures in Hokkaido, Shikoku, and Kyushu have some attractive recreation sites in day trip areas, residents may have little motivation to take overnight trips to other regions.

These results imply that trip generation models should include regional factors in addition to individual characteristics. Although disaggregate models estimated by samples from several regions could contain regional variables, calibrating aggregate models to include regional factors and improve models' predictability is now possible with NRTS data.

Cross-Categorical Aggregated Model

To introduce both personal characteristics and regional factors into the model, a cross-categorical aggregated (CCA) model formulation was developed. Aggregate generation model is usually described by

$$Y_r = \sum_{j=1}^{J} \beta^j x_r^j \qquad (1)$$

where

β^j = coefficient,
x^j = explanatory variable aggregated by zone (here by prefecture),
J = number of variables, and
Y_r = average trip frequency for every prefecture: r.

On the other hand, for categorical data classified according to demographic attributes, the volume in a cell of a multiple cross table is regarded as a sample in the estimation of models. The volume in a cell corresponds to the average trip frequency of multiple categories, such as the combination of age and income. Using such samples,

$$y_g = \sum_{m=1}^{M} \sum_{k=1}^{K} \alpha^{mk} \delta_g^{mk} \qquad (2)$$

will be a model formulation of trip generation y_g of multiple categories, g. In Equation 2, g is identical to a cell; M is number of factors; K is the number of categories in each factor; δ_g^{mk} is 1 if k of factor m corresponds to the category of a cell g, and otherwise it is 0; α^{mk} is the parameter of a category in a factor.

Therefore, integration of regional and aggregated demographic data is performed by the following joint equation:

$$y_{rg} = \sum_{j=1}^{J} \beta^j x_r^j + \sum_{m=1}^{M} \sum_{k=1}^{K} \alpha^{mk} \delta_g^{mk} \qquad (3)$$

where y_{rg} is an average trip frequency in a cell g of prefecture r. As categorical demographic data and regional factors are combined in the estimation of an aggregate model, the model is the CCA model. The parameters β and α in CCA models are estimated by the weighted least-squares method. Sample sizes in cells are used as weights in the estimation.

For example, if two categories are considered by gender and five categories are considered by age for 20 regions, 10 (2 × 5) cells are produced and samples in the estimation will be 200 (10 × 20). Therefore, the sample size in the estimation depends on the size of

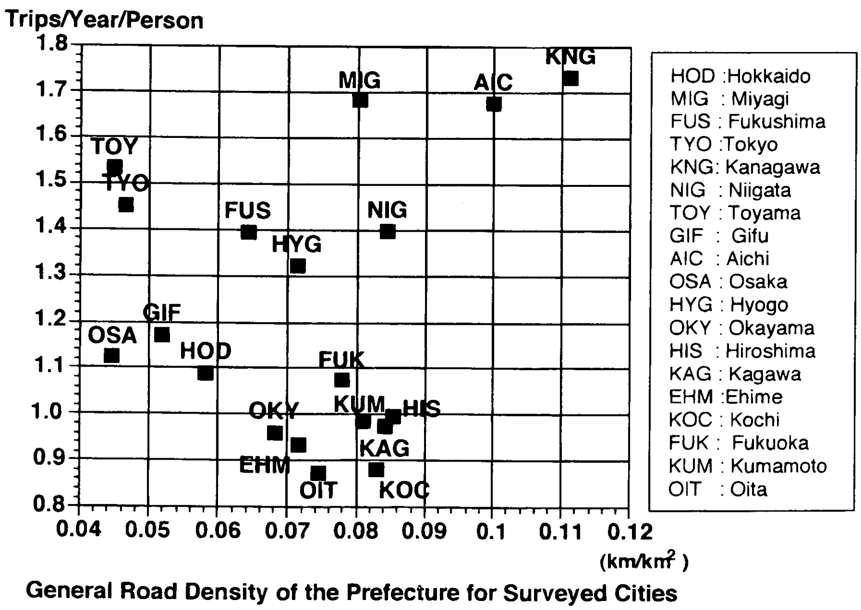

FIGURE 7 Correlation between overnight recreation trip frequency and general road density in prefecture for surveyed cities.

cells. The parameters that represent the correlation among factors, such as age and income, are also available in the models.

Estimation Results of CCA Models

The estimation results of CCA models are presented in Table 1. Three kinds of regional variables—the prefectural income per capita, the car ownership ratio, and the general road density—were introduced in every model to explain regional differences of trip generation. Regional variables differ by prefecture, not by city or household. The individual income level was incorporated in every model because of its evident importance to the models. One additional factor was selected to increase the explanatory power because introducing three or more personal factors increases the cell size and decreases the model's reliability. The adjusted correlation coefficients are fairly high compared with those of ordinary models for recreational trip generation (*2*). The model using gender or car ownership as a personal variable has a higher correlation coefficient. The parameters of the individual income variable increase in accor-

TABLE 1 Estimation Results of CCA Models for Overnight Recreational Trip Frequency

variables		model 1	model 2	model 3	model 4	model 5
Regional characteristics						
regional income per person		0.3913	0.3348	0.3352	0.3288	0.2713
[million yen]		(5.63)	(5.13)	(6.52)	(3.44)	(4.21)
share of car-ownership		0.02267	0.02590	0.02686	0.02706	0.02588
[%=vehicle/ 100person]		(2.55)	(3.07)	(4.05)	(2.16)	(3.12)
index of road development		4.995	5.090	5.304	4.818	4.501
		(2.87)	(3.07)	(4.08)	(2.00)	(2.76)
Demographic characteristics						
car-ownership	no					
	yes	0.3571				
		(4.56)				
sex	male		-			
	female		0.29921			
			(4.03)			
age	≤ 29			-		
	30-49			-0.22073		
				(3.26)		
	50-64			-0.068590		
				(0.94)		
	≥65			-0.25887		
				(3.30)		
frequency of holiday						
	≤6days per month				-	
	≥7days per month				0.2806	
					(2.39)	
	housewife & student				0.5695	
					(2.02)	
passport possession						
	no					-
	yes					0.5686
						(9.38)
personal income	<100	-	-	-	-	-
[million yen]	<700	0.2935	0.4670	0.3008	0.6354	0.2393
		(4.55)	(6.37)	(6.26)	(2.28)	(3.95)
	<1000	0.5303	0.8492	0.5910	0.9036	0.44607
		(3.94)	(5.89)	(5.68)	(2.78)	(3.55)
	≥1000	1.042	1.358	1.018	1.476	0.7766
		(5.55)	(7.43)	(6.24)	(3.70)	(3.93)
const		-1.3097	-1.2552	-0.88534	-1.4481	-0.95945
		(3.42)	(3.43)	(3.07)	(2.46)	(2.71)
sample size		117	112	202	118	123
multiple correlation coefficient adjusted for the degrees of freedom		0.8004	0.8098	0.7474	0.6286	0.7934

dance with the increase in income level. Three regional variables also are adequately significant, and increases in these variables enlarge the trip frequency. Most of these results correspond with aggregation results of survey data and experimental facts. The estimation of these models was successful because of NRTS, the first large-scale survey.

DESTINATION CHOICE MODELS

Destination choice depends on activity, season, travel time, travel cost, attractiveness of destination, and so forth. Modeling trip distribution was traditionally conducted by aggregate models such as the gravity model or the present pattern method used in the planning of metropolitan regions. Selection of model forms sometimes depends on the sample size for the estimation.

NRTS has a large sample size in total. If total samples are pooled, as in trip generation modeling, an aggregated distribution model of the whole country is applicable. However, before pooling total samples, comparing regional differences in destination choice behavior and examining the applicability of the distribution model to recreational travel are required. This is because alternative destinations in a region differ from those in other regions and the parameters of the models may be different among regions.

In this section, the applicability of destination choice models was examined using a disaggregate approach after some previous studies (*4,5*). The approach has the advantage of modeling individual behaviors with relatively small samples and also has a form similar to that of the aggregated distribution model.

Destination Choice Behaviors of Recreational Travel

Figure 8 indicates an example of the distribution of travel destinations for overnight and day trips from Tokyo and Yokohama home-based surveys. The circle indicates the sample size for destination. Overnight and day trip percentages are indicated within the circle. Trip destinations beyond the described area are not illustrated here, in spite of the existence of a few long-distance trips. Distributions of day trips are in accordance with distance from the origin, whereas distributions of overnight trips for nearby destinations represent a small portion of the total.

Data for Destination Choice Models

Car travel data from a personal record of home-based and recreational site surveys were pooled for each origin region to estimate destination choice models for overnight and day trips. A multinomial logit (MNL) model was employed, and travel record data from July through December were selected. The sample size for each model is presented in Table 2 and is discussed later. Not including the trips on the surveyed day, travel record data from recreational site surveys are assumed to be data from exogenous sampling for the corresponding destination choice model. Estimation of MNL model parameters with such samples is possible because of the former works on the estimation theory of discrete choice models.

With chosen destinations arranged in order of decreasing percentage of samples for each region, those within the top 90 percent (cumulative) were selected for the choice set. This 90 percent threshold provides a maximum choice set size for each region. The largest regional choice set size is 30 in Chubu and Kinki for

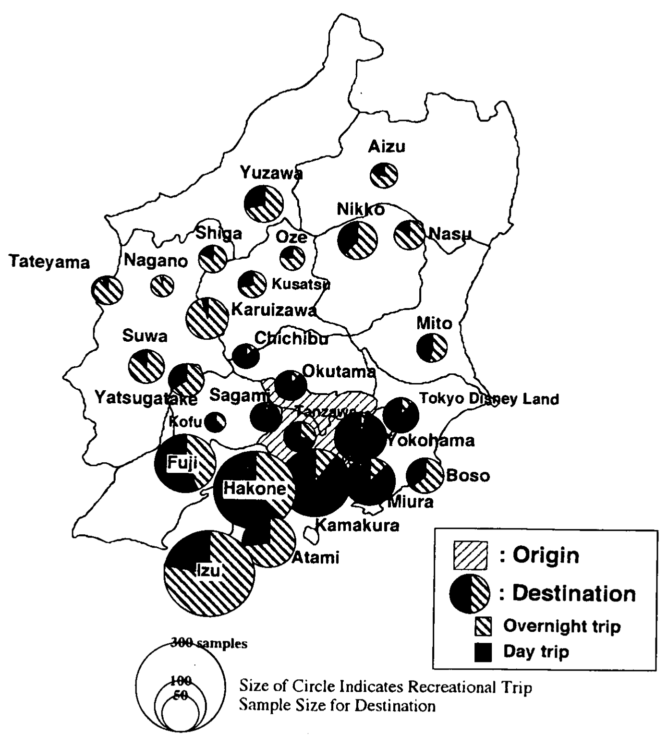

FIGURE 8 Sample size for recreational destinations from Tokyo and Yokohama home-based survey.

overnight travel destinations, and the smallest size is 11 in Shikoku for day trips. These data are also given in Table 2.

Because a destination choice set depends on personal activity interests, the destination alternatives that have no recreational resources corresponding to an individual's activity were excluded. (It is obvious that no one goes to the seaside to climb a mountain.)

Regional utility functions are composed of six variables: travel time, travel cost, and four attraction variables. Travel time between origin and destination was calculated using road network data and shortest-path algorithm. The travel cost variable was transformed by dividing out-of-pocket costs by the logarithm of personal income. Attraction variables are combined with attractiveness of destination and a personal activity dummy. The attraction variable is expressed as

$$\text{Activity attraction of } k = (k \text{ activity dummy}) * [\ln (k \text{ attraction resources})] \quad (4)$$

$$k \text{ activity dummy} = \begin{cases} 1 & \text{if traveler's activity is } k \\ 0 & \text{if traveler's activity is not } k \end{cases}$$

where *k* attraction resources is the number of attraction resources corresponding to activity *k* in a destination. For example, only travelers who participate in seaside or marine activity have an attraction variable of "seaside and marine activities." The attraction resources of each destination were obtained by summing up the number of recreational spots recognized by the Japan Travel Bureau.

Estimation Results of Destination Choice Models

Comparisons of model parameters among regions are discussed here, with consideration given to future integration to a nationwide common model. Previous survey samples never enable the re-

TABLE 2 Estimation Results of Destination Choice Models for Overnight and Day Recreational Trips

(a) Overnight Trip Destination Choice Models

Variables	Hokkaido	Tohoku	Kanto	Surveyed Area Hokuriku	Chubu	Kinki	Chugoku	Shikoku	Kyushu
Travel time	-0.00178	-0.00454	-0.003	-0.0038	-0.000024	-0.00203	-0.00108	-0.00458	-0.00266
t-statistics	-8.58	-8.0	-5.8	-8.46	-0.05	-4.6	-1.87	-8.48	-2.8
Travel cost / ln(Personal Income)	-0.000287	-0.000455	-0.000246	-0.000406	-0.00105	-0.000689	-0.00106	-0.000055	-0.00086
t-statistics	-2.12	-4.11	-2.48	-4.21	-11.5	-7.25	-9.4	-0.28	-4.37
Seaside & Marine Activity Attraction	0.326	-0.107	0.319	-0.123	0.144	-0.235	0.736	0.0336	0.123
t-statistics	6.04	-1.8	4.78	-1.96	2.75	-3.54	8.14	0.31	0.8
Field Activity Attraction	0.0682	0.552	0.596	0.682	0.828	1.12	0.595	0.305	0.762
t-statistics	0.73	5.75	8.39	3.65	10.0	12.23	4.32	2.83	3.61
Spa Visit Attraction	0.392	0.545	0.435	0.73	1.3	0.0303	0.0611	0.612	1.32
t-statistics	5.99	4.48	4.48	5.11	12.6	0.26	0.35	3.24	5.78
Sightseeing Attraction	0.706	0.303	0.923	0.510	0.722	0.422	1.35	1.45	1.39
t-statistics	11.5	3.26	14.7	4.46	11.6	4.84	10.1	8.60	13.9
Log-Likelihood at zero	-2594.7	-2271.9	-3071.8	-1898.9	-3192.1	-2471.8	-1372.0	-1025.5	-1303.2
Log-Likelihood at convergence	-2400.1	-2040.5	-2786.0	-1737.0	-2897.1	-2277.6	-1183.6	-906.5	-1051.2
Sample Size	1000	802	1000	614	1000	765	442	353	469
Choice Set Size	15	21	27	27	30	30	26	21	19

(b) Day Trip Destination Choice Models

Variables	Hokkaido	Tohoku	Kanto	Surveyed Area Hokuriku	Chubu	Kinki	Chugoku	Shikoku	Kyushu
Travel time	-0.00815	-0.0156	-0.0164	-0.0125	-0.00602	-0.00464	-0.00876	-0.00899	-0.00971
t-statistics	-22.9	-11.1	-17.7	-23.7	-7.64	-5.26	-13.4	-16.2	-11.9
Travel cost / ln(Personal Income)	-0.000237	-0.00143	0.000276	-0.00128	-0.00275	-0.00148	-0.000856	-0.00215	-0.00273
t-statistics	-1.57	-6.04	1.48	-9.07	-15.4	-6.78	-4.65	-4.92	-11.3
Seaside & Marine Activity Attraction	0.134	0.494	0.543	0.128	0.316	0.0936	0.296	0.434	0.494
t-statistics	2.6	8.14	8.54	1.36	5.81	1.63	2.79	4.67	4.1
Field Activity Attraction	0.196	0.898	1.01	0.572	0.485	0.779	1.62	0.495	1.12
t-statistics	1.83	7.1	12.5	4.49	5.36	6.48	6.05	5.19	5.39
Spa Visit Attraction	0.815	0.83	0.617	0.517	0.844	0.917	0.276	1.27	2.67
t-statistics	4.47	5.52	6.84	3.55	6.52	3.48	1.4	4.81	8.57
Sightseeing Attraction	0.674	0.0918	0.788	0.28	1.06	-0.585	0.845	1.63	1.23
t-statistics	5.68	0.38	6.4	1.64	5.1	-1.05	3.77	7.21	6.98
Log-Likelihood at zero	-2558.8	-2624.5	-2598.1	-2445.0	-2598.7	-1553.3	-1494.5	-1667.8	-1754.0
Log Likelihood at convergence	-1988.2	-1629.8	-2252.9	-1451.9	-2163.8	-1387.4	-1129.4	-1225.5	-1154.1
Sample Size	1000	1000	922	939	933	577	626	744	660
Choice Set Size	15	16	23	17	18	18	13	11	17

searchers to examine such a comparison for recreational trip distributions, in spite of unique recreation sites in each region.

Using samples from home-based and recreation site surveys, regional destination choice models were estimated for overnight and day trips (Table 2).

Estimation results indicate that most regions have reasonable and expected signs of parameters. Parameters of travel time in Chubu and travel cost in Shikoku are insignificant for overnight trips. The attraction variable for sightseeing in Tohoku, Hokuriku, and Kinki has an unexpected sign for overnight trip models. For day trip models, the travel cost variable in Kanto and an attraction variable for a spa visit in Kinki had unacceptable parameters. However, most parameters had reasonable results, which is useful for the future integration of models.

The sample size and log likelihoods are given in Table 2. Sample sizes in most regions exceeded 1,000 and log likelihood ratios stand between nearly 0.1 and 0.4, permitting a comparison of the models.

Figure 9 shows regional differences of two important parameters of overnight trips. The intersection of two lines in the figure indicates expected values of parameters, and the line length indicates the standard deviation of the parameter. It seems that there are two significantly different groups of parameters, except for the parameters for the Shikoku and Chubu region. One is formed by the parameters for East Japan: Hokkaido, Tohoku, Kanto, and Hokuriku regions. The other is formed by the parameters for West Japan: Kinki, Chugoku, and Kyushu regions. West Japan has larger cost and smaller time parameters than East Japan. Relatively speaking, this implies that the West is cost conscious and the East is time conscious. Results of day trip models were similar, although the positions of Chugoku and Shikoku changed. As a result, different regions may have different parameters of time and cost, and the regional combination to make a few model segmentations, such as east and west Japan, is possible to represent trip distributions in Japan. Furthermore, the fact that parameter trade-off ratios between time and cost variables, in regions in which the *t*-statistics of both parameters exceed 2.0 (Tohoku, Hokuriku, Kinki, and Kyusyu), were nearly identical among overnight and day trip models suggests the possibility of integrating overnight and day trip models.

CONCLUSIONS

The outline of the first large-scale survey of recreation travel in Japan is summarized and the applicability of survey data to trip generation and distribution models is briefly examined. Recreational travel volume is definitely increasing in Japan, and the improvement of transportation facilities is expected in several recreational areas. Understanding recreational trip behavior is essential to revising the road planning in suburban areas.

The results of NRTS provided fundamental characteristics of recreational travel, which differ by demographic attributes and regional factors. The modeling abilities from NRTS were also

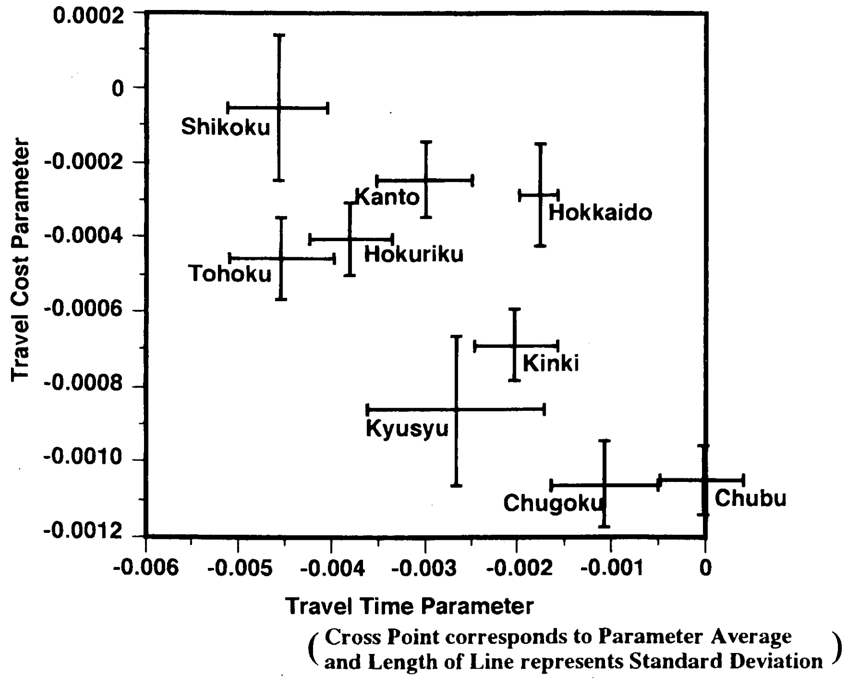

FIGURE 9 Regional difference of time and cost parameters of destination choice models for overnight recreational trips.

conformed by successful results of trip generation and destination choice models. The trip generation models had much higher correlation coefficients than other models from previous studies in Japan. Destination choice models in most regions provided significant and reasonable parameters and the possibility of regional data pooling.

However, several fruitful researches using NRTS data are still unexplored. Ongoing and additional research on the following aspects will activate NRTS potentials for planning fields: (*a*) establishment of a survey method using home-based and choice-based recreation site samples to estimate a nationwide origin destination matrix; (*b*) integration of destination choice models to improve their statistical accuracy and stability; (*c*) consideration of travel duration and interval in the trip generation process to improve the model's predictability; (*d*) modeling of intraregional travel behaviors in several regions to establish the prediction methods of recreational traffic volume in recreational areas.

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