TRAVEL DEMANDS FORECAST MODELLING FOR SIGHTSEEING EXCURSION

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INTRODUCTION

A sightseeing behaviour is excursion ones, that is to say travellers visit in some sightseeing areas from their origin and return to their home. We should regard the sightseeing trips as not a set of some independent trips but a trip-chain consisting of a series of trips between some sightseeing areas. In forecasting the sightseeing travel demands and the total number of guests of a certain area [3],[6] a model which can explicitly explain the excursion behaviour seems to be more effective.

In order to formulate such excursion behaviour as a mathematical model, it is necessary to solve, in particular, the following two main subjects ;
(a) how do we quantify the degree of integrated attraction of each sightseeing area, and
(b) what kind of model do we use to formulate sightseeing excursion behaviour.

On the subject (a), since it's difficult to solve, there seems to be little research except for Morikawa[4]. On the subject (b), we could use Markov process [2] and utility theory approach. The former approach is effective in case the transition property on area choices has the Markov property. However, since we cannot regard the decision-making process for area choices as independent and the transition probabilities as stationary, we cannot apply directly the Markov process to the formulation of sightseeing excursion behaviour. On the other hand, the Kitamura's idea [1] may belong to the latter one. When he defined the utility of a certain destination, he included attributes of trips which a trip-maker expects to make after the visit to this destination. Morisugi [5] also formulated a sequential areas choice behaviour by using the nested logit model. In this paper, I generalize their ideas still further and proposed a sightseeing excursion travel demands forecasting model considering the above two subjects.

1. SIGHTSEEING EXCURSION PATTERN

1.1. The Actual Conditions of the Sightseeing Excursion Patterns

The total number of sightseers for a certain area is usually shown by using the total number of visitors who make circular tours among some areas including the present area. Then, we have to analyze the actual condition of these circular tours so that we can clearly comprehend the essential characteristics of sightseeing excursion behaviour. I examined the sightseeing excursion patterns an the time series changes of them by using data resulting from two surveys which were carried out in 1981 and 1986 in Kumamoto Prefecture. In these surveys, we ask guests who have been staying in lodges in the survey area about (a) their socioeconomic attributes, (b) transport modes, the number of lodging days, the aim of this sightseeing, (c) excursion areas and their order and so on. Futhermore, since we can collect same number of samples from the same hotels, it is meaningful to compare between both values of ratio resulting from each aggregation analysis. Figure 1 shows the ratios of the number of visitors who make some typical excursion patterns covering the north and middle area, consisting of North, Aso, Kumamoto City and the Amakusa Islands of Kumamoto Prefecture. Figures written in each circle are ratios of travellers who visited only this area, and figures written on each arrow are those who visited two areas to which its edges point. It is found that the ratios of piston-type sightseeing decrease in every area over a five year period. On the other hand, excursion-type rapidly increase in ratio and in '86 we can find a new excursion pattern which did not exist in '81. On the excursion patterns which travellers visit over three areas, these tendencies are more noticable. I count samples by each area visited and compare values of its ratio to each other. The results are shown in Table 1. In Aso and Kumamoto City, these values increased over a five year period, but area Amakusa Islands area remarkably decreases in ratio. These trends correspond to those which are shown in the official statistics on sightseeing in Kumamoto Prefecture.

Table 1. Comparison of ratios of the number of samples aggregated by area

Sightseeing area	1981	1986
North	385 (14.3)	280 (12.3)
Aso	845 (31.4)	838 (36.8)
Kumamoto city	751 (27.9)	768 (33.8)
Amakusa	710 (26.4)	389 (17.1)

(Note) Percentages in Parentheses.

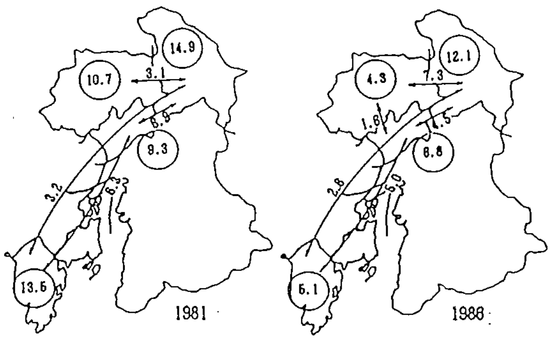

Figure 1. Comparison of the excursion patterns

1.2. Analysis on Factors Affecting Excursion Patterns

I enumerate about 40 excursion patterns which consist of visits to one or more among these four sightseeing areas by using original data of '81 survey. It is found that the ratio of travellers who visited over three areas is about 13%, and that even if a traveller visits some of the same areas, there are some different patterns in the order of visits. I will educe factors affecting the differences in excursion patterns. Properly speaking, it is appropriate that I directly educe them by use of a statistical method like an ANOVA. However, both the number of patterns are large and samples belonging to almost all patterns are small, so that I seem not to be able to obtain results which are significant in a statistical test from ANOVA. Therefore, I divided the structure of a excursion pattern into these two elements, (a) the number of sightseeing areas, and (b) the areas where a sample visited during an excursion. With the results from the aggregation analysis on these two substitute indices by factor, it is found that season, origin place, the number of lodging days, the number of companions ans so on affect the structure of an excursion pattern. As a example, I refer to the effects of the number of lodging days on a structure of an excursion pattern. We find that, under three nights tour, according as the number of lodging days increase, the ratio of multi-area type visits increase and the average value of the number of visiting areas increases from 1.48

to 2.02. In contrast with this, in case of over four nights, according as the number of lodging days increase, the average tends to become small.

In consequence, in the case that we make a forecasting model on a sightseeing travel demands, we have to regard sightseeing behaviour as a excursion one and introduce some factors affecting excursion behaviour into it.

2. MEASURING THE INTEGRATED ATTRACTION OF AREAS

2.1. Structural Elements of Sightseeing Attraction

The integrated attraction of a certain sightseeing area could be assumed to consist of these two attraction elements ;
(a) the attraction by both quantity and quality of each area's own sightseeing resources, and
(b) the attraction which a traveller expects from the other sightseeing areas where he can visit next from the present area.

The first element is the attraction that depends on the resources which each area originally has independently of the other areas like natural landscape beauty, historical inheritances, amusement facilities, accommodations and so on. The second element is the attraction that depends both on the integrated attraction of the other sightseeing areas where travellers can visit next from the present area and on the accessibility to them. In measuring the integrated attraction of each area, we should consider these two attraction elements.

2.2. Measuring the Attraction of Each Area's Own Resources

There are various kinds of sightseeing resources which each area originally has, so that it is difficult not only to grasp them quantitatively but to evaluate the attraction of each area by any measure consolidated the difficulty. However, I tried to measure the degree of this attraction of each sightseeing area by use of the Analytic Hierarchy Process (AHP) method which applies to decision-making problems under uncertainty. Data by which estimate the relative weights of areas by attribute is collected using a comparison questionnaire about a couple of areas. I show kinds of resource that I assume to constitute the area's own attraction and the hierarchical configuration in applying AHP method in Figure 2. (a) Natural landscape beauty, (b) historical inheritances, (c) foods and a health resort seem to be essential factors that motivate us to go sightseeing. As recent conditions on sightseeing behaviour show a tendency to not only swell in numbers but on top of that to become more active and experience the world outdoors, I add (d) the degree of diversification on kinds of resource in this area and (e) convenience of transport in this area to these three resources. Because we would like to grasp the absolute evaluation measure of the attraction by area, the comparison questionnaire about a couple of areas by resource was carried out not for travellers but for experts of tourism who are well aware of the degree of attractions of each area. The ten subjects of this questionnaire are composed of eight business managers of travel agencies and two public servants connected with sightseeing policy. In Table 2, the values of average and standard deviation of weights given from this questionnaire are shown. There are some subjects whose answers are inconsistent, and the coefficients of variation on some resources are rather large. However, we know from our experience that the appropriate values on the average against all factors seem to be given.

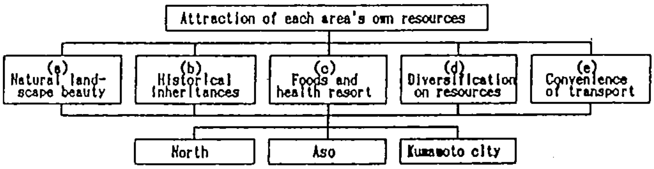

Figure 2. Sightseeing resources and their hierarchical configuration in AHP

Table 2. Attraction measures depending on each area's own sightseeing resources

Resources / Sightseeing areas	(a) Natural landscape beauty	(b) Historical inheritances	(c) Foods and health resort	(d) Diversification on resources	(e) Convenience of transport
North	0.051(0.017)	0.251(0.152)	0.111(0.100)	0.068(0.038)	0.233(0.174)
Aso	0.533(0.160)	0.092(0.056)	0.414(0.165)	0.479(0.158)	0.180(0.121)
Kumamoto city	0.139(0.160)	0.452(0.183)	0.188(0.155)	0.254(0.180)	0.501(0.203)
Amakuse	0.277(0.138)	0.205(0.088)	0.292(0.132)	0.200(0.078)	0.087(0.054)

(Note) Standard deviations in Parentheses.

2.3. Formulation of the Integrated Attraction

I define the integrated attraction of sightseeing area j ($j \in A$, where A is a choice set of sightseeing area alternatives) as a random variable, and let $W_{(j)}$ be its deterministic component of it. The attraction which a traveller expects to get from area k ($k \in A_j$, where A_j is a set of area which it is possible for him to visit from area j) after a visit to area j will be explained as the expected value of maximum of the differences between $W_{(j)}$ and disutility value, u_{jk}, resulting from a movement between areas jk. Giving that the random component of the integrated attraction varies according to the independent and identical Weible distribution across alternatives, the second element of the integrated attraction as shown in section 2.1 may be written as

$$1/\lambda \ln \sum_{k \in A_j} \exp\{\lambda(W_{(k)} - u_{jk})\}. \tag{1}$$

In consequence, the integrated attraction of sightseeing area j is

$$W_{(j)} = W_{(j)}^0 + 1/\lambda \ln \sum_{k \in A_j} \exp\{\lambda(W_{(k)} - u_{jk})\}, \tag{2}$$

where $W_{(j)}^0$ is the attraction of area j depending on its own resources as shown in section 2.2. For simplicity, $W_{(j)}^0$ is assumed to be a linear function of $w_{(j)m}$ as follows :

$$W_{(j)}^0 = a_0 + \sum_{m \in M} a_m w_{(j)m}, \tag{3}$$

where $w_{(j)m}$ is the attraction value by sightseeing resources m in area j. We can re-express Equ.(2) as

$$W_{(j)}=a_0+\sum_{m\in M} a_m w_{(j)m}+1/\lambda \ln \sum_{k\in A_j} \exp\{\lambda(W_{(k)}-u_{jk})\} \tag{4}$$

Equation (4) composes of the simultaneous equations of which variables are $W_{(j)}$'s ($j \in A_j$). If we can estimate a_0, a_m and λ by some method, it is possible to solve $W_{(j)}$ as solutions of the simultaneous Eqs.(4). I will show a solution method in section 4.

3. A EXCURSION DEMAND FORECASTING MODEL

3.1. Configuration of Time-Space Choice Tree

We may regard a sightseeing excursion behaviour as a sequential choice for sightseeing area alternatives. In the case that we explain such behaviour by a mathematical model, it is effective to apply the sequential nested logit model. We have to set the hierarchical choice set tree when we formulate such choice behaviour using the sequential logit model. In general, this tree is the structural representation of alternatives. We will add a new idea to it as follows. We explicitly let each branch of tree explain time which a traveller spent on staying at a sightseeing area or on moving between areas as shown in Figure 3. I'm supposing that a proposed model will be applied to the excursion behaviour such that time spent on staying and moving is about half a day. Then, the tree of Fig.3 can be transformed into a new tree having branches of which length is all half a day as shown in Figure 4. As a result, it is possible to formulate the excursion behaviour by use of the usual sequential choice model. Using this method, we can forecast not only the whereabouts of travellers in process of time but also the time-of-day a persons trip demands on primary sightseeing road networks.

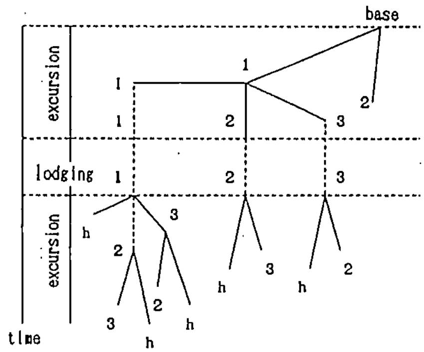

Figure 3. A representation of the structure of excursion behaivour

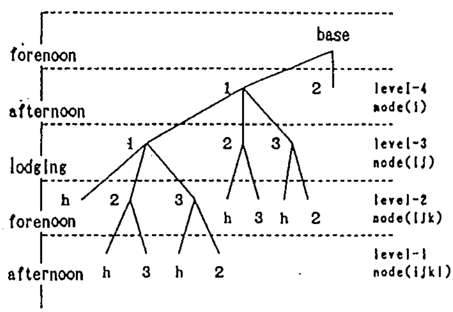

Figure 4. A time-space choice tree

3.2. Formulation of Choice Probabilities

Individual n is seemed to choose the sightseeing area alternative that yields the highest utility from his alternative choice set. On this assumption, the conditional probability by choice level is explained by the set of nested logit models as follows :

$$p_{(l|kji)n}=\exp \lambda_1 V_{(l|kji)n} / \sum_{l' \in E_n} \exp \lambda_1 V_{(l'|kji)n} \tag{5}$$

$$p_{(k|ji)n}=\exp \lambda_2[V_{(k|ji)n}+V^*_{(k|ji)n}] / \sum_{k' \in E_n} \exp \lambda_2[V_{(k'|ji)n}+V^*_{(k'|ji)n}] \tag{6}$$

$$p_{(j|i)n}=\exp \lambda_3[V_{(j|i)n}+V^*_{(j|i)n}] / \sum_{j' \in A} \exp \lambda_3[V_{(j'|i)n}+V^*_{(j'|i)n}] \tag{7}$$

$$p_{(i)n}=\exp \lambda_4[V_{(i)n}+V^*_{(i)n}] / \sum_{i' \in A} \exp \lambda_4[V_{(i')n}+V^*_{(i')n}] \tag{8}$$

where,

$$V^*_{(k|ji)n}= (1/\lambda_1) \ln \sum_{l' \in E_n} \exp \lambda_1 V_{(l'|kji)n} \tag{9}$$

$$V^*_{(j|i)n}= (1/\lambda_2) \ln \sum_{k' \in A} \exp \lambda_2[V_{(k'|ji)n}+V^*_{(k'|ji)n}] \tag{10}$$

$$V^*_{(i')n}= (1/\lambda_3) \ln \sum_{j' \in A} \exp \lambda_3[V_{(j'|i)n}+V^*_{(j'|i)n}], \tag{11}$$

these are referred to as inclusive values that is a necessary condition for a sequential logit model to be consistent with utility maximization. E_n is a sum set of sightseeing set A and an individual base. $p_{(l|kji)n}$ is the conditional choice probability that individual n chooses a sightseeing area alternative (l) on level-1 on condition that an alternative (kji) has been chosen on level-2. The other p(.)'s are same conditional probabilities by each choice level. $V_{(l|kji)n}$ is the value of deterministic component of alternative (l)'s utility on level-1 given that an alternative (kji) has been chosen. The others are same utility values. λ_1's are the dispersion parameters by each choice level. Then, a joint probability which individual n chooses a i-j-k-l sightseeing excursion pattern can be obtained :

$$p_{(lkji)n} = p_{(l|kji)n} \cdot p_{(k|ji)n} \cdot p_{(j|i)n} \cdot p_{(i)n} \, . \tag{12}$$

3.3. Specification of Utility Function

The deterministic utility component of an alternative (lkji) for an individual n, $V_{(lkji)n}$, can be given by

$$V_{(lkji)n} = V_{(l|kji)n} + V_{(k|ji)n} + V_{(j|i)n} + V_{(i)n} \, , \tag{13}$$

where we defined the utility function of each level as follows :

$$V_{(l|kji)n} = \alpha_0 + \alpha_1 W_{(l)} + \alpha_2 g_{kl} + \alpha_3 f_{lh} \tag{14}$$

$$V_{(k|ji)n} = \beta_0 + \beta_1 W_{(k)} + \beta_2 g_{jk} + \beta_3 f_{kh} \tag{15}$$

$$V_{(j|i)n} = \gamma_0 + \gamma_1 W_{(j)} + \gamma_2 g_{ij} + \gamma_3 f_{jh} \quad (16)$$

$$V_{(i)n} = \delta_0 + \delta_1 W_{(i)} + \delta_2 g_{hi} \quad (17)$$

$W_{(l)}$'s are the integrated attractions which travellers can get by visiting to the sightseeing area l as shown in Equ.(2). g_{kl}'s are the generalized costs spent on moving between kl. f_{lh}'s are the generalized costs spent on returning to his base from the area l. These utility functions have a distinguishing characteristic that variables like f_{lh}'s appearing accessibility to each base from sightseeing areas are introduced.

4. A CASE STUDY

4.1. Data Making and Estimation Procedure

We apply this model to an actual forecasting procedure of a sightseeing excursion travel demands. Bases are four prefectures which are named Fukuoka, Ohita, Nagasaki and the others. The three sightseeing areas are called North, Aso and Kumamoto City in Kumamoto Prefecture as shown in Fig.1. In applying this model, we need such kinds of data as follows :

(a) the values of attraction by each sightseeing area's own resources,
(b) the level of transportation service among sightseeing areas and bases, and
(c) base, excursion pattern, staying place and so on of each traveller.

As data on (a), we use mean of values of attraction by each area's own resources resulting from AHP in section 3, although they are ratio scale values. As the attributes of service on (b), we use the travel time and travel cost. Travel times are calculated by use of the minimum path search on road networks which consists of primary roads connecting prefectural seats and sightseeing areas. Travel costs are total fairs of expressways and toll roads on minimum paths. Data on (3) are made by selecting samples that have gone on one night sightseeing excursion among these areas from the original data of '81 survey.

In section 3, the model was formulated on a disaggregated base, so it is appropriate to estimate the parameters of the utility expressions in Equs.(14)-(17) by use of maximum likelihood estimation using individual data which in many cases is preferable to any of the other available methods, However, the number of available data is small in comparison with the number of sightseeing area alternatives, especially in level-1. The transportation service variables are manufactured aggregation data and the kind of socioeconomic variables are few, so we don't have any advantages that we can us to estimate the parameters. Then, I estimate the parameters of the utility expressions by the aggregated sequential nested logit models. At the beginning, we determine a criterion alternative and its probability by level as follows :

level-1 : an alternative that shows a return base h and its probability, $p_{(h|kji)}$
level-2 : an alternative that shows a return base h and its probability, $p_{(h|ji)}$
level-3 : an alternative that shows a remaining at the same area and its probability, $p_{(i|i)}$
level-4 : an alternative that shows a choice of area 1 and it probability, $p_{(1)}$

The logarithm of the ratios of the other alternatives' choice probabilities to the criterion's one are

$$\ln(p_{(l|kji)}/p_{(h|kji)}) = \lambda_1[V_{(l|kji)} - V_{(h|kji)}]$$

$$\ln(p_{(k|ji)}/p_{(h|ji)}) = \lambda_2[(V_{(k|ji)} + V^*_{(k|ji)}) - (V_{(h|ji)} + V^*_{(h|ji)})]$$

$$\ln(p_{(j|i)}/p_{(i|i)}) = \lambda_3[(V_{(j|i)} + V^*_{(j|i)}) - (V_{(i|i)} + V^*_{(i|i)})]$$

$$\ln(p_{(i)}/p_{(1)}) = \lambda_4[(V_{(i)} + V^*_{(i)}) - (V_{(1)} + V^*_{(1)})]\,.$$

We find that they are linear functions of the difference between utilities and we can estimate the parameters by use of the general linear multi-regression method. However, the right hand side of these equations includes not only the parameters of utility functions but also the integrated attraction variables, $W_{(j)}$, having parameters, a_0 and a_m, which should be estimated. Properly, these parameters and $W_{(j)}$ ought to be estimated simultaneously by minimization method of residual sum of squares subjected to simultaneous equations (5). But, we use an altemative iterative method as follows :

step-0 : Set the index of iteration s=0.

step-1 : Set the initial values of $W_{(r)}^{(s)}$, where $r \in A$, and $\lambda = \lambda^{(s)}$.

step-2 : Substitute Equ.(2) into Equ.(14), we can obtain

$$V_{(l|kji)}^{(s)} = A_0 + \sum_{m \in M} A_m w_{(l)m} + \alpha_1 \ln \sum_{r \in A} \exp\{\lambda^{(s)}(W_{(r)}^{(s)} - u_{l|r})\} + \alpha_2 g_{kl} + \alpha_3 f_{lh}.$$

Estimate parameters A_0, A_m, α_1, α_2, α_3 by the multi-regression analysis.

step-3 : Calculate $a_0 = A_0/\alpha_1$, $a_m = A_m/\alpha_1$.

step-4 : Substitute these values into Equ.(2), and replace $W_{(r)}^{(s)}$ with $W_{(r)}^{(s+1)}$.

step-5 : The iteration can terminate if, for example, $|W_{(r)}^{(s+1)} - W_{(r)}^{(s)}| < \varepsilon$, where ε is a predetermined tolerance selected especially. Otherwise, set s=s+1 and go to step-2.

4.2. The Empirical Results

We tried to estimate the parameters by the iteration method as shown in section 4.1. After on level-2, however, we obtain results that the sign condition against some explanation variables is not appropriate or F-values of some regression functions are too small, because it seems that the high correlation exists between the inclusive values $V^*_{(k\,ji)}$ and the integrated attraction values $W_{(k)}$ mutually. The main reason is that the set A_j corresponds to the set A since sightseeing area altematives are only three. It seems that the second term of Equ.(2) does not become effective in explaining the integrated attraction of a sightseeing area when the number of area alternatives are few in relative frequency. Then, we estimate the parameters again on the assumption that $W_{(j)}$'s are equivalent to $W_{(j)}^0$'s. The explanation variables are selected by the stepwise-method in consideration for both sign condition and statistical significance of coefficients. But, we try to accept variables which are essential to explain the choice behaviour on each level if their signs is not logical, even though their t-value is a little low. We accept as many as possible the variables explaining the attraction of area's own resources. We show the results in Table 3.

level-1 : The multiple correlation coefficient, R, is 0.76. The statistical reliability of this model is rather high. On the explanation variables, "travel times between sightseeing areas" and "the degree of divercification on kinds of resource" are significant. Because "travel time to base from a sightseeing area" seems to be essential, we accept it in spite of the value of t-value is not high. The condition of sign seems to be logical.

level-2 : This level appears the next area choice behaviour from lodgings. "travel times between sightseeing areas" and "travel cost between sightseeing areas" become significant. On variables explaining the attraction of area's own resources, "the degree of divercification on kinds of resource" is extremely significant. The t-value of Inclusive value is not too high, but we accept it because the condition of sign is not illogical. R-value is equal to 0.79 and the reliability of this model is high.

level-3 : This level appears in which areas travellers choose to lodge. We accept "foods and a health resort" which seems to mainly affect this choice behaviour as a political variable. It is satisfied with the sign condition, but its t-value is a little low. The sign of "travel time between sightseeing areas" is positive, but, that of "convenience of transport" is negative. It is difficult to interpret these results. The value of multiple correlation coefficient, R, is 0.54 and is low. The statistical reliability of this model is not too high.

level-4 : The sign of "travel time between sightseeing areas" and the inclusive value are also logical, and these variables are statistically significant. On variables explaining the attraction of area's own resources, "the degree of divercification on kinds of resource in this area" is accepted as a statistically significant variable. R-value is 0.91 and the statistical reliability is good.

Table 3. Estimation Results (t-statistics in Parentheses)

Level	Variable	Parameter	R-value
1	Constant Travel Time Travel Cost Diversification on resources Convenience of transport Travel time to base	-3.56373 (2.99) -0.00896 (3.70) -0.16536 (1.16) 1.42921 (2.32) 0.30189 (0.48) -0.14848 (1.04)	0.76
2	Constant Travel Time Travel Cost Diversification on resources Convenience of transport Inclusive value	-3.14546 (2.68) -3.14546 (2.68) -0.01481 (4.43) -0.09299 (1.52) 2.24650 (3.13) 0.38042 (1.02)	0.79
3	Constant Travel Time Convenience of transport Foods and health resort Inclusive value	-3.38154 (1.88) 0.02419 (1.30) -1.96511 (1.18) 1.41893 (1.02) 0.32771 (1.31)	0.64
4	Constant Travel Time Diversification on resources Inclusive value	-8.43853 (1.65) -0.05142 (2.98) 10.32960 (2.90) 19.29560 (2.50)	0.91

4.3. Goodness-of-fit

In order to determine the goodness-of-fit for this model, I would like to carry out the multi-regression analysis between the predicted values (y) and the observed values (x). We investigate these two points as follows ;

(a) the choice probabilities and the choices by level, and

(b) the total number of guests up to each level.

On (a), Table 4 shows the regression coefficients a_0, a_1 of the simple regression function $y = a_0 + a_1x$ and multiple correlation coefficient (where it correspond to the correlation coefficient), R, by base and by level. Where we do not distinguish bases, R-values are greater than 0.70 for all levels and a_0 is nearly equal to 0.0 and a_1 is nearly equal to 1.0 statistically. The pairs of (x, y) on the choice probabilities against all levels are plotted in Figure 5. I found that the goodness-of-fit on the investigation point (a) for this model is sufficiently high.

Next, on point (b), Table 5 shows the results of regression between y and x on the total number of guests up to each level. R-values are over 0.98 and null-hypotheses, that is to say $a_0=0.0$ and $a_1=1.0$, are not rejected against 5% significant level. We put both the predicted and observed total number of guests visiting each area side by side in Figure 6. They are almost all of an value. On the investigation point (b), it seems that the goodness-of-fit is high. These empirical results are encouraging to apply this model to the sightseeing excursion travel demands forecasting procedure.

Table 4. Goodness-of-fit on the choices and probabilities

Level		Choices by base				Total	
		Fukuoka	Ohita	Nagasaki	The Others	Choices	Probabilities
1	a_0	0.78(2.18)	0.17(2.13)	0.20(2.27)	0.17(1.78)	0.33(3.16)	0.01(4.64)
	a_1	0.62(3.95)	0.38(24.6)	0.65(8.83)	0.67(6.25)	0.64(12.4)	0.46(23.4)
	R	0.67	0.90	0.84	0.75	0.70	0.80
2	a_0	2.95(2.71)	0.99(1.13)	-0.01(0.01)	0.55(1.26)	1.02(2.83)	0.01(2.05)
	a_1	0.81(6.48)	0.68(2.24)	1.01(0.19)	0.76(2.10)	0.83(9.08)	0.81(4.00)
	R	0.98	0.68	0.93	0.79	0.97	0.86
3	a_0	7.91(2.57)	0.45(0.79)	-0.47(0.73)	-0.35(0.27)	2.14(0.39)	0.01(0.76)
	a_1	0.83(4.16)	0.95(1.23)	1.08(1.14)	1.05(0.42)	0.88(5.69)	0.96(0.67)
	R	0.99	0.99	0.99	0.95	0.99	0.98
4	a_0	43.4(2.10)	2.69(0.46)	-6.27(1.13)	7.85(21.8)	2.22(0.74)	0.02(0.67)
	a_1	0.69(2.18)	0.90(0.49)	1.25(1.20)	0.61(22.4)	0.96(1.07)	0.93(0.71)
	R	0.98	0.98	0.99	0.99	0.99	0.95
Total	a_0	1.57(2.59)	0.13(0.44)	-0.09(0.59)	0.05(0.28)	0.45(2.59)	0.01(1.02)
	a_1	0.90(6.66)	0.68(3.07)	1.02(0.84)	0.95(1.46)	0.91(10.8)	0.94(4.52)
	R	0.99	0.93	0.98	0.95	0.99	0.96

(Note) t-statistics against $a_0=0.0, a_1=1.0$ in parentheses

Table 5. Goodness-of-fit on the choices up to each level

Up to	level-4	level-3	level-2	level-1
a_0	2.216(0.74)	6.113(0.86)	0.142(0.02)	-1.922(0.32)
a_1	0.959(1.07)	0.943(1.24)	0.987(0.28)	0.989(0.32)
R	0.992	0.988	0.990	0.994

(Note) t-statistics against $a_0=0.0, a_1=1.0$ in parentheses

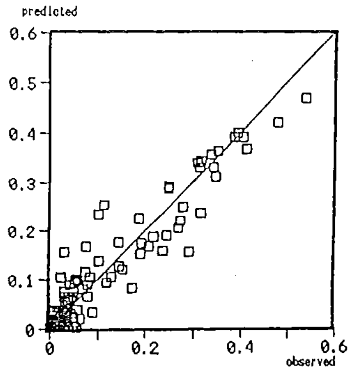

Figure 5. The relationship between predicted and observed choice probabilities

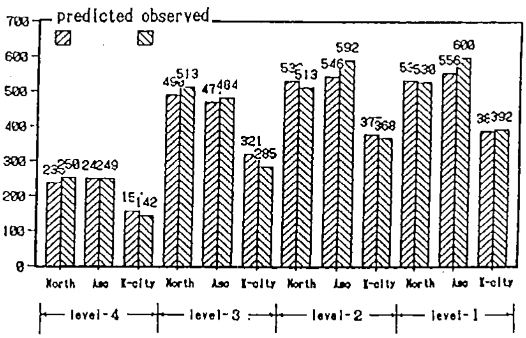

Figure 6. The relationship between predicted and observed total number of guests up to each level

5. CONCLUSION REMARKS

In this paper, it was found that ;
(1) the sightseeing excursion patterns shift from piston type to excursion ones.
(2) Factors like origin, the number of lodging days and so on affect the excursion patterns. I have to regard a sightseeing behaviour as a excursion behaviour and introduce them into a sightseeing excursion travel demands forecasting model.
(3) I develop a model which can quantify the integrated attraction of a certain sightseeing area. It could be assumed to consist of the attraction by both quantity and quality of its own sightseeing resources and the attraction which a traveller expects to get from the other sightseeing areas where he can visit next from the present area.
(4) I propose a time-space choice tree whose branches explicitly explain time. Using this tree, I can formulate a forecasting model on sightseeing excursion demands as a sequential nested logit model.
(5) I apply this model to a sightseeing demands forecasting procedure. The goodness-of-fit for the proposed model is high. In consequence, this model is sufficiently available to the sightseeing excursion demands forecasting.

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