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## **Sensitivity Analysis of the Questionnaire about Japanese Consumers**

**Shigeo KURODA**

It is said that one of the most important strategies in Japanese businesses is regional (area) marketing, because Japan is a small island chain but extending a great distance from north to south. Furthermore, the preferences and tastes of people from one region to another are rather different. On culture and history, for instance, people in Hokkaido Prefecture, located in far northern Japan, are considerably different from people in Okinawa prefecture, located in far southern Japan.

Recently, I unearthed some findings on these problems from analyses based on survey results. Two of them are presented in this paper. One is the differences of consumer attitude among seven districts in Japan. The other is the sensitivity analyses about the respondents' partiality as revealed in answers to questions in the questionnaire.

In this paper especially, I would like to emphasize the following results: The questions which cause the respondents' partiality are very important, for they are the bases for differences among the respondents from the various districts.

### **1. Introduction**

This paper investigates consumer sensitivity and behavior in seven different districts of Japan. The characteristics of the commercial system; (numbers, types, and sizes of retailers and so on) in those districts could influence their citizens. Results of the investigation are compared to demonstrate the significance of each of the commercial systems.

### **2. Districts and Methods for Analysis**

As for the above problems, Kuroda (1982) presented the following findings:

The investigated districts are Sapporo in Hokkaido (Dec. 1979 & Dec. 1981), Ebetsu in Hokkaido (Nov. 1982), Hakodate in Hokkaido (Oct. 1983), Hirosaki in Aomori Prefecture (Nov. 1981 & Nov. 1984), Narashino in Chiba Prefecture (Nov. 1979), Nagano in Nagano Prefecture (Aug. 1980), and Ohita in Ohita Prefecture (Nov. 1979). The investigations in Sapporo and Hirosaki were conducted twice.

The methods for research were random and judgement sampling based on a

Table 1-1. Comparison by Consumer Group among Districts

		consumer group				Total
		A	B	AB	O	
(1) Sapporo (1979)	No. <sup>a</sup>	67	47	24	57	195
	% <sup>b</sup>	34.4	24.1	12.3	29.2	100.0
(2) Narashino	No. <sup>a</sup>	51	49	51	52	203
	% <sup>b</sup>	25.1	24.1	25.1	25.6	100.0
(3) Ōita	No. <sup>a</sup>	40	45	39	74	198
	% <sup>b</sup>	20.2	22.7	19.7	37.4	100.0
(4) Nagano	No. <sup>a</sup>	68	28	44	67	207
	% <sup>b</sup>	32.9	13.5	21.3	32.4	100.0
(5) Sapporo (1981)	No. <sup>a</sup>	73	41	27	60	201
	% <sup>b</sup>	36.3	20.4	13.4	29.9	100.0
(6) Hirosaki	No. <sup>a</sup>	56	36	71	29	192
	% <sup>b</sup>	29.2	18.8	37.0	15.1	100.0
(7) Ebetsu	No. <sup>a</sup>	62	46	49	44	201
	% <sup>b</sup>	30.8	22.9	24.4	21.9	100.0
(8) Hakodate	No. <sup>a</sup>	45	39	42	58	184
	% <sup>b</sup>	24.5	21.2	22.8	31.5	100.0

<sup>a</sup>: Sample size by consumer group in a district.

<sup>b</sup>: ratio of No. to total in the district.

Table 1-2a. Test of Difference between Ratios

		5%		1.96	
		A	B	AB	O
Sapporo (1979) &	Narashino	×	○	×	○
	Ōita	×	○	×	○
	Nagano	○	×	×	○
	Sapporo (1981)	○	○	○	○
	Hirosaki	○	○	×	×
	Ebetsu	○	○	×	○
	Hakodate	×	○	×	○
Narashino &	Ōita	○	○	○	×
	Nagano	○	×	○	○
	Sapporo (1981)	×	○	×	○
	Hirosaki	○	○	×	×
	Ebetsu	○	○	○	○
	Hakodate	○	○	○	○
Ōita &	Nagano	×	×	○	○
	Sapporo (1981)	×	○	○	○
	Hirosaki	×	○	×	×
	Ebetsu	×	○	○	×
	Hakodate	○	○	○	○
Nagano &	Sapporo (1981)	○	○	×	○
	Hirosaki	○	○	×	×
	Ebetsu	○	×	○	×
	Hakodate	○	×	○	○
Sapporo (1981) &	Hirosaki	○	○	×	×
	Ebetsu	○	○	×	○
	Hakodate	×	○	×	○
Hirosaki &	Ebetsu	○	○	×	○
	Hakodate	○	○	×	×
Ebetsu &	Hakodate	○	○	○	×

○: no difference between two districts.

×: have a difference between two districts.

Table 1-2b. Test of Difference between Ratios

	1% 2.576			
	A	B	AB	O
Sapporo (1979) & Narashino	○	○	×	○
Ôita	×	○	○	○
Nagano	○	×	○	○
Sapporo (1981)	○	○	○	○
Hirosaki	○	○	×	×
Ebetsu	○	○	×	○
Hakodate	○	○	×	○
Narashino & Ôita	○	○	○	○
Nagano	○	×	○	○
Sapporo (1981)	○	○	×	○
Hirosaki	○	○	○	×
Ebetsu	○	○	○	○
Hakodate	○	○	○	○
Ôita & Nagano	×	○	○	○
Sapporo (1981)	×	○	○	○
Hirosaki	○	○	×	×
Ebetsu	○	○	○	×
Hakodate	○	○	○	○
Nagano & Sapporo (1981)	○	○	○	○
Hirosaki	○	○	×	×
Ebetsu	○	○	○	○
Hakodate	○	○	○	○
Sapporo (1981) & Hirosaki	○	○	×	×
Ebetsu	○	○	×	○
Hakodate	○	○	○	○
Hirosaki & Ebetsu	○	○	×	○
Hakodate	○	○	×	×
Ebetsu & Hakodate	○	○	○	○

○ : no difference between two districts.

× : have a difference between two districts.

Table 2-1. Comparison by Consumer Group among Districts  
— Except 3 Questions, (6), (10), (14) —

		A°	B°	AB°	O°	Total
(1) Sapporo (1979)	No. %	53 27.2	45 23.1	41 21.0	56 28.7	195 100.0
(2) Narashino	No. %	54 26.6	48 23.6	49 24.1	52 25.6	203 100.0
(3) Ôita	No. %	55 27.8	47 23.7	46 23.2	50 25.3	198 100.0
(4) Nagano	No. %	57 27.5	41 19.8	50 24.2	59 28.5	207 100.0
(5) Sapporo (1981)	No. %	51 25.4	49 24.4	43 21.4	58 28.9	201 100.0
(6) Hirosaki	No. %	58 30.2	47 24.5	48 25.0	39 20.3	192 100.0
(7) Ebetsu	No. %	57 28.4	51 25.4	45 22.4	48 23.9	201 100.0
(8) Hakodate	No. %	60 32.6	45 24.5	37 20.1	42 22.8	184 100.0

Table 2-2a. Test of Difference between Ratios

	5%		1.96	
	A°	B°	AB°	O°
Sapporo (1979) & Narashino	○	○	○	○
Ôita	○	○	○	○
Nagano	○	○	○	○
Sapporo (1981)	○	○	○	○
Hirosaki	○	○	○	○
Ebetsu	○	○	○	○
Hakodate	○	○	○	○
Narashino & Ôita	○	○	○	○
Nagano	○	○	○	○
Sapporo (1981)	○	○	○	○
Hirosaki	○	○	○	○
Ebetsu	○	○	○	○
Hakodate	○	○	○	○
Ôita & Nagano	○	○	○	○
Sapporo (1981)	○	○	○	○
Hirosaki	○	○	○	○
Ebetsu	○	○	○	○
Hakodate	○	○	○	○
Nagano & Sapporo (1981)	○	○	○	○
Hirosaki	○	○	○	○
Ebetsu	○	○	○	○
Hakodate	○	○	○	○
Sapporo (1981) & Hirosaki	○	○	○	×
Ebetsu	○	○	○	○
Hakodate	○	○	○	○
Hirosaki & Ebetsu	○	○	○	○
Hakodate	○	○	○	○
Ebetsu & Hakodate	○	○	○	○

○ : no difference between two districts.

× : have a difference between two districts.

questionnaire. Consumers in each of the districts were divided into four groups (A, B, AB, and O) using quantification theory III. The analysis of A in Sapporo, for example, is compared with that of the same group in Narashino.

Table 1-1, 1-2a, and 1-2b summarize the research results. These tables indicate that consumers' attitude and behavior are significantly different in each district. In the event that questions (6), (10), and (14) of the questionnaire are excluded, however (See Table 2-1, 2-2a, and 2-2b), there is no difference in the attitude and the behavior among the districts.

The factors differentiating consumers' attitudes and behaviors among the seven districts are found in their family configuration, occupations, ages, incomes, whether they have a car, etc. Social and natural environmental differences in the districts are not considered. The research we did this time, however, did not indicate such differences.

Other factors relate to how well qualified the interviewers are, in what way the questionnaire is given, and differences between the results of the random sam-

Table 2-2b. Test of Difference between Ratios

	1%		2.576	
	A°	B°	AB°	O°
Sapporo (1979) & Narashino	○	○	○	○
Ôita	○	○	○	○
Nagano	○	○	○	○
Sapporo (1981)	○	○	○	○
Hirosaki	○	○	○	○
Ebetsu	○	○	○	○
Hakodate	○	○	○	○
Narashino & Ôita	○	○	○	○
Nagano	○	○	○	○
Sapporo (1981)	○	○	○	○
Hirosaki	○	○	○	○
Ebetsu	○	○	○	○
Hakodate	○	○	○	○
Ôita & Nagano	○	○	○	○
Sapporo (1981)	○	○	○	○
Hirosaki	○	○	○	○
Ebetsu	○	○	○	○
Hakodate	○	○	○	○
Nagano & Sapporo (1981)	○	○	○	○
Hirosaki	○	○	○	○
Ebetsu	○	○	○	○
Hakodate	○	○	○	○
Sapporo (1981) & Hirosaki	○	○	○	○
Ebetsu	○	○	○	○
Hakodate	○	○	○	○
Hirosaki & Ebetsu	○	○	○	○
Hakodate	○	○	○	○
Ebetsu & Hakodate	○	○	○	○

○ : no difference between two districts.

× : have a difference between two districts.

pling and of the judgement sampling.

This paper explains Table 2-2a and 2-2b based on an analysis of the questionnaire, as follows:

- (a) Comparisons by consumer type among the districts after excluding questions in which the answers indicate some differences from one district to another (See Table 3).
- (b) Comparisons by consumer type among the districts after excluding questions in which the answers indicate some great difference in each of the districts.

In comparisons of (a), differences of consumer image among the districts remain unchanged. But (b) does not indicate any variation because of the exclusion of questions (6), (10), and (14). These questions are the causes of differences in consumer image among the districts. They are called the 'variation in sensitivity due to the three questions' discussed in this paper.

Table 3. Results of Response by Items (four districts)

Item 1	Category (1)		Category (2)	
	Freq.	%	Freq.	%
Sapporo	89	45.6	106	54.4
Narashino	75	36.9	128	63.1
Ôita	89	44.9	109	55.1
Nagano	88	42.9	117	57.1

Item 2	(1)		(2)	
	freq.	%	freq.	%
Sapporo	80	41.2	114	58.8
Narashino	87	43.1	115	56.9
Ôita	93	47.0	105	53.0
Nagano	85	41.1	122	58.9

Item 3	(1)		(2)	
	freq.	%	freq.	%
Sapporo	109	55.9	86	44.1
Narashino	95	47.0	107	53.0
Ôita	95	48.0	103	52.0
Nagano	94	45.4	110	54.6

Item 4	(1)		(2)	
	freq.	%	freq.	%
Sapporo	106	54.6	88	45.4
Narashino	112	55.2	91	44.8
Ôita	106	53.5	92	46.5
Nagano	126	61.5	79	38.5

Item 5	(1)		(2)	
	freq.	%	freq.	%
Sapporo	94	48.5	100	51.5
Narashino	84	41.4	119	58.6
Ôita	112	56.6	86	43.4
Nagano	92	44.9	113	55.1

Item 6	(1)		(2)	
	freq.	%	freq.	%
Sapporo	49	25.1	146	74.9
Narashino	44	21.7	159	78.3
Ôita	71	36.0	126	64.0
Nagano	46	22.3	160	77.7

Item 7	(1)		(2)	
	freq.	%	freq.	%
Sapporo	57	29.5	136	70.5
Narashino	79	38.9	124	61.1
Ôita	55	27.9	142	72.1
Nagano	53	25.7	153	74.3

Item 8	(1)		(2)	
	freq.	%	freq.	%
Sapporo	81	42.0	112	58.0
Narashino	99	49.0	103	51.0
Ôita	77	39.7	117	60.3
Nagano	72	35.0	134	65.0

Item 9	(1)		(2)	
	Freq.	%	Freq.	%
Sapporo	85	43.8	109	56.2
Narashino	97	47.8	106	52.2
Ôita	93	47.2	104	52.8
Nagano	84	40.8	122	59.2

Item 10	(1)		(2)	
	freq.	%	freq.	%
Sapporo	45	23.2	149	76.8
Narashino	34	17.0	166	83.0
Ôita	32	16.2	165	83.8
Nagano	35	17.1	170	82.9

Item 11	(1)		(2)	
	freq.	%	freq.	%
Sapporo	80	41.0	115	59.0
Narashino	73	36.0	130	64.0
Ôita	87	44.4	109	55.6
Nagano	73	35.3	134	64.7

Item 12	(1)		(2)	
	freq.	%	freq.	%
Sapporo	98	50.3	97	49.7
Narashino	99	49.3	102	50.7
Ôita	98	50.0	98	50.0
Nagano	96	47.3	107	52.7

Item 13	(1)		(2)	
	freq.	%	freq.	%
Sapporo	69	35.8	124	64.2
Narashino	90	44.3	113	55.7
Ôita	78	39.6	119	60.4
Nagano	69	33.3	138	66.7

Item 14	(1)		(2)	
	freq.	%	freq.	%
Sapporo	6	3.1	189	96.9
Narashino	10	4.9	193	95.1
Ôita	10	5.1	187	94.9
Nagano	5	2.4	201	97.6

Item 15	(1)		(2)	
	freq.	%	freq.	%
Sapporo	135	70.3	57	29.7
Narashino	150	73.9	53	26.1
Ôita	138	69.7	60	30.3
Nagano	154	74.4	53	25.6

Item 16	(1)		(2)	
	freq.	%	freq.	%
Sapporo	105	53.8	90	46.2
Narashino	99	49.3	102	50.7
Ôita	70	35.9	125	64.1
Nagano	84	41.0	121	59.0

**3. Variation in Sensitivity due to Questions (6), (10), and (14)**

The main problems about the variation in sensitivity due to the three questions are:

- 1) A different dimension exists between comparisons after excluding the three questions and before excluding them.
- 2) Other questions after excluding the questions whose answer indicate some great differences do not particularly show the characteristics of each district.
- 3) Researchers use the method of the possibly-biased 'distance matrix' when they categorize consumers and their answers to the questionnaire.
- 4) We sometimes used random and sometimes judgement samplings presented as to whether two different methods affect the results of the analysis.

To understand the above problems, it would be necessary to analyze the sensitivity by means of computational statistics.

**4. Quantification Method III**

It is possible to categorize the respondents by the quantification method III (Hayashi, 1975).

Table 4. A Pattern of the Respondents' Mark

items	(1)		(2)		.....	(15)		(16)		Respondent's Score{ $x_i$ }	
	①	②	①	②		①	②	①	②		
Categories	1	2	3	4		29	30	31	32		
Respondents	Category's Numbers										
1		✓	✓				✓		✓	$x_1$	
2		✓		✓				✓	✓	$x_2$	
3			✓		✓		✓		✓	$x_3$	
⋮										⋮	
$n$		✓	✓				✓		✓	$x_n$	
Category's Score{ $y_j$ }		$y_1$	$y_2$	$y_3$	$y_4$	.....	$y_{29}$	$y_{30}$	$y_{31}$	$y_{32}$	

Suppose Table 4 is one pattern of the respondents' mark necessary to rearrange the rank and the file so as to cluster on or near the diagonal line.

Respondent  $i$  has Score  $x_i$ .

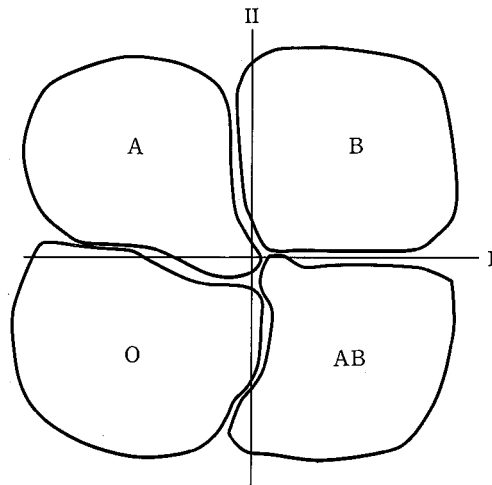
Item Category  $j$  has Score  $y_j$ .

Respondents of similar sensitivity are given  $x$ .

Item categories in a similar pattern are given  $y$ .



Fig. 1. Clusters of Item Categories Classified



When respondent  $i$  picked category  $j$ , we have  $(x_i, y_j)$ .  $\{x_k, y_k\}$ , one of the pair  $\{x_i, y_j\}$ , could make the coefficient of correlation,  $r$ , greatest in relation to score  $x_i$  and  $y_j$ . Item categories and respondents are classified in Fig. 1.

### 5. Results of the Sensitivity Analysis

If we exclude the three questions, we have a new classification of item categories and respondents in Fig. 2. In this case, the important point of sensitivity analysis is that it can check the relative importance of categories (Tanaka, 1983), and allow for analysis from two points of view.

(A) How do the category scores move when we change the weight of a specific item category or exclude it (See  $m \rightarrow m'$  in Fig. 3)?

Fig. 2. New Clusters of Item Categories Except 3 Questions

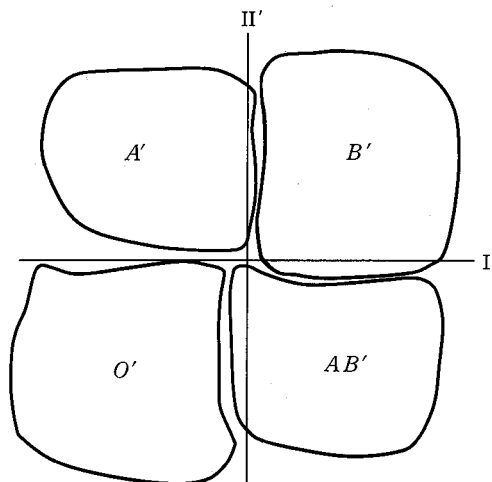
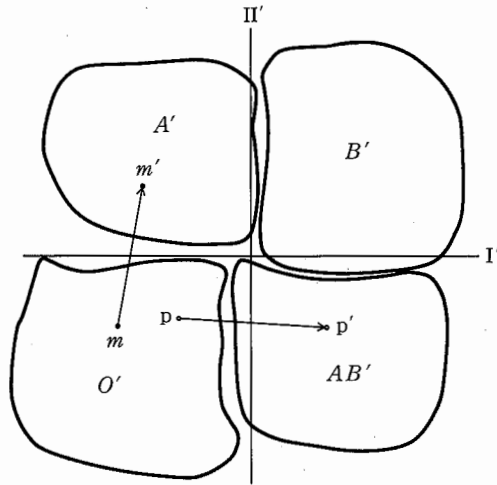


Fig. 3. Transition of Each Category( $m$ ) and Each Respondent( $p$ )

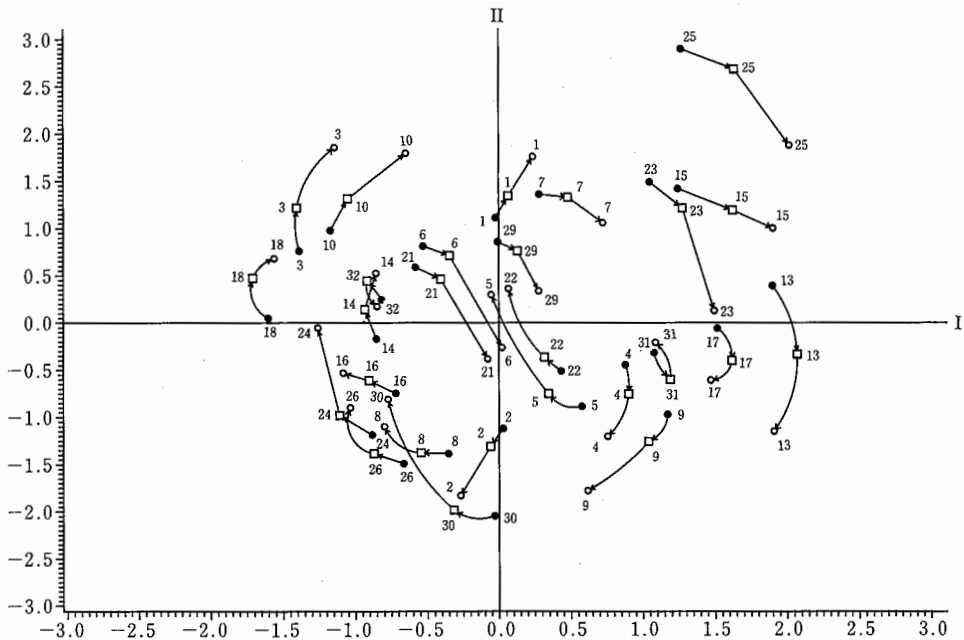


(B) (A) could change the Respondents' Score (See  $p \rightarrow p'$  in Fig. 3). As a result, how do respondents' scores change?

Firstly, we will try (A) to change the weight of the item categories (6), (10), and (14), showing partiality of the item categories (See Fig. 4-1, 4-2, and 4-3).

When the weight of all item categories=1, it will be shown by dot (●).

Fig. 4-1. Sapporo (categories)<sup>1)</sup>



1) The numbers in this figure match category's numbers in Table 4.

When the weight of item categories (6), (10), and (14)=0.7 (namely  $e=0.3$ ), it will be shown by (□). When the weight of item categories (6), (10), and (14)=0 ( $e=1$ ), it will be shown by (○). Then we will have the following

Fig. 4-2. Hirosaki (categories)

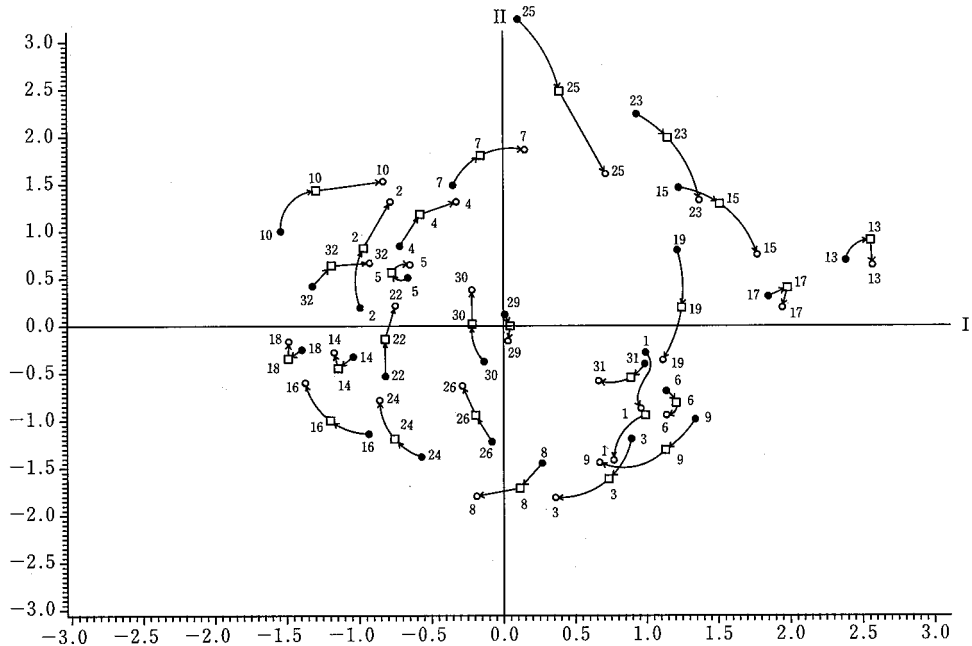
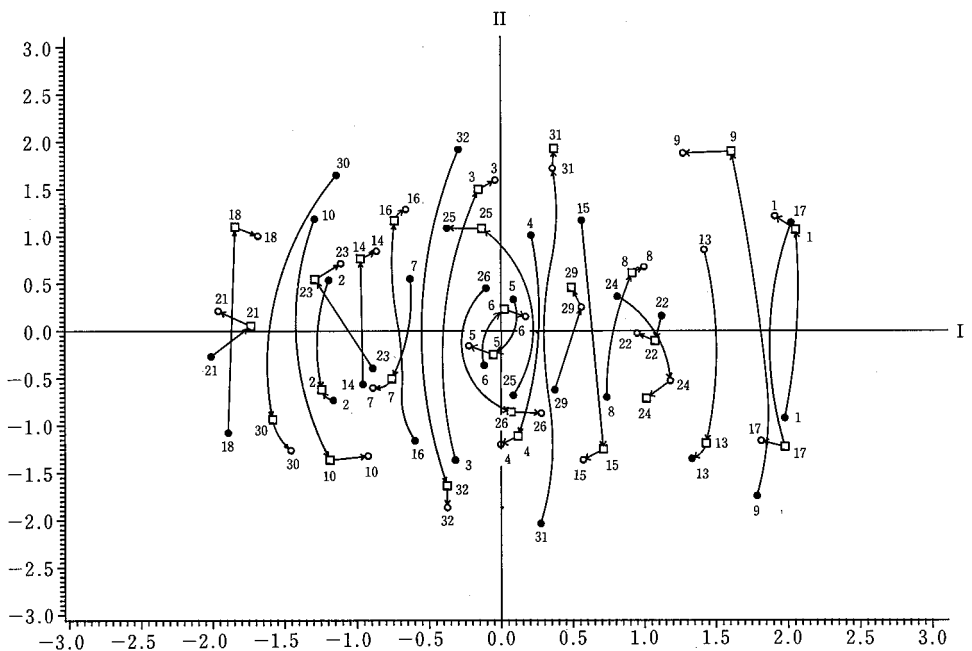


Fig. 4-3. Narashino (categories)



results :

At Sapporo and Hirosaki, the categories move clockwise.

At Narashino, the categories move up and down.

Fig. 4-1'. Sapporo (categories)

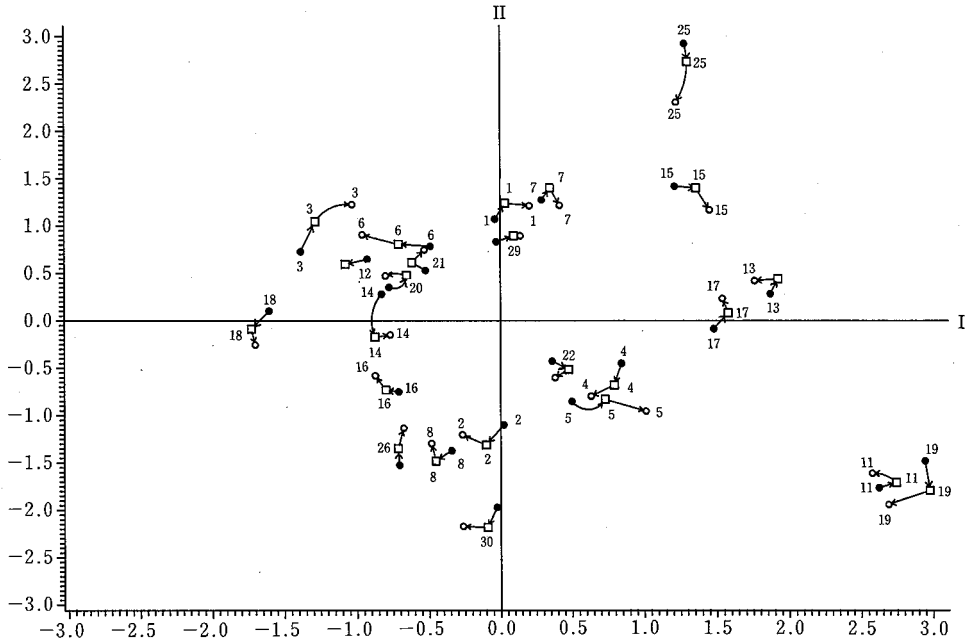
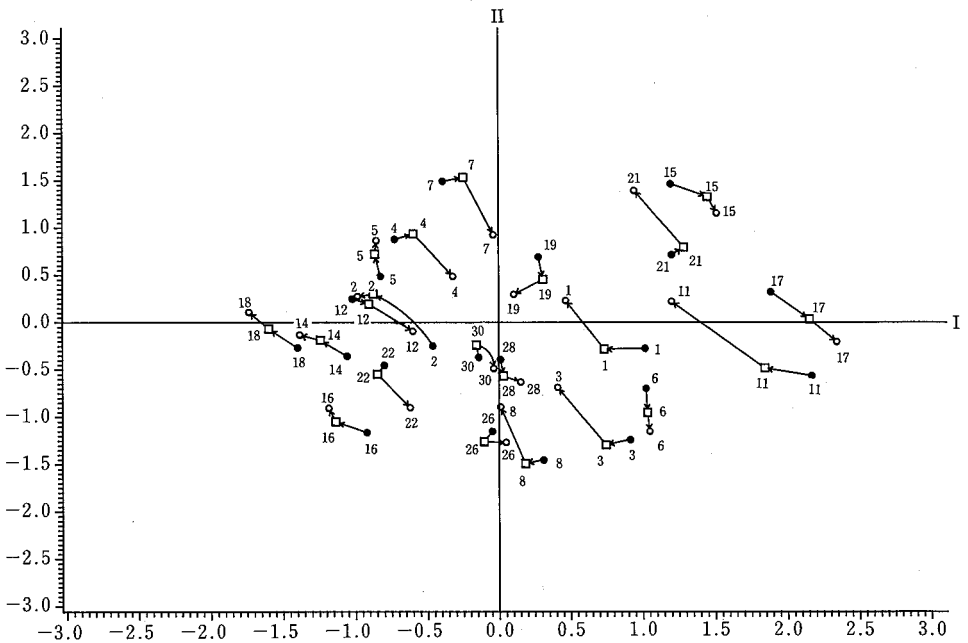


Fig. 4-2'. Hirosaki (categories)



On the other hand, we will also change the weight of item categories (5), (12), and (16), showing no partiality (See Fig. 4-1', 4-2', and 4-3').

When the weight of all item categories=1, it will be shown by dot (●).

Fig. 4-3'. Narashino (categories)

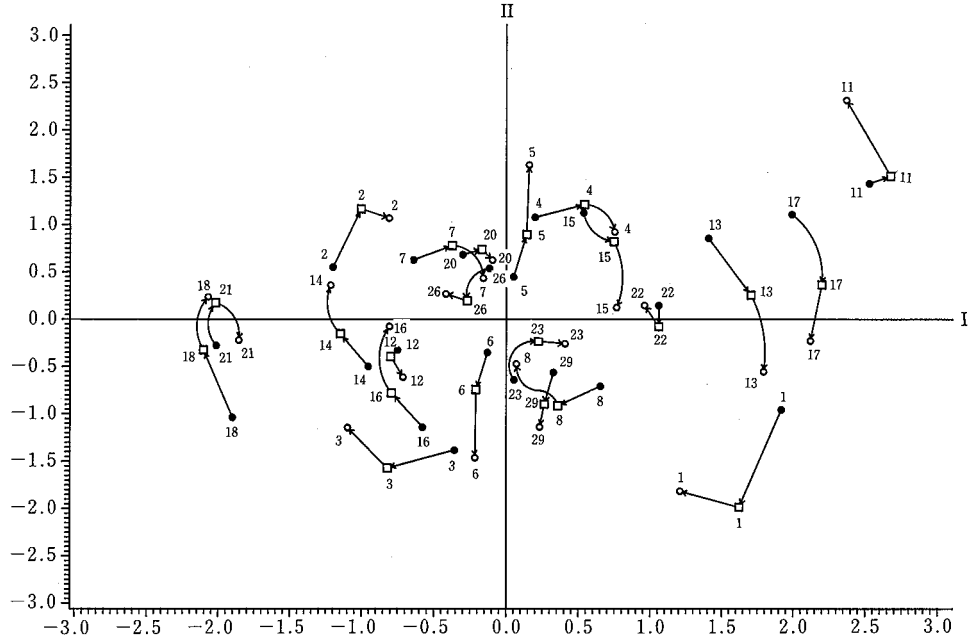
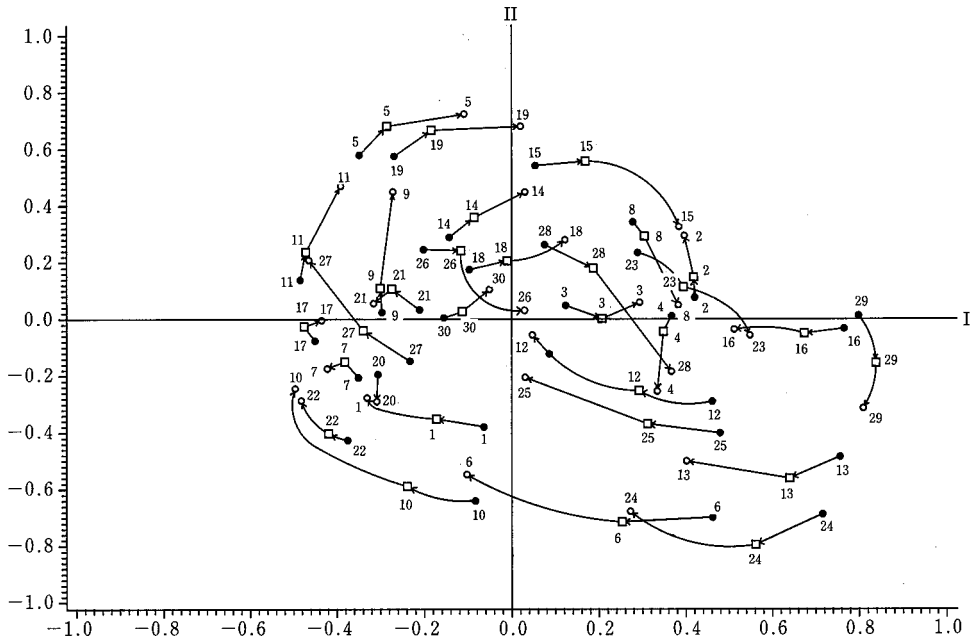


Fig. 5-1. Sapporo (respondents)<sup>2)</sup>



2) The numbers in this figure match 30 of all respondents in Sapporo.

When the weight of item categories (5), (12), and (16)=0.7 ( $e=0.3$ ), it will be shown by (□). When the weight of all item categories=0 ( $e=1$ ), it will be shown by (○).

These experiments show that (5), (12), and (16) do not have as much

Fig. 5-2. Hirosaki (respondents)

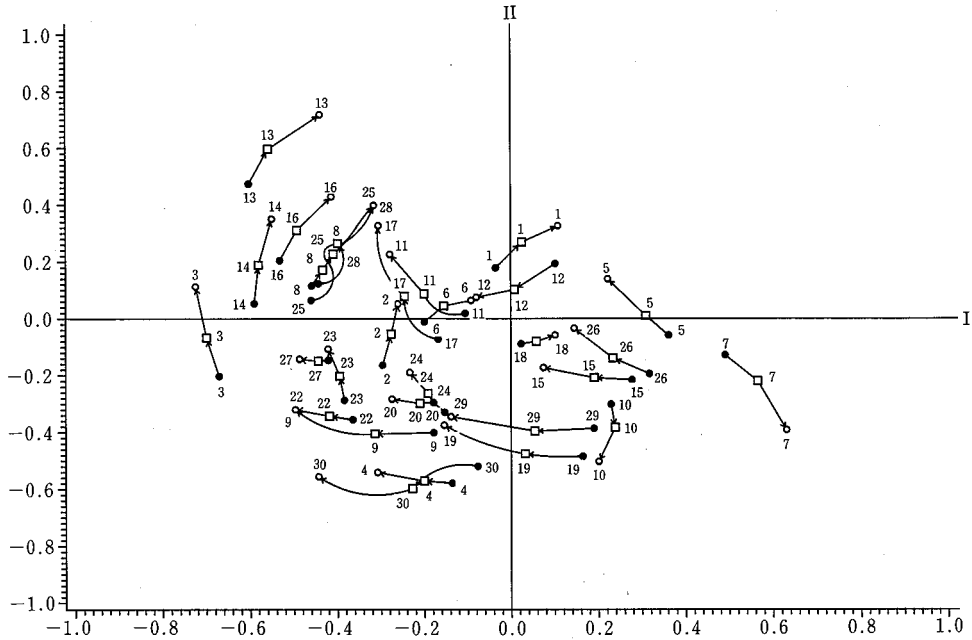
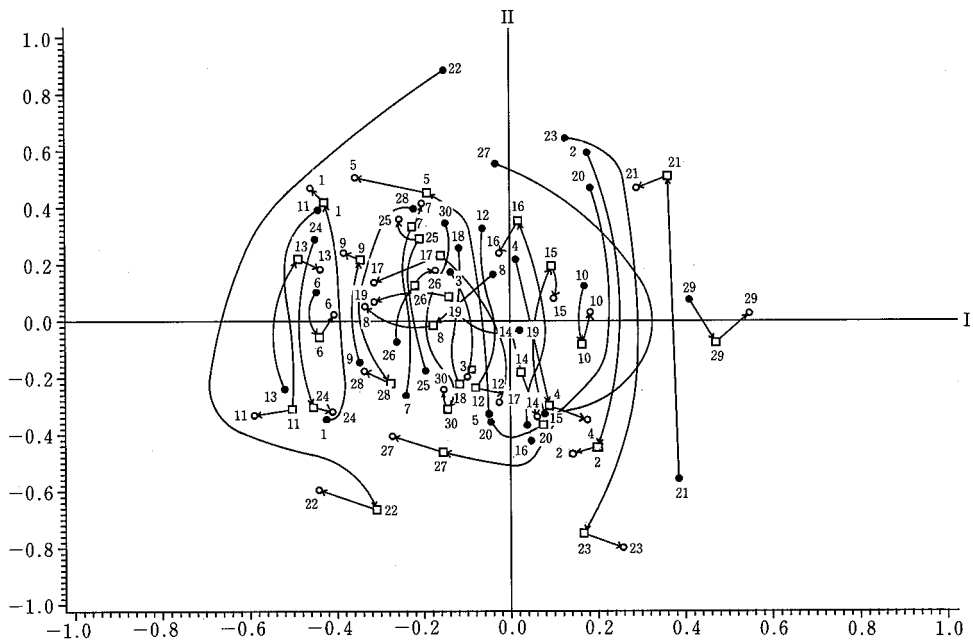


Fig. 5-3. Narashino (respondents)



influence on the results as (6), (10), and (14).

Secondly, we observe the respondents' score when the weight of the respondents change ( $e=0$ ,  $e=0.7$ ,  $e=1$ ).

The analyses of (B) are shown in Fig. 5-1, 5-2, and 5-3, and in Fig. 5-1',

Fig. 5-1'. Sapporo (respondents)

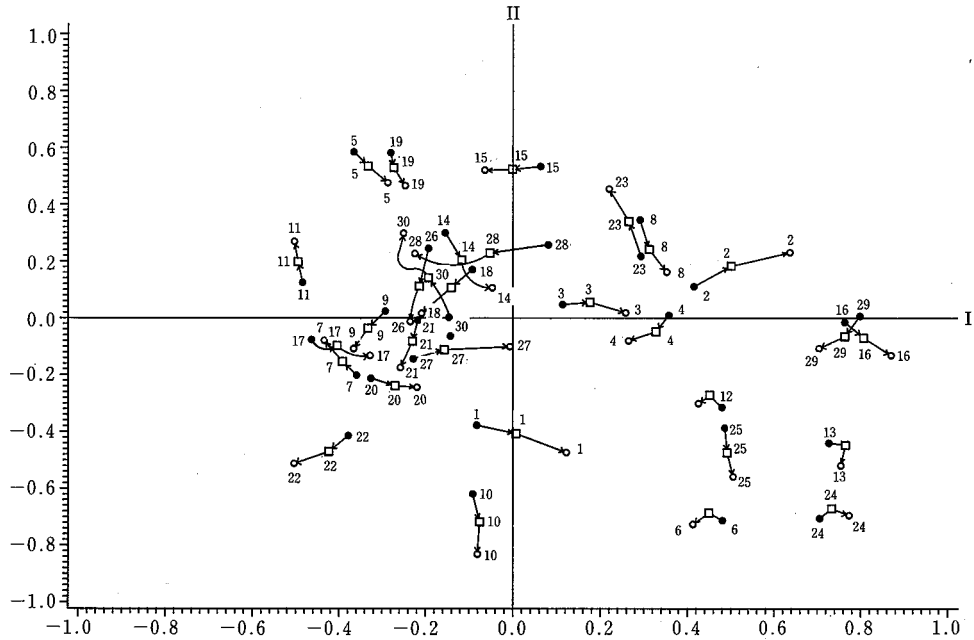


Fig. 5-2'. Hirosaki (respondents)

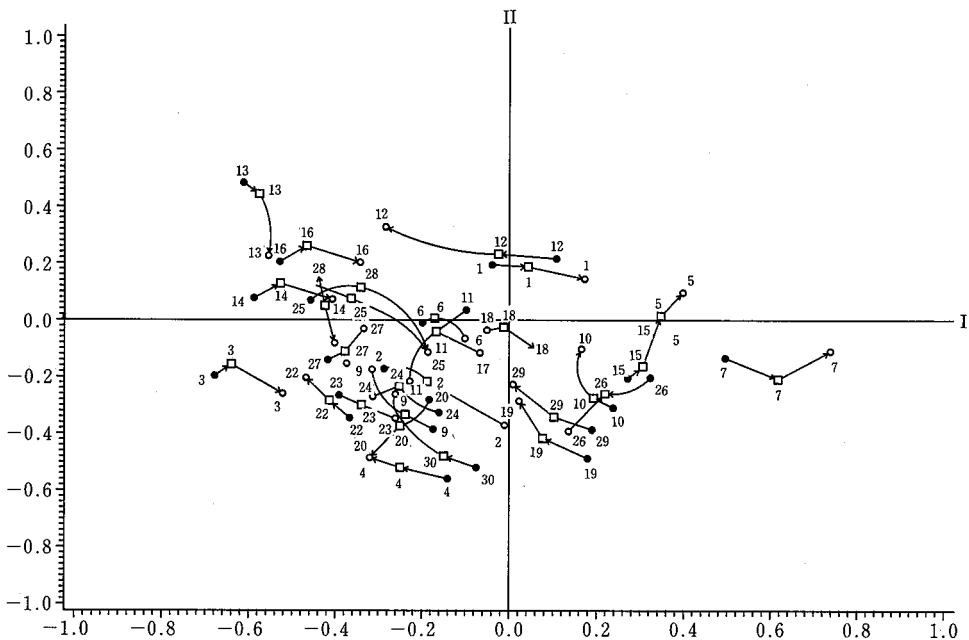
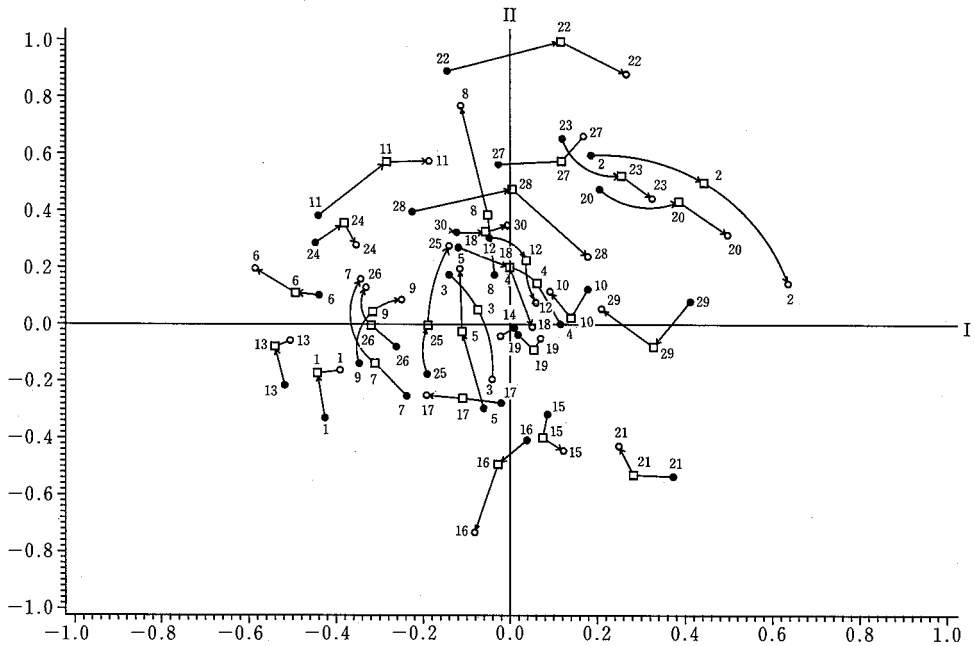


Fig. 5-3'. Narashino (respondents)



5-2' and 5-3'. These also show that Questions (6), (10), and (14) greatly influence the respondents' (consumers') score.

## 6. Other Problems with Regard to the Relative Importance of Items in the Questionnaire

Nowadays, methods involving analysis of the questionnaire (such as a good-poor analysis) and analysis of criteria are controversial.

Sensitivity analysis in this paper gives the following results: The questions which cause the respondents' partiality are very important, for they are the origin of differences among respondents in the districts. One problem to be examined is the method of discerning the relation between 'partiality in the answers' and 'categories/respondents' while considering changes in the weight of other questions.

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### Questionnaire

1. When you buy a commercial item :
  - (1) Do you get pamphlets to compare one item with others?
  - (2) Do you go directly to a shop and decide which to buy?
2. When you buy daily necessities :
  - (1) Do you get pamphlets to compare one item with others?
  - (2) Do you go directly to a shop and decide which to buy?



3. When you buy an electric appliance :
  - (1) Do you decide alone which one to buy ?
  - (2) Do you ask your friends' or sales clerks' advice ?
4. How do you form friendships ?
  - (1) I wish to socialize with as many people as possible.
  - (2) I prefer making close relationships with a limited number of people.
5. When do you buy durable consumer goods, to which shop do you go ?
  - (1) A well-known shop.
  - (2) Any shop.
6. Which do you prefer buying ?
  - (1) Things of top quality.
  - (2) Ordinary things.
7. When you have found something you want :
  - (1) I buy it immediately.
  - (2) I think about buying it and not spending.
8. When you have encountered financial difficulty although you wish to buy a house :
  - (1) Do you give up the plan ?
  - (2) Do you still continue the plan ?
9. When you have holidays and money :
  - (1) Do you prefer traveling ?
  - (2) Do you prefer relaxing at home ?
10. Which do you prefer obtaining ?
  - (1) Higher social status.
  - (2) Wealth rather than a good salary.
11. In your free time, what do you do ?
  - (1) Watch T. V.
  - (2) Do what you have wanted to do.
12. What do you think of your standard of living now compared with that of one year ago ?
  - (1) I think I am better off.
  - (2) I think I am worse off.
13. What are your expectations of your standard of living in five years time ?
  - (1) I think I will be better off.
  - (2) I think I will be rather worse off.
14. What do you think consumer goods' prices will be within five years ?
  - (1) I think they will become stable.
  - (2) I think they will rise.
15. What do you think of a large-scale store recently built ?
  - (1) I think it is favourable, because it is lively and a convenient place to shop.
  - (2) I think it is unfavourable, because it has become crowded with more people and cars.
16. Do you think where you live has specific local characteristics ?
  - (1) Yes, I do.
  - (2) No, not at all.

## References

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