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Consumers' Activities for Brand Selection — Questionnaire Investigation to Automobile Purchasing Case—

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Abstract

Consumers often buy higher ranked brand after they are bored using current brand goods. This may be analyzed utilizing matrix. Suppose past purchasing data are set input and current purchasing data are set output, then transition matrix is identified using past and current data. If all brand selections are composed by the upper shifts, then the transition matrix becomes an upper triangular matrix. Questionnaire investigation to automobile purchasing case is executed and above structure is confirmed. If transition matrix is identified, S-step forecasting can be executed. Generalized forecasting matrix components' equations are introduced. We have made a questionnaire investigation concern automobile purchase before (Takeyasu et al.,(2007)). In that paper, questionnaire was executed mainly on an urban area. In this paper, we make investigation on a rural area and make comparison for both of them. Planners for products need to know whether their brand is higher or lower than other products. Matrix structure makes it possible to

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ascertain this by calculating consumers' activities for brand selection. Thus, this proposed approach makes it possible to execute an effective marketing plan and/or establish a new brand.

Keywords: brand selection, matrix structure, brand position, automobile industry

1 Introduction

It is often observed that consumers select upper class brand when they buy next time.

Suppose that former buying data and current buying data are gathered. Also suppose that upper brand is located upper in the variable array. Then transition matrix becomes upper triangular matrix under the supposition that former buying variables are set input and current buying variables are set output. If the top brand were selected from lower brand in jumping way, corresponding part in upper triangular matrix would be 0. These are verified in numerical examples with simple models.

If transition matrix is identified, S-step forecasting can be executed. Generalized forecasting matrix components' equations are introduced. Planners for products need to know whether their brand is higher or lower than other products. Matrix structure makes it possible to ascertain this by calculating consumers' activities for brand selection. Thus, this proposed approach makes it possible to execute an effective marketing plan and/or establish a new brand.

Quantitative analysis concerning brand selection has been executed by Yamanaka(1982), Takahashi et al.(2002). Yamanaka(1982) examined purchasing process by Markov Transition Probability with the input of advertising expense. Takahashi et al.(2002) made analysis by the Brand Selection Probability model using logistics distribution.

We have made a questionnaire investigation concern automobile purchase before (Takeyasu et al.,(2007)). In that paper, questionnaire was executed mainly on an urban area. In this paper, we make investigation on a rural area and make comparison for both of them. It is expected that somewhat different trend will be extracted.

Hereinafter, matrix structure is clarified for the selection of brand in section 2. Block matrix structure is analyzed when brands are handled in group and *s*-step forecasting is formulated in section 3. Questionnaire investigation to Automobile Purchasing case is examined and its Numerical calculation is executed in section 4. Application of this method is extended in section 5.

2 Brand selection and its matrix structure

(1) Upper shift of Brand selection

It is often observed that consumers select upper class brand when they buy next time.

Now, suppose that x is the most upper class brand, y is the second upper brand, and z is the lowest brand.

Consumer's behavior of selecting brand would be $z \to y$, $y \to x$, $z \to x$ etc. $x \to z$ might be few.

Suppose that x is current buying variable, and x_b is previous buying variable. Shift to x is executed from x_b, y_b, or z_b.

Therefore, x is stated in the following equation.

$$x = a_{11}x_b + a_{12}y_b + a_{13}z_b$$

Similarly,

$$y = a_{22}y_b + a_{23}z_b \quad \text{and} \quad z = a_{33}z_b$$

These are re-written as follows.

$$\begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} a_{11} & a_{12} & a_{13} \\ 0 & a_{22} & a_{23} \\ 0 & 0 & a_{33} \end{pmatrix} \begin{pmatrix} x_b \\ y_b \\ z_b \end{pmatrix} \quad (1)$$

Set

$$\mathbf{X} = \begin{pmatrix} x \\ y \\ z \end{pmatrix}$$

$$\mathbf{A} = \begin{pmatrix} a_{11} & a_{12} & a_{13} \\ 0 & a_{22} & a_{23} \\ 0 & 0 & a_{33} \end{pmatrix}$$

$$\mathbf{X_b} = \begin{pmatrix} x_b \\ y_b \\ z_b \end{pmatrix}$$

then, $\mathbf{X}$ is represented as follows.

$$\mathbf{X} = \mathbf{A}\mathbf{X_b} \quad (2)$$

Here,

$$\mathbf{X} \in \mathbf{R}^3, \mathbf{A} \in \mathbf{R}^{3\times3}, \mathbf{X_b} \in \mathbf{R}^3$$

$\mathbf{A}$ is an upper triangular matrix.

To examine this, generating following data, which are all consisted by upper brand shift data,

$$\mathbf{X^i} = \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix} \quad \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix} \quad \cdots \quad \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix} \quad (3)$$

$$\mathbf{X_b^i} = \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix} \quad \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix} \quad \cdots \quad \begin{pmatrix} 0 \\ 0 \\ 1 \end{pmatrix} \quad (4)$$

$$i = 1 \quad , \quad 2 \quad \cdots \quad N$$

parameter can be estimated using least square method.

Suppose

$$\mathbf{X}^i = \mathbf{A}\mathbf{X}_{\mathbf{b}}^i + \boldsymbol{\varepsilon}^i \tag{5}$$

and

$$J = \sum_{i=1}^{N} \boldsymbol{\varepsilon}^{iT} \boldsymbol{\varepsilon}^i \rightarrow Min \tag{6}$$

$\hat{\mathbf{A}}$ which is an estimated value of $\mathbf{A}$ is obtained as follows.

$$\hat{\mathbf{A}} = \left(\sum_{i=1}^{N} \mathbf{X}_{\mathbf{b}}^i \mathbf{X}_{\mathbf{b}}^{iT} \right)^{-1} \left(\sum_{i=1}^{N} \mathbf{X}^i \mathbf{X}_{\mathbf{b}}^{iT} \right) \tag{7}$$

In the data group of upper shift brand, estimated value $\hat{\mathbf{A}}$ should be upper triangular matrix.

If following data that have lower shift brand are added only a few in equation (3) and (4),

$$\mathbf{X}^i = \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix}$$

$$\mathbf{X}_{\mathbf{b}}^i = \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix}$$

$\hat{\mathbf{A}}$ would contain minute items in the lower part triangle.

(2) Sorting brand ranking by re-arranging row

In a general data, variables may not be in order as x, y, z. In that case, large and small value lie scattered in $\hat{\mathbf{A}}$. But re-arranging this, we can set in order by shifting row. The large value parts are gathered in upper triangular matrix, and the small value parts are gathered in lower triangular matrix.

$$\begin{pmatrix} x \\ y \\ z \end{pmatrix} \overset{\hat{\mathbf{A}}}{\begin{pmatrix} \bigcirc & \bigcirc & \bigcirc \\ \varepsilon & \bigcirc & \bigcirc \\ \varepsilon & \varepsilon & \bigcirc \end{pmatrix}} \quad \xLeftarrow{\text{Shifting row}} \quad \begin{pmatrix} z \\ x \\ y \end{pmatrix} \overset{\hat{\mathbf{A}}}{\begin{pmatrix} \varepsilon & \varepsilon & \bigcirc \\ \bigcirc & \bigcirc & \bigcirc \\ \varepsilon & \bigcirc & \bigcirc \end{pmatrix}} \tag{8}$$

(3) In the case that brand selection shifts in jump

It is often observed that some consumers select the most upper class brand from the most lower class brand and skip selecting the middle class brand.

We suppose v, w, x, y, z brands (suppose they are laid from upper position to lower position as $v > w > x > y > z$).

In the above case, selection shifts would be

$$v \leftarrow z$$
$$v \leftarrow y$$

Suppose they do not shift to y, x, w from z, to x, w from y, and to w from x, then Matrix structure would be as follows.

$$\begin{pmatrix} v \\ w \\ x \\ y \\ z \end{pmatrix} = \begin{pmatrix} a_{11} & a_{12} & a_{13} & a_{14} & a_{15} \\ 0 & a_{22} & 0 & 0 & 0 \\ 0 & 0 & a_{33} & 0 & 0 \\ 0 & 0 & 0 & a_{44} & 0 \\ 0 & 0 & 0 & 0 & a_{55} \end{pmatrix} \begin{pmatrix} v_b \\ w_b \\ x_b \\ y_b \\ z_b \end{pmatrix} \tag{9}$$

3 Block matrix structure in brand groups and *s*-step forecasting

Next, we examine the case in brand groups. Matrices are composed by Block Matrix.

[1] Brand shift group — in the case of two groups

Suppose brand selection shifts from Corolla class to Mark Ⅱ class in car. In this case, it does not matter which company's car they choose. Thus, selection of cars are executed in a group and brand shift is considered to be done from group to group. Suppose brand groups at time n are as follows.

$\mathbf{X}$ consists of p varieties of goods, and $\mathbf{Y}$ consists of q varieties of goods.

$$\mathbf{X_n} = \begin{pmatrix} x_1^n \\ x_2^n \\ \vdots \\ x_p^n \end{pmatrix}$$

$$\mathbf{Y_n} = \begin{pmatrix} y_1^n \\ y_2^n \\ \vdots \\ y_q^n \end{pmatrix}$$

$$\begin{pmatrix} \mathbf{X_n} \\ \mathbf{Y_n} \end{pmatrix} = \begin{pmatrix} \mathbf{A_{11}}, & \mathbf{A_{12}} \\ \mathbf{0}, & \mathbf{A_{22}} \end{pmatrix} \begin{pmatrix} \mathbf{X_{n-1}} \\ \mathbf{Y_{n-1}} \end{pmatrix} \tag{10}$$

Here,

$\mathbf{X_n} \in \mathbf{R}^p \ (n = 1,2,\cdots)$, $\mathbf{Y_n} \in \mathbf{R}^q \ (n = 1,2,\cdots)$, $\mathbf{A_{11}} \in \mathbf{R}^{p \times p}$,

$\mathbf{A_{12}} \in \mathbf{R}^{p \times q}$, $\mathbf{A_{22}} \in \mathbf{R}^{q \times q}$

Make one more step of shift, then we obtain following equation.

$$\begin{pmatrix} \mathbf{X_n} \\ \mathbf{Y_n} \end{pmatrix} = \begin{pmatrix} \mathbf{A_{11}}^2, & \mathbf{A_{11}A_{12}} + \mathbf{A_{12}A_{22}} \\ \mathbf{0}, & \mathbf{A_{22}}^2 \end{pmatrix} \begin{pmatrix} \mathbf{X_{n-2}} \\ \mathbf{Y_{n-2}} \end{pmatrix} \tag{11}$$

Make one more step of shift again, then we obtain following equation.

$$\begin{pmatrix} \mathbf{X_n} \\ \mathbf{Y_n} \end{pmatrix} = \begin{pmatrix} \mathbf{A_{11}}^3, & \mathbf{A_{11}}^2\mathbf{A_{12}} + \mathbf{A_{11}A_{12}A_{22}} + \mathbf{A_{12}A_{22}}^2 \\ \mathbf{0}, & \mathbf{A_{22}}^3 \end{pmatrix} \begin{pmatrix} \mathbf{X_{n-3}} \\ \mathbf{Y_{n-3}} \end{pmatrix} \tag{12}$$

Similarly,

$$\begin{pmatrix} \mathbf{X_n} \\ \mathbf{Y_n} \end{pmatrix} = \begin{pmatrix} \mathbf{A_{11}}^4, & \mathbf{A_{11}}^3\mathbf{A_{12}} + \mathbf{A_{11}}^2\mathbf{A_{12}A_{22}} + \mathbf{A_{11}A_{12}A_{22}}^2\mathbf{A_{12}A_{22}}^3 \\ \mathbf{0}, & \mathbf{A_{22}}^4 \end{pmatrix} \begin{pmatrix} \mathbf{X_{n-4}} \\ \mathbf{Y_{n-4}} \end{pmatrix} \tag{13}$$

$$\begin{pmatrix}\mathbf{X_n}\\ \mathbf{Y_n}\end{pmatrix}= \\ =\begin{pmatrix}\mathbf{A_{11}}^5, & \mathbf{A_{11}}^4\mathbf{A_{12}}+\mathbf{A_{11}}^3\mathbf{A_{12}}\mathbf{A_{22}}+\mathbf{A_{11}}^2\mathbf{A_{12}}\mathbf{A_{22}}^2+\mathbf{A_{11}}\mathbf{A_{12}}\mathbf{A_{22}}^3+\mathbf{A_{12}}\mathbf{A_{22}}^4\\ \mathbf{0}, & \mathbf{A_{22}}^5\end{pmatrix}\begin{pmatrix}\mathbf{X_{n-5}}\\ \mathbf{Y_{n-5}}\end{pmatrix} \tag{14}$$

Finally, we get generalized equation for s-step shift as follows.

$$\begin{pmatrix}\mathbf{X_n}\\ \mathbf{Y_n}\end{pmatrix}=\begin{pmatrix}\mathbf{A_{11}}^s, & \mathbf{A_{11}}^{s-1}\mathbf{A_{12}}+\sum_{k=2}^{s-1}\mathbf{A_{11}}^{s-k}\mathbf{A_{12}}\mathbf{A_{22}}^{k-1}+\mathbf{A_{12}}\mathbf{A_{22}}^{s-1}\\ \mathbf{0}, & \mathbf{A_{22}}^s\end{pmatrix}\begin{pmatrix}\mathbf{X_{n-s}}\\ \mathbf{Y_{n-s}}\end{pmatrix} \tag{15}$$

If we replace $n-s\to n, n\to n+s$ in equation (15), we can make s-step forecast.

[2] Brand shift group — in the case of three groups

Suppose brand selection is executed in the same group or to the upper group, and also suppose that brand position is $x>y>z$ (x is upper position). Then brand selection transition matrix would be expressed as

$$\begin{pmatrix}\mathbf{X_n}\\ \mathbf{Y_n}\\ \mathbf{Z_n}\end{pmatrix}=\begin{pmatrix}\mathbf{A_{11}}, & \mathbf{A_{12}}, & \mathbf{A_{13}}\\ \mathbf{0}, & \mathbf{A_{22}}, & \mathbf{A_{23}}\\ \mathbf{0}, & \mathbf{0}, & \mathbf{A_{33}}\end{pmatrix}\begin{pmatrix}\mathbf{X_{n-1}}\\ \mathbf{Y_{n-1}}\\ \mathbf{Z_{n-1}}\end{pmatrix} \tag{16}$$

Where

$$\mathbf{X_n}=\begin{pmatrix}x_1^n\\ x_2^n\\ \vdots\\ x_p^n\end{pmatrix}\quad \mathbf{Y_n}=\begin{pmatrix}y_1^n\\ y_2^n\\ \vdots\\ y_q^n\end{pmatrix}\quad \mathbf{Z_n}=\begin{pmatrix}z_1^n\\ z_2^n\\ \vdots\\ z_r^n\end{pmatrix}$$

Here,

$\mathbf{X_n}\in\mathbf{R}^p\ (n=1,2,\cdots)$, $\mathbf{Y_n}\in\mathbf{R}^q\ (n=1,2,\cdots)$, $\mathbf{Z_n}\in\mathbf{R}^r\ (n=1,2,\cdots)$, $\mathbf{A_{11}}\in R^{p\times p}$, $\mathbf{A_{12}}\in R^{p\times q}$, $\mathbf{A_{13}}\in R^{p\times r}$, $\mathbf{A_{22}}\in R^{q\times q}$, $\mathbf{A_{23}}\in R^{q\times r}$, $\mathbf{A_{33}}\in R^{r\times r}$

These are re-stated as

$$\mathbf{W_n}=\mathbf{A}\mathbf{W_{n-1}} \tag{17}$$

where,

$$\mathbf{W_n} = \begin{pmatrix} \mathbf{X_n} \\ \mathbf{Y_n} \\ \mathbf{Z_n} \end{pmatrix}, \quad \mathbf{A} = \begin{pmatrix} \mathbf{A}_{11}, & \mathbf{A}_{12}, & \mathbf{A_{13}} \\ \mathbf{0}, & \mathbf{A}_{22}, & \mathbf{A_{23}} \\ \mathbf{0}, & \mathbf{0}, & \mathbf{A_{33}} \end{pmatrix}, \quad \mathbf{W_{n-1}} = \begin{pmatrix} \mathbf{X_{n-1}} \\ \mathbf{Y_{n-1}} \\ \mathbf{Z_{n-1}} \end{pmatrix}$$

Hereinafter, we shift steps as is done in previous section.

In the general description, we state as

$$\mathbf{W_n} = \mathbf{A^{(s)}W_{n-s}} \tag{18}$$

Here,

$$\mathbf{A^{(s)}} = \begin{pmatrix} \mathbf{A_{11}}^{(s)}, & \mathbf{A_{12}}^{(s)}, & \mathbf{A_{13}}^{(s)} \\ \mathbf{0}, & \mathbf{A_{22}}^{(s)}, & \mathbf{A_{23}}^{(s)} \\ \mathbf{0}, & \mathbf{0}, & \mathbf{A_{33}}^{(s)} \end{pmatrix},$$

$$\mathbf{W_{n-s}} = \begin{pmatrix} \mathbf{X_{n-s}} \\ \mathbf{Y_{n-s}} \\ \mathbf{Z_{n-s}} \end{pmatrix}$$

From definition,

$$\mathbf{A^{(1)}} = \mathbf{A} \tag{19}$$

In the case $s = 2$, we obtain

$$\begin{aligned} \mathbf{A}^{(2)} &= \begin{pmatrix} \mathbf{A}_{11}, & \mathbf{A}_{12}, & \mathbf{A_{13}} \\ \mathbf{0}, & \mathbf{A}_{22}, & \mathbf{A_{23}} \\ \mathbf{0}, & \mathbf{0}, & \mathbf{A_{33}} \end{pmatrix} \begin{pmatrix} \mathbf{A}_{11}, & \mathbf{A}_{12}, & \mathbf{A_{13}} \\ \mathbf{0}, & \mathbf{A}_{22}, & \mathbf{A_{23}} \\ \mathbf{0}, & \mathbf{0}, & \mathbf{A_{33}} \end{pmatrix} \\ &= \begin{pmatrix} \mathbf{A}_{11}^2, & \mathbf{A}_{11}\mathbf{A}_{12} + \mathbf{A}_{12}\mathbf{A}_{22}, & \mathbf{A}_{11}\mathbf{A}_{13} + \mathbf{A}_{12}\mathbf{A}_{23} + \mathbf{A}_{13}\mathbf{A}_{33} \\ \mathbf{0}, & \mathbf{A}_{22}^2, & \mathbf{A}_{22}\mathbf{A}_{23} + \mathbf{A}_{23}\mathbf{A}_{33} \\ \mathbf{0}, & \mathbf{0}, & \mathbf{A}_{33}^2 \end{pmatrix} \end{aligned} \tag{20}$$

Next, in the case $s = 3$, we obtain

$$\mathbf{A}^{(3)} = \begin{pmatrix} \mathbf{A}_{11}^3, & \mathbf{A}_{11}^2\mathbf{A}_{12} + \mathbf{A}_{11}\mathbf{A}_{12}\mathbf{A}_{22} + \mathbf{A}_{12}\mathbf{A}_{22}^2, & \mathbf{A}_{11}^2\mathbf{A}_{13} + \mathbf{A}_{11}\mathbf{A}_{12}\mathbf{A}_{23} + \mathbf{A}_{11}\mathbf{A}_{13}\mathbf{A}_{33} + \mathbf{A}_{12}\mathbf{A}_{22}\mathbf{A}_{23} + \mathbf{A}_{12}\mathbf{A}_{23}\mathbf{A}_{33} + \mathbf{A}_{13}\mathbf{A}_{33}^2 \\ \mathbf{0}, & \mathbf{A}_{22}^2, & \mathbf{A}_{22}^2\mathbf{A}_{23} + \mathbf{A}_{22}\mathbf{A}_{23}\mathbf{A}_{33} + \mathbf{A}_{23}\mathbf{A}_{33}^2 \\ \mathbf{0}, & \mathbf{0}, & \mathbf{A}_{33}^2 \end{pmatrix} \tag{21}$$

In the case $s = 4$, equations become wide-spread, so we express each Block

Matrix as follows.

$$\left.\begin{aligned}
&\mathbf{A}_{11}^{(4)} = \mathbf{A}_{11}^{4} \\
&\mathbf{A}_{12}^{(4)} = \mathbf{A}_{11}^{3}\mathbf{A}_{12} + \mathbf{A}_{11}^{2}\mathbf{A}_{12}\mathbf{A}_{22} + \mathbf{A}_{11}\mathbf{A}_{12}\mathbf{A}_{22}^{2} + \mathbf{A}_{12}\mathbf{A}_{22}^{3} \\
&\mathbf{A}_{13}^{(4)} = \mathbf{A}_{11}^{3}\mathbf{A}_{13} + \mathbf{A}_{11}^{2}\mathbf{A}_{12}\mathbf{A}_{23} + \mathbf{A}_{11}^{2}\mathbf{A}_{13}\mathbf{A}_{33} + \mathbf{A}_{11}\mathbf{A}_{12}\mathbf{A}_{22}\mathbf{A}_{23} + \mathbf{A}_{11}\mathbf{A}_{12}\mathbf{A}_{23}\mathbf{A}_{33} + \mathbf{A}_{11}\mathbf{A}_{13}\mathbf{A}_{33}^{2} \\
&\qquad + \mathbf{A}_{12}\mathbf{A}_{22}^{2}\mathbf{A}_{23} + \mathbf{A}_{12}\mathbf{A}_{22}\mathbf{A}_{23}\mathbf{A}_{33} + \mathbf{A}_{12}\mathbf{A}_{23}\mathbf{A}_{33}^{2} + \mathbf{A}_{13}\mathbf{A}_{33}^{2} \\
&\mathbf{A}_{22}^{(4)} = \mathbf{A}_{22}^{4} \\
&\mathbf{A}_{23}^{(4)} = \mathbf{A}_{22}^{3}\mathbf{A}_{23} + \mathbf{A}_{22}^{2}\mathbf{A}_{23}\mathbf{A}_{33} + \mathbf{A}_{22}\mathbf{A}_{23}\mathbf{A}_{33}^{2} + \mathbf{A}_{23}\mathbf{A}_{33}^{2} \\
&\mathbf{A}_{33}^{(4)} = \mathbf{A}_{33}^{4}
\end{aligned}\right\} \tag{22}$$

In the case $s = 5$, we obtain the following equations similarly.

$$\left.\begin{aligned}
&\mathbf{A}_{11}^{(5)} = \mathbf{A}_{11}^{5} \\
&\mathbf{A}_{12}^{(5)} = \mathbf{A}_{11}^{4}\mathbf{A}_{12} + \mathbf{A}_{11}^{3}\mathbf{A}_{12}\mathbf{A}_{22} + \mathbf{A}_{11}^{2}\mathbf{A}_{12}\mathbf{A}_{22}^{2} + \mathbf{A}_{11}\mathbf{A}_{12}\mathbf{A}_{22}^{3} + \mathbf{A}_{12}\mathbf{A}_{22}^{4} \\
&\mathbf{A}_{13}^{(5)} = \mathbf{A}_{11}^{4}\mathbf{A}_{13} + \mathbf{A}_{11}^{3}\mathbf{A}_{12}\mathbf{A}_{23} + \mathbf{A}_{11}^{3}\mathbf{A}_{13}\mathbf{A}_{33} + \mathbf{A}_{11}^{2}\mathbf{A}_{12}\mathbf{A}_{22}\mathbf{A}_{23} + \mathbf{A}_{11}^{2}\mathbf{A}_{12}\mathbf{A}_{23}\mathbf{A}_{33} + \mathbf{A}_{11}^{2}\mathbf{A}_{13}\mathbf{A}_{33}^{2} \\
&\qquad + \mathbf{A}_{11}\mathbf{A}_{12}\mathbf{A}_{22}^{2}\mathbf{A}_{23} + \mathbf{A}_{11}\mathbf{A}_{12}\mathbf{A}_{22}\mathbf{A}_{23}\mathbf{A}_{33} + \mathbf{A}_{11}\mathbf{A}_{12}\mathbf{A}_{23}\mathbf{A}_{33}^{2} + \mathbf{A}_{11}\mathbf{A}_{13}\mathbf{A}_{33}^{3} \\
&\qquad + \mathbf{A}_{12}\mathbf{A}_{22}^{3}\mathbf{A}_{23} + \mathbf{A}_{12}\mathbf{A}_{22}^{2}\mathbf{A}_{23}\mathbf{A}_{33} + \mathbf{A}_{12}\mathbf{A}_{22}\mathbf{A}_{23}\mathbf{A}_{33}^{2} + \mathbf{A}_{12}\mathbf{A}_{23}\mathbf{A}_{33}^{3} + \mathbf{A}_{13}\mathbf{A}_{33}^{4} \\
&\mathbf{A}_{22}^{(5)} = \mathbf{A}_{22}^{5} \\
&\mathbf{A}_{23}^{(5)} = \mathbf{A}_{22}^{4}\mathbf{A}_{23} + \mathbf{A}_{22}^{3}\mathbf{A}_{23}\mathbf{A}_{33} + \mathbf{A}_{22}^{2}\mathbf{A}_{23}\mathbf{A}_{33}^{2} + \mathbf{A}_{22}\mathbf{A}_{23}\mathbf{A}_{33}^{3} + \mathbf{A}_{23}\mathbf{A}_{33}^{4} \\
&\mathbf{A}_{33}^{(5)} = \mathbf{A}_{33}^{5}
\end{aligned}\right\} \tag{23}$$

In the case $s = 6$, we obtain

$$\left.\begin{aligned}
&\mathbf{A}_{11}^{(6)} = \mathbf{A}_{11}^{6} \\
&\mathbf{A}_{12}^{(6)} = \mathbf{A}_{11}^{5}\mathbf{A}_{12} + \mathbf{A}_{11}^{4}\mathbf{A}_{12}\mathbf{A}_{22} + \mathbf{A}_{11}^{3}\mathbf{A}_{12}\mathbf{A}_{22}^{2} + \mathbf{A}_{11}^{2}\mathbf{A}_{12}\mathbf{A}_{22}^{3} + \mathbf{A}_{11}\mathbf{A}_{12}\mathbf{A}_{22}^{4} + \mathbf{A}_{12}\mathbf{A}_{22} \\
&\mathbf{A}_{13}^{(6)} = \mathbf{A}_{11}^{5}\mathbf{A}_{13} + \mathbf{A}_{11}^{4}\mathbf{A}_{12}\mathbf{A}_{23} + \mathbf{A}_{11}^{4}\mathbf{A}_{13}\mathbf{A}_{33} + \mathbf{A}_{11}^{3}\mathbf{A}_{12}\mathbf{A}_{22}\mathbf{A}_{23} + \mathbf{A}_{11}^{3}\mathbf{A}_{12}\mathbf{A}_{23}\mathbf{A}_{33} + \mathbf{A}_{11}^{3}\mathbf{A}_{13}\mathbf{A}_{33}^{2} \\
&\qquad + \mathbf{A}_{11}^{2}\mathbf{A}_{12}\mathbf{A}_{22}^{2}\mathbf{A}_{23} + \mathbf{A}_{11}^{2}\mathbf{A}_{12}\mathbf{A}_{22}\mathbf{A}_{23}\mathbf{A}_{33} + \mathbf{A}_{11}^{2}\mathbf{A}_{12}\mathbf{A}_{23}\mathbf{A}_{33}^{2} + \mathbf{A}_{11}^{2}\mathbf{A}_{13}\mathbf{A}_{33}^{3} \\
&\qquad + \mathbf{A}_{11}\mathbf{A}_{12}\mathbf{A}_{22}^{3}\mathbf{A}_{23} + \mathbf{A}_{11}\mathbf{A}_{12}\mathbf{A}_{22}^{2}\mathbf{A}_{23}\mathbf{A}_{33} + \mathbf{A}_{11}\mathbf{A}_{12}\mathbf{A}_{22}\mathbf{A}_{23}\mathbf{A}_{33}^{2} + \mathbf{A}_{11}\mathbf{A}_{12}\mathbf{A}_{23}\mathbf{A}_{33}^{3} + \mathbf{A}_{11}\mathbf{A}_{13}\mathbf{A}_{33}^{4} \\
&\qquad + \mathbf{A}_{12}\mathbf{A}_{22}^{4}\mathbf{A}_{23} + \mathbf{A}_{12}\mathbf{A}_{22}^{3}\mathbf{A}_{23}\mathbf{A}_{33}\mathbf{A}_{12}\mathbf{A}_{22}^{2}\mathbf{A}_{23}\mathbf{A}_{33}^{2} + \mathbf{A}_{12}\mathbf{A}_{22}\mathbf{A}_{23}\mathbf{A}_{33}^{2} + \mathbf{A}_{12}\mathbf{A}_{23}\mathbf{A}_{33}^{4} + \mathbf{A}_{13}\mathbf{A}_{33}^{5}
\end{aligned}\right\} \tag{24}$$

We get generalized equations for s-step shift as follows.

$$
\left.
\begin{aligned}
\mathbf{A}_{\mathbf{11}}^{(s)} &= \mathbf{A}_{\mathbf{11}}^{s} \\
\mathbf{A}_{\mathbf{12}}^{(s)} &= \mathbf{A}_{\mathbf{11}}^{s-1}\mathbf{A}_{\mathbf{12}} + \sum_{k=2}^{s-1}\mathbf{A}_{\mathbf{11}}^{s-k}\mathbf{A}_{\mathbf{12}}\mathbf{A}_{\mathbf{22}}^{k-1} + \mathbf{A}_{\mathbf{12}}\mathbf{A}_{\mathbf{22}}^{s-1} \\
\mathbf{A}_{\mathbf{13}}^{(s)} &= \mathbf{A}_{\mathbf{11}}^{s-1}\mathbf{A}_{\mathbf{13}} + \mathbf{A}_{\mathbf{11}}^{s-2}\left(\sum_{k=1}^{2}\mathbf{A}_{\mathbf{1(k+1)}}\mathbf{A}_{\mathbf{(k+1)3}}\right) + \sum_{j=1}^{s-3}\left[\mathbf{A}_{\mathbf{11}}^{S-2-j}\left\{\mathbf{A}_{\mathbf{12}}\left(\sum_{k=1}^{j+1}\mathbf{A}_{\mathbf{22}}^{j+1-k}\mathbf{A}_{\mathbf{23}}\mathbf{A}_{\mathbf{33}}^{k-1}\right) + \mathbf{A}_{\mathbf{13}}\mathbf{A}_{\mathbf{33}}^{j+1}\right\}\right] \\
\mathbf{A}_{\mathbf{22}}^{(s)} &= \mathbf{A}_{\mathbf{22}}^{s} \\
\mathbf{A}_{\mathbf{23}}^{(s)} &= \sum_{K-1}^{s}\mathbf{A}_{\mathbf{22}}^{s-k}\mathbf{A}_{\mathbf{23}}\mathbf{A}_{\mathbf{33}}^{k-1} \\
\mathbf{A}_{\mathbf{33}}^{(s)} &= \mathbf{A}_{\mathbf{33}}^{s}
\end{aligned}
\right\}
\tag{25}
$$

Expressing them in matrix, it follows.

$$
\mathbf{A}^{(S)} = \begin{pmatrix}
\mathbf{A}_{11}^{s}, & \mathbf{A}_{11}^{s-1}\mathbf{A}_{12} + \sum_{k=2}^{s-1}\mathbf{A}_{11}^{s-k}\mathbf{A}_{12}\mathbf{A}_{22}^{k-1} + \mathbf{A}_{12}\mathbf{A}_{22}^{s-1}, & \mathbf{A}_{11}^{s-1}\mathbf{A}_{13} + \mathbf{A}_{11}^{s-2}\left(\sum_{k=1}^{2}\mathbf{A}_{1(k+1)}\mathbf{A}_{(K+1)3}\right) + \sum_{j=1}^{s-3}\left[\mathbf{A}_{11}^{s-2-j}\left\{\mathbf{A}_{12}\left(\sum_{k=1}^{j+1}\mathbf{A}_{22}^{j+1-k}\mathbf{A}_{23}\mathbf{A}_{33}^{k-1}\right) + \mathbf{A}_{13}\mathbf{A}_{33}^{j+1}\right\}\right] \\
\mathbf{0}, & \mathbf{A}_{22}^{s}, & \sum_{k=1}^{s}\mathbf{A}_{22}^{s-k}\mathbf{A}_{23}\mathbf{A}_{33}^{k-1} \\
\mathbf{0}, & \mathbf{0}, & \mathbf{A}_{33}^{s}
\end{pmatrix}
\tag{26}
$$

Generalizing them to m groups, they are expressed as

$$
\begin{pmatrix} \mathbf{X}_{\mathbf{n}}^{(1)} \\ \mathbf{X}_{\mathbf{n}}^{(2)} \\ \vdots \\ \mathbf{X}_{\mathbf{n}}^{(m)} \end{pmatrix}
=
\begin{pmatrix}
\mathbf{A}_{\mathbf{11}} & \mathbf{A}_{\mathbf{12}} & \cdots & \mathbf{A}_{\mathbf{1m}} \\
\mathbf{A}_{\mathbf{21}} & \mathbf{A}_{\mathbf{22}} & \cdots & \mathbf{A}_{\mathbf{2m}} \\
\vdots & \vdots & & \vdots \\
\mathbf{A}_{\mathbf{m1}} & \mathbf{A}_{\mathbf{m2}} & \cdots & \mathbf{A}_{\mathbf{mm}}
\end{pmatrix}
\begin{pmatrix} \mathbf{X}_{\mathbf{n-1}}^{(1)} \\ \mathbf{X}_{\mathbf{n-1}}^{(2)} \\ \vdots \\ \mathbf{X}_{\mathbf{n-1}}^{(m)} \end{pmatrix}
\tag{27}
$$

$$
\mathbf{X}_{\mathbf{n}}^{(1)} \in R^{k_1}, \quad \mathbf{X}_{\mathbf{n}}^{(2)} \in R^{k_2}, \quad \cdots, \quad \mathbf{X}_{\mathbf{n}}^{(m)} \in R^{k_m}, \quad \mathbf{A}_{\mathbf{ij}} \in R^{k_i \times k_j} \ (i = 1, \cdots, m)(j = 1, \cdots, m)
$$

4 Questionnaire investigation and numerical calculation

Questionnaire Investigation to Automobile Purchasing case is executed.

<Delivery of Questionnaire Sheets>

・Questionnaire sheet : Appendix1

・Delivery Term : July to September/2012

・Delivery Place : Shizuoka, Mie Prefecture in Japan

・Number of Delivered Questionnaire sheets: 300

<Result of collected Questionnaire Sheets>

・Collected Questionnaire Sheets:98 (male:47,female:51)

・Collected sheets for Sedan Typed Automobile: 41

<Fundamental Statistical Result>

Table1: Summary for 98 sheets

Age		**Sex**		**Occupation**		**Annual income (Japanese Yen)**		**Marriage**		**Kids**	
Teens	10	Male	47	Student	16	0-3 million	71	Single	46	0	55
Twenties	20	Female	51	Officer	48	3-5 million	15	Married	51	1	11
Thirties	18			Company employee	6	5-7.5 million	5	Not filled in	1	2	23
Forties	20			Clerk of Organization	1	7.5-10 million	2			3	9
Fifties	15			Independents	25	10-15 million	2			4	
Sixties and over	15			Miscellaneous	0	15 million or more	0			5	0
Not filled in	0			Not filled in	2	Not filled in	3				
Sum	98		98		98		98		98		98

Table 2: Sedan Typed Summary for 41 Sheets

Age		**Sex**		**Occupation**		**Annual income (Japanese Yen)**		**Marriage**		**Kids**	
Teens	0	Male	14	Student	0	0-3 million	28	Single	17	0	10
Twenties	9	Female	27	Officer	38	3-5 million	7	Married	24	1	10
Thirties	7			Company employee	0	5-7.5 million	3	Not filled in	0	2	16
Forties	12			Clerk of Organization	0	7.5-10 million	1			3	5
Fifties	6			Independents	3	10-15 million	1			4	0
Sixties and over	7			Miscellaneous	0	15 million or more	0			5	0
Not filled in	0			Not filled in	0	Not filled in	1				
Sum	41		41		41		41		41		41

The questionnaire includes the question of the past. Therefore plural date may be gathered from one sheet. For example, we can get two data such as (Third ahead, before former automobile)(before former automobile, former automobile),(former automobile, current automobile),(current automobile, next automobile),(current automobile, future automobile).

Analyzing these sheets based on Model ranked Table (Appendix2, Appendix3),we obtained the following 201 data sets. Appendix2 shows total ranking Table and Appendix3 shows the ranking Table for sedan type.

① Number of shift from 5th position to 5th position : 87

② Number of shift from 5th position to 4th position : 10

③ Number of shift from 5th position to 3rd position : 11

④ Number of shift from 5th position to 2nd position : 3

⑤ Number of shift from 5th position to 1st position : 1

⑥ Number of shift from 4th position to 5th position : 15

⑦ Number of shift from 4th position to 4th position : 17

⑧ Number of shift from 4th position to 3rd position : 3

⑨ Number of shift from 4th position to 2nd position : 6

⑩ Number of shift from 3rd position to 5th position : 5

⑪ Number of shift from 3rd position to 4th position : 3

⑫ Number of shift from 3rd position to 3rd position : 8

⑬ Number of shift from 3rd position to 2nd position : 6

⑭ Number of shift from 2nd position to 5th position : 3

⑮ Number of shift from 2nd position to 4th position : 4

⑯ Number of shift from 2nd position to 3rd position : 4

⑰ Number of shift from 2nd position to 2nd position : 10

⑱ Number of shift from 2nd position to 1st position : 2

⑲ Number of shift from 1st position to 2nd position : 1

⑳ Number of shift from 1st position to 1st position : 2

Total:201

The vector $\mathbf{X}, \mathbf{X_b}$ in these cases are expressed as follows.

① $$\mathbf{X} = \begin{pmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 1 \end{pmatrix} \qquad \mathbf{X_b} = \begin{pmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 1 \end{pmatrix}$$

② $$\mathbf{X} = \begin{pmatrix} 0 \\ 0 \\ 0 \\ 1 \\ 0 \end{pmatrix} \qquad \mathbf{X_b} = \begin{pmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 1 \end{pmatrix}$$

③ $\mathbf{X} = \begin{pmatrix} 0 \\ 0 \\ 1 \\ 0 \\ 0 \end{pmatrix}$ $\mathbf{X_b} = \begin{pmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 1 \end{pmatrix}$

④ $\mathbf{X} = \begin{pmatrix} 0 \\ 1 \\ 0 \\ 0 \\ 0 \end{pmatrix}$ $\mathbf{X_b} = \begin{pmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 1 \end{pmatrix}$

⑤ $\mathbf{X} = \begin{pmatrix} 1 \\ 0 \\ 0 \\ 0 \\ 0 \end{pmatrix}$ $\mathbf{X_b} = \begin{pmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 1 \end{pmatrix}$

⑥ $\mathbf{X} = \begin{pmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 1 \end{pmatrix}$ $\mathbf{X_b} = \begin{pmatrix} 0 \\ 0 \\ 0 \\ 1 \\ 0 \end{pmatrix}$

⑦ $\mathbf{X} = \begin{pmatrix} 0 \\ 0 \\ 0 \\ 1 \\ 0 \end{pmatrix}$ $\mathbf{X_b} = \begin{pmatrix} 0 \\ 0 \\ 0 \\ 1 \\ 0 \end{pmatrix}$

⑧ $\mathbf{X} = \begin{pmatrix} 0 \\ 0 \\ 1 \\ 0 \\ 0 \end{pmatrix}$ $\mathbf{X_b} = \begin{pmatrix} 0 \\ 0 \\ 0 \\ 1 \\ 0 \end{pmatrix}$

⑨ $\mathbf{X} = \begin{pmatrix} 0 \\ 1 \\ 0 \\ 0 \\ 0 \end{pmatrix}$ $\mathbf{X_b} = \begin{pmatrix} 0 \\ 0 \\ 0 \\ 1 \\ 0 \end{pmatrix}$

⑩ $\mathbf{X} = \begin{pmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 1 \end{pmatrix}$ $\mathbf{X_b} = \begin{pmatrix} 0 \\ 0 \\ 1 \\ 0 \\ 0 \end{pmatrix}$

⑪ $\mathbf{X} = \begin{pmatrix} 0 \\ 0 \\ 0 \\ 1 \\ 0 \end{pmatrix}$ $\mathbf{X_b} = \begin{pmatrix} 0 \\ 0 \\ 1 \\ 0 \\ 0 \end{pmatrix}$

⑫ $\mathbf{X} = \begin{pmatrix} 0 \\ 0 \\ 1 \\ 0 \\ 0 \end{pmatrix}$ $\mathbf{X_b} = \begin{pmatrix} 0 \\ 0 \\ 1 \\ 0 \\ 0 \end{pmatrix}$

⑬ $\mathbf{X} = \begin{pmatrix} 0 \\ 1 \\ 0 \\ 0 \\ 0 \end{pmatrix}$ $\mathbf{X_b} = \begin{pmatrix} 0 \\ 0 \\ 1 \\ 0 \\ 0 \end{pmatrix}$

⑭ $\mathbf{X} = \begin{pmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 1 \end{pmatrix}$ $\mathbf{X_b} = \begin{pmatrix} 0 \\ 1 \\ 0 \\ 0 \\ 0 \end{pmatrix}$

⑮ $$\mathbf{X} = \begin{pmatrix} 0 \\ 0 \\ 0 \\ 1 \\ 0 \end{pmatrix} \qquad \mathbf{X_b} = \begin{pmatrix} 0 \\ 1 \\ 0 \\ 0 \\ 0 \end{pmatrix}$$

⑯ $$\mathbf{X} = \begin{pmatrix} 0 \\ 0 \\ 1 \\ 0 \\ 0 \end{pmatrix} \qquad \mathbf{X_b} = \begin{pmatrix} 0 \\ 1 \\ 0 \\ 0 \\ 0 \end{pmatrix}$$

⑰ $$\mathbf{X} = \begin{pmatrix} 0 \\ 1 \\ 0 \\ 0 \\ 0 \end{pmatrix} \qquad \mathbf{X_b} = \begin{pmatrix} 0 \\ 1 \\ 0 \\ 0 \\ 0 \end{pmatrix}$$

⑱ $$\mathbf{X} = \begin{pmatrix} 1 \\ 0 \\ 0 \\ 0 \\ 0 \end{pmatrix} \qquad \mathbf{X_b} = \begin{pmatrix} 0 \\ 1 \\ 0 \\ 0 \\ 0 \end{pmatrix}$$

⑲ $$\mathbf{X} = \begin{pmatrix} 0 \\ 1 \\ 0 \\ 0 \\ 0 \end{pmatrix} \qquad \mathbf{X_b} = \begin{pmatrix} 1 \\ 0 \\ 0 \\ 0 \\ 0 \end{pmatrix}$$

⑳ $$\mathbf{X} = \begin{pmatrix} 1 \\ 0 \\ 0 \\ 0 \\ 0 \end{pmatrix} \qquad \mathbf{X_b} = \begin{pmatrix} 1 \\ 0 \\ 0 \\ 0 \\ 0 \end{pmatrix}$$

Substituting these to equation (7), we obtain

$$\hat{\mathbf{A}} = \begin{pmatrix} 2 & 2 & 0 & 0 & 1 \\ 1 & 10 & 6 & 6 & 3 \\ 0 & 4 & 8 & 3 & 11 \\ 0 & 4 & 3 & 17 & 10 \\ 0 & 3 & 5 & 15 & 87 \end{pmatrix} \begin{pmatrix} 3 & 0 & 0 & 0 & 0 \\ 0 & 23 & 0 & 0 & 0 \\ 0 & 0 & 22 & 0 & 0 \\ 0 & 0 & 0 & 41 & 0 \\ 0 & 0 & 0 & 0 & 112 \end{pmatrix}^{-1} = \begin{pmatrix} \frac{2}{3} & \frac{2}{23} & 0 & 0 & \frac{1}{112} \\ \frac{1}{3} & \frac{10}{23} & \frac{3}{11} & \frac{6}{41} & \frac{3}{112} \\ 0 & \frac{4}{23} & \frac{4}{11} & \frac{3}{41} & \frac{11}{112} \\ 0 & \frac{4}{23} & \frac{3}{22} & \frac{17}{41} & \frac{5}{56} \\ 0 & \frac{3}{23} & \frac{5}{22} & \frac{15}{41} & \frac{87}{112} \end{pmatrix}$$

Questionnaire investigation to automobile purchasing case is executed and matrix structure stated in 2.(1) can be confirmed. This is rather a slight upper shift on the whole compared with the former research. We make comparison for both of them in Table 3 and 4.

Table 3: The results of the former research (Takeyasu et al., (2007))

Rank	I	II	Ⅲ	Ⅳ	V	Summary	Share (%)
Upper shift	-	3	7	5	23	38	38.8
Same Rank movement	2	6	9	9	18	44	44.9
Lower shift	2	1	3	10	-	16	16.3
Summary	4	10	19	24	41	98	
Share (%)	4.1	10.2	19.4	24.5	41.8		

Table 4: The results of this research

	I	II	III	IV	V	Summary	Share (%)
Upper shift	-	2	6	9	25	42	20.9
Same Rank movement	2	10	8	17	87	124	61.7
Lower shift	1	11	8	15	-	35	17.4
Summary	3	23	22	41	112	201	
Share (%)	1.5	11.4	10.9	20.4	55.7		

Apparently, the former one has a clear upper shift. To clarify this reason, we have made an interview to the car dealers.

Hearing results from the car dealers are as follows. There is a tendency to the shift to the upper brands. But some of them have each feature such as

a. When young, they ride on high ranked automobile. But when married, they ride on ordinary level automobile.

b. Office workers are apt to buy higher ranked automobile as they promote.

c. Recently interior of automobile became upgraded. Therefore user can enjoy higher ranked automobile in a rather lower grade automobile, which cause less need to upgrade.

In this research, residents are in rural area therefore that may affect the behavior for the purchase. Anyway we have obtained interesting results. This should be expanded in many areas.

5 Application of this method

Consumers' behavior may converge by repeating forecast with above method and total sales of all brands may be reduced. Therefore, the analysis results suggest when and what to put new brand into the market which contribute the expansion of the market.

There may arise following case. Consumers and producers do not recognize brand position clearly. But analysis of consumers’ behavior let them know their brand position in the market. In such a case, strategic marketing guidance to select brand would be introduced.

Setting in order the brand position of various goods and taking suitable marketing policy, enhancement of sales would be enabled. Setting higher ranked brand, consumption would be promoted.

6 Conclusion

It is often observed that consumers select upper class brand when they buy next time. Suppose that former buying data and current buying data are gathered. Also suppose that upper brand is located upper in the variable array. Then transition matrix become upper triangle matrix under the supposition that former buying variables are set input and current buying variables are set output. If the top brand is selected from lower brand in jumping way, corresponding part in upper triangle matrix would be 0.

Questionnaire investigation to automobile purchasing case was executed and above structure was confirmed. We have made a questionnaire investigation concern automobile purchase before. In that paper, questionnaire was executed mainly on an urban area. In this paper, we have made investigation on a rural area and made comparison for both of them. Interesting results were obtained.Various fields should be examined hereafter. In the end, we appreciate Ms. Kurumi Kawamura for her helpful support of work.

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Appendix 1 Questionnaire Sheet

1. Age

<teens・twenties・thirties・forties・fifties・more than sixties >

2. Sex

< Woman・Man >

3. Occupation

< Company employee・public official・Independent・Housewife・Miscellaneous>

4. Official position

< Chairman・President・Officer・General manager・Deputy general manager・Section chief・Deputy Section chief・Chief・Employee・Miscellaneous >

5. Annual Income

< Less than 3 million・5-3 million・7.5-5 million・10-7.5 million・15-10 million・15 million or more >

6. Address. (City・Town・Village)

7. Marriage

< Single・Married >

8. Number of children

Working ( ) ,University student ( ) ,High school student ( ) ,Junior high school student ( ) ,School child ( )

child before entering school ( )

9. Please write the car that you own.

	Third Ahead	***Second Ahead***	***First ahead***	***Present***	***Next time***	***future***
Manufacturer Name						
Model Name						
Purchase Reason						
Car Name						

Manufacturer Name : A. Toyota Motor B. Honda Motor C. Nissan Motor D. Mitsubishi Motors
E. Mazda F. Subaru G. Isuzu H. Daihatsu Kogyo I. Suzuki J. Benz K.BMW L.Audi M. Miscellaneous

Model Name : a. Sedan b. Coupe (Sports car) c. One box・Minivan d. Wagon e.RV f. Compact car・Light car g. Recreational vehicle h. Miscellaneous

Purchase Reason or Reason why you want to buy. : 1. Design2. Structure (It is possible to load with a lot of luggage.) 3. Performance (It is flexible.,The engine is good.)4. Sales price5. Family structure 6. Favorite Manufacturer7. According to the lifestyle（Hobby etc.） 8. It is good for the environment. (Fuel cost etc.) 9. Area of garage 10. Present (You are presented used car.) 11. Interest rate 12. Maintenance expense (The tax is cheap.) 13. Miscellaneous (Please write in the frame.)

Appendix 2 Model Ranking Table(Total classification) (CC)

	Toyota	Nissan	Honda	Subaru	Suzuki	Mitsubishi	Mazda	Daihatsu	Benz
Sedan	Opa WiLL Avalon Avensis Allion Aristo Windom Verossa Origin Camry Corolla Corolla axio Crown Crown- athlete Crown- comfort Crown sedan Crown hybrid Crown- majesta Crown- royalsaloon Classic Cressida Cresta Corsa Corona Comfort Sprinter cielo Century Tercel	Infiniti Q Auster Gloria Sunny Cima Stanza Cedric Cefiro Teana Tiida latio Pulsar Fuga Primera Bluebird- sylphy President Presea Maxima Langley Liberta villa Leopard Laurel	CR-X Accord Ascot Insight Inspire Integra Concerto City Civic Civic type-R Civic hybrid Saber Today Domani Torneo Ballade Vigor Fit aria Rafaga Legend Logo	Impreza Impreza- anesis Leone Legacy B4	SX4 sedan Aerio Cultus Chevrolet- optra Chevrolet- cruze	Aspire Eterna Emeraude Carisma Galant fortis Sigma Diamante Dignity Debonair Tredia Proudia Magna Mirage Lancer- evolution Lancer sedan		Applause Altis Charmant	

	Chaser Duet Vista Platz Prius Brevis Premio Progres Pronard Belta Mark X Mark Ⅱ Lexus ES Lexus GS Lexus HS Lexus IS Lexus LS								
Coupe・Sports car	MR2 MR-S Curren Corolla levin Cynos Supra Starlet Sprinter Sera Celica Soarer Lexus SC	GT-R 180SX NX coupe Exa Gazelle Silvia Skyline- coupe Figaro Fairlady z Micra C+C Lucino	S2000 NSX Integra- type-R Prelude	Alcyone		FTO GTO Cordia Starion	RX-3 MX-6 RX-7 Etude Autozuma- AZ-3 Cosmo Familia- astina Eunos- presso Roadster		

One box・Minivan	Isis Alphard Ipsum Wish Vellfire Voxy Estima Gaia Corolla– spacio Granvia Sienta Sparky Nadia Noah Hiace Passo sette Masterace Regius	Elgrand Caravan– silkroad Serena Bassara Presage Lafesta Largo Liberty	Edix Elysion Elysion– prestige Odyssey Stepwgn Stepwgn– spada Stream Partner Freed Mobilio MObilio– spike	Exiga Domingo Traviq	Every landy Landy	Chariot Dion Delica D:5 Delica star– wagon Delica space– gear Lancer cargo	MPV Biante Premacy Bongo– friendee Eunos– cargo		
Wagon	Caldina Corolla– fielder Crown estate Succeed– wagon Sprinter carib Probox– wagon Mark x zio	Avenir Wingroad Expert Stagea R´nessa	Avancier Accord– tourer Airwave Orthia	Legacy– touring wagon		Lancer wagon Libero Legnum	Atenza– sportswagon Demio		

SUV	RAV4 Vanguard Cami Kluger Hilux surf Harrier Mega cruiser Rush Land cruiser Lexus GX Lexus LX Lexus RX	X-trail Safari Dualis Terrano Mistral Murano Rasheen	CR-V HR-V Z Crossroad Passport Horizon	Bighorn Forester Legacy- outback	X-90 Escudo Grand- escudo Jimny- sierra	Outlander Airtrek Pajero Pajero Jr	CX-7 Proceed Proceed- levante		
Compact car	bB iQ ist Vitz Auris Corolla- rumion Passo Fun cargo Blade Porte Raum Ractis	Cube Tiida Tino Note Pao March	S-MX Capa That's Fit	Justy Dex	SX4 Chevrolet- MW Swift Swift sports Splash Solio	RVR Colt Colt plus Mirage dingo	Infini MS-6 Verisa		

Light car		Otti Kix Clipper rio Pino Moco	Acty truck Acty van Street Zest Vamos Vamos- hobio Beat Life	R1 R2 Vivio Sambar Pleo Pleo van Rex	Kei Kei-works MR wagon MR wagon- wit Alto Alto lapin Every- wagon Cappuccino Cara Jimny Suzu light Cervo Cervo SR Twin Palette Fronte Wagon R Wagon R- stingray	eK sports eK wagon i Town box Toppo Toppo BJ Pajero mini Bravo Minica Minica van	AZ-offroad AZ-wagon R360 coupe Autozam- AZ-1 Carol Chantez Scrum- wagon Spiano Porter Laputa	MAX Atrai wagon Esse Esse- custom Opti Cuore Copen Sonica Tanto Tanto- custom Terioskid Naked Mira Mira custom Mira gino Move Move- custom Moveconte Moveconte- custom Leeza	

Appendix 3 Model Ranking Table(classification for Sedan Type) (CC)

	SEDAN	COUPE・SPORTS CAR	ONE BOX CAR・MINIVAN	WAGON	SUV	COMPACT CAR	LIGHT CAR	TRUCK
I	525i BMW CROWN HYBRID CROWN MAJESTA CELSIOR BENZ LEXUS LEXUS ES LEXUS LS DIAVLO	GTR M3 NSX AUDI COUNTACH CORVETTE BOXSTER PORSCHE VOLVO LEXUS SC			HUMMER LAND CRUISER LEXUS GX RANGE ROVER			

Ⅱ	C4 MS-9 VW GOLF VW VENT ACCORD ARISTO ALTEZZA INSPIRE WINDOM CAMRY CADILLAC CROWN CROWN ROYAL GLORIA CIMA CHANSON SKYLINE CEDRIC CEDRIC CUBE FUGA PEUGEOT207 BORA MARKⅡ MARKⅡBLIT LANCER EVOLUTION X LEXUS IS	MR-S RX-7 RX-8 S2000 INTEGRA TYPE-R COSMO SKYLINE COUPE FAIRLADY Z	MPV ASTRO ALPHARD ALPHARD HYBRID VELLFIRE ESTIMA ELYSION PRESTIGE ELGRAND ODYSSEY DELICA SPACE GEAR LUCIDA BASARA	ACCORD TOURER MARK X ZIO AIRWAVE	KLUGER SAFARI BIGHORN PRADO			
Ⅲ	IMPREZA CRESTA SIGMA CIVIC TYPE R CEFIRO DIAMANTE BEETLE VIGOR PRIUS MARK X LEGACY LEOPARD LAUREL	LEVIN	IPSUM STEP WGN STEP WGO SPADA SPACIO SERENA DELICA HIACE REGIUS	ACCORD WAGON GOLF WAGON STAGEA PRIMERA WAGON LEGACY TOURINGWAGON LEGNUM	CRV OUTLANDER X-TRAIL SURF TERRANO HILUX SURF PAJERO HARRIER DUALIS			

Ⅳ	SX4 SEDAN	180SX	ISIS	AVENIR	RAV-4	RVR		
	ASCOT	CAVALIER	WISH	CALDINA	AIRTREK	COROLLARUMION		
	INSIGHT	SILVIA	VOXY	MARK ⅡWAGON	CAMI	MINICOOPER		
	INTEGRA	SUPRA	EDIX	WINGROAD	TRIBUTE	RAUM		
	IMPREZA	SMART	CARAVAN		FORESTER	RUMION		
	ANESIS	CELICA	SIENTA		IST			
	EXIV	PRELUDE	CHARIOT					
	CAPELLA		STREAM					
	CARINA ED		NOAH					
	GALAT		PREMACY					
	FORTIS		BONGO					
	KRONOS		VANETTE					
	CIVIC							
	CHASER							
	VISTA							
	VISTA							
	ARDEO							
	PRIMERA							
	BLUEBIRD							
	BLUEBIRD							
	SYLPHY							
	PRESEA							

V	CR-X	MR2	ACTY VAN	SPRINTER	CHEVROLET	bB	EKWAGON	ACTY
	AXELA	COROLLA	EVERY	CARIB	PAJERO Jr	iQ	MAX	TRUCK
	AERIO	LEVIN	CHARIOT	DEMIO	RASHEEN	VITZ	MR	HYBRID
	CARINA	SPRINTER	TOWNACE	LANCER CEDIA		CUBE	WAGON	TRUCK
	COROLLA	SPRINTER	HIJET	WAGON		SWIFT	ATRAI	MIGHTY
	COROLLA II	TRUENO	PRAIRIE	LIBERO		NOTE	WAGON	BOY
	CRUZE		MASTERACE			PYZAR	ALTO	
	CORSA		LITEACE			PASSO	VIVIO	
	CORONA					FUNCARGO	EVERY	
	SUNNY					FIT	WAGON	
	GEMINI					MARCH	OTTI	
	CITY					FREED	OPTI	
	TERCEL						JIMNY	
	TIIDA						SCRUM	
	PULSAR						STELLA	
	FAMILIA						STREAT	
	FESTIVA						SONICA	
	PLATZ						TANTO	
	MIRAGE						BISTRO	
	LANCER						PINO	
	SEDAN						MINICA	
	LEONE						MIRA	
	LOGO						MOVE	
							MICO	
							LIFE	
							LAPIN	
							REX	
							WAGON R	
							TERIOSKID	
							THATS	