A market segmentation model of enterprise marketing based on an improved grey correlation analysis methods

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Abstract

In order to make out quick and effective enterprise sales strategy, this paper studies market segmentation for key brand products and proposes a market segmentation model based on an improved grey correlation analysis methods. Key indicators about market segmentation are analysed first. These indicators are then subject to standardization to be in the unified measurement. On this basis, classical grey correlation analysis methods get impTableroved and Hamming distance is adopted to cope with fuzzy information. Grey correlation coefficient and grey correlation degree of market segmentation are acquired. AHP is introduced to assign weight to indicators of market segmentation in order to get weighed comprehensive grey correlation degree. Finally, test is given to the effectiveness, scientific nature and feasibility of the model and algorithm through case study of a brand product.

Keywords: market segmentation, marketing strategy, grey correlation analysis, correlation degree, model

1 Introduction

Before launching a new product to the market, enterprises usually need to be familiar with the market segmentation and plan for it. Market segmentation serves to lowering the marketing cost, yielding more profits and increasing the competitiveness, which is significant to the operation of enterprises [1-4].

However, factors that influence marketing effect and promotion prospect should be taken into consideration when doing market segmentation, including market factor, economic factor, development factor, competitive factor, etc. Besides, market position, promotion distribution and promotion areas should also have a place in the analysis. Thus, market segmentation is a complicated systematic analytical process. It involves with multiple indicators for evaluation to get effective and clear market segmentation.

Currently, there are many ways for the multi-attribute system decision analysis [5-8], such as Analytical Hierarchy Process, Delphi method, fuzzy comprehensive evaluation method, expert score method, etc. These methods are adapted to different cases with practical results. However, subjectivity, uncertain information, complicated calculating process, little reliability stand in the way of scientific and effective decision analysis. Thus, this paper proposes a market segmentation model based on an improved grey correlation analysis method.

2 Evaluation index system of market segmentation

2.1 THE SELECTION OF INDICATORS

Marketing factors are multi-attribute, uncertain and complicated. Market information differs from each other. Thus, evaluation indicators are selected in a scientific way from multiple perspectives to ensure that market segmentation is accurate, effective and objective. Based on previous researches, this paper makes out the following rules for the selection of indicators.

Objectivity: The characteristics of the enterprise and real market operation should be taken into consideration when selecting indicators. Subjectivity should be avoided.

Scientific feature: Indicators should be selected from a scientific perspective. These indicators should have scientific inner and extension meanings to be objective and reasonable.

Dynamic feature: Marketing is dynamic. As market information changes, the marketing environment changes along with it. Therefore, indicators should reflect the dynamic information of market to ensure the reliability of market segmentation.

Integral feature: Market segmentation is a complicated system decision analysis process. So, indicators should be correlated within the system. An overlap or lack should be avoided.

Based on these principles, this paper selects market share, marketing profit rate, sales growth rate, customer satisfaction and marketing investment cost as evaluation indicators.

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2.2 WEIGHT OF EVALUATION INDICATORS OF MARKET SEGMENTATION

Evaluation indicators contribute differently to market segment. Thus, they should be given different weight. Expert score method, fuzzy comprehensive analysis method, grey correlation method, entropy weight method and AHP are existing ways to address weight distribution. To avoid subjectivity and ensure the reasonability and reliability of weight distribution, this paper uses AHP to give weight to indicators of market segmentation. Through expert opinions and surveys, here comes the relative importance matrix A between every two indicators:

$$A=\begin{vmatrix} a_{11} & a_{12} & ... & a_{1n} \\ a_{21} & a_{22} & ... & a_{2n} \\ ... & ... & ... & ... \\ a_{n1} & a_{n2} & ... & a_{nn} \end{vmatrix}_{n\times n}. \tag{1}$$

The maximum characteristics value $\lambda\ A$ is obtained. Calculate the coincidence indicator CI:

$$CI=\frac{\lambda\ A_{\max}-n}{n-1}. \tag{2}$$

After referring to relevant table, the average random coincidence indicator RI can be obtained. Calculate the coincidence ratio CR of evaluation indicator:

$$CR=\frac{CI}{RI}. \tag{3}$$

If evaluation indicator fits the threshold of coincidence, the weight of the evaluation indicator is:

$$w_i=\frac{\sum_{j=1}^{n}a_{ij}}{\sum_{i=1}^{n}\sum_{k=1}^{n}a_{ik}}. \tag{4}$$

3 Market segmentation model based on grey correlation decision analysis model

3.1 STANDARDIZATION OF EVALUATION INDICATORS OF MARKET SEGMENTATION

Market profit rate, market share, sales growth rate and customer satisfaction are indicators of profit type while marketing investment cost is indicator of cost type. In these indicators, accurate data are available through survey and statistical analysis. For some indicators, there is only fuzzy statistical information. So, to unify the evaluation standard, indicators should be subject to standardization to eradicate difference of scale and type.

When the indicator is of profit type, the value of segment market U_i about evaluation indicator j is $v_{ij}=\left[v_{ij}^a,v_{ij}^b\right]$. The standardized value $\tilde{v}_{ij}$ is:

$$\tilde{v}_{ij}=\left[\frac{v_{ij}^a-\min\limits_{1\le i\le m}v_{ij}}{\max\limits_{1\le i\le m}v_{ij}-\min\limits_{1\le i\le m}v_{ij}},\frac{v_{ij}^b-\min\limits_{1\le i\le m}v_{ij}}{\max\limits_{1\le i\le m}v_{ij}-\min\limits_{1\le i\le m}v_{ij}}\right], \tag{5}$$

In particular, when $v_{ij}^a=v_{ij}^b$, i.e. when v_{ij} is an accurate value, there is: $\frac{v_{ij}^a-\min\limits_{1\le i\le m}v_{ij}}{\max\limits_{1\le i\le m}v_{ij}-\min\limits_{1\le i\le m}v_{ij}}=\frac{v_{ij}^b-\min\limits_{1\le i\le m}v_{ij}}{\max\limits_{1\le i\le m}v_{ij}-\min\limits_{1\le i\le m}v_{ij}}$.

When the indicator is of cost type, the value of segment market U_i about evaluation indicator j is $v_{ij}=\left[v_{ij}^a,v_{ij}^b\right]$. The standardized value $\tilde{v}_{ij}$ is:

$$\tilde{v}_{ij}=\left[\frac{\min\limits_{1\le i\le m}v_{ij}-v_{ij}^a}{\max\limits_{1\le i\le m}v_{ij}-\min\limits_{1\le i\le m}v_{ij}},\frac{\min\limits_{1\le i\le m}v_{ij}-v_{ij}^b}{\max\limits_{1\le i\le m}v_{ij}-\min\limits_{1\le i\le m}v_{ij}}\right] \tag{6}$$

In particular, when $v_{ij}^a=v_{ij}^b$, that is, when v_{ij} is an accurate value, there is: $\frac{\min\limits_{1\le i\le m}v_{ij}-v_{ij}^a}{\max\limits_{1\le i\le m}v_{ij}-\min\limits_{1\le i\le m}v_{ij}}=\frac{\min\limits_{1\le i\le m}v_{ij}-v_{ij}^b}{\max\limits_{1\le i\le m}v_{ij}-\min\limits_{1\le i\le m}v_{ij}}$.

3.2 GREY CORRELATION DECISION ANALSIS OF MARKET SEGMENTATION

With uncertain data, only when potential market information and statistical data are referred to in the decision analysis of market segmentation scheme, can the process is objective and reasonable. However, for fuzzy information with range, traditional grey correlation decision analysis has certain limitations. Thus, this paper integrates calculation equation of fuzzy information distance into grey correlation decision analysis.

Suppose $V_1=\left[v_1^a,v_1^b\right]$ and $V_2=\left[v_2^a,v_2^b\right]$ are fuzzy interval number with uncertain information. In particular, $v_1^a\le v_1^b$, $v_2^a\le v_2^b$, there is:

$$d_{V_1,V_2}^T=\frac{\left[\left|v_1^a-v_2^a\right|^T+\left|v_1^b-v_2^b\right|^T\right]^{\frac{1}{T}}}{\sqrt[T]{2}}. \tag{7}$$

It refers to distance between V_1 and V_2.

In particular, when $T=1$, $d_{V_1,V_2}^T=d_{V_1,V_2}^1$ is the Hamming distance between V_1 and V_2. There is:

$$d_{V_1,V_2}^1=\frac{\left[\left|v_1^a-v_2^a\right|^T+\left|v_1^b-v_2^b\right|^T\right]^{\frac{1}{T}}}{\sqrt[T]{2}}. \tag{8}$$

When $T=2$, $d^T_{V_1,V_2}=d^2_{V_1,V_2}$ is the Euclidean distance between V_1 and V_2. There is:

$$d^T_{V_1,V_2}=\sqrt{\frac{\left|v_1^a-v_2^a\right|^2+\left|v_1^b-v_2^b\right|^2}{2}}. \quad (9)$$

Suppose the optimal value of market segmentation about evaluation indicator j is $u_j=\left[u_j^a,\mathrm{u}_j^b\right]$. The grey correlation coefficient between segmented market U_i about indicator j and the optimal value $u_j=\left[u_j^a,\mathrm{u}_j^b\right]$:

$$\delta_{ij}=\frac{\min\limits_i\min\limits_j\left|d^T_{v_{ij},u_j}\right|+\rho\max\limits_i\max\limits_j\left|d^T_{v_{ij},u_j}\right|}{\left|d^T_{v_{ij},u_j}\right|+\beta\max\limits_i\max\limits_j\left|d^T_{v_{ij},u_j}\right|}, \quad (10)$$

where ρ refers to discrimination coefficient of grey correlation analysis model, $\rho\in[0,1]$, usually $\rho=0.5$.

Given that the indicators have different weight, the weighed grey correlation degree σ_i between segmented market U_i and the optimal value $u_j=\left[u_j^a,\mathrm{u}_j^b\right]$ is:

$$\sigma_i=\sum_{j=1}^{n} w_j*\delta_{ij} \quad (11)$$

After the consultation with management team and other experts, we set up the threshold σ_0 of market segmentation. When there is:

$$\exists\ \forall\sigma_i\ \geq\sigma_0 \quad (12)$$

It means that the segmented market U_i has a feasibility and prospect for investment.

For s segmented market that fits the threshold σ_0, if there is:

$$U_{\max}=\max\ U_1,U_2,...,U_s\ =U_k \quad (13)$$

It means that the segmented market U_i has the most investment value and brightest prospect. Thus, it can be a key focus.

3.3 MARKET SEGMENTATION MODEL AND ALGORITHM BASED ON GREY CORRELATION DECESION ANALYSIS METHOD

The algorithm can be described as follows:

Step 1: According to selection principles of indicators in Chapter 1.1, the ideas from management team and relevant experts are collection for the selection of indicators.

Step 2: Based on Equations (1)-(4) in subsection 1.2, distribute the weight to these indicators.

Step 3: Standardize these indicators according to Equations (5) and (6).

Step 4: Analyse the distance between different evaluation indicators and the optimal value of indicators according to Equations (7)-(9).

Step 5: Acquire the weighed grey correlation degree between different indicators and the optimal value of indicators according to Equations (10) and (11).

Step 6: Acquire the hierarchy of segmented market that fits the threshold according to Equations (12) and (13) that pave the way for the development of key market.

4 Case study and test

Test is given to the effectiveness, scientific nature and feasibility of the model and algorithm through case study of a brand product. Market share, marketing profit rate, sales growth rate, customer satisfaction and marketing investment cost as evaluation indicators. The relative importance matrix A is obtained through AHP method:

$$A=\begin{vmatrix}1 & \frac{1}{3} & \frac{1}{3} & 5 & 5\\ 3 & 1 & 3 & 7 & 9\\ 3 & \frac{1}{3} & 1 & 5 & 9\\ \frac{1}{5} & \frac{1}{7} & \frac{1}{5} & 1 & 1\\ \frac{1}{5} & \frac{1}{9} & \frac{1}{9} & 1 & 1\end{vmatrix}_{5\times5}.$$

In the relative importance matrix, $CI=0.075\leq1$ all fitting the coincidence. Then the weighed of evaluation indicator is $W=\ 0.169,0.460,0.284,0.047,0.040$.

According to surveys of marketing performance and analysis on market information, market is divided into high-end market, middle-end market and low-end market. The evaluation result of each market is shown in Table 1.

TABLE 1 Evaluation result of segmented market of a home appliance product

	High-end market U_1	**Middle-end market U_2**	**Low-end market U_3**
Market share	11.50	22.30	15.60
Marketing profit rate	15.28-15.78	17.65-18.25	7.32-7.84
Sales growth rate	8.40-8.60	6.05-6.35	10.06-10.28
Customer satisfaction	0.90	0.95	0.90
Marketing investment cost	1260.00	980.00	840.00

The evaluation result after standardization is shown in Table 2.

TABLE 2 Evaluation result of segmented market after standardization

	High-end market U_1	**Middle-end market U_2**	**Low-end market U_3**
Market share	0.000	1.000	0.380
Marketing profit rate	0.728-0.774	0.945-1.000	0.000-0.048
Sales growth rate	0.556-0.603	0.000-0.071	0.948-1.000
Customer satisfaction	0.000	1.000	0.000
Marketing investment cost	0.000	0.667	1.000

The optimal value sequence of different evaluation indicators is:

$$u = 1.000,\ 0.945,1.000\ ,\ 0.948,1.000\ ,1.000,1.000\ .$$

The distance matrix B between different segmented market about indicator and the optimal value is:

$$B = \begin{vmatrix} 1.000 & 0.000 & 0.620 \\ 0.222 & 0.000 & 0.949 \\ 0.395 & 0.938 & 0.000 \\ 1.000 & 0.000 & 1.000 \\ 1.000 & 0.333 & 0.000 \end{vmatrix}_{5\times 3}.$$

The grey correlation coefficient matrix C between different segmented market about indicator and the optimal value is:

$$C = \begin{vmatrix} 0.333 & 1.000 & 0.446 \\ 0.693 & 1.000 & 0.345 \\ 0.558 & 0.348 & 1.000 \\ 0.333 & 1.000 & 0.300 \\ 0.333 & 0.600 & 0.000 \end{vmatrix}_{5\times 3}.$$

Therefore, the weighted grey correlation sequence is calculated as $\sigma = 0.563, 0.799, 0.574$. After consultation with management team and experts, we set the threshold as $\sigma_0 = 0.60$. In segmented market for this new type of home appliance, middle-end market is the best choice, followed by low-end market. The development value of high-end market is the lowest. Thus, middle-end market can be a target to shot. In this market, this enterprise can lower the sales cost, yield profit and increase competitiveness.

5 Conclusions

This paper studies market segmentation for key brand products and proposes a market segmentation model based on an improved grey correlation analysis methods. In this model, selection principles of evaluation indicators of market segmentation are first proposed. Weighed distribution is adopted based on AHP method to make sure the indicators are objective, scientific and reliable. These indicators are then subject to standardization to be in the unified measurement. In the process of grey correlation analysis, fuzzy distance calculation is introduced to deal with fuzzy and uncertain information. Weighed comprehensive grey correlation degree is then available, making the segmentation more reliable. Finally, test is given to the effectiveness, scientific nature and feasibility of the model and algorithm through case study. The model and algorithm provides scientific evidence for the enterprise to do market segmentation.

References

[1] Xu J, Ren Yu-long 2003 Application of Extension Method in Choosing Target Market of Electricity Marketing *Journal of Chongqing University* **26**(11) 142-145+154 *(in Chinese)*

[2] Wang J, Wang N 2010 Telecom Market Segmentation Research based on extension evaluation theory *Journal of Beijing University of Post and Telecommunication (Social science edition)* **12**(6) 60-5 *(in Chinese)*

[3] Ran J, Shao P 2008 To study on customers segmenting strategy of personal mobile communication based on customer value evaluation *Value Engineering* (**10**) 56-9

[4] Liao Y 2008 Study on market segmentation based on customers' satisfaction trap *Statistics and Information Forum* **23**(5) 5-10

[5] Chen T, Feng X, Liang B, Sun W 2013 Grey Fuzzy Evaluation of CBM Development and Area Selection *Journal of Northeastern University(Natural Science)* **34**(3) 429-33 *(in Chinese)*

[6] Ma D, Liu X, Wang S 2010 Comprehensive evaluation of high-speed railway track based on analytic hierarchy process *Subgrade Engineering* **151**(6) 6-8

[7] Wan Shu-ping 2009 New method for interval multi-attribute group decision making with incomplete attribute weights *Computer Integrated Manufacturing Systems* **15**(4) 104-9

[8] Xiang Y, Zou P, Ma L 2013 Multi-attribute Group Decision-making Based on Rapid Self-adjusting Delphi Method with Biased Information Sampling *Journal of Belting University of Technology* **39**(8) 1172-8 *(in Chinese)*

[9] Wu J, Wu X, Chen Y 2010 Validation of simulation models based on improved grey relational analysis *Systems Engineering and Electronics* **32**(8) 1677-9

[10] Wang T, Yang A, Bu L 2013 Mechanism scheme design based on multi-attribute extension grey relevant optimized decision-making model *Systems Engineering – Theory & Practice* 2013 **33**(9) 2321-9

[11] Liu S, Cai H, Yang Y 2013 Advance in grey incidence analysis modelling *Systems Engineering – Theory & Practice* **33**(8) 2041-6

[12] Liu S F, Dang Y G, Fang Z G 2010 Grey system theory and application *Beijing: Science Press (in Chinese)*

[13] Shi H X, Liu S F, Fang Z G, Zhang A 2008 The model of grey periodic incidence and their rehabilitation *Chinese Journal of Management Science* **16**(3) 131-6 *(in Chinese)*

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