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The Research on Sort Method of Consumer's Brand Preference Under Uncertain Environment

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Abstract: This study described the degree of influencing brand degree preference in different consumers through linguistic term, operated linguistic assessment information by applying evidential reasoning algorithm and combining the operator of dyadic semanteme, concluded different brand language evaluation value based on dyadic semanteme then measured and sorted different brand preference with the dyadic semanteme properties. The consumer brand preference ranking method under uncertain environment is a scientific solution to various uncertain problems in the consumer brand preference ordering. Finally, an analysis example is given to illustrate the feasibility and affectivity of the method.

Key words: Uncertain environment, evidence reasoning, dyadic semanteme, brand preference

INTRODUCTION

The consumer's brand preference is consumers' attempt to maintain a relationship with the target brand through a series of behaviors, primarily including allocation of a higher share of wallet to a particular service provider and their engagement in dissemination of the public praise and repeated purchases. Brand preference is not only a kind of behavior process but also a kind of psychological decision evaluation process (Lu and Zhang, 2004). Degree of brand preference is particularly important to consumers' scientific and reasonable decision-making for a purchase. At the same time, to determine the extent of consumers' brand preference is especially important to product designers, producers and sellers, based on which correct and effective operation decisions are made (Grimm, 2005; Da and Yingqing, 2005).

Consumers' brand preference behavior research is conducted mainly from three aspects in existing literature: The first, with reference to the utility maximization principle in economics, assuming that the consumers are informed completely of the various generic property of the brand, all information is to be synthesized, then the utility of each brand is calculated and compared with others', subsequently, the brand of the biggest overall utility is chosen. MNL model by Swait and Adamowicz (1996) and IPM model by Currim (1982) are the typical of this selection model of utility maximization. The second category simulates customers' purchase psychology, presuming that consumers have complete knowledge of the various generic property of the brand. Comparing the brands in pairs based on the attribute value to eliminate

the inferior, so as to determine the ideal brand for consumers. The binary choice model of Restle (1961) and multiple choice model of EBA by Tversky and Kahneman (1991) are the representatives of the second type; The third type measures multidimensional consumers' decision-making psychological characteristics upon the presumption that consumers are fully acquainted with various brand generic values and gives the multi-factor model consisting of different psychological characteristics (Walsh *et al.*, 2001). At present, most of both Chinese and foreign marketing researchers widely employ these three models to analyze the market structure, determine the product market, predict consumer's brand preference and divide consumers into groups (DeSarbo *et al.*, 1994; Eliashberg and Manrai, 1992). Obviously, the above-mentioned types of studies are based on probability theory or the utility function of the brand preference sorted, whether it is based on factual data or expert experience, are built on the basis of certain assumptions (such as the assumption that consumer understood completely to brand various generic attribute value; the data fully, etc.) to expand the research.

However, when the consumers choose the brand in real life, due to ambiguity of the human mental activities, uncertainties of decision-making environment and absence of decision-making data, the consumers hardly judge information of the brand preference by the accurate data but by language phrases instead. For instance, it is relatively easy to use the information of the language preference such as good, better, bad, worse to evaluate post-sale service of a certain brand (Shiv and Fedorikhin, 1999). As for uncertainty of the consumer's

brand preference, Wu and Pan (2004) and Matsatsinis and Samaras (2000) have done some related research. Their research paper presupposes that attribute values working on brand choice has been given in the form of vague language, namely through the fuzzy semantics into a triangular fuzzy number, then use computational methods such as fuzzy number generalized addition, approximate multiplication and scalar multiplication to determine the consumer brand preference sequence.

However, the decision-making of the consumers' brand preference is different from that of large projects in that the latter one is characteristic of strict procedures, enough time and money and involvement of some experts in the field in decision-making, while the consumer's decision-making may occur at any time without participation of experts in the field in most cases. The decision makers may be the consumer himself or the group familiar with him, due to their knowledge background, ability, money and time pressure and the lack of some data, they give their evaluation information of the brand in vague language and more possibly, by the language between two standard language evaluation grades or they are unable to give some attributes of a brand, namely a certain language attribute value is absent. But, Wu and Pan (2004) and Matsatsinis and Samaras (2000) research into the brand preference in language fails to consider one fact that to give the brand appraisal information possibly is situated between two standard language opinion rating or the vacancy situation. At the same time it does not take it into account the effect of different attribute weights on the intrgrited utility of the degree of brand preference. In order to solve many uncertainties in the consumer's brand preference sequence scientifically and effectively, this article applies the evidence inference algorithm, together with dual semantic the related operator, taking family car brand as an example to integrate information of different brand preferences on the uncertain environment and then to carry on the computation on the different degree of brand preference and to do reasonable sorting according to the computations.

THE METHOD OF THE CONSUMER'S BRAND PREFERENCE SEQUENCE

The expression method of confidence level under uncertainty environment: supposes L be a standard language phrase collection, it is a pre-defined ordered set composed of some odd number elements (Herrera and Martinez, 2000). This study considers a set which is made up of 7 element (i.e., standard language phrases), namely $L = (L_0, L_1, L_2, L_3, L_4, L_5, L_6) = \{\text{worst, worse, bad,$

common, good, better, best\}. For a scheduling problem of the consumer brand preference degree, we suppose that there be M index factors $C = \{C_1, C_2, \dots, C_M\}$ which influence consumer brand preference, we use the set $W = \{\omega_1, \omega_2, \dots, \omega_M\}$ to express the weight of the index factors and:

$$\sum_{j=1}^M \omega_j = 1$$

there are N consumer brand $A = \{A_1, A_2, \dots, A_N\}$, the decision-makers give r_{ij} which is the language evaluation value of Brand A_i relative to the index C_j , Namely obtains language appraisal matrix $R = (r_{ij})_{N \times M}$. Here, r_{ij} belongs to a L language opinion rating, either is situated between two language opinion rating or vacancy. Specifically, if the decision-makers give a standard evaluation rating which is the language evaluation value of Brand A_i relative to the index C_j , we mark it with L_s ($s = 0, 1, \dots, T$); if the decision-makers gives the language appraisal value is situated between two standard language opinion rating, we mark it with $L_{s+\alpha}$, $\alpha \in (0, 1)$, its meaning is that the decision-makers gives actually the appraisal information is situated between L_s and L_{s+1} , its deviation is α which relative to L_s , its deviation is $1-\alpha$ which relative to L_{s+1} ; if the decision-makers can not give a standard evaluation rating which is the language evaluation value of Brand A_i relative to the index C_j , we mark it with “-” which is expressed vacancy.

Thus, the following is evaluation information belonging to confidence level of the language opinion rating expression (Zhijian and Chao, 2006):

- If the decision-makers gives r_{ij} the language appraisal value is L_s , then evaluation of the value of A_i brand preference degree relative index C_j belongs to the L_s confidence level is $Q(i, j, s) = 1$
- If the decision-makers gives r_{ij} the language appraisal value is $L_{s+\alpha}$, then evaluation of the value of A_i brand preference degree relative index C_j belongs to the L_s confidence level is $Q(i, j, s) = 1-\alpha$, belongs to the L_{s+1} confidence level is $Q(i, j, s+1) = \alpha$
- If the decision-makers can not give r_{ij} the language appraisal value, namely the decision-makers can not describe that A_i brand preference degree relative index C_j , then evaluation of the value of A_i brand preference degree relative index C_j belongs to the L_s confidence level is $Q(i, j, s) = 0$

Solving the confidence level of the brand under language opinion rating: According to evidence theory related content (Shafer, 1976), evaluation of the value of A_i ($i = 1, \dots, N$) brand preference degree relative index

C_j ($j = 1, \dots, M$) belongs to the L_s confidence level as evidence of the theory of evidence, language opinion rating $L = \{L_s, s = 0, 1, \dots, T\}$ as the overall recognition frame. Set $Q(i, j, s)$ is the j th evidence of brand A_i , define its basic probability assignment function:

$$m_{j,s}(A_i) = \omega_j \times Q(i, j, s); m_{j,L}(A_i) = 1 - \sum_{s=0}^T m_{j,s}(A_i) \quad (1)$$

$j=1, \dots, M; i=1, \dots, N; s=0, 1, \dots, T$

Here, to mark the weight of the index C_j with ω_j , to mark decision with $m_{j,s}(A_i)$ expressing the basic probability distribution function produced by the degree of brand A_i preference of the decision-makers and assigned to the language opinion rating on the L_s . $m_{j,L}(A_i)$ expresses that the decision-makers can not describe the degree of brand preference A_i , namely has not been assigned to basic probability distribution function of any language opinion rating L_s ($s = 0, 1, \dots, T$).

Set:

- $m_{j(0)}(A_i) = m_1(A_i) \oplus m_2(A_i) \oplus \dots \oplus m_{j(0)}(A_i)$,
- $m_{j(i),s}(A_i) = m_{1,s}(A_i)$ ($s = 0, 1, \dots, T$), $m_{j(i),L}(A_i) = m_{1,L}(A_i)$

To use the recursive algorithm of literature (Zhijian and Chao, 2006), we get the comprehensive language evaluation level of the degree of A_i brand preference. Specific algorithm:

$$m_{j(j+1),s}(A_i) = K_{j(j+1)}(m_{j(j),s}(A_i)m_{j+1,s}(A_i) + m_{j(j),L}(A_i)m_{j+1,L}(A_i)) + m_{j(j),L}(A_i)m_{j+1,s}(A_i) \quad (2)$$

$$m_{j(j+1),L}(A_i) = K_{j(j+1)}m_{j(j),L}(A_i)m_{j+1,L}(A_i);$$

$$K_{j(j+1)} = [1 - \sum_{s=0}^T \sum_{s \neq g}^T m_{j(j),s}(A_i)m_{j+1,g}(A_i)]^{-1}$$

Obviously, $\forall s, 0 \leq s \leq T, m_s(A_i) = m_{j(M),s}(A_i), m_L(A_i) = m_{j(M),L}(A_i)$.

According to the value of $m_{j(M),s}(A_i), m_{j(M),L}(A_i)$, Brand A_i ($i = 1, \dots, N$) in different language opinion rating confidence level distribution is obtained:

$$S(A_i) = \{(L_s, \beta_s(A_i)) | s = 0, 1, \dots, T\} \quad (3)$$

and:

$$\beta_s(A_i) = \frac{1 - \beta_L(A_i)}{1 - m_{j(M),L}(A_i)} m_{j(M),s}(A_i),$$

$$\beta_L(A_i) = \sum_{j=1}^M \left(1 - \sum_{s=0}^T m_{j(M),s}(A_i) \right)$$

To gather the language symbols of different consumers' brand confidence level: From the formula 1-3, it can be known $\beta_0(A_i) + \beta_1(A_i) + \dots + \beta_T(A_i) \leq 1$, In order to facilitate the language of the brand symbols A_i assembly, normalized processing is done to $\beta_s(A_i)$ ($s = 0, 1, \dots, T$), then:

$$\bar{\beta}_s(A_i) = \frac{\beta_s(A_i)}{\sum_{s=0}^T \beta_s(A_i)}$$

Then confidence level of the brand A_i under various languages opinion rating: $\bar{\beta}_0(A_i), \bar{\beta}_1(A_i), \dots, \bar{\beta}_T(A_i)$. According to θ function of the two-tuple (Herrera and Martinez, 2000), various standard language opinion rating corresponds to two-tuple: $(L_0, 0), (L_1, 0), \dots, (L_T, 0)$. Let:

$$\theta(i) = \bar{\beta}_0(A_i) * \Delta^{-1}(L_0, 0) + \bar{\beta}_1(A_i) * \Delta^{-1}(L_1, 0) + \dots + \bar{\beta}_T(A_i) * \Delta^{-1}(L_T, 0)$$

It expresses the result of gathering linguistic symbols of brand A_i (Zhijian and Chao, 2006). According to the Δ^{-1} function of the two-tuple, there is:

$$\theta(i) = \bar{\beta}_0(A_i) * 0 + \bar{\beta}_1(A_i) * 1 + \dots + \bar{\beta}_T(A_i) * T \quad (4)$$

According to the formula (1-4), $\theta(i)$ can be transformed into the corresponding the two-tuple:

$$\Delta(\theta(i)) = (L_s, \alpha_i) = \begin{cases} L_s, s = \text{Round}(\theta(i)) \\ \alpha_i = \theta(i) - s \end{cases} \quad (5)$$

According to the formula 5, we obtain the corresponding evaluation information of the two-tuple $\Delta(\theta(1)), \Delta(\theta(2)), \dots, \Delta(\theta(N))$ of brand $A = \{A_1, A_2, \dots, A_N\}$, then according to sequence of the two-tuple nature (Herrera and Martinez, 2000), sorting of the degree of consumers' brand preference is made.

A CASE STUDY OF THE FAMILY CAR BRAND PREFERENCE SEQUENCE

Suppose some consumer wants to purchase a family car, he is to sort preference of five brands $A = \{A_1, A_2, \dots, A_5\}$ to sort the preferences. The family car is expected to hold advanced technology, scientific standards, the reliable quality and the excellent service. This article probes into the factors which affect car brand preference of consumers in the perspective of both behavior and emotion (You *et al.*, 2006) and concludes that these factors composed of five first-level targets: quality and safety of cars, cars visual image, price and maintenance costs, unique spiritual position and post-sale service and twenty-one second-level targets such as power, brake, manoeuvring, security and reliability. The consumer gives the weight of the first-level target and the second-level target according to backgrounds of individual experience, the knowledge and preference which is shown in Table 1.

The consumer gives the linguistic assessment information value of different brands under the

Table 1: Indexes and weights affecting the family car brand preference

First-level target		Second-level target	
Name	Weight	Name	Weight
Quality and safety (C ₁)	0.25	Dynamic (C ₁₁)	0.20
		Manoeuvring (C ₁₂)	0.20
		Safety and reliability (C ₁₃)	0.30
		Air-conditioning and soundbox (C ₁₄)	0.15
		Noise (C ₁₅)	0.15
Visual image (C ₂)	0.20	Colour (C ₂₁)	0.10
		Vehicle model (C ₂₂)	0.30
		Quality paint (C ₂₃)	0.20
		Lantern design (C ₂₄)	0.10
		Interior trim (C ₂₅)	0.30
Price and maintenance costs (C ₃)	0.20	Buying price (C ₃₁)	0.40
		Oil consumption (C ₃₂)	0.20
		Daily maintenance (C ₃₃)	0.20
		Maintenance costs (C ₃₄)	0.20
		Philosophy (C ₄₁)	0.30
The unique spirit of the proposition (C ₄)	0.15	Indulgent (C ₄₂)	0.40
		Unique cultural (C ₄₃)	0.30
		Maintenance convenience (C ₅₁)	0.30
Post-sale service (C ₅)	0.20	Maintenance capability (C ₅₂)	0.20
		Quality of service (C ₅₃)	0.20
		Parts supply capacity (C ₅₄)	0.30

Table 2: The consumers language evaluation value

C _j	C ₁₁	C ₁₂	C ₁₃	C ₁₄	C ₁₅	C ₂₁	C ₂₂	C ₂₃	C ₂₄	C ₂₅	C ₃₁	C ₃₂	C ₃₃	C ₃₄	C ₄₁	C ₄₂	C ₄₃	C ₅₁	C ₅₂	C ₅₃	C ₅₄
A ₁	L _{2,3}	L ₄	L ₅	L _{4,3}	L _{5,6}	L _{4,3}	L ₅	-	L _{4,5}	L _{5,2}	L _{2,3}	L ₄	L ₅	L _{4,3}	L _{5,2}	L ₄	-	-	L _{5,2}	L _{4,6}	L ₄
A ₂	-	L _{4,3}	L _{3,9}	L _{3,1}	L ₅	L _{3,6}	L _{4,3}	L _{3,9}	L ₄	-	L ₃	L _{4,3}	-	L _{3,1}	-	L ₃	L ₄	L _{5,6}	L _{4,3}	L ₃	-
A ₃	L _{3,4}	L _{3,3}	L ₂	-	L _{4,3}	-	L _{4,6}	-	L _{3,6}	L ₄	-	L ₅	L _{2,6}	L ₃	L ₃	-	L _{4,3}	L ₃	-	L _{3,8}	L _{4,8}
A ₄	L ₄	L _{3,7}	L _{3,6}	L ₃	-	L ₂	-	L _{3,8}	-	L ₃	L ₅	-	L ₃	L ₃	L ₄	L _{5,2}	L ₅	L ₅	L _{4,2}	L ₃	-
A ₅	L _{4,2}	-	L _{4,3}	L _{3,7}	L _{4,5}	L _{5,2}	L _{4,5}	L ₅	L ₃	-	L ₄	L _{4,2}	L ₄	-	L _{4,3}	L ₅	-	L _{4,8}	L ₄	-	L _{5,6}

second-level target according to backgrounds of individual experience, the knowledge and preference, specific information is shown in the Table 2.

According to the formula 1, at first, basic probability distribution function values of the different brands under second-level target is obtained, then using the formula 2 and 3, the basic probability distribution function values of the different brands are gathered to obtain the language opinion rating basic probability distribution function of brand A_i (i = 1, 2, 3, 4, 5) under the first-level target C_j (j = 1, 2, 3, 4, 5).

The formula 2 and 3 are used to together the language opinion rating basic probability distribution function under the first-level target, at the same time, to carry on normalized processing to get the overall distribution of brand language opinion rating.

The formula 4 is employed to deal with the dates of the Table 2, to get the two-tuple function value of Δ⁻¹ of different brands:

$$\theta(1) = 4.5124, \theta(2) = 3.7773, \theta(3) = 3.7343, \theta(4) = 4.1666, \theta(5) = 4.4677$$

According to the formula 5, θ(i) can be transformed into the corresponding the two-tuple Δ(θ(i)):

$$\Delta(\theta(1)) = (5, -0.4876), \Delta(\theta(2)) = (4, -0.2227), \Delta(\theta(3)) = (4, -0.2657), \Delta(\theta(4)) = (4, 0.16666), \Delta(\theta(5)) = (4, 0.4677)$$

The ordering of the five family car brand preference is obtained, according to the ordered nature of the two-tuple: A₁ > A₂ > A₃ > A₄ > A₅, here “>” expresses “surpass”.

CONCLUSION

In marketing activities, the consumer product attitude, namely the brand preference, has great influence on consumers’ potential future purchase behavior. When the consumer decides to choose the products of different brands, he always chooses that of a high degree of preference. Moreover, the psychological characteristics revealed in purchase decision-making directly affect the enterprise’s choice of the target market, product formulation and promotion strategies, accordingly, the studies on consumer’s brand preference behavior have become the centre of marketing research. At present, the consumer’s brand preference sequence research in certain environment has been perfect and mature. But in real life, due to the incompleteness of brand preference ranking

system's information and the loss of data, measurement of the preference degree by means of traditional mathematical modeling is of low reliability.

In response, the study fully considers many uncertainties of the consumer brand preference system, based on the analysis of existing achievements. It puts forward a consumer brand preference sequence model, comprehensively using evidential reasoning and the relevant operators of two-tuple. Finally, by a case study of the sequence of family car brand preference, the concrete application process is elaborated in detail which renders the theoretical significance as well as practicality and more accords with the actual situation.

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REFERENCES

- Currim, I.S., 1982. Predictive testing of consumer choice models that not subject to independence of irrelevant alternatives. *J. Marketing Res.*, 19: 208-222.
- Da, R. and L. Yingqing, 2005. Concerning Chinese car brand competition. *Auto Ind. Res.*, 1: 1-9.
- DeSarbo, W.S., A.K. Manrai and L.A. Manrai, 1994. Latent Class Multidimensional Scaling Approaches: A Review of the Recent Developments in the Marketing and Psychometric Literature. In: *Advanced Methods of Marketing Research*, Bagozzi (Ed.). Blackwell Publishers, Cambridge, MA., pp: 190-222.
- Eliashberg, J. and A.K. Manrai, 1992. Optimal positioning of new product-concepts: Some analytical implications and empirical results. *Eur. J. Operat. Res.*, 63: 376-397.
- Grimm, P.E., 2005. Ab components impact on brand preference. *J. Bus. Res.*, 58: 508-517.
- Herrera, F. and L. Martinez, 2000. A 2-tuple fuzzy linguistic representation model for computing with words. *IEEE Trans. Fuzzy Syst.*, 8: 746-752.
- Lu, J. and D.H. Zhang, 2004. An empirical study on the factors influencing brand loyalty. *Finance Trade Res.*, 6: 39-46.
- Matsatsinis, N.F. and A.P. Samaras, 2000. Brand choice model selection based on consumers multicriteria preferences and experts knowledge. *Comput. Operat. Res.*, 27: 689-707.
- Restle, F., 1961. *Psychology of Judgment and Choice: A Theoretical Essay*. Wiley Press, New York.
- Shafer, G., 1976. *A Mathematical Theory of Evidence*. 1st Edn., Princeton University Press, Princeton, New Jersey, USA.
- Shiv, B. and A. Fedorikhin, 1999. Heart and mind in conflict: The interplay of affect and cognition in consumer decision making. *J. Consum. Res.*, 26: 278-292.
- Swait, J. and W.L. Adamowicz, 1996. The effect of choice environment and task demands on consumer behavior: Discriminating between contribution and confusion. Staff Paper 96-09, University of Alberta, Department of Rural Economy, Staff Paper Series. <http://ageconsearch.umn.edu/handle/24091>
- Tversky, A. and D. Kahneman, 1991. Loss aversion in riskless choice: A reference-dependent model. *Q. J. Econ.*, 9: 1039-1061.
- Walsh, G., V.W. Mitchell and T. Hennig-Thurau, 2001. German consumer decision-making styles. *J. Consum. Affairs*, 35: 73-95.
- Wu, G.H. and D.H. Pan, 2004. A fuzzy method of ranking consumer's preference for brand. *Syst. Eng. Theory Practice*, 9: 28-32.
- You, H., T. Ryu, K. Oh, M.H. Yun and K.J. Kim, 2006. Development of customer satisfaction models for automotive interior materials. *Int. J. Ind. Ergon.*, 36: 323-330.
- Zhijian, W. and S. Chao, 2006. Based on the evidence of the semantic reasoning and two-tuple group decision-making method. *Stat. Decis.*, 2: 57-58.