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NEW STATISTICAL ANALYSIS IN MARKETING STUDIES USING FUZZY DATA APPROACH

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Resumen. Esta investigación propone nuevos métodos estadísticos para estudios de marketing y toma de decisiones. Este estudio utiliza una metodología de cálculo suave, así como una nueva herramienta estadística para evaluar el pensamiento de la gente. Dado que el sistema de medición clásico es difícil de tratar con información de valores falsos, el propósito de este estudio es encontrar un sistema de medición apropiado para superar este problema. La idea principal de esta investigación es dividir los datos en dos dimensiones de su centro y su extensión (región). Finalmente, el cuestionario bidimensional de este estudio nos ayuda a acceder a la información del mercado. En esta investigación, se ha abordado la satisfacción de los clientes en el mercado metropolitano de Mashhad utilizando el enfoque de datos difusos para las conocidas marcas LG, Samsung, Kenwood y Daewoo en la industria de lavadoras. Los resultados de este estudio indican que la marca de LG entre otras marcas en términos de índices de participación en el producto del mercado objetivo en su conjunto, así como características de rendimiento superior, y, de hecho, los clientes eligen la marca coreana en la elección de la lavadora en el primer lugar.

Abstract. This research proposes new statistical methods for marketing and decision-making studies. This study uses a soft calculation methodology as well as a new statistical tool for evaluating people's thinking. Since the classic measurement system is difficult to deal with untrue value information, the purpose of this study is to find an appropriate measurement system to overcome this problem. The main idea behind this research is to divide the data into two dimensions of its center and its extension (region). Finally, the two-dimensional questionnaire of this study helps us to access market information. In this research, the satisfaction of customers in Mashhad's metropolitan market by using the fuzzy data approach for the well-known brands LG, Samsung, Kenwood and Daewoo in the washing machine industry has been addressed. The results of this study indicate that LG's brand among other brands in terms of product share indices from the target market as a whole, as well as superior performance characteristics, and in fact, customers choose the Korean brand in the choice of washing machine in the first place.

Key Words: Decision Making, Fuzzy Logic, Fuzzy Data, Marketing Studies.

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1. INTRODUCTION

Talking about improving the quality of market research is not possible in order to systematically evaluate the performance of the work without tackling the problem of implementing a productivity evaluation tool. Using this measurement system requires the creation of a metric system for sampling or field studies using fuzzy data (Wu and Gang, 2006).

Given the nature of the subject, market research and decision-making studies can analyze how people plan how their activities are conducted within a given time frame; researchers can see this difference in Plan and act as a function of dynamic events, budgets, time, and so on. However, many research studies use cross-sectional design and measurement tools that emphasize stability and sustainability rather than dynamic aspects of time management behavior. Future research can benefit from dynamic approaches in the field of theorizing as well as research and research (Nguyen & Wu, 2011).

In many areas, including language, thought, and decision making, where classification or ranking is somewhat vague and irreducible, often we may simply lose significant data. As a result, the phenomenon of statistics can easily and quickly describe the basic structure of information for analyzing data used in many scientific fields. Many researchers focus on statistical analysis applications with a fuzzy data approach in the social sciences that helps identify and also build a model through qualitative simulation.

Wu & Tseng (2002) used a fuzzy regression method to estimate the coefficient for the analysis of the country's economic monitoring index. Nguyen et al. (2011) have presented a broad-based approach to fuzzy logic theory.

2. RESEARCH BACKGROUND

Marketing research includes the process of identifying needs, defining goals for achieving needs, prioritizing and scheduling the tasks required to achieve these goals. Although we know there are several other definitions.
Macan (1996), a technique to use effective time, in particular having enough time to perform, scheduling and time, has proposed many of the required tasks. Strongman & Burt (2000), Maximizing Intellectual Productivity, have evaluated the relative importance of activity through the development of a prioritization plan.
Kahraman & Yavuz (2010), in their book, put forward all areas of production management that reflect a natural order of production management responsibilities.

The authors focus on functionality, so whenever possible, numerical examples may appear. Marketing management behaviors include:

1) Marketing assessment behaviors that are relevant to the purpose of the present, or in the past, present and future, and the self-awareness of the use of marketing (attitudes and cognition that help to accept the duties and responsibilities that apply in the use of capabilities Marketing)

2) Marketing planning behaviors such as goal setting, task scheduling, prioritization, to do list creation and task grouping that are used in effective marketing use (Lee, Chang & Wu, 2012; Macan, 1996).

Marketing oversight behaviors are seen by observing people's use of goal marketing while limiting their activities by creating a feedback loop that allows the interruption of others' perceptions (Wu, Mei & Zhong, 2012).

In light of the above discussion, this research proposes an idea of marketing management, entitled "Behaviors that are effective in achieving effective use of time while the ultimate goal is to target activities." This definition affirms that an efficient marketing management assessment depends on the difference between expectations and market observation (realized).

Marketing Management Inventory includes operating items in:

1) Attitude towards marketing management

2) Planning the allocation of the market

This scale includes three short-term planning, long-term planning and time-based approaches. Establishing goals and priorities of the organization has a positive relationship with time control, while there is a negative correlation between time management mechanics and time control.

Claessens, Van Eerde, Rutte, & Roe (2004) have used a variety of marketing management measures to test an intermediate model over time. Instead, the research was conducted using a planning scale.

This study also shows part of the mediating time control. As a result, these studies find a kind of support for a process model that the control hypothesis can be fully understood between time management behaviors and intermediate and intermediate career and interpersonal outcomes.

Many of the marketing-related studies are the result of several other variables. Some definitions focus on the effects on proximal variables, such as the duration of estimation accuracy and the time spent on performing priority tasks. Other studies have examined the effects of marketing management on job performance and the academic environment, including job efficiency, inferiority performance, and overall study habits. As for emotional exhaustion, Peeters & Rutte (2005) found that intermediate and high-demand interacting with each other are interlinked, with low autonomy and emotional exhaustion on the other.

3. STATISTICAL ANALYSIS USING SOFT COMPUTING

3.1 Questionnaire based on fuzzy theory

Concerning the choice of statistical tools in the evaluation, since the evaluation must be aligned on the same logic, there should be significant differences in the criteria. Finding a validation system with good fixation is the key to achieving this goal. In the study of Fuzzy Graphic Assessment Scale (FGRS), by Hesketh, Pryor, Gleitzman & Hesketh (1988), Costas, Maranon and Cabrera (1994), in which 100 students were selected as the sample of study, they found that (FGRS) Commensurate with the characteristics of human psychology.

Herrera & Herrera-Viedma (2000) state that language linguistic analysis is now underway as linguistic information. By examining fuzzy numbers, there are different degrees of opportunity for the expression of linguistics. However, studies should answer whether the same fuzzy number will be produced. Creating similarity in terms of linguistic concept, at present, obtains a formula in terms of the fuzzy relationship. Carlson and Fuller (2000); Chiang, Chow & Wang (2000); and Herrera & Herrera-Viedma (2000) have introduced many concepts about how to calculate the fuzzy proper language segment.

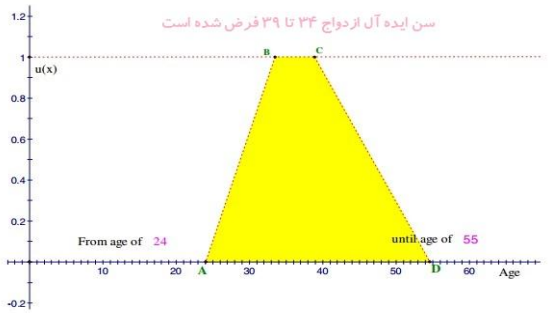

Figure 1. The fuzzy diagram of the expected marriage age

Figure 1 is a picture of a fuzzy questionnaire about the first time of marriage. Before responding to the fuzzy questionnaire, respondents could click on three buttons to understand the meaning of each of the options. For example, if people decide that the point AB represents the ideal age for marriage, then the marriage age will increase continuously from age 24 to 34. The BC point represents the optimal age of marriage, which is assumed here from age 34 to 39. The CD point represents the ideal age of marriage from 39 to 55 years of age. As a result, respondents know that their expected age for marriage will be derived from moving between the four points A, B, C, and D. Finally, moving between the four decision points will automatically change the age.

3.2 Measure with fuzzy data

A trapezoidal fuzzy set is similar to a comet fuzzy set, which is more indicative of uncertain events. In an example of trapezoidal fuzzy data, the interests of the researcher are measured in the scale of the real value line.
However, in some practical applications, it should be noted that instead of the main class, there is a linear measurement of a more general class of non-linear variations between scales, which is more reasonable. For example, earthquake energy is presented in both the usual energy scale and logarithmic scale (Richter scale). Similarly, the power of a signal (sound) is measured in watts as well as logarithmic scale. Considering the proper and meaningful conditions of the trapezoidal map of the real value line data, two conditions are necessary:

1) Modified data has a finite dimension.
2) The dependence on these parameters should be simple (recognizable). And mathematically, this means that this modified group is in fact a fake group.

After choosing a change, instead of considering the original trapezoidal data, a new value appears as y = f (x). Under ideal conditions, this new value y has a normal distribution. (In practice, a normal distribution for y may be a good initial estimate.) When choosing a change, it is necessary to consider the numerical values of x that are not unique because of the possibility of a re-measurement.

Definition (1): Measure a trapezoidal fuzzy number in GUASS software. Suppose A = [a, b, c, d] is a trapezoidal fuzzy number on U with the following center of gravity Equation 1:

$$(cx.cy) = \left(\frac{\int Xu_{A(X)dx}}{Xu_{A(X)dx}}\right)\frac{\int \frac{1}{2}\left(uA(x)\right)^2 dx}{\int uA(x)dx} \quad (1)$$

Then we define the fuzzy value (RA), the matrix A = [a, b, c, d] as follows in Equation 2:

$$RA = cx + \frac{\| A \|}{2\ln(e+\| cx \|)} \quad (2)$$

In the above statement, A is the trapezoidal area. Note that for convenience calculations we consider it as follows:

$$\text{Trapezoid} \leftarrow \| A \| = \frac{a+b+c+d}{4}$$

$$\text{Triangle} \leftarrow \| A \| = \frac{a+b+c}{3}$$

$$\text{Interrupts} \leftarrow \| A \| = \frac{b+c}{2}$$

Example (1):
Suppose A1 = [2,2,3,3], A2 = [1,1,4,4], A3 = [1,2,5,2,5,4], A4 = [1,2,5,2,5,8], A5 = [1,2,3,4] and finally A6 = [1,2,3,8] are fuzzy data. According to the definition in Table 1, the fuzzy data is shown.

However, some studies and definitions of the measurement system are apparent. In this section, we study the well-defined distance scale for trapezoidal fuzzy data.

Example (2):
Assume that Ai = [ai, bi, ci, di] is a sequence of trapezoidal fuzzy numbers called U with gravity center as Equation 3, 4:

$$(cx.cy) = \left(\frac{\int Xu_{A(X)dx}}{Xu_{A(X)dx}}\right)\frac{\int \frac{1}{2}(uA(x))^2 dx}{\int uA(x)dx} \quad (3)$$

$$d(A_i.A_j) = |cx_i - cx_j| + \left|\frac{\| A_i \|}{2\ln(e+\| cx_i \|)} - \frac{\| A_j \|}{2\ln(e+\| cx_j \|)}\right| \quad (4)$$

Example (3):
Suppose A1 = [2,2,3,3], A2 = [1,1,4,4], A3 = [1,2,5,2,5,4], A4 = [1,2,5,2,5,8], A5 = [1,2,3,4] and finally A6 = [1,2,3,8] are fuzzy data. Given the definition of 3.2, Table 2 shows the distance between them.

Fuzzy data	cx	$\frac{\| A_i \|}{2\ln(e+\| cx_i \|)}$	RA
A_1= [2,2,3,3]	20.5	0.30	2.80
A_2= [1,1,4,4]	20.5	0.91	3.41
A_3= [1,2.5,2.5,4]	20.5	0.45	2.95
A_4= [1,2.5,2.5,8]	20.5	0.96	4.46
A_5= [1,2,3,4]	20.5	0.61	3.16
Source: Research calculations			

Table 1. Fuzzy Data Created

According to Table 1 there is a gap between the data and the expected value, the smaller the gap, the more the observed data is proportional to the expected values. Defining a clear picture of the distance between the idea and actual data on productivity is necessary because the standard constraint is between zero and one. This research uses the f (x) transform, which is a set of fuzzy data and possible values for x between zero and one.

3.3 Two-dimensional questionnaire and its answers

The main topic in this research is to answer the two-dimensional questionnaire (X, Y). In the two-dimensional questionnaire, we need not only the relative weight of the factor X but also the perception of the factor Y (as a member). For example, a U domain with K is a different factor: (x1, x2, ..., xk) and (y1, y2, ..., yk). And for the perception of the xi factor: Equation 5.

$$\sum_{i=1}^{k} \mu_i(x) = 1 \text{ و } \mu_i(y) \rightarrow (0.1)$$

(5)

Hence, the two-dimensional example will appear as follows in Equation 6:

$$\mu_u(x.y) = \frac{(\mu_1(x);\mu_1(y))}{x_1} + \frac{(\mu_2(x);\mu_2(y))}{x_2} + \cdots + \frac{(\mu_k(x);\mu_k(y))}{x_k}$$

(6)

For actual calculations, we perform the following Equation 7:

$$\mu_u(x.y_j) = \frac{(\mu_1(x);\mu_1(y_j))}{x_1} + \frac{(\mu_2(x);\mu_2(y_j))}{x_2} + \cdots + \frac{(\mu_k(x);\mu_k(y_j))}{x_k}.j = 1.2.\cdots.n$$

(7)

J is a series of random samples. Then the Fs statistic means that these fuzzy data will be as follows in Equation 8:

$$F_s = \frac{(\frac{1}{n}\sum_{j=1}^{n} x_{1j}.\frac{1}{n}\sum_{j=1}^{n} y_{1j})}{x_1} + \frac{(\frac{1}{n}\sum_{j=1}^{n} x_{2j}.\frac{1}{n}\sum_{j=1}^{n} y_{2j})}{x_2} + \cdots + \frac{(\frac{1}{n}\sum_{j=1}^{n} x_{kj}.\frac{1}{n}\sum_{j=1}^{n} y_{kj})}{x_k}$$

(8)

As we know (xi, yi), data are related to the weight of factors and the sense of understanding of people's thinking. If the fuzzy data is discrete, the actual value of the conversion of this data is between zero and one, and then the weight of the factors is as follows in Equation 9:

$$s_i = \frac{1}{m-1}\left[\sum_{j=1}^{m} j\cdot\mu_j(y_i) + \frac{1}{m-1}(\sum_{j=1}^{m} j\cdot\mu_j(y_i)\cdot\left|j - \sum_{j=1}^{m} j\cdot\mu_j(y_i)\right|)\right]$$

(9)

To find a general satisfaction index, computing the community average is required through a sample. This whole index is as follows in Equation 10:

$$GIS = \frac{1}{n}\sum_{i=1}^{n} I\cdot s_i$$

(10)

Simply put, the sample has become a matrix form.

Definition (2): A sample of fuzzy data in the matrix form

Suppose that U and V are two fuzzy samples, each of which is defined as follows:

$$U.\{p_j.j = 1.2.\cdots.m\}$$

$$V.\{s_k.k = 1.2.\cdots.r\}$$

$$\{L_i.i = 1.2.\cdots.n\}$$

$$L_i(\sum_{i=1}^{n} U_{i.k}) = 1$$

$$P_i(\sum_{j=1}^{m} V_{ij.k}) = 1$$

(11)

(12)

$d(A_i.A_j)$	A_1=[2,2,3,3]	A_2=[1,1,4,4]	A_3=[1,2.5,2.5,4]	A_4=[1,2.5,2.5,8]	A_5=[1,2,3,4]
A_1=[2,2,3,3]	0	0.61	0.15	1.66	0.31
A_2=[1,1,4,4]	⋯	0	0.46	1.05	0.30
A_3=[1,2.5,2.5,4]	⋯	⋯	0	1.51	0.16
A_4=[1,2.5,2.5,8]	⋯	⋯	⋯	0	1.35
A_5=[1,2,3,4]	⋯	⋯	⋯	⋯	0
Source: Research calculations					

Table 2. Large data spacing

	household			Cleaning companies			Nursing homes		
	improvement	service	diversity	improvement	service	diversity	improvement	service	diversity
A	0.3	0.4	0.2	0.5	0.4	0.5	0.2	0.6	0.4
B	0.4	0.4	0.5	0.1	0.3	0.4	0.2	0.1	0.4
C	0.3	0.2	0.3	0.4	0.3	0.1	0.6	0.3	0.2
Source: Research calculations									

Table 3. Data for three major groups of customers

Therefore, the matrix of the above example is as follows in Equation 13:

$$S_k = \begin{bmatrix} (v_{1.1}.u_1)k & (v_{2.1}.u_2)k & \cdots & (v_{n.1}.u_n)k \\ (v_{1.2}.u_1)k & (v_{2.2}.u_2)k & \cdots & (v_{n.2}.u_n)k \\ \vdots & \vdots & \ddots & \vdots \\ (v_{1.m}.u_1)k & (v_{2.m}.u_2)k & \cdots & (v_{n.m}.u_n)k \end{bmatrix} \quad (13)$$

We assume that $\overline{u_i} = \frac{1}{r}\sum_{k=1}^{r} u_{i.k}$ and $\overline{v_{i.j}} = \frac{1}{r}\sum_{k=1}^{r} v_{ij.k}$, the fuzzy data matrix can be represented as Equation 14:

$$S_k = \begin{bmatrix} (v_{1.1}.u_1)k & (v_{2.1}.u_2)k & \cdots & (v_{n.1}.u_n)k \\ (v_{1.2}.u_1)k & (v_{2.2}.u_2)k & \cdots & (v_{n.2}.u_n)k \\ \vdots & \vdots & \ddots & \vdots \\ (v_{1.m}.u_1)k & (v_{2.m}.u_2)k & \cdots & (v_{n.m}.u_n)k \end{bmatrix} \quad (14)$$

If that $\overline{u_i} = \frac{1}{r}\sum_{k=1}^{r} u_{i.k}$ and $\overline{v_{i.j}} = \frac{1}{r}\sum_{k=1}^{r} v_{ij.k}$, For a series of fuzzy data with matrix matrix form, the sample is as Equation 15:

$$\bar{S} = \begin{bmatrix} (\bar{v}_{11}.\bar{u}_1) & (\bar{v}_{21}.\bar{u}_2) & \cdots & (\bar{v}_{n1}.\bar{u}_n) \\ (\bar{v}_{12}.\bar{u}_1) & (\bar{v}_{22}.\bar{u}_2) & \cdots & (\bar{v}_{n2}.\bar{u}_n) \\ \vdots & \vdots & \ddots & \vdots \\ (\bar{v}_{m1}.\bar{u}_1) & (\bar{v}_{m2}.\bar{u}_2) & \cdots & (\bar{v}_{nm}.\bar{u}_n) \end{bmatrix} \quad (15)$$

	LG	SAMSUNG	KENWOOD	DEAWO
PRICE	0.067	0.747	0.373	0.481
Efficiency	0.038	0.247	0.080	0.168
Appearance	-0.127	0.323	0.350	-0.127
brand	0.032	0.402	0.102	-0.438
Source: Research calculations				

Table 4. Fuzzy correlation for four brands in the laundry industry

4. EVALUATION OF THE QUALITY OF 4 WELL-KNOWN WASHING MACHINES IN THE MASHHAD METROPOLIS AND ITS IMPACT ON THE MARKETING OF THESE PRODUCTS:

Information about the degree of satisfaction with the washing machine is very important for future washing machine marketing research in the future. This study uses fuzzy data and a two-dimensional questionnaire to assess the satisfaction of the quality of washing machines and also provide a mathematical model for assessing customer satisfaction from the quality of 4 well-known brands of washing machines in the Mashhad metropolitan area, and The collected data is collected in the form of an empirical study to use the owners of these companies to achieve their results in research and development, after-sales services, etc., thereby improving and improving the marketing process of these products.

4 famous brands of washing machines on the Mashhad, LG, Samsung, Kenwood and Daewoo markets. This study examines the customer satisfaction based on the four factors of price, performance, appearance and brand name (brand). In the first place, we obtain the matrix of the sample mean, which is as follows in Equation 16:

$$\bar{S} = \begin{bmatrix} (0/328\ .0/175) & (0/276\ .0/539) & (0/319\ .0/170) & (0/291\ .0/116) \\ (0/239\ .0/175) & (0/132\ .0/539) & (0/279\ .0/170) & (0/243\ .0/116) \\ (0/298\ .0/175) & (0/217\ .0/539) & (0/267\ .0/170) & (0/226\ .0/116) \\ (0/135\ .0/175) & (0/194\ .0/539) & (0/135\ .0/170) & (0/240\ .0/116) \end{bmatrix} \quad (16)$$

For example, the average of the four brands of LG, Samsung, Kenwood and Doo is respectively 175. 0, 0 539, 0.061, and 0.116, respectively. The fuzzy mode for these four brands (based on the brand's share of the percentage among the sample) is as follows in Equation 17:

$$Max: \left\{ \frac{28/5}{SAMSUNG} . \frac{34/2}{LG} . \frac{18/4}{KENWOOD} . \frac{20/2}{DEAWOO} \right\} = \frac{34/2}{LG} \quad (17)$$

The above result (Equation 17) means that many of the customers surveyed have chosen LG's brand for their laundry, and in fact they have trusted this Korean brand. And the brand has also earned the most points and scores (from 100 points) in its performance review.

$$Max: \left\{ \frac{60/699}{PRICE} . \frac{68/041}{\text{Efficiency}} . \frac{50/413}{\text{Appearance}} . \frac{45/848}{\text{brand}} \right\} = \frac{68/041}{\text{Efficiency}} \quad (18)$$

4.1 Experimental Evidence

1) From the commercial point of view, the LG brand has a large negative correlation with the price variable, while the type of this correlation is positive and weak for other competitors.

2) In terms of performance, LG's brand has a

strong, positive correlation with its competitors. And both the results of this hypothesis confirm that in the Mashhad metropolitan area, the Korean brand LG is the top priority for all brands of customers.

5. CONCLUSION AND SUGGESTIONS

Today, the soft computing technique as a new discipline needs to be expanded to address the vague and imprecise examples of human thinking in empirical environments. The necessity of this research is based on two bases:

1) Provide multivariate modeling and dependency analysis between fuzzy data.

2) Provide the necessary legal frameworks to expand the scope of engineering science, including applications, the generalization of the science of business statistics, which includes belief and behavioral functions.

The proposed technique is able to provide a more detailed and sophisticated analysis of fuzzy data than other available methods. Especially when data does not clearly represent a section of human thinking, the demand for creating fuzzy data that is faithfully expressed in the same flow of ideology and human beliefs is constantly increasing.

Here is the basic question: What is the most desirable method for fitting a good model of a set of fuzzy data? Fuzzy matching fitting by AIC method or SSE method?

Obviously, comparisons of large statistical societies with limited and random sampling and the calculation of random indices such as random sample covariance and expected mean of a random sample are taken.

This study examines the customer satisfaction in Mashhad's major market relative to the four well-known brands LG, Samsung, Kenwood and Daewoo in the washing industry using the fuzzy data approach. Finally, it was determined that LG's Korean brand the market share indicators and performance characteristics of its other rivals are leading. In fact, Mashhad's customers in the selection of the washing machine will place this Korean brand in their top priority.

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