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A Fuzzy Decision Model for Clothing Sales

Ji Zeng
College of Management, Sichuan University of Science &Engineering, China

ABSTRACT: *Sale issue is a common topic among dealers. How to reasonably arrange the purchases and sales is very important. In this paper, the purchases and sales of clothes sales are studied, and a mathematical model for clothing sales is proposed. Fuzzy comprehensive evaluation is used to help predict the market sales. This model is useful for dealers to reasonably manage their sales.*
Keywords: *Fuzzy Decision, Fuzzy Comprehensive Evaluation, Management, clothing sales*

I. INTRODUCTION

Clothing industry is one of the pillar industries in the textile industry, which is an extremely important role for stimulating the economic benefits of the whole textile industry[1-3]. It is also a hot spot in consumer market. The sellers always want to know whether the clothes would be popular when they purchase. Popular clothes will bring more profit.

A scientific and convenient method is needed for the administrator to objectively give out the order list of clothes. Fuzzy decision based on fuzzy comprehensive evaluation is a simple and valid method to deal with this issue[4-6].

Fuzzy comprehensive[7-11] evaluation transforms the qualitative evaluation into the quantitative evaluation according to the subordinative degree theory in fuzzy mathematics, which would give the comprehensive evaluation for an object associated with multiple factors by using fuzzy mathematics. It is systematic and will give the clearly results. It is a good method to solve the problems, which are hard to quantify, and it is suitable to deal with the uncertain problems[12-13].

II. PRELIMINARIES

1.1 Subordinative Degree

Let u_i denote the factor related with the object, and we assume there are *m* various factors related with the evaluation object in the collection set, i.e.,

$$U = \{u_1, u_2, u_3, \ldots u_i, \ldots u_m\}.$$

Usually, these elements with different degrees of ambiguity are difficult to quantify.
In order to indicate the importance of various factors, the factors should be given the corresponding weights $a_i (i = 1,2,\cdots,m)$. The weights set is

$$A = (a_1, a_2, \cdots, a_m)$$

where, $\sum_{i=1}^{m} a_i = 1,\ a_i \geq 0\ (i = 1,2,\cdots,m)$.

This expression can be shown as

$$A = \frac{a_1}{u_1} + \frac{a_2}{u_2} + \cdots + \frac{a_m}{u_m}.$$

The weights are always determined according to actual situation by using the subordinative degree function. For the same evaluation factors, different weights will get different evaluation results.

1.2 Fuzzy Inner Product

The symbol "$\circ$" denotes the inner product, the operation is as follows

$$A \circ B = \vee_{u \in U} (\mu_A(u) \wedge \mu_B(u))$$

$a \vee b = \max(a, b)$, $a \wedge b = \min(a, b)$, $\mu_A(u) \in [0, 1]$ is the subordinative degree.
For example, if $A = (0.8, 0.5, 0.3, 0.7)$, $B = (0.4, 0.7, 0.5, 0.2)$, then

$$A \circ B^T = (0.8, 0.5, 0.3, 0.7) \circ \begin{bmatrix} 0.4 \\ 0.7 \\ 0.5 \\ 0.2 \end{bmatrix}$$

$$= (0.8 \wedge 0.4) \vee (0.5 \wedge 0.7) \vee (0.3 \wedge 0.5) \vee (0.7 \wedge 0.2)$$
$$= 0.4 \vee 0.5 \vee 0.3 \vee 0.2$$
$$= 0.5$$

III. FUZZY DECISION MODEL

Let

$$V = \{v_1, v_2, v_3 ... v_j, ... v_n\}, \quad v_i (i = 1,2,3,\cdots,m)$$

denote the evaluation result, which is a set consisting of a variety of evaluation results.
Our goal is to give the best evaluation results to help the final decision based on the comprehensive consideration of all the factors.

The evaluation of every factor u_i will get a subordinative degree $\mu_{v_j}(u_i) \in [0, 1]$ $(j = 1,2,3,\cdots,n)$,

$$\mu_{v_1}(u_i)/v_1 + \mu_{v_2}(u_i)/v_2 + \cdots + \mu_{v_n}(u_i)/v_n,$$

which forms a fuzzy evaluation set.

We denote $\mu_{v_j}(u_i) = r_{ij}$, then for every factor u_i, we will get a fuzzy vector $r_i = [r_{i1}, r_{i2}, r_{i3}, \cdots r_{in}]$.

The evaluation matrix is a $m \times n$ fuzzy matrix

$$R = \begin{bmatrix} r_1 \\ r_2 \\ \vdots \\ \vdots \\ r_m \end{bmatrix} = \begin{bmatrix} r_{11} & r_{12} & \cdots\cdots & r_{1n} \\ r_{21} & r_{22} & \cdots\cdots & r_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ \cdots & \cdots & \cdots & \cdots \\ r_{m1} & r_{m2} & \cdots\cdots & r_{mn} \end{bmatrix}$$

The comprehensive evaluation result is $B = A \circ R = (b_1, b_2, \cdots, b_n)$.

Usually, the result is not suitable for the final decision, because $b_1 + b_2 + \cdots + b_n \neq 1$. Different result cannot be compared, for some $b_1 + b_2 + \cdots + b_n > 1$ and some $b_1 + b_2 + \cdots + b_n < 1$. We have to normalize the result.

If $b_1 + b_2 + \cdots + b_n = k$, then,

$$\tilde{B} = (\frac{b_1}{k}, \frac{b_2}{k}, \cdots, \frac{b_n}{k}) = (k_1, k_2, \cdots k_n)$$

will be the suitable final result.

IV. APPLICATION

In clothing sales industry of clothing, the sales man will know whether the clothes are popular or not according to the customer's preferences, such as, color, style, durability, price and comfort level. We want give a evaluation for a kind of clothes, how most of the customers feel about it, love, enjoy, like, dislike. The factors are list in Table 1.

Table 1 the factors of the clothes

u_1	u_2	u_3	u_4	u_5
color	style	durability	price	comfort level

And the evaluation result elements are list in Table 2.

Table 2 the evaluation result elements

v_1	v_2	v_3	v_4
love	enjoy	like	dislike

The factor set is

$U = \{color, style, durability, price, comfort\ level\}$,

and the evaluation set is

$V = \{love, enjoy, like, dislike\}$

We use the fuzzy evaluation method. The subordinative degree associated with evaluation set will be given by the sales man according to their rich experience.

Color: $r_1 = (0.2, 0.4, 0.3, 0.1)$

Style: $r_2 = (0, 0.2, 0.5, 0.3)$

Durability: $r_3 = (0.1, 0.6, 0.2, 0.1)$

Price: $r_4 = (0.2, 0.5, 0.3, 0)$

Comfort level: $r_5 = (0.4, 0.5, 0.1, 0)$

The fuzzy matrix is

$$R = \begin{bmatrix} 0.2 & 0.4 & 0.3 & 0.1 \\ 0 & 0.2 & 0.5 & 0.3 \\ 0.1 & 0.6 & 0.2 & 0.1 \\ 0.2 & 0.5 & 0.3 & 0 \\ 0.4 & 0.5 & 0.1 & 0 \end{bmatrix} = \begin{bmatrix} r_1 \\ r_2 \\ r_3 \\ r_4 \\ r_5 \end{bmatrix}$$

When customers want to by some clothes, they will think about various aspects. And different factors will be given different weight. We assume the weights given by a group of customers are color 0.3, style 0.1, durability 0.1, price 0.1, comfort level 0.4, i.e.,

$A = (0.3, 0.1, 0.1, 0.1, 0.4)$.

Then, we compute

$$B = A \circ R$$

$$= (0.3, 0.1, 0.1, 0.1, 0.4) \circ \begin{bmatrix} 0.2 & 0.4 & 0.3 & 0.1 \\ 0 & 0.2 & 0.5 & 0.3 \\ 0.1 & 0.6 & 0.2 & 0.1 \\ 0.2 & 0.5 & 0.3 & 0 \\ 0.4 & 0.5 & 0.1 & 0 \end{bmatrix}$$

$$= (0.4, 0.4\ 0.3\ 0.1)$$

Normalization

$$(\frac{0.4}{1.2}, \frac{0.4}{1.2}, \frac{0.3}{1.2}, \frac{0.1}{1.2}) = (0.33, 0.33, 0.25, 0.09).$$

This indicates that in this customer group, about 66% of them would like this kind of clothes, the sales man will purchase with large amount of the clothes.

V. CONCLUSION

Multiple factors should be considered and rich experience is needed in selling clothes. The popular clothes will bring a lot of benefits. A scientific and rational decision will be given by using our fuzzy decision model. The abstract factors are quantified, and quantitative result is output. This model will give the guidance for dealers. They may foresee whether the clothes are popular or not.

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