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MATHEMATICAL CALCULATION OF FUZZY STATISTICS FOR QUALITY EVALUATION

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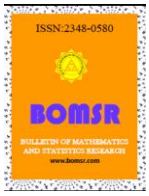

ABSTRACT

The quality evaluation is an essential need for accepting cotton towel products having desired quality specification. Human perceived sensation depends on physiological and physical properties of quality as well as demographic characters of consumers. In this paper, a mathematical method of fuzzy Statistics for quality evaluation is proposed. It illustrates the cotton towel products of quality evaluation such as colour, designs, quality and price etc. of a product with consumer's demographic characters on a hedonic scale.

Keywords: Fuzzy set, fuzzification, de-fuzzification, performance measures, hedonic scale.

2010 Mathematics and Statistics Subject Classification: 94D, 11K.

1. Introduction

Fuzzy sets were introduced by Lotfi A Zadeh in 1965 to represent/manipulate data and information possessing non statistical uncertainties. It was specifically designed to mathematically represent uncertainty and vagueness and to provide formalized tools for dealing with the imprecision intrinsic to many problems. Fuzzy number is an extension of the interval of confidence on uncertainty. *A* is a fuzzy set and *x* is a relevant object, the proposition *x* is a member of *A* is not necessarily either true or false, as required by two – valued logic, but it may be true only to some degree, the degree to which *x* is actually a member of *A*. It most common, but not required to express degrees of membership in fuzzy sets as well as degrees of truth of the associated propositions by numbers in the closed unit interval [0,1].Helledoorn and Thomas (1993) have specifiedfive criteria which to measurethe methods. These criteria will be repeated here for the benefit of the reader who also ponders the question just given in terms of the advantages and disadvantages of the various methods. The first criterion is *continuity*. Second, a criterion is called*dis-ambiguity*. The third criterion is called plausibility. To be plausible, Z^*should lie approximately in the middle of the support region of $\underset{\sim}{C}_k$ and have a high degree of membership in $\underset{\sim}{C}_k$. The centroid method equationZ^* does not exhibit plausibility in some situations when it lies in a region of the output that has a low degree of membership. The fourth criterion is that of

computational simplicity and the fifth criterion is called the *weighting* method. Sargunamary(2009) et al. has studied fuzzy statistical measures for linguistic variables associated with traditional ranks through rectangular membership function. Sinija(2011) et al has studied ranking of the quality of instant green tea powder and granule samples using triangular fuzzy membership distribution. The ranking method cannot be helpful for comparing similar qualities involving large sample size. Sune(2002) et al. makes a comparative study of sensory attribute used by children and experts to evaluate e chocolate. They have surprisingly found that some of the attributes most cited by children are not those better explained by experts. Their study finds the semantic gaps and differences between children and adult experts in rating sensory attributes. It is essential to understand these differences which may be explained by demographic characters like age, environment, social status, etc.In this paper, mathematical modelling of fuzzy statistics for quality evaluation using a hedonic scale is proposed and thereby a desired consistency table is constructed for obtaining coefficient of association between physical intensity and evaluator's demographic character like age, gender, social status or environment. An example of cotton towel is illustrated the computation feasibility of the fuzzy statistics qualitymeasures on the hedonic scale.

2. Fuzzy Evaluation of Quality of Cotton Towels

In this section, the planned method is applied for the fuzzy evaluation of cotton towel. Luxury towels were of the utmost importance. With all this creative drive being thrust upon the weavers the birth of the first looped towel happened sometime in the **18th century**. The new invention was called *havly* and it sported rows of loops making up little rectangular clusters. There are different types and sizes are given below;

Towel: A towel is a piece of absorbent fabric or paper used for drying or wiping. It draws moisture through direct contact, often using a blotting or a rubbing motion. Common household textile towels are made from cotton, rayon, bamboo, nonwoven fibers or a few other materials.

Types of Towel: There are many types of towel. Some are them given below:

1. Baby Towels
2. Bath Towels
3. Beach Towels
4. Golf Towels
5. Hand Towels
6. Hotel Towels

Baby Towel: Baby towel is made with fine quality 100% cotton yarn to give it that soft texture and smooth feel. This is very essential for a baby, because a baby's skin is very sensitive in nature. The baby requires a baby towel which is mild, and not harsh on the skin.

A *Hooded Towel* is a variety of a baby towel, which is extremely popular and used by almost all mothers. When babies are slightly wet from being bathed, they lose heat very quickly, especially on the head. *Hooded Towels* eliminate this problem by covering the head. A hooded towel is usually square in shape and has a triangle shaped hood in one corner. It is usually made out of soft unbleached 100% cotton yarn. The reason being, it has to be very soft and mild, since it comes in direct contact with the baby's tender skin.

Bath Towel:A Bath Towel is typically rectangular in shape and is normally available in a size of approximately 75x150cms. Bath towels in any form are one of the most basic needs of a human being. We tend to ignore the importance of a bath towel. A point of great interest and one to note is that towel day is celebrated every year on May 25th. The standard *bath towel*, understand the need for high quality bath towels, and it is our endeavour to supply 100% cotton yarn towels to all our esteemed clients, at prices which are highly economical.

Beach Towel: Beach towels as the name suggests, are towels carried outdoors in general, and to the beach in particular. They cater to all and sundry, right from babies and little toddlers, to adults and older people. Due to this reason, they come in all types of sizes and weights. Beach towels are available in many varieties. Two of the more popular ones are the *Terry Velour Beach Towel* and the *Printed Beach Towel*. Both these types are made with 100% cotton yarn. The standard beach towels are soft, absorbent and generously size and also provide the buyer with a lot of flexibility, in terms of size, content and material used. Beach towels are also made with *polyester cotton yarn* and *blended yarn*. This form of blended yarn is used essentially as per customer requirements.

Golf Towel: Golf Towels have been conceived for the sport of golf. Today these towels still cater to the sport, but the range and quality of Golf Towels have grown by leaps and bounds. They are available in many sizes and their uses are varied. To begin with, there is *The Original Mini Golf Towel*. This is a towel which is 7.5 x 7.5 inches in size, with an attached ball marker.

Hand Towel:A hand towel is significantly smaller than a bath towel. The basic aim of any towel is to have good water absorbency, and the hand towels supplied by us, boast of the same. Today, a hand towel has taken on a different meaning and it can be used for various purposes. There are different sizes of towels are available and starting to 30X30 cm small one, to a 50X80 cm self-coloured large one. The weight of a hand towel is also variable and could oscillate between 15 g/pc to about 50g/pc. The range of hand towels and the colours in which they can be made available are enormous. This ranges from small to big in terms of size, and from the bright reds to the more sober shades like lemon, sky blue etc in terms of colour. Due consideration can also be given to the weight factor, keeping in mind the specific needs of a client. Another innovative feature that can be incorporated within the hand towel is the use of satin strips, to give it that different look.

Hotel Towel: Hotel Towels are a very big part of the towel manufacturing and supplying industry. They are generally white in colour and made of 100% cotton. These towels can also be of the polyester/cotton blended variety. Today, some hotel towels are made with, twisted loop ring spun, long cotton threads. These loop terry towels are some of the most absorbent. Hotel Towels consist of bath towels, hand towels, wash cloths *etc*, which vary in size and weight. They can be broadly classified into four categories, in terms of size:

1. Large or Jumbo size bath towels.(Approximate size of 67x140cm)
2. Medium size bath towels.(Approximate size of60x120cm)
3. Small size hand towels.(Approximate size of 30x50cm)
4. Smallest size towels, which are suitable for the face.

In our study, we are taken the standard bath towels come in different dimensions, depending on the manufacturer, but they typically range in size from 27 inches by 52 inches to 30 inches by 58 inches.A sample survey method is used to collect the physical intensity form the five point hedonic scale for quality evaluation. The College students aged are24 or less than 24 andPublic aged more than 24 are considered from a college and a public having a total strength of 490 and 230 respectively. There are 270 male and 220 females in the selected college and 120 males and 110 females in the selected public peoples. The total population size is 720 and there are four stratum sizes N_1=270, N_2=220, N_3=120, N_4=110. A sample size of n=27is selected on the basis of square root of the population size (N). Using the method of proportion allocation of sample size to stratum, that is $n_i \alpha N_i$ or $n_i=(n/N)\times N_i$= 1,2,3and 4the stratum sample size are n_1=10, n_2=8, n_3=5 , and n_4=4, Such that n_1 +n_2+ n_3 +n_4=27. In this method a sample of 27 evaluatorsof which 10 meals and 8 females

aged less than are equal to 24; and 5 males and 4 females aged more than 24 are selected by simple random sampling method for the mathematical computation of fuzzy statistics on quality evaluation of towel. They are selected based on good health, non-smokers, non-beetle leaf chewers, interested in quality evaluation, ability to concentrate, learn and familiarity with bath towel. Theyare trained quality evaluation procedure in terms of identification of quality attributes, score sheet and method of scoring before the actual test. Evaluation are asked to rate the physical intensity of quality attributes of cotton on the five point hedonic scale running from excellent, very good, good, satisfied and poor. The assigned scores of the attributes on hedonic scale are 5,4,3,2 and 1 for excellent, very good, good, satisfied and poor respectively. *A* and *B* be the attributes, Where *A* students for the physical intensity scores greater than median as the scale and *B* stands for the panellists age which may be greater than 24. α and β are the complimentary attributes of *A* and *B* respectively. The 2×2 consistency table each attributes i.e., colour, design, quality, and price of the product is formed and then Yule's Co-efficient of associations calculated. Table 4 shows the mathematical models of perceived sensation of the quality attributes based on the Yule's Co-efficient of association for Colour is 0.48, Design is 0.31, Quality is 0.53, and Price is 0.39 and over all 0.65; mean values are 0.0654, 0.0661, 0.0649, 0.0657 and 0.0637 respectively.

3. Conclusion

In this paper discussed the method of quality evaluation depends on the mathematical and Statistics principles and does not involve complicated iterations. The fuzzy statistical measures obtained from the mathematical computations methods using fuzzy logic should be more reasonable than the traditional method of analysis. The calculation methods of fuzzy statistics for quality evaluation increases the amount of information from the evaluators and discusses the quality of factors such as colour, design, quality, price etc. of a product with consumers demographic characters on a hedonic scale.

4. Relative Materials of the Present Method

Dr.A. Santhakumaran and C.V Kavitha Abirani (2016) have discussed the mathematical computation of fuzzy statistics for sensory evaluation.

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