

FUZZY RANKING APPROACH FOR RANDOMIZED BLOCK DESIGNS IN A REAL TIME PROBLEM

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ABSTRACT: The Two-way classification Randomized Block Designs (RBD) has been generally utilized in agricultural and industrial fields to represent randomness with fuzziness, because uncertainty is common to all real-life problems. In such cases, statistical RBD analysis using ambiguous observations is unavoidable. The statistical analysis of RBD is proposed in this study utilizing a fuzzy ranking method formed on the position of the mean value in support of Hexagonal Fuzzy Numbers (HFNs). The proposed approach's numerical examples would be more precise. We suggested a neural network application in this paper. One of the main components of mathematics instruction is the neural network to find the best one.

Keywords: Hexagonal Fuzzy Numbers, Ranking Method, Mean Value, Randomized Block Design, Neural Network.

1. INTRODUCTION

Prof. R.A. Fisher first proposed the Analysis of Variance (ANOVA) in the 1920 to solve problems in agricultural and biological investigations. For significance testing, the analysis of variance is a useful statistical tool. For agricultural experiments, the RCB is the conventional design. The field or orchard is divided into sections to account for any variances in the field. Then, once per block, the participants in the blocks are randomly assigned treatments. Treatments are distributed at random among neighboring subject blocks, with each treatment occurring only once in each block. There are exactly as many replications as there are blocks. Within the block, any treatment may be placed next to another treatment, but not the same treatment. Used to account for spatial effects and manage variation in an experiment.

RBD are used in two-way categorization. Experimentation is a must for new ideas and technologies. Replication, randomization, and local control are the three essential elements of experimental designs and they are used to identify cause and effect correlations. The most basic of all the principles-based designs of randomization and replication is Completely Randomized Designs (CRD). When the testing tools are not homogeneous in some circumstances. RBD divides the experimental area into smaller homogeneous blocks, with treatments applied at random to each block and reproduced across all blocks. Any treatment's inaccuracy can be separated, and any number of treatments can be eliminated without complicating the study. The data in this examination is ambiguous, necessitating the use of an wide view of the RBD to analyze this ambiguous evaluations. Fuzzy set theory interposed by Lotfi A. Zadeh [1] in 1965. For integrating membership values that express ambiguous knowledge, this approach provides appealing coordination bonds. The term "fuzzy number" refers to a theory of a normal number and a real number

that isn't associated with a specific value but rather than a collection of related alternative values, each with its own membership functions between 0 and 1. Where each conceivable value has its own membership function between 0 and 1.

A new membership function on hexagonal fuzzy numbers was introduced by Dhurai K, Karpagam A [2]. Jain [3] was proposed ranking fuzzy numbers method for making decisions in uncertain situations. Fuzzy interval and fuzzy number can be considered as real number by according to Dubois and Prade [4]. Bodjanova [5] established the concept of a fuzzy number. Shaun-Hu Chen [6] has demonstrated an rankings and distances of exponential fuzzy number. According to Sanjib Kumar Behera and Dhyan Singh [7] manganese should be applied continuously. The randomised block designs were immediately affected by fertilizer in the soil as a portion of a dose. Generalized fuzzy integers with different left and right heights has been proposed by Shyi-Ming Chen [8]. Using two illustrations with trapezoidal fuzzy numbers, Parthiban and Gajivarathan [9] discovered an ANOVA two-way method under distinct forms of fuzzy trapezoidal numbers. Rajarajeswari P, Sudha AS [10] was proposed using rank, mode, divergence and spread ordering hexagonal fuzzy numbers. Gnanapriya [11] proposed a incomplete block design based on the cut interval method for determining decision level. Rajarajeshwari P, Sudha AS, Karthika [12] introduced the hexagonal fuzzy number for use in a ranking technique for solving multi-objective Fuzzy Linear Programming Problems. John Wiley & Sons, Cochran and Cox [13] Complete Randomized Block Designs to improve from Experimental Designs. DIPA & Dutt S and FAO [14,15,16] to proposed the facts and role of Sustainability Fertilization Handbook. The fundamental theory and architecture of the main artificial neural networks introduced by D.Graupe [17]. Comparison of artificial neural networks with other networks and their definition by Erkam Guresen, Gulgun Kayakutlu [18].

2. PRELIMINARIES

2.1. Definition: (Fuzzy Set)

Let X is a nonempty set. A fuzzy set of A of X is defined as

$$\tilde{A} = \{(x, \mu_A(x)) / x \in X\}, \mu_A(x) \text{ is called membership function.}$$

2.2. Definition: (Fuzzy Number)

A fuzzy number is a generalization of a regular real number. Set of each possible value has between 0 and 1.

There exist at least one $x \in R$ with $\mu_A(x) = 1$
 $\mu_A(x)$ is piecewise continuous

2.3. Arithmetic Operation:

If $(A) = (m, n, o, p, q, r)$ and $(B) = (s, t, u, v, w, x)$ are two fuzzy number.

Addition: $(A) + (B) = (m+s, n+t, o+u, p+v, q+w, r+x)$

Subtraction: $(A) - (B) = (m-x, n-w, o-v, p-u, q-t, r-s)$

Multiplication: $(A) * (B) = (m*s, n*t, o*u, p*v, q*w, r*x)$

2.4. Artificial Neural Network (ANNs):

Artificial neural networks are effective tools that may be used to solve problems. A neural network is a system made up of numerous simple processing pieces that operate in parallel and can gather, store, and apply experimental knowledge. A system of logic called a fuzzy neural network (FNN) is architecture. There are three layers of neurons in the FNN. While outputs from the conditioning layer are transferred to the rule layer, the input layer of neurons reflects the input variables as crisp values. A typical multi-layer perception (MLP) network's hidden layer and the rule layer are structurally and functionally equivalent.

3. APPLICATION

The key data from Chennai district's fuel consumption rates are shown in the observations that follow. There were 4 distinct car brands (P, Q, R, and S). The various speeds were (30, 40, 50, 55, 60 and 70

mph). The issue of estimating gasoline use was raised. Rates of the various car brands for an appropriate average speed and contrast them. The suggested approach for analyzing RBD was assumed to be HFNs.

Table 1: Table based on *HFNs* of Miles per gallon of petrol

Car brands	Cars' top speeds in miles per hour (mph)					
	30	40	50	55	60	70
P	[20,22,23,24,25,26]	[17,19,20,21,22,23]	[15,17,18,19,20,21]	[13,16,17,18,19,20]	[13,15,16,17,18,19]	[12,14,15,16,17,18]
Q	[19,21,22,24,25,27]	[17,19,20,22,24,25]	[15,17,18,21,22,23]	[14,16,19,20,21,22]	[13,15,16,17,18,20]	[12,13,15,17,18,19]
R	[20,21,23,25,26,28]	[17,19,20,22,24,25]	[15,17,18,21,22,23]	[13,14,16,17,19,20]	[12,13,15,16,18,19]	[10,11,14,15,17,18]
S	[19,20,22,23,24,26]	[17,18,19,20,22,24]	[15,16,17,19,20,22]	[14,15,16,17,18,19]	[12,13,15,16,17,18]	[10,11,14,16,17,18]

Test whether the significant difference between the Car brands and Speeds in the petrol consumption rates. Find the mean for each and every set of values.

Table 2: *RBD values* using Mean Value concept

Car brands	Cars' top speeds in miles per hour (mph)					
	30	40	50	55	60	70
P	23.3	20.3	18.3	17.2	16.3	15.3
Q	23	21.2	19.3	18.7	16.5	15.7
R	23.8	21.2	19.3	16.5	15.5	14.2
S	22.3	20	18.2	16.5	15.2	14.3

(i) $TSS = 199.82$

(ii) $BSS = 190.34$

(iii) $TrSS = 5.21$

(iv) $ESS = 4.27$

Table 3: F-Ratio

SS	df	SS	MSS	F -Ratio
Blocks	5	190.34	38.07	133.76
Treatment	3	5.21	1.73	6.10
Remainder	15	4.27	0.29	

F-Ratio for Speeds

$$F_B = \frac{MSS(B)}{MSS(E)} = 133.76 \text{ at } F_t(\text{Table Value}) = 2.90 \text{ Where } F_B > F_t$$

The alternative hypothesis H_1 is accepted. The variance in speeds is significant. As a result, in terms of miles per gallon of gasoline, the six speeds vary greatly.

F-Ratio for Car brands

$$F_T = \frac{MSS(T)}{MSS(E)} = 6.10 \text{ at } F_{t(\text{Table Value})} = 3.29 \text{ Where } F_T > F_t$$

The alternative hypothesis H_1 is accepted. There is a big difference in car brands. As a result, the miles per gallon of gasoline for the four distinct car brands vary greatly.

We suggested a neural network application in this paper. One of the main components of mathematics instruction is the neural network to find the best one.

Algorithm:**Step: 1**

Estimate the problem of fuzzy membership function.

Step: 2

Consider the fuzzy number is fuzzy weight and assume the input 0 and 1.

$$\text{Weight} = B_i = \sum W_{j,i} \quad x_j = w_i x_i$$

Step: 3

Output of a neuron $s = f(B)$

Sigmoid function $f(B)$

And calculate $f(B) = 1.0 / (1.0 + \exp(-B))$

Step: 4

Find the maximum value of $f(B)$.

Let as assume that there are four brands of cars P, Q, R, and S.

$W = (a, b, c, d, e, f)$

Where a, b, c, d, e, f produce the cars average speeds in miles per hours (mph).

Step: 1

Table 4: Estimate the problem of fuzzy membership function

Car brands	Cars' top speeds in miles per hour (mph)					
	30	40	50	55	60	70
P	23.3	20.3	18.3	17.2	16.3	15.3
Q	23	21.2	19.3	18.7	16.5	15.7
R	23.8	21.2	19.3	16.5	15.5	14.2
S	22.3	20	18.2	16.5	15.2	14.3

$$W1 = (23.3, 20.3, 18.3, 17.2, 16.3, 15.3)$$

$$W2 = (23, 21.2, 19.3, 18.7, 16.5, 15.7)$$

$$W3 = (23.8, 21.2, 19.3, 16.5, 15.5, 14.2)$$

$$W4 = (22.3, 20, 18.2, 16.5, 15.2, 14.3)$$

Convert into fuzzy numbers.

$$W1 = (0.23, 0.20, 0.18, 0.17, 0.16, 0.15)$$

$$W2 = (0.23, 0.21, 0.19, 0.19, 0.17, 0.16)$$

$$W3 = (0.24, 0.21, 0.19, 0.17, 0.16, 0.14)$$

$$W4 = (0.22, 0.20, 0.18, 0.17, 0.15, 0.14)$$

Step: 2

$$W11 = 0.23, W12 = 0.20, W13 = 0.18, W14 = 0.17, W15 = 0.16, W16 = 0.15$$

$$W21 = 0.23, W22 = 0.21, W23 = 0.19, W24 = 0.19, W25 = 0.17, W26 = 0.16$$

$$W31 = 0.24, W32 = 0.21, W33 = 0.19, W34 = 0.17, W35 = 0.16, W36 = 0.14$$

$$W41 = 0.22, W42 = 0.20, W43 = 0.18, W44 = 0.17, W45 = 0.15, W46 = 0.14$$

Let assume (1, 1, 0, 0, 1, 1)

$$\begin{aligned} B1 &= W11 x1 + W12 x2 + W13 x3 + W14 x4 + W15 x5 + W16 x6 \\ &= (0.23) (1) + (0.20) (1) + (0.18) (0) + (0.17) (0) + (0.16) (1) + (0.15) (1) \\ &= 0.23 + 0.20 + 0 + 0 + 0.16 + 0.15 \\ &= 0.74 \end{aligned}$$

$$\begin{aligned} B2 &= W21 x1 + W22 x2 + W23 x3 + W24 x4 + W25 x5 + W26 x6 \\ &= (0.23) (1) + (0.21) (1) + (0.19) (0) + (0.19) (0) + (0.17) (1) + (0.16) (1) \\ &= 0.23 + 0.21 + 0.17 + 0.16 \\ &= 0.77 \end{aligned}$$

$$\begin{aligned} B3 &= W31 x1 + W32 x2 + W33 x3 + W34 x4 + W35 x5 + W36 x6 \\ &= (0.24) (1) + (0.21) (1) + (0.19) (0) + (0.17) (0) + (0.16) (1) + (0.14) (1) \\ &= 0.24 + 0.21 + 0.16 + 0.14 \\ &= 0.75 \end{aligned}$$

$$\begin{aligned} B4 &= W41 x1 + W42 x2 + W43 x3 + W44 x4 + W45 x5 + W46 x6 \\ &= (0.22) (1) + (0.20) (1) + (0.18) (0) + (0.17) (0) + (0.15) (1) + (0.14) (1) \\ &= 0.22 + 0.20 + 0 + 0 + 0.15 + 0.14 \\ &= 0.71 \end{aligned}$$

Step: 3

Output:

$$B1 = 0.74$$

$$B2 = 0.77$$

$$B3 = 0.75$$

$$B4 = 0.71$$

To calculate the sigmoid function:

$$f(B) = 1.0 / (1.0 + \exp(-B))$$

$$f(B1) = 1.0 / (1.0 + \exp(-B1)) = 1.0 / (1.0 + \exp(-0.74)) = 0.6770$$

$$f(B2) = 1.0 / (1.0 + \exp(-B2)) = 1.0 / (1.0 + \exp(-0.77)) = 0.6835$$

$$f(B3) = 1.0 / (1.0 + \exp(-B3)) = 1.0 / (1.0 + \exp(-0.75)) = 0.6792$$

$$f(B4) = 1.0 / (1.0 + \exp(-B4)) = 1.0 / (1.0 + \exp(-0.71)) = 0.6704$$

Step: 4

The maximum value is 0.6835.

So, Q is best car brand.

4. CONCLUSION

In Six various speeds were (30, 40, 50, 55, 60 and 70 mph) with four kinds of car brands are [P, Q, R, S] investigated in the Randomized Block Designs examination. The Randomized Block Designs is used in the study were approximations. As a result, fuzzy observations are required to make analysis. The variance in speeds is significant. As a result, in terms of miles per gallon of gasoline, the six speeds vary greatly. There is a big difference in car brands. As a result, the miles per gallon of gasoline for the four distinct car brands vary greatly. The numerical example to confirm the recommended best car brand is provided, and this method is extremely helpful for choosing the best outcome.

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