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FUZZY SEQUENCING PROBLEM IN HEXAGONAL FUZZY NUMBER

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ABSTRACT

In this paper, we use a Hexagonal fuzzy number and its membership function. We set out a way of dealing with to solve fuzzy sequencing problem where processing time taken as Hexagonal fuzzy numbers. Fuzzy sequencing problem are transformed into a crisp valued sequence problem which is illustrated with a numerical example.

KEYWORDS: Hexagonal Fuzzy number, Membership function, Fuzzy sequencing problem.

INTRODUCTION

This paper investigates the application of the Hexagonal fuzzy number to the job sequencing problem. The fuzzy set concept, introduced by Zadeh [1], is relevant because real-life decision-making often involves unclear (fuzzy) information, particularly concerning the order of events (sequencing). The job sequencing problem—a critical issue in computer science and optimization—aims to find the optimal sequence of jobs on machines to minimize total processing time. To solve this problem, the authors utilize the Hexagonal fuzzy number and its membership function. By employing Pascal's triangular Graded Mean method, the fuzzy sequencing problem is converted into a crisp (clear-valued) problem. Solving the resulting crisp problem yields the optimal order, idle time, and total elapsed time for the machines, given that the processing times are modeled as Hexagonal fuzzy numbers. The concept of fuzzy sets, pioneered by Zadeh, addresses the ambiguity inherent in many decision-making scenarios, such as determining the sequencing (order of occurrence) of events. A key example is the job sequencing problem, which is fundamental in computer science and

optimization techniques. The goal of this problem is to identify the best way to run jobs on machines to reduce the total time needed to finish all tasks. This study utilizes the recently developed Icosikaioctagonal fuzzy number [3]—an extension of the Icosagonal fuzzy number [2]—to model the processing time in the sequencing problem. The authors then apply the Pascal's triangular Graded Mean method to transform the fuzzy sequencing problem into a crisp-valued equivalent. By solving this crisp problem, the optimal job order, machine idle time, and total elapsed time are determined.

2. PRELIMNARIES

In this section, we give the preliminaries that are required for this study.

Definition 2.1. *A fuzzy set* A *is defined by* $A = \{(x, \mu_A(x)) : x \in A, \mu_A(x) \in [0,1]\}$. *Here* x *is crisp set* A *and* $\mu_A(x)$ *is membership function in the interval* $[0,1]$.

Definition 2.2. *The fuzzy number* A *is a fuzzy set whose membership function must satisfy the following conditions.*

(i) A fuzzy set A of the universe of discourse X is convex

(ii) A fuzzy set A of the universe of discourse X is a normal fuzzy set if $x_i \in X$ exists

(iii) $\mu_A(x)$ is piecewise continuous

2.3 Ranking of Hexagonl fuzzy number:

Let I be a normal Hexagonl fuzzy number. The value $M(I)$, called as measure of I is calculated as

$$M(I) = \frac{e_1 + e_2 + e_3 + e_4 + e_5 + e_6}{6}$$

Definition 2.4

A fuzzy number A = $(a_1, a_2, a_3, a_4, a_5, a_6)$ is Hexagonl fuzzy number and its membership function is given by

$$\mu_{\tilde{E}}(x) = \begin{cases} 0, \text{ for } x < e_1 \\ \frac{1}{2}\left(\frac{x-e_1}{e_2-e_1}\right), \text{ for } e_1 \le x \le e_2 \\ \frac{1}{2} + \frac{1}{2}\left(\frac{x-e_2}{e_3-e_2}\right), \text{ for } e_2 \le x \le e_3 \\ 1, \text{ for } e_3 \le x \le e_4 \\ 1 - \frac{1}{2}\left(\frac{x-e_4}{e_5-e_4}\right), \text{ for } e_4 \le x \le e_5 \\ \frac{1}{2}\left(\frac{e_6-x}{e_6-e_5}\right), \text{ for } e_5 \le x \le e_6 \\ 0, \text{ for } x > e_6 \end{cases}$$

4. Processing of 'n' jobs through '2' machines:

Let 'n' jobs A_1, A_2, …..,A_n be processing through 2 machines that is M_1 , M_2 respectively. Let R_{ij} be the fuzzy processing time taken by i^{th} job to be done by j^{th} machine. Using Johnson method, we can find optimal sequence, total elapsed time and idle time on machines. Here fuzzy times are taken as Hexagonal fuzzy number.

Jobs	Machine M I	Machine M II
A1	R11	R12
A2	R21	R22
A3	R31	R32
A4	R41	R42

5. Pascals Triangular graded mean for Icosagonal Fuzzy Number:

Consider $G_{I\cos koct} = (a_1, a_2, a_3, a_4, a_5, a_6)$ be a Hexagonal fuzzy number .By taking the co efficient of fuzzy numbers from Pascal's triangle. Then the formula of Pascal's triangular graded mean for Icosikaioctagonal fuzzy number is

$G(A) = \frac{(1a_1 + 5a_2 + 10a_3 + 10a_4 + 5a_5 + 1a_6)}{720}$ The coefficients of $(a_1, a_2, a_3, a_4, a_5, a_6)$ are 1, 5, 10,10,5,1 respectively. These coefficients are taken from the Pascal's triangles.

6. Procedure for solving fuzzy sequencing problem.

Step 1: Using Pascal graded mean, fuzzy sequencing problem is converted to a crisp valued problem.

Step 2: The optimal sequence for the crisp sequence problem is determined using crisp sequencing problem.

Step 3: After finding the optimal sequence. Determine the total elapsed fuzzy time and also the fuzzy ideal time on machines

7. Numerical example:

We are taking into account the fuzzy sequence problem. Let us take the processing time of 4 jobs are given in which all the elements are fuzzy quantifiers which signalize the linguistic variables that are taking the place of Icosikaioctagonal fuzzy numbers.

These qualitative datas are transformed into quantitative datas and which is shown in the below table. The processing time is between 1 to 112 and the minimum value is considered as 1 and maximum value is considered as 112 and is shown in the following table.

Low	1,2,3,4,5,6
Medium	9,10,11,12,13,14
Good	15,16,17,18,19,20
Very Good	21,22,23,24,25,26

The problem is shown in the table

Jobs	**Machine I**	**Machine II**
A_1	1,2,3,4,5,6	15,16,17,18,19,20
A_2	9,10,11,12,13,14	21,22,23,24,25,26
A_3	21,22,23,24,25,26	9,10,11,12,13,14
A_4	15,16,17,18,19,20	1,2,3,4,5,6

Apply Pascal's triangular graded mean for Icosikaioctagonal fuzzy number, the fuzzy valued time connected to respective valued time

R_{11}= 3.5	R_{12}= 17.5
R_{21}=11.5	R_{22}= 23.5
R_{31}= 23.5	R_{32}= 11.5
R_{41}= 17.5	R_{42}= 3.5

The Optimum sequence is

A_1	A_2	A_4	A_3

Total elapsed time and idle time

Jobs	**Machine I**		**Machine II**	
	Time in	**Time out**	**Time in**	**Time out**
A_1	0	3.5	3.5	21
A_2	3.5	15	21	44.5
A_4	15	32.5	44.5	48
A_3	32.5	56	48	59.5

Total Elapsed time = 59.5 Hrs

Idle time on Machine I = 3.5 Hrs

Idle time on Machine II = 3.5 Hrs

8. CONCLUSION:

In this paper, we have solved fuzzy sequencing problem by using Hexagonal fuzzy numbers. The Fuzzy sequencing problem of Hexagonal Fuzzy Numbers has been transformed into crisp sequencing problem using Pascal's Graded mean formula. By this method, we got the result of optimal sequence, total elapsed time and idle time for each machine.

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