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Fuzzy Sequencing Problem in Octagonal Fuzzy Number

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Abstract: *The membership function of an octagonal fuzzy number is used in this paper. We outline a method for handling fuzzy sequencing problems where processing time is expressed as octagonal fuzzy numbers. A numerical example demonstrates how fuzzy sequencing problems are converted into crisp valued sequence problems.*

Keywords: Octagonal Fuzzy number, Membership function, Fuzzy sequencing problem.

I. INTRODUCTION

The application of the hexagonal fuzzy number to the job sequencing problem is examined in this research. Zadeh [1] proposed the fuzzy set notion, which is pertinent since decision-making in real life frequently incorporates ambiguous (fuzzy) information, especially when it comes to the sequencing of events. Finding the best order for jobs on machines to save overall processing time is the goal of the job sequencing problem, a crucial problem in computer science and optimization. The authors use the Hexagonal fuzzy number and its membership function to tackle this issue. The fuzzy sequencing problem is transformed into a crisp (clear-valued) problem by using Pascal's triangle Graded Mean approach. Given that the processing times are represented as hexagonal fuzzy integers, the best order, idle time, and total elapsed time for the machines can be found by solving the resulting crisp problem. The uncertainty present in many decision-making situations, such as figuring out the sequencing (order of occurrence) of events, is addressed by Zadeh's invention of fuzzy sets. The task sequencing problem, which is essential to computer science and optimization methods, is a prime example

The objective of this topic is to determine how to run jobs on machines in a way that minimizes the overall time required to complete all tasks. The processing time in the sequencing problem is modeled in this work using the newly created Icosikaioctagonal fuzzy number [3], which is an extension of the Icosagonal fuzzy number [2]. The fuzzy sequencing problem is then converted into a crisp-valued equivalent by the authors using Pascal's triangle Graded Mean approach. The ideal job sequence, machine idle time, and total elapsed time are found by solving this clear problem.

II. 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

2.1 Ranking of Hexagonl fuzzy number:

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

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$$M(I)=\frac{e_1+e_2+e_3+e_4+e_5+e_6+e_7+e_8}{8}$$

Definition 2.6

A fuzzy number A = $(a_1,a_2,a_3,a_4,a_5,a_6,a_7,a_8)$ is Octagonal fuzzy number and its membership function is given by

$$\mu_E(x)=\begin{cases}0, for\ x<a_1\\ \frac{1}{2}\left(\frac{x-a_1}{a_2-a_1}\right), for\ a_1\le x\le a_2\\ 0.5, \quad for \quad a_2\le x\le a_3\\ \frac{1}{2}+\frac{1}{2}\left(\frac{x-a_2}{a_4-a_2}\right), for\ a_3\le x\le a_4\\ 1, for\ a_4\le x\le a_5\\ \frac{1}{2}+\frac{1}{2}\left(\frac{a_6-x}{a_6-a_5}\right), for\ a_5\le x\le a_6\\ 0.5, \quad for \quad a_6\le x\le a_7\\ \frac{1}{2}\left(\frac{a_8-x}{a_8-a_7}\right), for\ a_7\le x\le a_8\\ 0, for\ x>a_8\end{cases}$$

III. PROCESSING OF 'N' JOBS THROUGH '2' MACHINES:

Let 'n' jobs $A_1, A_2, \ldots, A_n$ 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
A_1	R_{11}	R_{12}
A_2	R_{21}	R_{22}
A_3	R_{31}	R_{32}
A_4	R_{41}	R_{42}

V. 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.

VI. PROCEDURE FOR SOLVING FUZZY SEQUENCING PROBLEM.

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

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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

VII. 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.

Jobs	Machine I	Machine II
A_1	Low	Good
A_2	Medium	Very Good
A_3	Very Good	Medium
A_4	Good	Low

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

A_1	A_2	A_4	A_3

The Optimum sequence is

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

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Total Elapsed time = 59.5 Hrs
Idle time on Machine I = 3.5 Hrs
Idle time on Machine II = 3.5 Hrs

VIII. 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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