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SINGLE MACHINE SCHEDULING WITH DISTINCT DUE DATES UNDER FUZZY ENVIRONMENT

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Abstract: Single machine, distinct due dates, early/lately machine problem and fuzzy environment closely models the situation faced by 'Just In Time' manufacturing. The objective of this paper is to sequence the jobs on the machine, so that the total penalty cost be minimum. This cost is composed of the total earliness and the total tardiness cost. An algorithm is developed here to minimize the total penalty cost due to earliness or lateness of jobs in fuzzy environment. Result shows that the developed heuristic algorithm performs well with small system.

Key Words: Distinct due dates, Early/late job, Fuzzy environment, Single machine, etc.

1. INTRODUCTION

The study of earliness and tardiness penalties in scheduling models is a relatively recent area of inquiry. For many years scheduling research focused on single performance measures. Most of the literature deals with regular measure such as mean flow time, mean lateness, percentage of jobs tardy, mean tardiness etc. in deterministic time but the environment in modern society is neither fixed nor probabilistic. So, here we are considering fuzzy environment i.e. the processing time of each job is in

indeterminist environment. Time considered here is in three situations (a, b, c) where a- in favorable condition, b- normal condition and c- in against conditions. The mean tardiness criterion, in particular, has been a standard way of measuring conformance to due dates, although it ignores the consequences of jobs completing early. However, this emphasis has changed with the current interest in 'Just In Time' (JIT) production, which espouses the notation that earliness as well as tardiness, should be discouraged. Baker and Scudder (1990) [1] studied sequences with earliness and tardiness penalties In a JIT scheduling environment, jobs that complete early must be held in finished goods inventory until their due date, while jobs that complete after their due date may cause a customer to shut down operations. Therefore, an optimal schedule is one in which all jobs finish on their assigned due dates. This can be translated to a scheduling objective in several ways. The most obvious objective is to minimize the deviation of job completion time around these due dates in non deterministic time.

The concept of penalizing both earliness and tardiness has spawned a new and rapidly developing line of research in the scheduling field. Because the use of both earliness and tardiness penalties in fuzzy environment give rise to a non regular performance measure, it has led to new methodological issues in the design of solution procedures. This paper presents a special case of Early/Tardy (E/T) having distinct due dates (DDD) problem, when the earliness and tardiness are penalized at the rates fixed by demand maker for the jobs. The next sections introduce the concept of single machine and the processing time of the jobs in fuzzy environment. The average high ranking and the scheduling of some small systems are determined in the section after. An algorithm based on these arguments is developed here and it is justified by a numerical example.

2. CONCEPT OF SINGLE MACHINE

Now a days, in competitive and flexible market installing of machines is very expensive, as the technology changes very frequently and the out dated machines can't satisfy the demands of the modern market. Secondly installing of more than one machines of the same type can speed up the work but needs more and more maintenance and supervision. Thirdly, installation of machines demands for more space to install, which also increases the idle cost of the project. So to reduce the expenditure, contractor wishes to process the work on single machine using an intelligent scheduling system and for the small systems single machine maximizes the profit of whole the project.

3. CONCEPT OF FUZZY PROCESSING TIME

The processing time of a job can vary in many ways, may be due to environmental factor or due to the different work places. We find that when a contractor takes the work from a department, he calculates total expenditure at the time of allotment. But due to many factors like non available of labor, weather not favorable, or some times abnormal conditions, cost may vary. Hence due to these reasons work can be completed late and creates due date problem i.e. order can't be delivered on time, on the other hand if the work completes before the due time it arises the inventory problem. So to overcome these factors, the processing time of a job considered here is in three situations- favorable, Normal and worse conditions. In this paper, a new concept of different processing time of each job is considered which helps the contractor to estimate the cost of the work at the time of allotment.

In this paper, different due dates for each of the job be considered which meets the demand maker with more satisfaction level. So using the algorithm developed here, contractor can save the penalty cost and can satisfy the demand maker to great extent.

4. FORMULATION OF FUZZY PROCESSING TIME

Different approaches to multi-objective single machine problems with fuzzy parameters have been presented in literature in the last decade. Ishibuchi et al (1996) [7] and Duenas A. & Petrovic (1995) [5] considered a single machine – scheduling problem with the objective to minimize the maximum tardiness of jobs. A fuzzy precedence relation relaxes the crisp precedence relation and represents the satisfaction level with respect to precedence between two jobs. Duenas. A & Petrovic [5] developed a genetic algorithm to single machine scheduling with two fuzzy due dates.

The concepts of fuzzy processing time, fuzzy due date, fuzzy precedence relation etc. are introduced by various researchers. Mohd Ikram (1986) [8], Conway (1965)[3] discussed about earliness & lateness of jobs in flow shop scheduling. Mc Cahon and Lee (1992) [4] studied the job sequencing problem when job processing time is represented with fuzzy numbers. Chong (1995) [2], Ishibuchi et al (1996) [7] and Ishii &Tada (1995)[6] has fuzzified the scheduling problems by using a fixed due date. Thus the fuzzy due date is directly related to the earliness and tardiness penalty in conventional scheduling problems. In this paper, different due dates for each of the jobs is considered. Next jobs are scheduled in increasing order of their slack time.

This paper investigates a different approach to single machine under fuzzy environment with bi-objective criteria. On one side it minimizes the penalty cost of the tardy jobs and on the other side it minimizes the total flow time of all the jobs. This paper differs with earlier work in the sense that I have considered here the processing time in fuzzy environment (a, b, c), which is real time situation and is defuzzified by average high ranking method <AHR> = [3b+ (c-a)] /3.

5. ASSUMPTION AND NOTATION

The machine scheduling problem studied in this paper requires n independent jobs J_i (i= 1,2,3…..n) to be processed on a single machine with the following assumptions:

(i) All jobs are available for processing at time zero.

(ii) The single machine can process at most one job at a time.

(iii) No pre-emption is allowed.

Let

S	Schedule for the n jobs.
<a,b,c>	Processing time of job i on the machine in fuzzy environment.
A_i	Average high ranking of the processing time <a, b, c> = [3b+ (c-a)] /3.
d_i	Due date for the job i.
c_i	Completion time of job i
T_i	Max. (0, c_i - d_i)
E_i	Max. (0, d_i - c_i)
Sl_i	slack time of job i
e_i	penalty per unit time for the earliness of job i.
l_i	penalty per unit time for the tardiness of job i.

An important special case in the family of E/T problems involves minimizing the sum of absolute deviations of job completion time form a DDD having processing time in fuzzy environment. In particular, the objective function can be written as

$$f(s) = \sum \left| c_i - d_i \right| = \sum (E_i + T_i)$$

When we write the objective function in this form, it is clear that earliness and tardiness are penalized at the rate e_i and l_i for all the jobs. In this paper, processing time of the jobs considered are in triangular fuzzy environment.

6. ALGORITHM

Step1. Find average high ranking <AHR> of the fuzzy processing time (a,b,c) of all the jobs.

Step2. Find the slack time of all the jobs $Sl_i = \left| A_i - d_i \right|$

Step3. Arrange the jobs in increasing order of their slack time. If two jobs have the same slack time then considers the jobs of lowest processing time at the earlier position.

Ste 4. Using the sequence obtained in step 3 find the total penalty of all the jobs using earliness (e_i) and lateness (l_i) penalty cost. into

7. NUMERICAL EXAMPLE

Table 6.1 shows a 5-jobs having fuzzy processing time, single machine and distinct due dates. Penalty cost (e_i) for earliness and (l_i) lateness is also given.

Job	P_i	<AHR>	d	Sl_i	e_i	l_i
1	5,7,8	8	9	1	2	3
2	3,5,7	19/3	7	2/3	2	3
3	11,15,17	17	18	1	2	3
4	6,8,11	29/3	10	1/3	2	3
5	7,8,10	9	10	1	2	3

Table 7.1

5 jobs having fuzzy processing time (a, b, c) are converted average high ranking by using <AHR> = [3b+ (c-a)] /3 and as per algorithm mentioned in section 6 the optimal sequence is 4-2-1-5-3. The table 7.2 shows the total flow time of the system and the total optimized penalty cost due to earliness/tardiness of the jobs.

Job	Processing time	d	sl_i	cost
4	0 – 29/3	10	1/3	1/3 * 2
2	29/3 – 16	7	9	9 * 3
I	16 – 24	9	15	15 * 3

5	24 – 33	10	23	23 * 3
3	33 – 50	18	32	32 * 3

Table 7.2

Total penalty cost is = 237.67

8. CONCLUSION

A single machine with distinct due dates has been studied. The objective was to find an optimal scheduling that minimizes a cost function containing earliness and tardiness costs with penalties by developing fuzzy to solve this problem. It was found that this method gives optimal solution for small systems and satisfies the demand maker to much extent.

REFERENCES

[1] Baker, K.S and G.D.Scudder (1990), “Sequencing with earliness and tardiness penalties”. A Review - Operation Research, 38. 22-36

[2] Chong T.C.E,(1995), “Optimal due date determination and sequence of n – jobs on a single machine” Journal. Op. Res. Soc. 35, (5) pp-433

[3] Conway, R. W (1965), “Priority dispatching and job lateness in a jobshop”.Journal. Ind Engg. 16, 228-237

[4] Mohd. Ikram (1986), “On minimization of lateness coast function and determination of optimal due date in two machines scheduling problem” Pure and applied Mathematika Sciences vol 1-2.

[5] C.S.Mc.Cahon & E.S.Lee (1992), “Fuzzy job sequencing for a job shop” Europian Journal of operation Research 62, 294-301.
[6] H. Ishii & M. Tada (1995), “Single machine scheduling with fuzzy precedence relation” Europian Journal of operation Research 87, 284-288.
[7] Dueness, A & Petrivic (1995), “ A new approach to Multi- objective single machine scheduling problem under fuzzyness” CTAC school of mathematics and Infermation Sciences, Conventry hjuniversity, Conventry U.K
[8] Ishubuchi H, T. Murtha and K. H. Lee (1996), “ Formulation of fuzzy flow shop scheduling with fuzzy processing time”Proceedings of IEEE International conference of Fuzzy system pp 199-205.