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Advanced Modified Time Deviation Method for Job Sequencing

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ABSTRACT

Job sequencing is the arrangement of the task that is to be precede in a machine in that particular order. In this paper, we proposed "Advanced modified time deviation method" for solving the optimal sequence for n-jobs. This method is first used for 2-machine n-jobs problem and extended for 3-machine n-jobs problem and also extended for m-machine n-job problem, by using Johnson's algorithm to find total elapsed time.

Keywords : Advanced Modified Time Deviation Method, Total Elapsed Time, Optimal Solution, Johnson's Algorithm

I. INTRODUCTION

Operation research can be defined as the science of decision-making. It has been successfully in providing a systematic and scientific approach to all kind of government, Military, manufacturing, and service operations. Operation research deals with the application of advanced analytical method to help make better decisions. Sequencing problem is one of the important application of OR. A sequence is the order for a series of jobs to be done on a finite number of service facilities, in some pre-assigned order, is called sequencing.

II. PRIOR WORK

2.1 Jobs:

The jobs or items are used in sequencing. There should be a certain number of jobs called n-jobs to be processed or sequenced.

2.2 Processing time:

The time it take to compete a prescribed procedure; "they increase output by increasing processing time". Every operation requires certain time at each of machine. Interval during a material is changed from one to another through machines, compounding or other operations.

2.3 Total elapsed time:

Elapsed time is the amount of time that passes from the start of an event to its finish. This activity allows the user to practice determining the elapsed time. Elapsed time is the difference between beginning and ending time.

III. ADVANCED MODIFIED TIME DEVIATION METHOD

This method is used to find the optimal sequence of the job. In this method time duration table is calculated for each rows and columns in a cell.

1. We can find the row deviation of the cell in the time duration table by using

(Maximum time duration of the row) – (time duration of the cell)

$$r_{ij} = p_i - t_{ij} \quad (1)$$

where, p_i – maximum time of the i^{th} row

r_{ij} - row time deviation of the $(i,j)^{th}$ cell

t_{ij} – time required for processing i^{th} job on the j^{th} processing.

2. We can find the column deviation of the cell in the time duration table by

(Maximum time duration of the column) – (time duration of the cell)

$$s_{ij} = c_i - t_{ij} \quad (2)$$

where, c_i – maximum time of the i^{th} column

s_{ij} - column time deviation of the $(i,j)^{th}$ cell

t_{ij} – time required for processing i^{th} job on the j^{th} processing.

3. We can find the time duration of the cell by using

$$T_{ij} = r_{ij} + s_{ij} \quad (3)$$

3.1 Algorithm

1. Start
2. Read the number of jobs and processing time for each jobs on M_1 & M_2
3. Calculate the time duration table for the given sequencing problem
4. The cell which contains the time as zero in M_1, perform the job in first
5. If more than one cell has zero then compare the jobs in M_2, which has the smallest value consider that has the first job
6. Similarly repeat the above steps for M_2 and perform the job last
7. Stop the procedure if we get the optimal sequence for all jobs
8. And use Johnson's algorithm to find the total elapsed time.

3.2 Numerical examples:

3.2.1 Sequencing n-jobs through 2-machine

Using advanced modified time deviation method for 2-machine n-jobs problem to find optimal sequence

Table 1

Job / Machine	J_1	J_2	J_3	J_4
M_1	3	5	2	6
M_2	4	2	3	2

Solution:

Table 2

Job / Machine	J_1	J_2	J_3	J_4
M_1	3	5	2	6
M_2	4	2	3	2

Calculate time duration table by using advanced modified time deviation method

Table 3

Job / Machine	J_1	J_2	J_3	J_4
M_1	(3+1)	(1+0)	(4+1)	(0+0)
M_2	(0+0)	(2+3)	(1+1)	(2+4)

Table 4

Job / Machine	J_1	J_2	J_3	J_4
M_1	4	1	5	0
M_2	0	5	2	6

J_4			J_1

Repeat the process until get the optimal sequence for all jobs

Table 5

Job / Machine	J_2	J_3
M_1	5	2
M_2	2	3

Table 6

Job / Machine	J_2	J_3
M_1	0	4
M_2	4	0

The required optimal sequence is

J_4	J_2	J_3	J_1

After finding the optimal sequence we have to find the total elapsed time by using Johnson's algorithm

Table 7

	M_1		M_2	
	In time	Out time	In time	Out time
J_4	0	6	6	8
J_2	6	11	8	10
J_3	11	13	10	13
J_1	13	16	13	17

Total elapsed time is 17 hrs. Idle time of M_1 is 1 hr and idle time of M_2 is 6 hrs.

3.2.2 Sequencing n-jobs through 3-machine

Using advanced modified time deviation method for 3-machine n-job problem to find optimal sequence

Table 8

Job / Machine	J_1	J_2	J_3	J_4	J_5	J_6	J_7
M_1	3	8	7	4	9	8	7
M_2	4	3	2	5	1	4	3
M_3	6	7	5	11	5	6	12

Solution:

Table 9

Job / Machine	J_1	J_2	J_3	J_4	J_5	J_6	J_7
M_1	3	8	7	4	9	8	7
M_2	4	3	2	5	1	4	3
M_3	6	7	5	11	5	6	12

Calculating time duration table by using advanced modified time deviation method

Table 10

Job / Machine	J_1	J_2	J_3	J_4	J_5	J_6	J_7
M_1	9	1	2	12	0	1	7
M_2	3	7	8	6	12	5	11
M_3	6	6	9	1	11	8	0

The required optimal sequence is

J_5	J_7	J_4	J_2	J_6	J_3	J_1

After finding the optimal sequence we have to find the total elapsed time by using Johnson's algorithm

Table 11

	M_1		M_2		M_3	
	In time	Out time	In time	Out time	In time	Out time
J_5	0	9	9	10	10	15
J_7	9	16	16	19	15	27
J_4	16	20	20	25	27	38
J_2	20	28	28	31	38	45
J_6	28	36	36	40	45	51
J_3	36	43	43	45	51	56
J_1	43	46	46	50	56	62

Total elapsed time is 62 hrs. Idle time of M_1 is 16 hr and idle time of M_2 is 12 hrs and idle time for M_3 is 10 hrs.

Also we can extend this method for n-jobs 4-machine and etc till n-job m-machine.

3.2.1 Sequencing n-jobs through m-machine

Using advanced modified time deviation method for m-machine n-jobs problem

To sequence the m-machine n-job problem we have to convert the m-machine n-jobs problem to 2-machine n-job problem

We are introducing two machines namely G & H

- $G = (M_1+M_2+\ldots\ldots + M_{m-1}) \geq M_m$ (4)
- $H = (M_2+M_3+\ldots+ M_m) \geq M_1$ (5)

Table 12

Job / Machine	J_1	J_2	……..	J_n
M_1	T_{11}	T_{12}	……..	T_{1n}
M_2	T_{21}	T_{22}	……..	T_{2n}

. . .	. . .	. . .		. . .
M_m	T_{m1}	T_{m2}	…….	T_{mn}

IV. CONCLUSION

In this paper, we have introduced a new method Advanced modified time deviation method. And also we prove this method for some numerical examples with n-jobs 2-machine, n-jobs 3machine and also for n-jobs m-machine. In future this method can be extended to process for sequencing the machine problems, such as n-job 2-machine or more than 2-machine with or without using this method.

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