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ANALYSIS OF SEQUENCING METHODS IN GARMENTS

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ABSTRACT
The study applied sequencing method problem for total elapsed time management in garments. The study examined the significant impact on total time management and the time management in the production of clothes in different process involved in its manufacturing. Here we examine and illustrate the use of sequencing methods on sequencing of n jobs two machines, on three machines and on m machines.
KEYWORDS: *Job, Number of Machines, Processing time, Total Elapsed Time, Idle Time.*

INTRODUCTION

Operations Research (OR) is a method of problem-solving and decision-making.
A sequencing problem is the order in which the jobs are processed. A sequencing problem could involve:

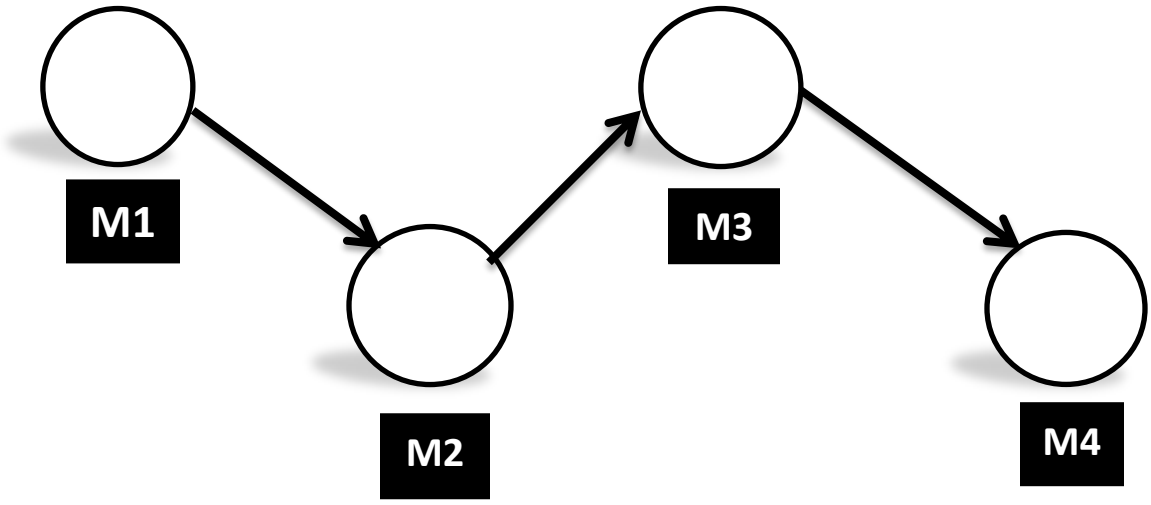
- Jobs in a manufacturing plant
- Aircraft waiting for landing and clearance
- Maintenance scheduling in a factory
- Programs to be run on a computer
- Customers in a bank & so on

Types of Sequencing Problem

There is three types of sequencing problems, which are as follows:

- Problem with 'n' jobs through one machine
- Problems with 'n' jobs through two machines
- Problem with 'n' jobs through m machines

Here the objective is to find out the optimum sequencing of the jobs to be processed and starting and finishing time of various jobs through all the machines.



JOHNSON'S ALGORITHM

To select the smallest processing time. If this is on M1, place the corresponding job at the front of the sequence, If this is on M2, place the corresponding job at the end of the sequence. Repeat the process until all the jobs are sequenced.

PROCESSING N JOBS THROUGH TWO MACHINES

Let there be 'n' jobs each of which is to be processed through two machines say M1 & M2, in the order AB. That is each job will go to machine M1 first and then to M2. All the 'n' jobs are to be processed on M1 without any idle time. On the other hand the machine M2 is subject to its remaining idle at various stages.

STEP 1: Select the smallest processing time occurring in list, A_i *or* B_i, if there is a tie select either of the smallest processing time.

STEP 2: If the smallest time on the machine M1, then place it at first place if it is for the M2 machine place the corresponding job at last. Cross off the job.

STEP 3: If there is a tie for minimum time on both the machines then select machine M1 first & machine M2 be last and if there is tie for minimum on machine A(same machine) then select any one of these jobs first and if there is tie for minimum on machine B among and select any of these job in the last.

STEP 4: Repeat the same step 2 & 3 to reduce the processing times obtained, by deleting the processing time for both the machines in respect to the jobs already assigned.

STEP 5: Continue the process placing the job next to the last and so on till al jobs have been placed and it is called optimum sequence.

STEP 6: Finding the optimum sequence:

i. Total elapsed time = Total time between starting the first job of the optimum sequence on machine M1 and completing the last job on machine M2.
ii. Idle time in machine M1 = Time when the last job in the optimum sequence is completed on machine M2 – time when the last job in the optimum sequence is completed on machine M1.

PROCESSING N JOBS ON THREE MACHINES

Let there be 'n' jobs on which it is to be processed through three machines say A, B & C in the order ABC. No jobs are permitted to pass the other. The problem is to find the optimum sequences which minimizes processing time.

JOB	MACHINE A	MACHINE B	MACHINE C
1	A_1	B_1	C_1
2	A_2	B_2	C_2
:	:	:	:
i.	A_i	B_i	C_i
:	:	:	:
n	A_n	B_n	C_n

CONDITION 1: Minimum of the times for different jobs on machine A is the least equal to the maximum of the times of different jobs on the machine B.

CONDITION 2: Minimum of the times for different jobs on machine C is the least equal to the maximum of the times of different jobs on machine B.

If the above two condition are not satisfied the method fails orelse we can proceed.

PROCESSING N JOBS ON M MACHINES

Let there be m no. of machines $A_1, A_2, \dots \dots A_m$. This problem can be converted to two machine problem, if one of the conditions is satisfied. Let $A_{i1}, A_{i2}, \dots \dots, A_{im}$ be the processing times on machines $A_1, A_2, \dots \dots, A_m$.

Then if $min_i A_{i1} \geq max_i A_{ij}, j = 2,3, \dots, m-1$ or $min_i A_{im} \geq max_i A_{ij}, j = 2,3, \dots, m-1$

Then this problem can be converted to processing n jobs on two machine problem. Hence two machines H and K are introduced such that $H_i = A_{i1} + A_{i3} + \cdots + A_{i\,m-1}$, $K_i = A_{i2} + A_{i3} + \cdots + A_{im}$.

Where i = 1, 2, 3, …, n

Where H_i and K_i are the processing times for the jobs on machines H and K respectively.

STATEMENT OF THE PROBLEM

To analysis the sequencing method from operation research to find the idle time taken for each machine doing its jobs and reduce the processing time and to find the minimum time taken for the production of a garment that is minimum that of their usual timing. This helps them to enhance their production.

REVIEW TO LITERATURE

[1] The author Eugeniusz N. & Czesl S. (2005). Published a journal in the topic "An Advanced Tabu search Algorithm for The Job Shop Problem" by using Scheduling.

[2] Joss Sanchez-Perez published the journal of Applied Mathematical Sciences regarding "A Payoff System for Job Scheduling Problems".

[3] The author Merten A.G, Muller, M.E. regarding Management Science on the topic "Minimization in Single Machine Sequencing Problems".

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[5] Kalavathy S.(2008) Operations Research 2nd edition regarding the sequencing methods.

[6] Fuzzy TOPSIS Method in Job Sequencing Problems on machines of unequal Efficiencies by Pragati J, & Manisha J.

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[8] Operation research for management by M P.Gupta, Sharma J K., regarding sequencing methods and job scheduling problems.

[9] Resource management techniques, related to Sequencing Methods by V. Sundaresan, Ganapathy Subramanian K. S., Ganesan K.

PROBLEMS

(a) In a factory, there are six different clothes for production, each of which should go to designing, sample making and patterning in the order. The processing time of each jobs in minutes are given, determine the optimal sequencing & total elapsed time.

Job	Designing	Sample Making	Patterning
Astra Cotton	3	8	13
Polyster	12	6	14
Lygra	5	4	9
Terry	2	6	12
Woolen	9	3	8
Jacod	11	1	13

Solution:

Minimum of $A_i = 2 >$ Maximum of $B_i = 8$ not satisfied.

Minimum of $C_i = 8 >$ Maximum of $B_i = 8$ satisfied.

Assume 1,2,3,4,5,6 be the clothes which is Astra Cotton, Polyster, Lygra, Terry, Woolen, Jacod and A,B,C be the machines involved in the jobs which is designing, sample making, patterning.

When atleast one among the conditions is satisfied, the problem can be converted into processing n jobs two machines.

Job	$G_i = A_i + B_i$	$H_i = B_i + C_i$
1	11	21
2	18	20
3	9	13
4	8	18
5	12	11
6	12	14

By G_i & H_i we find the smallest time in each job

The optimum solution is

4	3	1	6	2	5

Total elapsed time is obtained as

Job	Designing		Sample Making		Patterning	
	Time In	Time Out	Time In	Time Out	Time In	Time Out
4	0	2	2	8	8	20
3	2	7	8	12	20	29
1	7	10	12	20	29	42
6	10	21	21	22	42	55
2	21	33	33	39	55	69
5	33	42	42	45	69	77

Thus the minimum elapsed time is 77 minutes

Idle time for designing = 77-42 = 35

Idle time for sample making = 2+1+11+3+32 = 49

Idle time for patterning = 8.

(b) Continue the above process each of the clothes should go to the ironing and packing section in order. The processing time of each jobs in minutes is given. Determine the optimal sequencing & total elapsed time.

Jobs	Astra cotton	Polyster	Lygra	Terry	Woolen	Jacod
Cutting	7	4	2	5	9	8
Sewing	3	8	6	6	4	1

Solution:

Assume 1,2,3,4,5,6 be the clothes which is Astra Cotton, Polyster, Lygra, Terry, Woolen, Jacod and A,B be the jobs of the machines which is cutting and sewing.

The least times given for all the job in machine is found.

The optimal solution is

3	2	4	5	1	6

Total elapsed time T is obtained as:

Job	Cutting		Sewing	
	Time In	Time out	Time In	Time Out
3	0	2	2	8
2	2	6	8	16
4	6	11	16	22
5	11	20	22	26
1	20	27	27	30
6	27	35	35	36

Total elapsed time = 36 minutes
Idle time for cutting = 36-35 = 1
Idle time for sewing = 2+1+5 = 8.

(c) Continuation of the above process, the clothes which on production has to go on assembling, finishing, inspection and packing process on order. The processing timimg (in minutes) are given. Determine the optimal sequence & total elapse time.

Job	Astra cotton	Polyster	Lygra	Terry	Wollen	Jacod
Assembling	2	11	6	4	8	10
Finishing	5	6	4	3	6	4
Inspection	8	6	4	6	3	2
Packing	13	14	9	12	8	13

Solution:

$Min\ M_{i1} = 2 \geq \max M_{ij} = 6{,}8\ , j = 2{,}3$ or

$minM_{i4} = 8 \geq maxM_{ij} = 6{,}8, j = 2{,}3$

Hence, the required one of the condition are satisfied.

Since one of the conditions are satisfied, the abpve problem can be converted into 'n' jobs, 2 machines.

Two fictitious operations H & K can be written as(in times)

$H_i = M_{i1} + M_{i2} + M_{i3}$

$K_i = M_{i2} + M_{i3} + M_{i4}$

Let us assume 1,2,3,4,5,6 are the clothes involved in jobs such as Astra cotton, Polyster, Lygra, Terry, Woolen, Jacod and the machines of Assembling, Finishing, Inspection, packing are as M_1, M_2, M_3, M_4.

Job	H_1	K_i
1	15	26
2	23	26
3	14	17
4	13	21
5	17	17
6	16	19

The Optimal solution is:

4	3	1	6	5	2

Total elapsed time is obtained as

Job	Assembling		Finishing		Inspection		Packing	
	Time In	Time Out	Time In	Time Out	Time In	Time Out	Time In	Time out
4	0	4	4	7	7	13	13	25
3	4	10	7	11	13	17	25	34
1	10	12	11	16	17	25	34	47
6	12	22	16	20	25	27	47	60
5	22	30	20	26	27	30	60	68
2	30	41	26	32	30	36	68	82

Minimum total elapsed time = 82 minutes
Ideal time on assembling = 41
Ideal time on finishing = 32
Ideal time on inspection = 36
Ideal time on packing = 82
Hence from (a) , (b) , (c) we get the minimum total elapsed time of the machines to produce the different clothing in order = 77 + 36 + 82 =195 minutes (i.e.3.25 Hours)

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