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PAPER: OPERATION RESEARCH

SUBMITTED TO: SAIFULLAH JAN

SECTION: B

DEPARTEMENT: SOFTWARE ENGINEERING

DATE-23-06-2020

Question #1. Write a detail note on how operation research will help you in your professional life?

Answer: The field of operation research provides a more powerfull approch to decision making than ordinary software and data analytics tools. Employing operations research professionals can help companies achieve more complete datasets, consider all avaiable options; predicts all possible outcomes, and estimate risk. Additionally, operations research can be tailored to specific buisness processes or use cases to determine which ~~cases~~ techniques are most appropriate to solve the problem.
The mathematically techniques used in operations help managers to their jobs more effectively.

Product Mix: These techniques can be applied to determine best mix of the products for a plant with avaiable resources so as to get maximum profit or minimum cost of production.

Production Planing:

These techniques can also be applied to allocate various jobs to different machines so as to get maximum profit or to a maximum production or to minimize total production time.

Agriculture Production:

We can also apply this technique to maximize cultivator's profit, involving cultivation of number of ~~atoms~~ items with different returns and cropping time in different type of lands having variable fertility.

Finanical Applications:

Many finanical decision making problems can be solved by using linear programming techniques.

Better Coordination of Department:

Operation research analysis bends together the objectives of different departments For example operation research coordination the aims of the marketing department with the schedule of the production department.

Maintaning Better Control:

Managers used techniques of operations research to maintain better control over their subordinates. This is possible because operation research provides a basis in which to establish standards of performance and ways to measure productivity. Reporting deviations from standards enables manager to identify problems areas and to take corrective actions.

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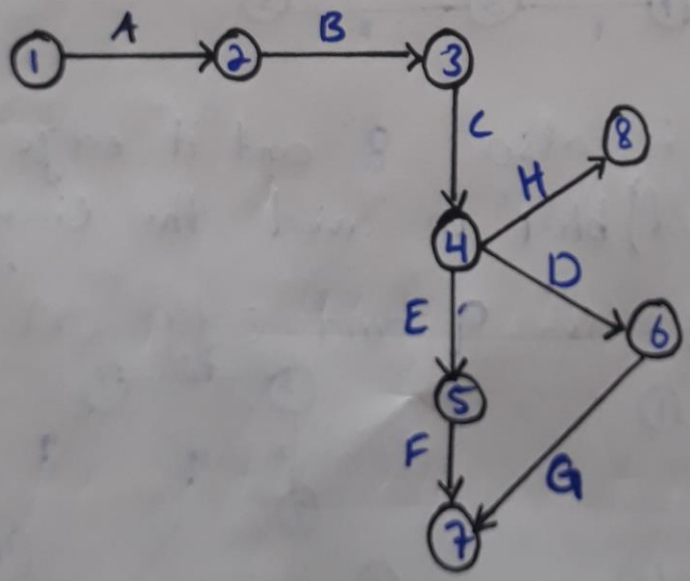
Q2:- The given table shows the details of a project:

Activity	Predecessor	optimistic time (o)	Most likely Time (M)	Pessimistic Time (P)
A	—	4	5	12
B	A	2	3	4
C	A	6	8	22
D	C	4	6	8
E	C	3	4	5
F	E	2	4	6
G	D, F	2	3	4
H	C	5	7	15

(a) Contruct the ~~following~~ project Network

Answer:-



(b) Find the expected duration and variance for each activity?

Answer:-

Activity	Predecessor	O	M	P	Mean/expected duration	Variance
A	–	4	5	12	6	1.77
B	A	2	3	4	3	0.11
C	B	6	8	22	10	7.09
D	C	4	6	8	6	0.44
E	C	3	4	5	4	0.11
F	E	2	4	6	4	0.44
G	D, F	2	3	4	3	0.11
H	C	5	7	15	8	2.76

By Formula:-

$$\text{(Mean) } te_1 = \frac{to + 4tm + tp}{6}$$

$$te_1 = \frac{4 + 4(5) + 12}{6} = \frac{4 + 20 + 12}{6} = 6$$

$$te_2 = \frac{2 + 4(3) + 4}{6} = \frac{2 + 12 + 4}{6} = 3$$

$$te_3 = \frac{6 + 4(2) + 22}{6} = \frac{6 + 32 + 22}{6} = 10$$

*6

$te_4 = \frac{4+4(6)+8}{6} = \frac{4+24+8}{6} = 6$

$te_5 = \frac{3+4(4)+5}{6} = \frac{3+16+5}{6} = 4$

$te_6 = \frac{2+4(4)+6}{6} = \frac{2+16+6}{6} = 4$

$te_7 = \frac{2+4(3)+4}{6} = \frac{2+12+4}{6} = 3$

$te_8 = \frac{5+4(7)+15}{6} = \frac{5+28+15}{6} = 8$

Variance (σ^2):-

By formula:-

$$\sigma^2 = \left(\frac{tp - to}{6}\right)^2$$

$$\sigma_1^2 = \left(\frac{12-4}{6}\right)^2 = \left(\frac{8}{6}\right)^2 = (1.33)^2$$

$$= 1.77$$

$$\sigma_2^2 = \left(\frac{4-2}{6}\right)^2 = \left(\frac{2}{6}\right)^2 = 0.11$$

$$\sigma_3^2 = \left(\frac{22-6}{6}\right)^2 = \left(\frac{16}{6}\right)^2 = 7.09$$

$$\sigma_4^2 = \left(\frac{8-4}{6}\right)^2 = \left(\frac{4}{6}\right)^2 = 0.44$$

$$\sigma_5^2 = \left(\frac{5-3}{6}\right)^2 = \left(\frac{2}{6}\right)^2 = 0.11$$

*7

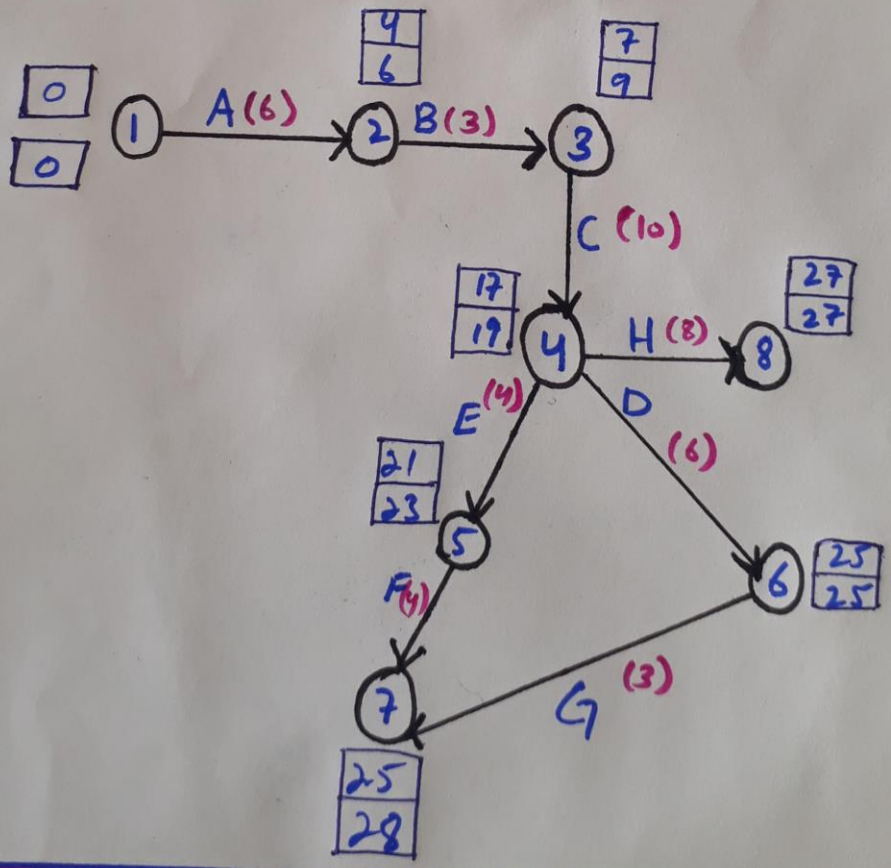
$$b_6^2 = \left(\frac{6-2}{6}\right)^2 = \left(\frac{4}{6}\right)^2 = 0.44$$

$$b_7^2 = \left(\frac{4-2}{6}\right)^2 = \left(\frac{2}{6}\right)^2 = 0.11$$

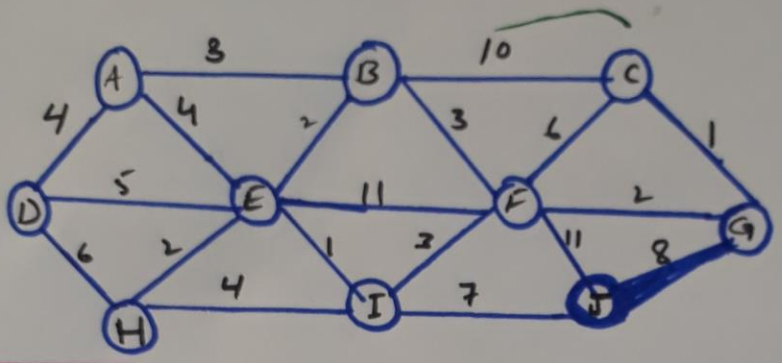
$$b_8^2 = \frac{(15-5)^2}{6} = \left(\frac{10}{6}\right)^2 = 2.76$$

(C) Find the critical path and expected project Completion time?

Critical path:-



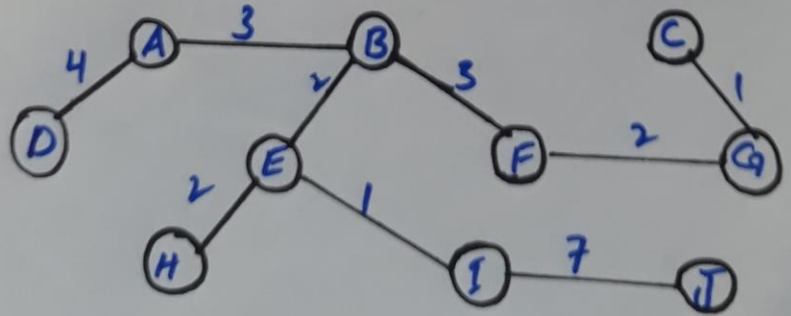
Q3: For the following graph, find the minimum spanning tree using Prim's algorithm. Start with vertex A. Show your work at each set and indicate the order in which edges are added to the minimum spannig Tree.



Answer:-

=> Now we have Connected all vertices our minimum spanning tree look like this. The minimum spanning tree is less of edges.

(CG, GF, FB, BE, EI, IJ, EH, BA, AD).



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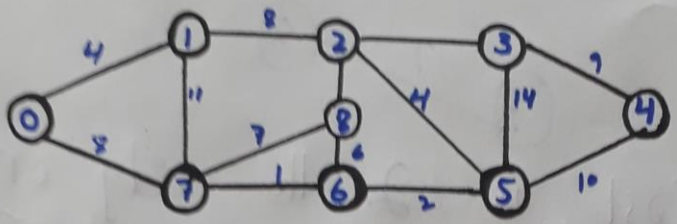
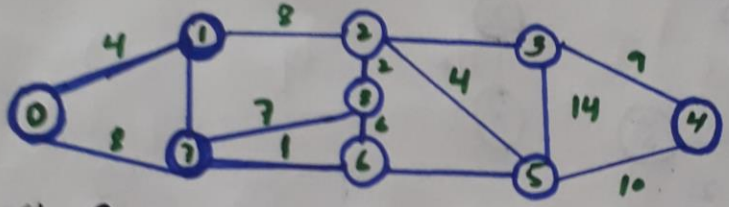
Q4:- For the following graph, find the minimum Spanning tree using kruskal's algorithm?



Answer:-

Step 1:- Remove all logs and parallel edge.



Step 2:- Arrange all edges in their increasing order of weight.

=> This graph Contain a vertics and 14 edges. So the minimum Spanning tree formed will be having (9-1) = 8 edges.

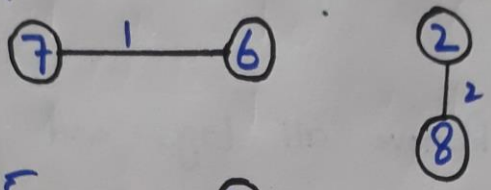
Src:Dest=	7,6	8,2	6,5	0,1	2,5	8,6	2,3
Weight=	1	2	2	4	4	6	7

7,8	0,7	1,2	3,4	5,4	6,7	3,5
7	8	8	9	10	11	14

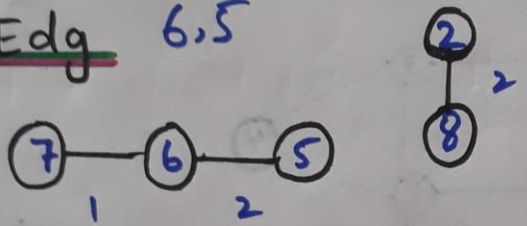
Step 3:- Add the edge which has least weightage.

Edge 7-6

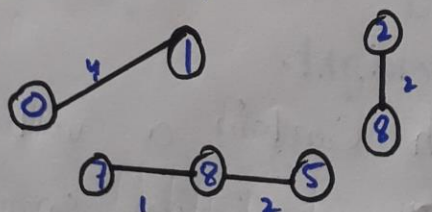
→Next Cost is 2 the edg on 8,2



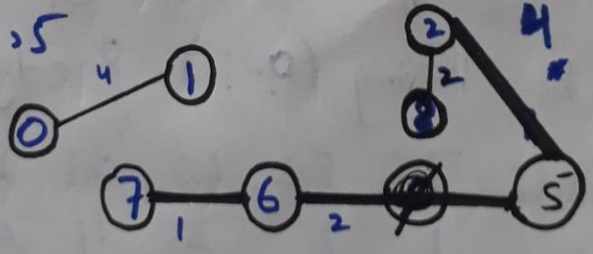
Edg 6,5



→Next Cost is four the edge on 0,7



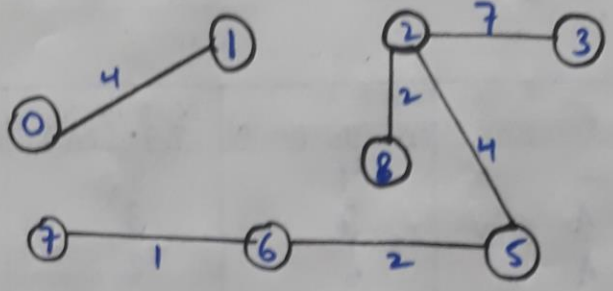
Edg- 2,5



→Next Cost is 6 (discard) between to avoid circuit.

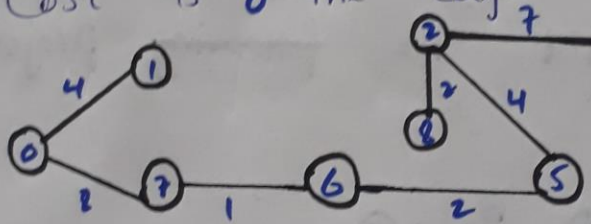
#3

→Next Cost is 7 the edg on 2,3..



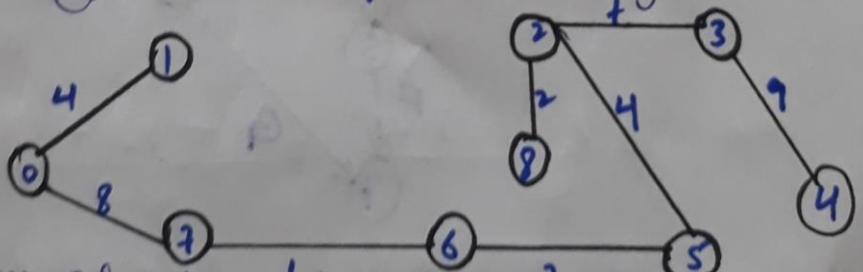
→Next Cost is also 7 (discard) so the edge is 8,6 to aviod the Circuit.

→Next Cost is 8 the edge on 0,7.



→Next Cost is also 8 and it edge is 1,2 (discard) blkl to aviod the Circuit.

→Next Cost is 9 and edge on 3,4



The number of edge include equal (V-1) the algorithm stop here.

MST is Completed.

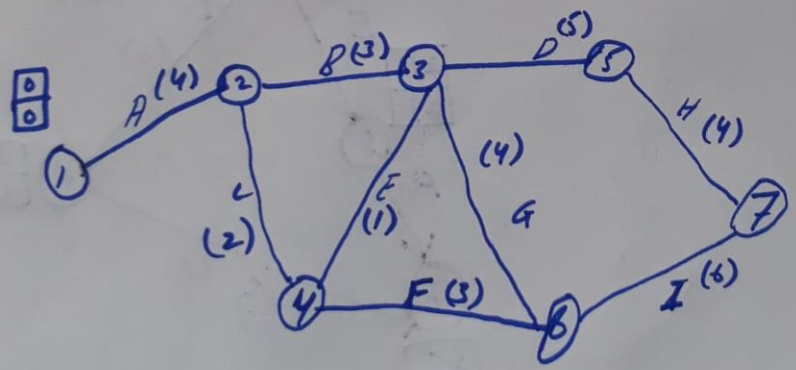
#9

Q1 => The given table show the details of a project:

Activity	Predecessor	Time
A	–	4
B	A	3
C	A	2
D	B	5
E	B, C	1
F	C	3
G	E, F	4
H	D, E	4
I	H, G	6

Answer:-

(a) Calculate the CPM Network:-



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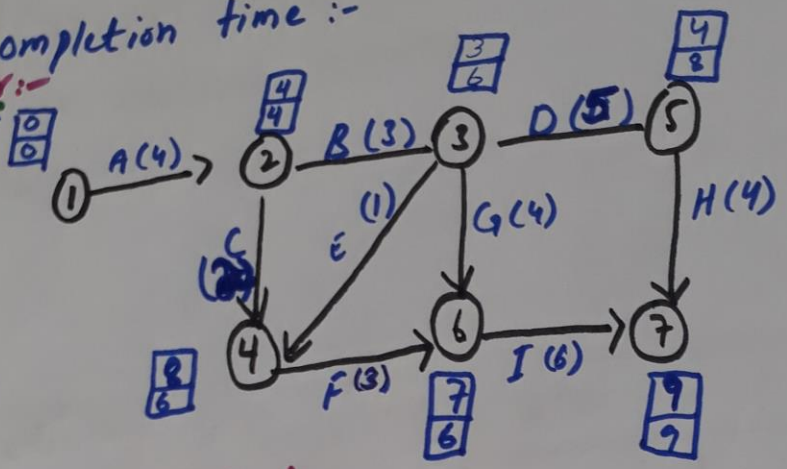
Q1: part B:

(B) Determine the Critical path and project Completion time :-

ANSWER:-



We know that:-

$$\Rightarrow E_{sj} = \text{Max}\,(E_{si} + D_{ij})$$

for Node 1 = $E_{s1} = 0$

$Node_2 = 0 + 4 = 4$

$Node_3 = 4 + 3 = 7$

$Node_4 = 3 + 1 = 4$

$Node_5 = 3 + 5 = 8$

$Node_6 = 3 + 4 = 7$

$Node_7 = 5 + 4 = 9$

(C) Compute total float and free float for non critical activities

Answer:- For total float we know that

$$TF_i = L_j - E_{si} - D_{ij}$$

Activity	Duration	Total	F. Float
A 1-2	4	1	1
B 1-3	3	4	5
C 1-4	2	3	3
D 3-4	5	2	2
E 2-5	1	1	1
F 2-6	3	2	
G 3-6	4	3	1
H 4-5	4	2	2
I 1-5	6	3	3

Total Float = $L_j = E_{si} - D_{ij}$

For A = 1-2 = 4-0 = 4

B = 2-3 = 3-1 = 2

C = 5 - 4 = 1

D = 5 - 1 = 4

E = 4 - 1 = 3

F = 3 - 1 = 2

G = 3 - 2 = 1

H = 6 - 4 = 2

I = 3 - 6 = 3

=> For Free Float:

A = 1 - 2 = 1 - 2 = 1

B = 2 - 3 = -1 - 4 = -5

C = 3 - 4 = 2 - 5 = -3

D = 4 - 5 = 4 - 2 = 2

E = 5 - 6 = 3 - 2 = 1

F = 6 - 7 = 1 - 2 = 1

G = 7 - 8 = 2 - 4 = 2

H = 8 - 9 = 10 - 2 = 8

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