

Name :: Shabir Ahmad

ID 15226

Subject :: Operation Research

Dpt :: BS. SE

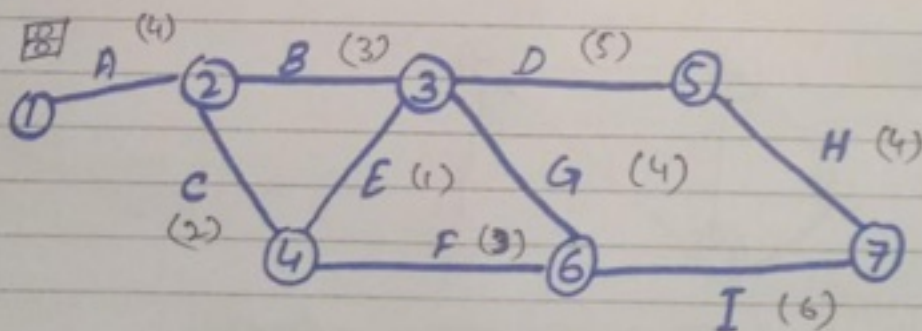
Q# 01

The given table shows the details of project.

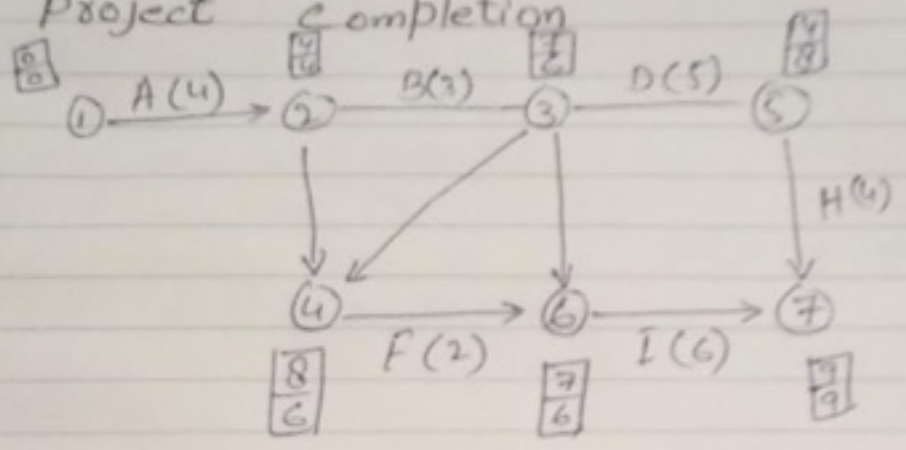
Activity	Predecessors	Time
A	-	4
B	A	3
C	A	2
D	B	5
E	B, C	1
F	C	3
G	E, F	4
H	D, E	4
I	H, G	6

ANSWERS

a) Calculate the CPM Network.



b) Determine the critical path and project completion



We know that

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

- 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 = $5 + 4 = 9$

Q# 02

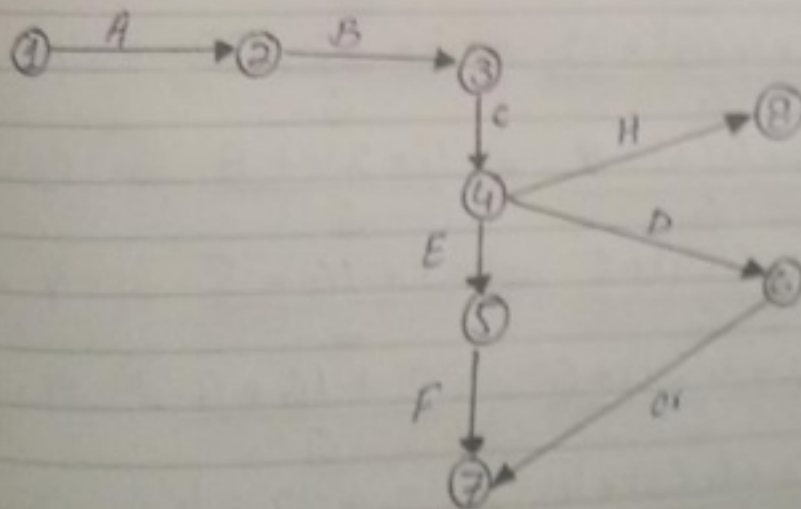
The given table shows the details of a project.

ANSWER

Activity	Predecessor	Optimistic Time (O)	Most Likely Time (M)	Pessimistic Time (P)
A	---	4	5	12
B	A	2	3	4
C	B	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

SOLUTION

a) Construct the project Network.



#FOU

b)

Activity	Predecessor	O	M	P	most 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.

$$(\text{mean}) t_e = \frac{t_o + 4t_m + t_p}{6}$$

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

$$t_{e_2} = \frac{2 + 4(3) + 4}{6} = \frac{2 + 12 + 4}{6} = 3$$

$$t_{e_3} = \frac{6 + 4(8) + 22}{6} = \frac{6 + 32 + 22}{6} = 10$$

$$t_{e_4} = \frac{4 + 4(6) + 8}{6} = \frac{4 + 24 + 8}{6} = 6$$

$$t_{e_5} = \frac{3 + 4(4) + 5}{6} = \frac{3 + 16 + 5}{6} = 4$$

$$t_{e_6} = \frac{2 + 4(4) + 6}{6} = \frac{2 + 16 + 6}{6} = 4$$

$$t_{e_7} = \frac{2 + 4(3) + 4}{6} = \frac{2 + 12 + 4}{6} = 3$$

#05

$$t_{e8} = \frac{5 + 4(7) + 15}{6} = \frac{5 + 28 + 15}{6} = 8$$

Variance (σ^2) is

by formula

$$\sigma^2 = \left(\frac{t_p - t_o}{6} \right)^2$$

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

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

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

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

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

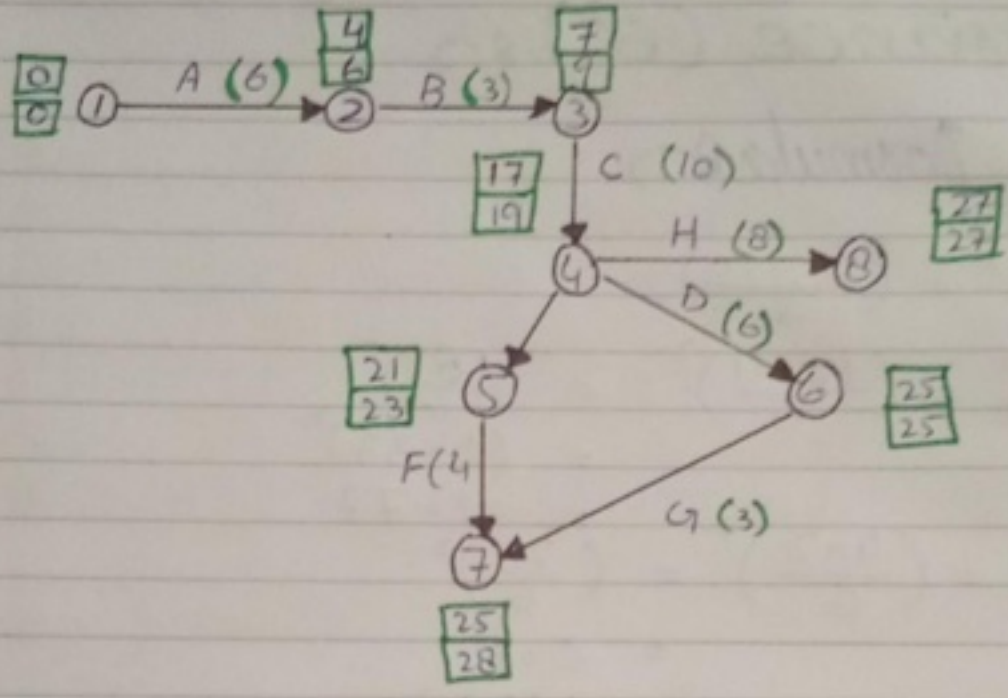
$$\sigma_6^2 = \left(\frac{6 - 2}{6} \right)^2 = \left(\frac{4}{6} \right)^2 = 0.44$$

$$\sigma_7^2 = \left(\frac{4 - 2}{6} \right)^2 = \left(\frac{2}{6} \right)^2 = 0.11$$

$$\sigma_8^2 = \left(\frac{15 - 5}{6} \right)^2 = \left(\frac{10}{6} \right)^2 = 2.76$$

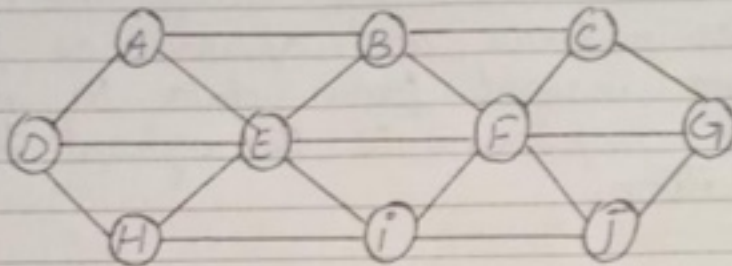
c) Find the critical path and expected project completion time.

Critical Path

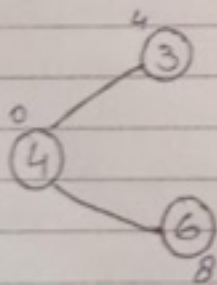


Q#03

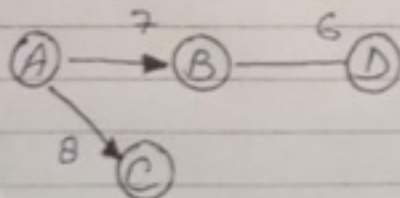
ANSWER



Prim's algorithm is to find minimum cost spanning tree. The node is added as a single tree and keep on adding new nodes to the spanning tree.

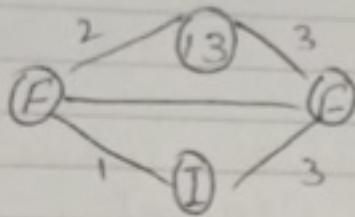


Pick the vertex with minimum key value and note already included vertex.

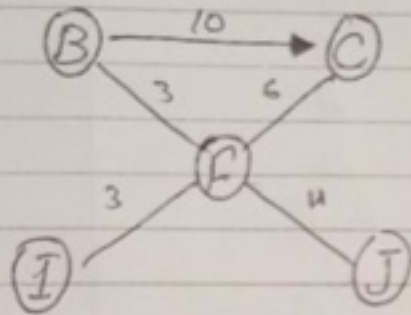


Remove all loops vertex edges from the given graph.

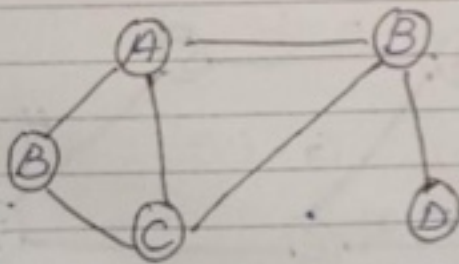
#08



↳ In this case we choose B node as the root of prime's Spanning tree.



↳ Now we select tree S-7 is treated as one node and we check for all edges going out from it. we select the one which has the lowest cost and include it in the tree.



we choose the edges.

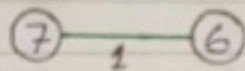
Q#04m

For the following graph. Find the minimum spanning tree using Kruskal's algorithm.

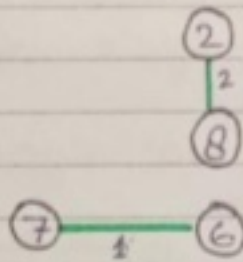
ANSWER

Pick all edges one by one from sorted list of edges.

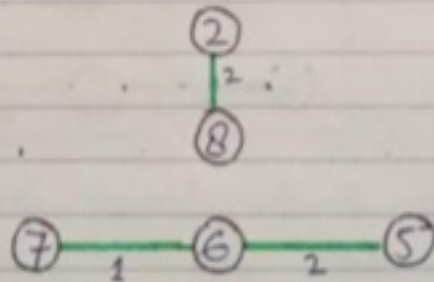
1. Pick edge 7-6: NO cycle is formed, include it.



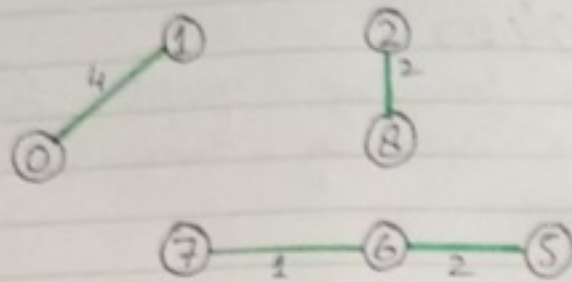
2. Pick edge 8-2: NO cycle is formed, include it.



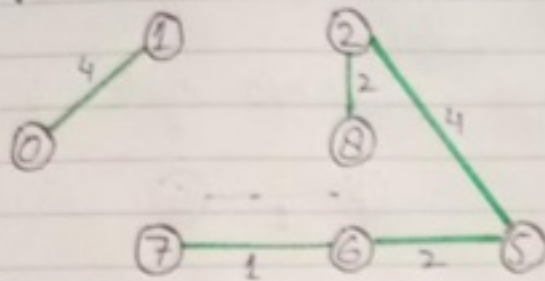
3. Pick edge 6-5: NO cycle is formed, include it.



4. Pick edge 0-1: NO cycle is formed, include it.

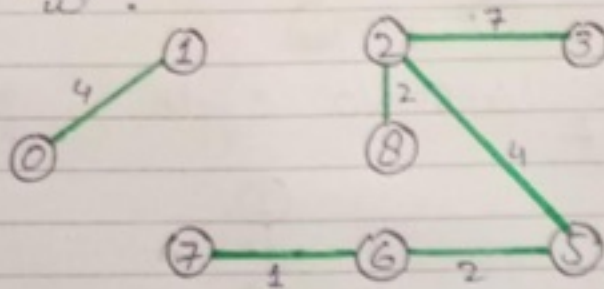


5i- Pick edge 2-5: No cycle is formed, include it.



6i- Pick edge 8-6: Since including this edge results in cycle, discard it.

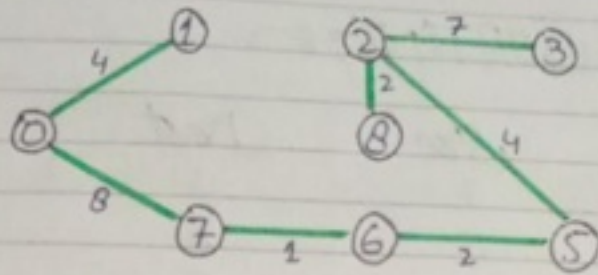
7i- Pick edge 2-3: No cycle is formed, include it.



8i- Pick edge 7-8: Since including this edge results in cycle, discard it.

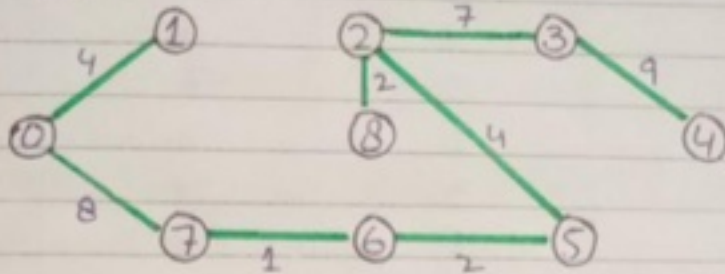
9i- Pick edge 0-7: No cycle is formed, include it.

#11

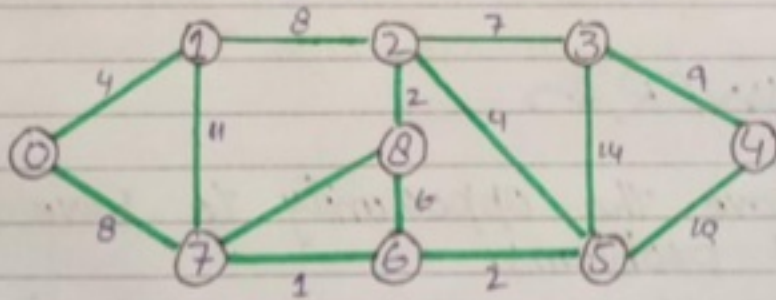


10th Pick edge 1-2: Since including this edge results in cycle, discard it.

11th Pick edge 3-4: No cycle is formed, include it.



Since the number of edges included equals $(v - 1)$, the algorithm stops here.
Low input graph.



The graph contains 9 vertices and 14 edges. So, the minimum Spanning tree formed will be having $(9 - 1) = 8$ edges.

AFTER SORTING

Weight	Src	Dest
1	7	6
2	8	2
2	6	5
4	0	1
4	2	5
6	8	6
7	2	3
7	7	8
8	0	7
8	1	2
9	3	4
10	5	4
11	1	7

Q# 05

write a detailed note on how this course (operations Research) will help you in your professional life?

ANSWER

1) You have the opportunity to solve real-world problems.

These problems matter to organizations and have an impact. In areas such as health-care, public policy, resource management, and disaster relief, you can truly change people's lives for the better.

2) You can use your analytical skills and your creativity.

whether your background is math,

software engineering, computer science, or an industry such as healthcare, manufacturing, finance, government, or military, there is a job in O.R. for you.

3. You have mobility across industries and careers.

You can apply your core O.R. skills to almost any industry - pharmaceuticals, law enforcement, even entertainment so you're far more recession-proof than if focused on one cyclical industry. And with O.R. training, you can move into management consulting, operations, marketing, finance, or a number of other fields.

4. You don't have to subscribe to a dominant worldview.

O.R. has no single mode of professional practice, so you never have to get boxed or pigeonholed into a specific technique or problem-solving approach that never changes.

5. You become a better strategist.

The O.R. discipline - looking at problems, creating models, and setting up analysis that points to better options and results - helps you make better personal and professional decisions, as the national bestseller *Smart Choices* by John S. Hammond demonstrates.

6. You become an essential link between technology departments and organizational management.

As an O.R. professional, you often act as interpreter between technical staff-

-operators, Operations management, Computer programmers, software engineers, and electrical engineers and management, helping to abstract real-world needs into software or models, then translating the results back into better real-world outcomes and results. In many forward-looking organizations, projects cannot go ahead until they receive approval from an O.R.-driven department.

7th YOU Can make a great living.

The average starting salary for an O.R. professional is \$60,000 to \$70,000, and it's easy to move up to \$100,000. In finance, you can make up to \$300,000 or more.

8th You're not part of a fad.

The diverse techniques of O.R.-including mathematical programming, simulation, decision analysis-are all proven with hundreds of successful case studies. At the same time, each application area is evolving, so you constantly have the opportunity to learn new things.

9th YOU Can have fun at work.

In many professional careers, little of what you create is implemented. The ability of O.R. to have an impact - save millions (even hundreds of millions) of dollars - means that companies put its solution to use. And when

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You've been part of a solution's. it's a great feeling.

10% You're extremely relevant today.

Many organizations find themselves awash in data, with little understanding of how to leverage that data for better results. with O.R., you bring "the Science of Better" - tools and approaches for harvesting insight from data to make dramatic improvements throughout the organization.

