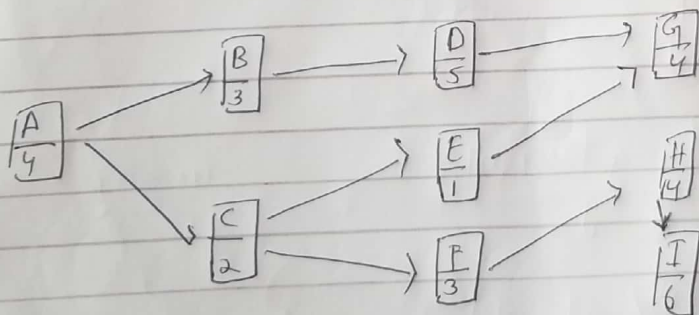
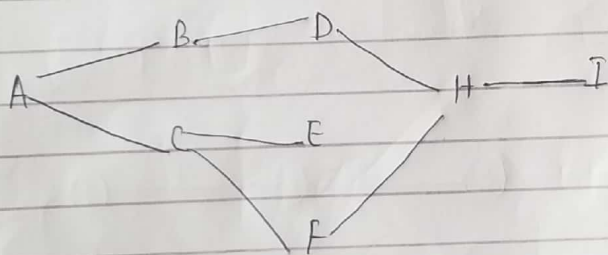


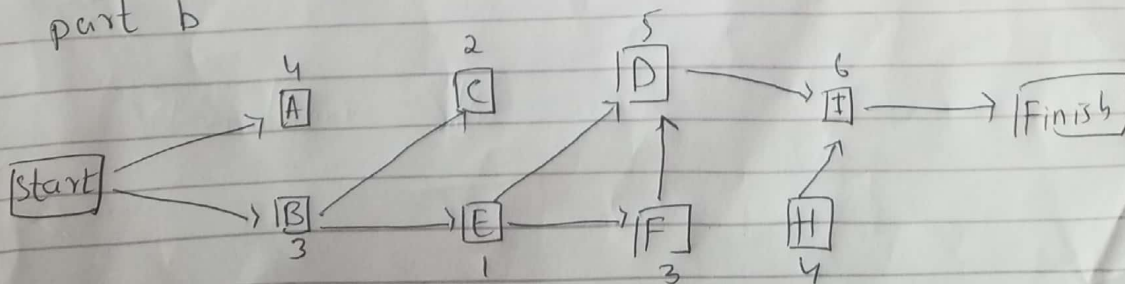
Name = Noveed Ahmad
ID = 14519
Subject = Operation Research
Date = 23/06/2020
Paper = Operation Research
Exam = Mid Term

Question (1)

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



part b

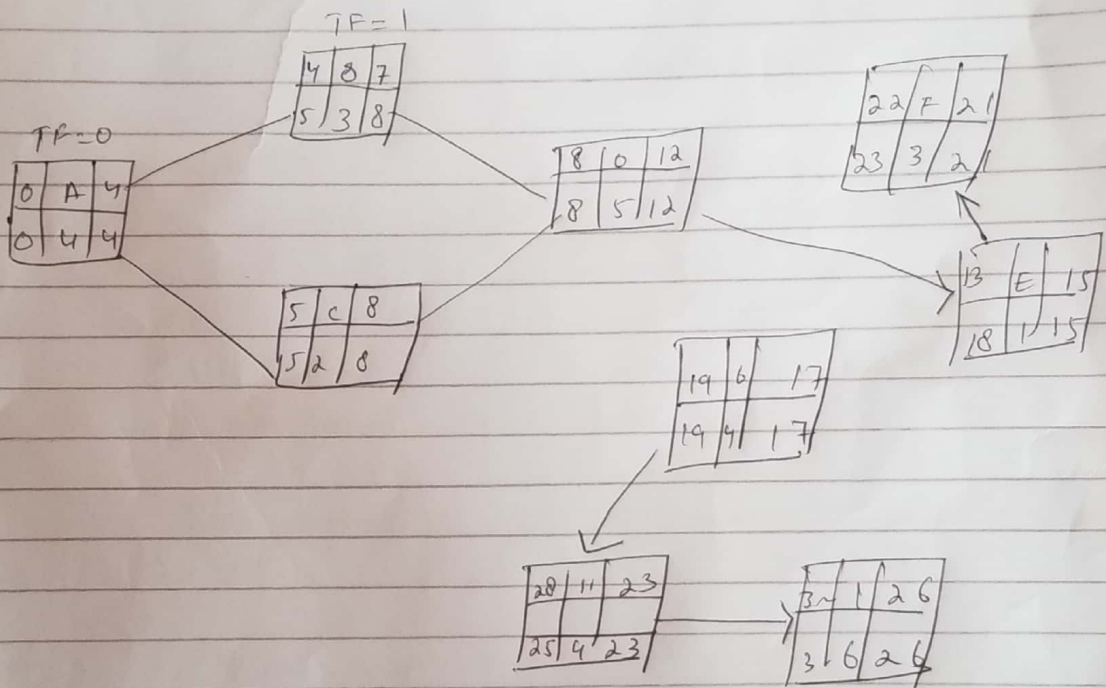


part (c)

total Float = TF

$$TF = LF - EF \quad \text{Finish}$$

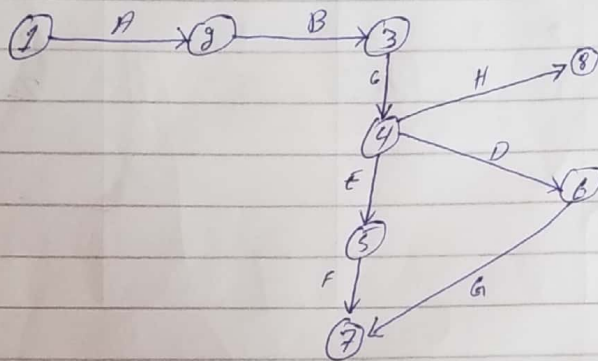
$$TF = L_s - E_s \quad \text{start}$$



Answer : (2)

Part (A)

Construct the Project Network.



(Main Table)

Activity	Predecessors	Optimistic Time (O)	Mostly Time (M)	Pessimistic Time (P)
A	-	4	5	12
B	A	2	3	4
C	B	6	8	99
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

Activity	Predecessor				duration	
		O	M	P	mean expected	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

Formula

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

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

$$\Rightarrow t_{e2} = \frac{2 + 4(3) + 4}{6} = \frac{2 + 12 + 4}{6} = 3$$

$$\Rightarrow t_{e3} = \frac{6 + 4(8) + 22}{6} = \frac{6 + 32 + 22}{6} = 10$$

$$\Rightarrow t_{e4} = \frac{4 + 4(6) + 8}{6} = \frac{4 + 24 + 8}{6} = 6$$

$$\Rightarrow t_{e5} = \frac{3 + 4(4) + 5}{6} = \frac{3 + 16 + 5}{6} = 4$$

$$\Rightarrow t_{e6} = \frac{2 + 4(4) + 6}{6} = \frac{2 + 16 + 6}{6} = 4$$

$$\Rightarrow t_{e7} = \frac{2 + 4(3) + 4}{6} = \frac{2 + 12 + 4}{6} = 3$$

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

Variance (σ^2):

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

$$\Rightarrow \sigma_1^2 = \left(\frac{12 - 4}{6} \right)^2 = \left(\frac{8}{6} \right)^2 = (1.33)^2 \Rightarrow 1.77$$

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

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

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

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

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

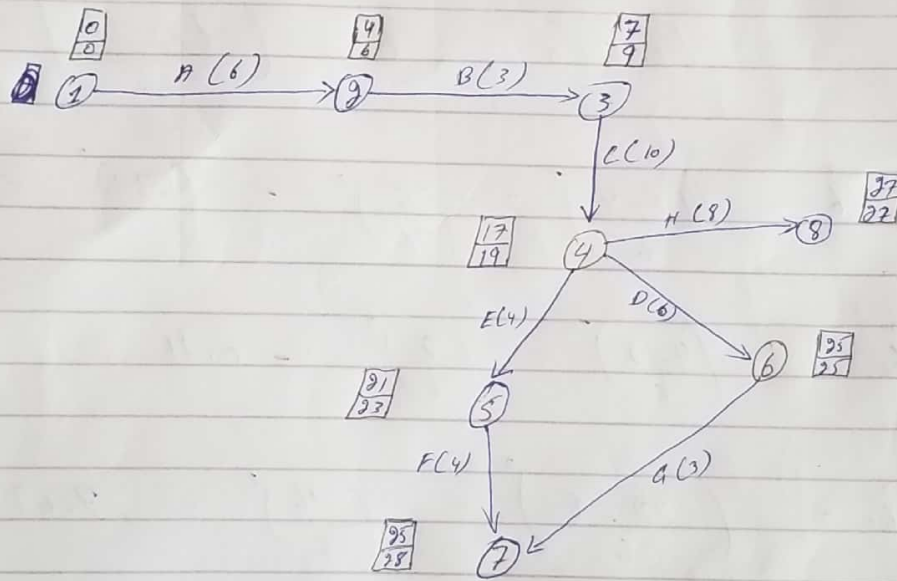
$$\Rightarrow \sigma_7^2 = \left(\frac{9 - 2}{6} \right)^2 = \left(\frac{7}{6} \right)^2 = 1.36$$

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

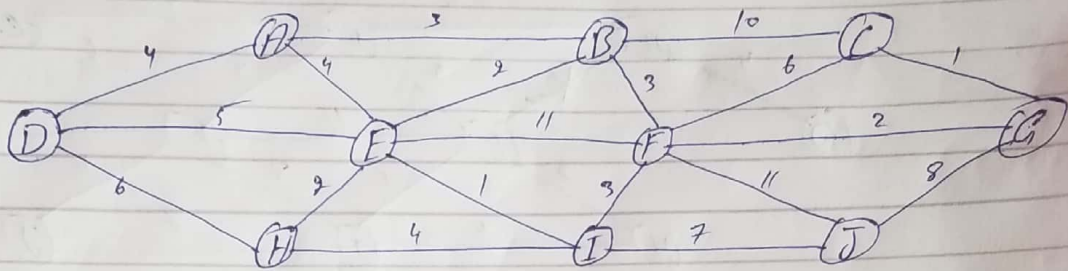
Part (C)

Find the critical path and expected project completion.

Critical Path



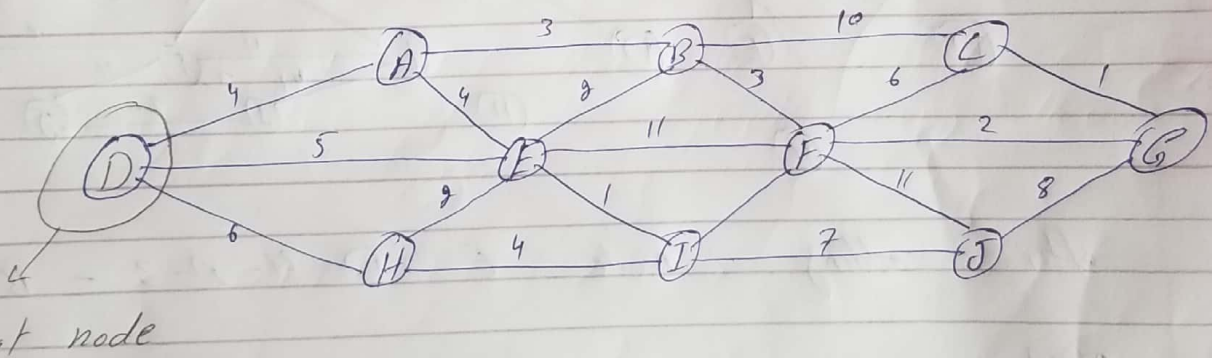
Answer (3).



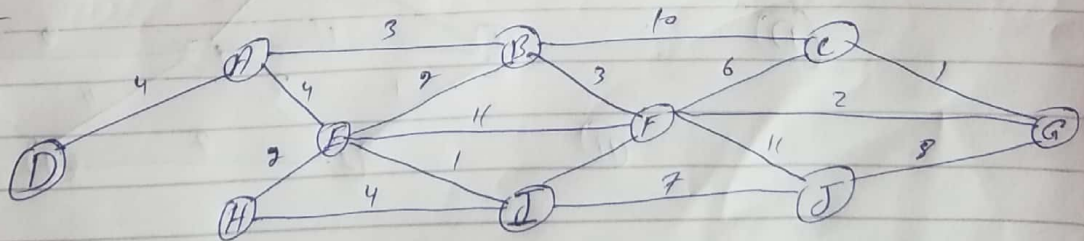
Step 1:

Removing all the loops and parallel edges.

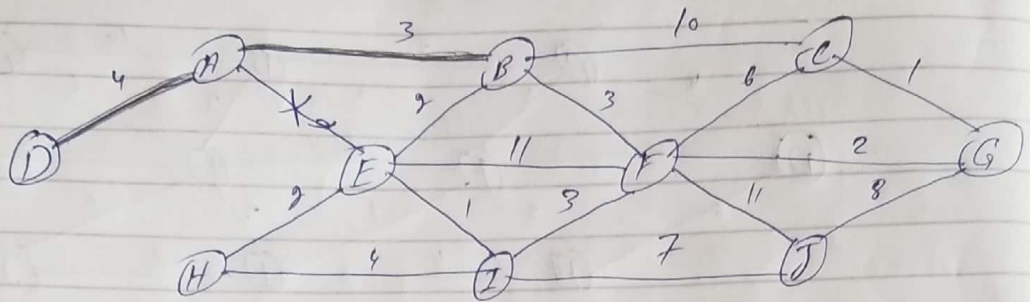
Step 2: Choosing arbitrary node as root node.



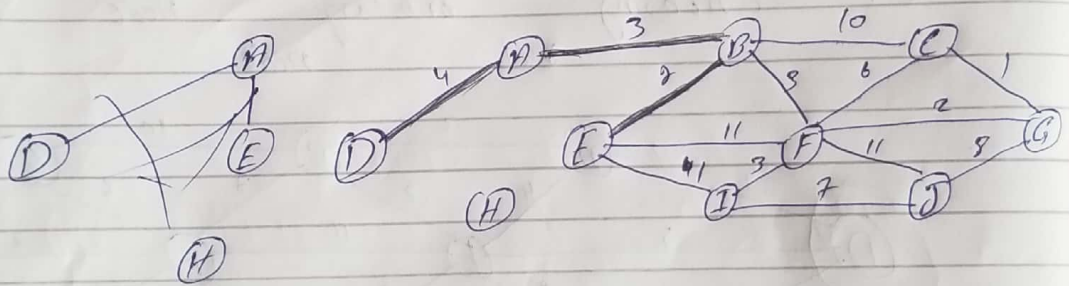
Step 3:



Now the tree D-A is treated as one node and we are checking for all edges.

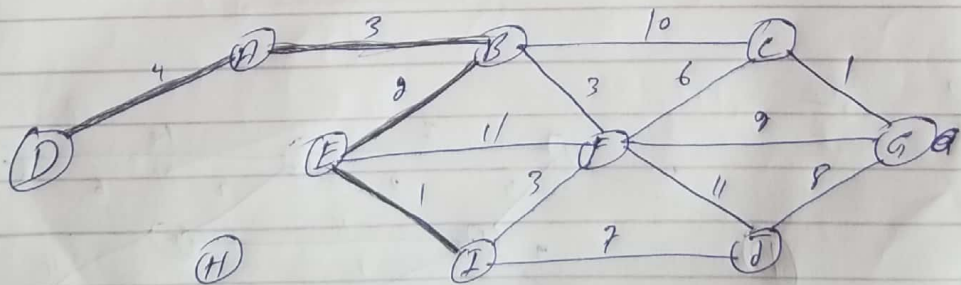


After this step $D-4-A-3$ tree is formed. Now we will again traverse it as a node and will check the edge again.



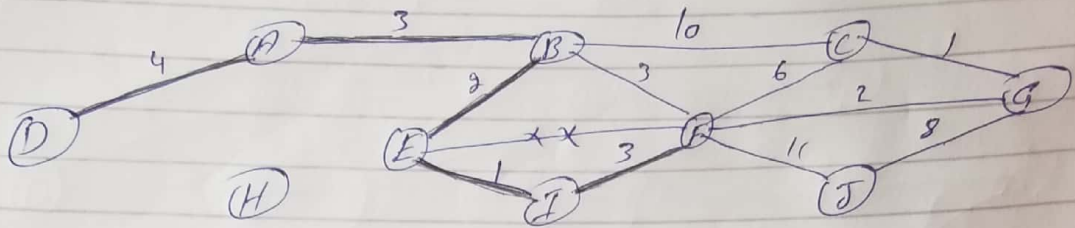
after adding node E $D-4-A-3-B-2$

Now



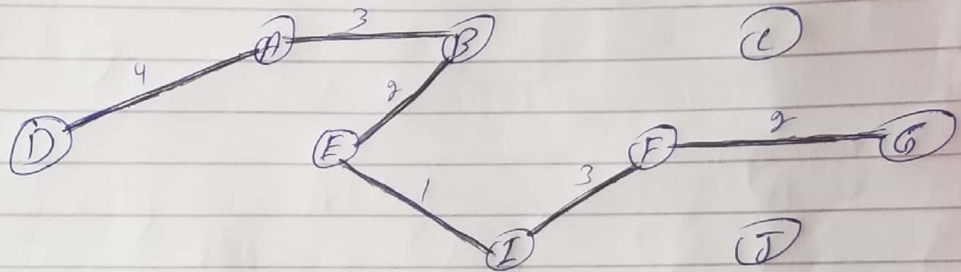
after adding root (E)
 $D-4-A-3-E-2-I-1$

Now



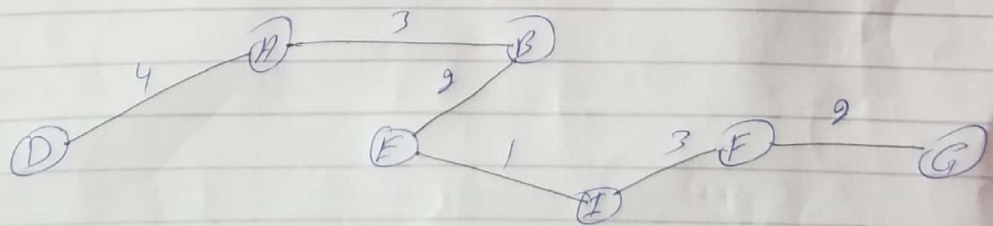
Now after adding root (F)
 $D-4-A-3-E-2-I-1-F-3$

Now



Now we find that that the output spanning tree of the graph using two different algorithm is same.

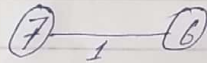
$$4 + 3 + 2 + 1 + 3 + 2 = 15$$



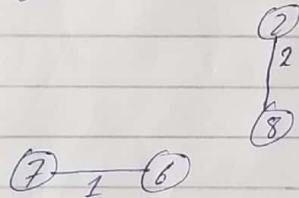
Answer: (4)

Now pick all edges one by one from sorted list to edges.

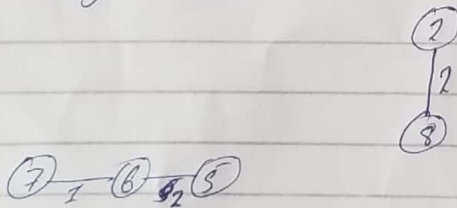
(1) Pick edge 7-6:



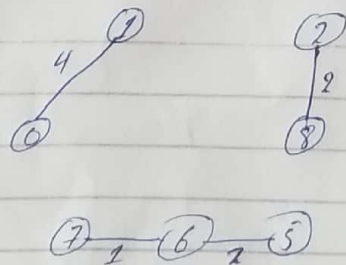
(2) Pick edge 8-2:



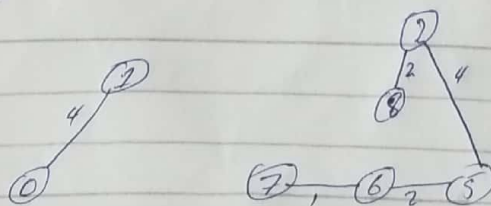
(3) Pick edge 0-1:



(4) Pick edge 0-1:

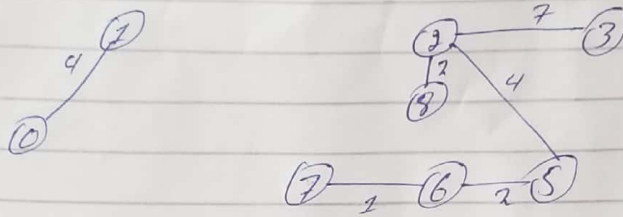


(5) Pick edge 2-5:



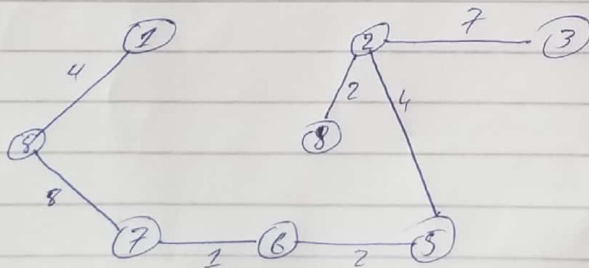
(6) Pick edge 8-6:
 Since including this edge results in cycle,
 discard it.

(7) Pick edge 2-3:



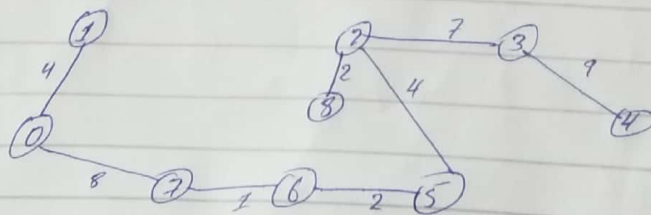
(8) Pick edge 7-8:
 Since including this edge results in cycle,
 discard it.

(9) Pick edge 0-7:

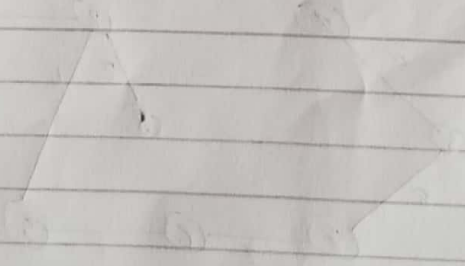


(10) Pick edge 1-2: discard it.

(11) Pick edge 3-4:



Since the number of edges included equals $(V-1)$, the algorithm stop here.



Answer (5)

Operation research (OR) is an analytical method of problem solving and decision making that is useful in the management of organizations. In operation research, problems are broken down into basic components and then solved in defined steps by mathematical analysis.

The concept of operation research arose during World War II by military planners. After the war, the techniques used in their operations research were applied to addressing problems in business, the government and society.

Characteristics of Operations research,

- (1) Optimization
- (2) Simulation
- (3) Probability.

Importance of Operation research:

The field of operation research provides a more powerful approach to decision making than ordinary software and data analytics tools. Employing operations research professionals can help companies achieve more complete datasets, consider all available options, predict all possible outcomes and estimate risk. Additionally,

Operations research can be tailored to specific business processes or use cases to determine which techniques are most appropriate to solve the problem.

Uses of Operation Research:

- * Scheduling and time management.
- * Urban and agricultural planning
- * Enterprise resource planning and supply chain management.
- * Inventory management.
- * Network optimization and engineering.
- * Packet routing optimization.
- * Risk management.