Personalized Learning

Personalized Learning is an educational approach that utilize learning experiences to the individual needs, preferences and goals of each student. It ensures that learners receive instruction, content and support that align with their unique strengths, weaknesses, interests and pace of learning.

Key Features of Personalized Learning:

- **Learner-Centered Approach** – The focus is on the student's needs allowing them to take an active role in their education.
- **Flexible Learning Paths** – Students can progress at their own pace rather than following a fixed curriculum timeline.
- **Adaptive Learning Methods** – Use of technology, assessments and teacher guidance to customize content and strategies.
- **Choice and Autonomy** – Learners have the ability to approach for topics, projects or methods that align with their interests and career aspirations.
- **Continuous improvement** – Regular evaluations helps in tracking progress and adjust learning plans accordingly.
- **Integration of Technology** – Digital tools, AI and data analytic help personalize learning experiences efficiently.

As a part of personalized learning, the department is assigning some task to the student subject wise on related topics and based on that student has to refer online platforms as an assignments and give presentation, they also need to submit the report over which the subject teacher will do the evaluation. So here we are providing some of the details given for the students.

This will count as an activity over which subject teacher will do the evaluation in marks assessment.

Video Link	QR Code
https://www.youtube.com/watch?v=SHelrRsrPuQ&list=PLyqSpQzTE6M9spod-UH7Q69wQ3uRm5thr&index=2&pp=iAQB	
https://www.youtube.com/watch?v=SHelrRsrPuQ&list=PLyqSpQzTE6M9spod-UH7Q69wQ3uRm5thr&index=3&pp=iAQB	
https://www.youtube.com/watch?v=SHelrRsrPuQ&list=PLyqSpQzTE6M9spod-UH7Q69wQ3uRm5thr&index=4&pp=iAQB	

Here is one example of activity report submitted bu the student.

PRIYADARSHINI COLLEGE OF ENGINEERING, NAGPUR

DEPARTMENT OF MECHANICAL ENGINEERING

Session : 2024-25

(An institute affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

Subject:- Operation Research
Activity : Presentation based on syllabus

Presented by: Aryan V. Luhure
Roll No: 108

Semester: VI
Section: A

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Name of subject teacher

Dr. I. A. Khan
Head of Department

Linear Part Programming

Objective Function Z (max/min) = $2x_1 + 5x_2 + 7x_3$

sub to constraints

$x_1 + 3x_2 + 8x_3 \leq 25$

$2x_1 + 9x_1 \geq 40$

$4x_1 + 6x_2 \leq 15$

$x_1, x_2 \geq 0$

- Coefficient of variable in Objective Function
- Variables in Objective Function
- Coefficient of variable in sub to constraints
- Variables in sub to constraints
- Only values in sub to constraints

Convert the above LPP in dual

1) $Z_{max} = 2x_1 + 3x_2$

Sub To Const

$1x_1 + 3x_2 \le 10$

$2x_1 + 4x_2 \le 12$

$x_1, x_2 \ge 0$

$Z_{min} = 10x_1 + 12x_2$

$1x_1 + 2x_2 \ge 2$

$3x_1 + 4x_2 \ge 3$

$x_1, x_2 \ge 0$

1) $Z_{max} = 2x_1 + 3x_2$ — For Zmax, all STC must be ≤ (less than or equals to)

Sub To Const

$1x_1 + 4x_2 \le 10$ ⇒ Satisfied

$2x_1 + 3x_2 \ge 12$ ⇒ Unsatisfied — Multiply by (-1)

$x_1, x_2 \ge 0$

$$\left.\begin{aligned} Z_{max} &= 2x_1 + 3x_2 \\ 1x_1 + 4x_2 &\le 10 \\ -2x_1 - 3x_2 &\le -12 \\ x_1, x_2 &\ge 0 \end{aligned}\right\} \text{Primal}$$

1) $Z_{min} = 10x_1 - 12x_2$

Sub To Const

$1x_1 - 2x_2 \ge 2$

$4x_1 - 3x_2 \ge 3$

$x_1, x_2 \ge 0$

Linear Part Programming by a Graphical Method

1. Considering the equation by putting equal to sign (=) in between variable & only values in subject to constraints.
2. After forming the equation in sub. to constraints, assume $x_1 = 0$ and find the value of x_2. then assume $x_2 = 0$ and find the value of x1. do it for all the equations and find the coordinates (x_1, x_2)
3. There will be two coordinates from one equation, that is called a equation of line.
4. Plot the graph acc to no. of lines formed
5. If there is a $\leq$ in sub of constraints then mark inner portion of that line.
6. If there is a $\geq$ in sub of constraints then mark outer portion of that line.
7. Mark the feasible region by points A, B, C, D, & E etc. (It is nothing but combined region of all the lines)
8. Find out the coordinate of all points A, B, C, D & E from the graph.
9. Consider the coordinate as a value of x_1 and x_2 and find out the value of Z. amongst all the values of Z if here is Zmax then select the maximum value and if there is Zmin then select the minimum value of Z

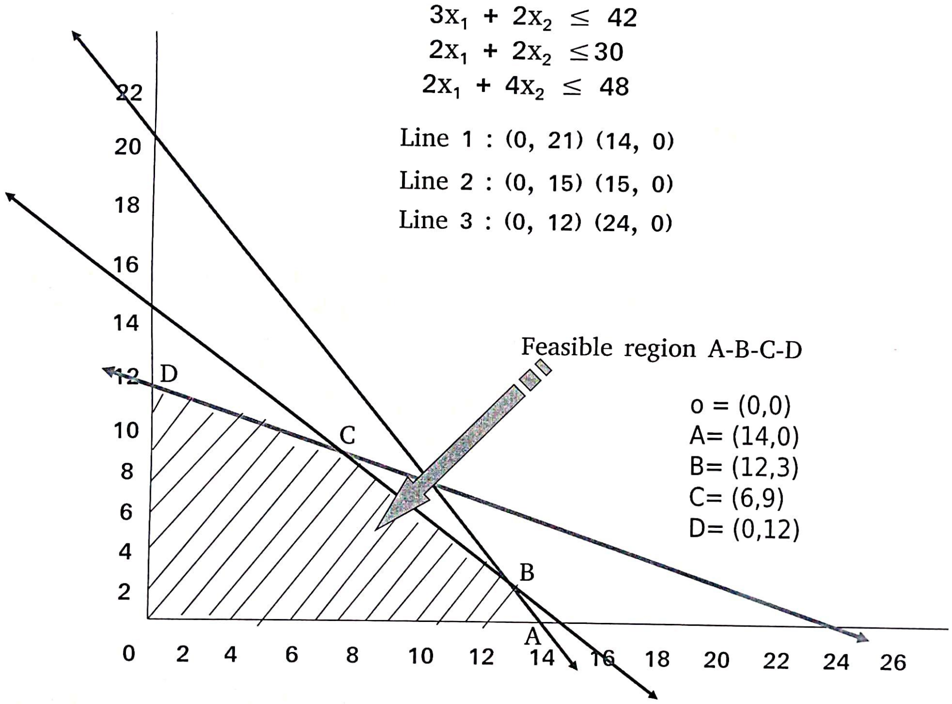
1) $Z_{max} = 12x_1 + 8x_2$, Sub To Const

$$3x_1 + 2x_2 \leq 42$$
$$2x_1 + 2x_2 \leq 30$$
$$2x_1 + 4x_2 \leq 48$$

Line 1 : (0, 21) (14, 0)

Line 2 : (0, 15) (15, 0)

Line 3 : (0, 12) (24, 0)



LPP By Simplex Method

Types of Constraints	Extra Added Variable	Values in Objective Function	
		Max Z	Min Z
Less than or equal to (≤)	Add a slack variable (S)	0	0
Greater than or equal to (≥)	Subtract a slack Variable (S) and add a Artificial variable (A)	S = 0	S = 0
		A = -M	A = M
Equal to (=)	Add a Artificial variable (A)	-M	M

Formation of LPP problem in tabulation form

Column Coefficient Cj →			Coefficient of variable in Objective function	
↓	↓	↓	Variables in Objective function	Θ ↓
Values of Positive extra added variable in STC	Positive extra added variable in STC	Only Values in Subject to constraints	Coefficient of all variable in STC (Row Wise)	
Objective coefficient Sj →			Each Column value multiply by Coefficient of extra added variables	
Cj - Sj →			Values	

$Zmax = 4x_1 + 3x_2$,
Sub To Const
$2x_1 + 2x_2 \leq 1000$
$x_1 + x_2 \leq 800$
$x_1 \leq 400$
$x_2 \leq 700$
$x_1, x_2 \geq 0$

New Sub To Const
$2x_1 + 2x_2 + S_1 = 1000$
$x_1 + x_2 + S_2 = 800$
$x_1 + S_3 = 400$
$x_2 + S_4 = 700$
$Zmax = 4x_1 + 3x_2 + 0S_1 + 0S_2 + 0S_3 + 0S_4$

$Sj_1 = (0x2) + (0x1) + (0x1) + (0x0) = 0$

		Cj	4	3	0	0	0	0
			X1	X2	S1	S2	S3	S4
0	S1	1000	2	2	1	0	0	0
0	S2	800	1	1	0	1	0	0
0	S3	400	1	0	0	0	1	0
0	S4	700	0	1	0	0	0	1
		Sj	0	0	0	0	0	0
		Cj - Sj	4	3	0	0	0	0

		Cj	4	3	0	0	0	0		
			X1	X2	S1	S2	S3	S4	θ	
0	S1	1000	2	2	1	0	0	0	500	
0	S2	800	1	1	0	1	0	0	800	
0	S3	400	1	0	0	0	1	0	400	→ Min +ve
0	S4	700	0	1	0	0	0	1	∞	
		Sj	0	0	0	0	0	0		
		Cj - Sj	4 ↑ Max +ve	3	0	0	0	0		

Key Column

For a new matrix the key row is to be divided by key element (1) and that is called to be new element

2 = key element of row 1
1 = key element of row 2
1 = key element of row 3
0 = key element of row 4

For new value of all variable in sub to constraints the calculation is to be do by formula

Old element - Key element of that row (New element)
OE - KECR (NE)

Unit II
Assignment and Transportation
Assignment

Selection of problem

1. **Minimization :- Cost time and distance**
2. **Maximization :- Profit, sales and efficiency**

Assignment problem is always solved by Hungarian method which includes the following steps.

1. **Ensuring the given matrix is a square matrix, if it was not then making it a square matrix by adding dummy row or column with a assignment cost zero.**
2. **Row operation :- select the lowest element of row and subtract it from all element of that row**
3. **Ensure that each row must have at least one zero.**
4. **Column operation :- select the lowest element of column and subtract it from all element of that column**
5. **Ensure that each column must have at least one zero.**

12	10	15	22	18	8
10	18	25	15	16	12
11	10	3	8	5	9
6	14	10	13	13	12
8	12	11	7	13	10

12	10	15	22	18	8
10	18	25	15	16	12
11	10	3	8	5	9
6	14	10	13	13	12
8	12	11	7	13	10
0	0	0	0	0	0

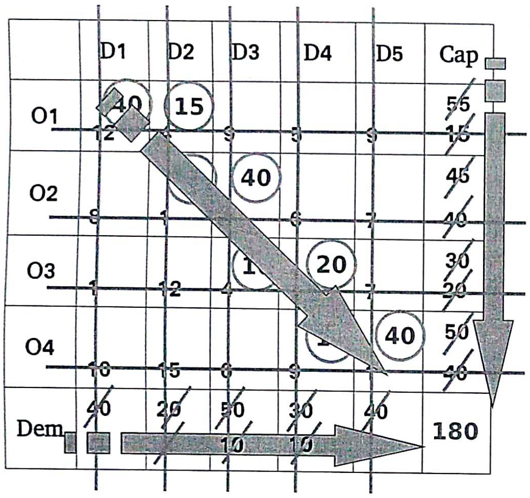
1 →	4	2	7	14	10	0
2 →	0	8	15	5	6	2
3 →	8	7	0	5	2	6
	0	8	4	7	7	6
4 →	1	5	4	0	6	3
	0	0	0	0	0	0
		↑ 5				

4	0	7	14	8	0
0	6	15	5	4	2
8	5	0	5	0	6
0	6	4	7	5	6
1	3	4	0	4	3
2	0	2	2	0	2

	4	0	7	14	8	0
1 →	0	6	15	5	4	2
	8	5	0	5	0	6
	0	6	4	7	5	6
2 →	1	3	4	0	4	3
	2	0	2	2	0	2
		↑ 5	↑ 3		↑ 4	

4 →	6	0	7	16	8	0
3 →	0	4	13	5	2	0
6 →	10	5	0	7	0	6
1 →	0	4	2	7	3	4
2 →	1	1	2	0	2	1
5 →	4	0	2	4	0	2

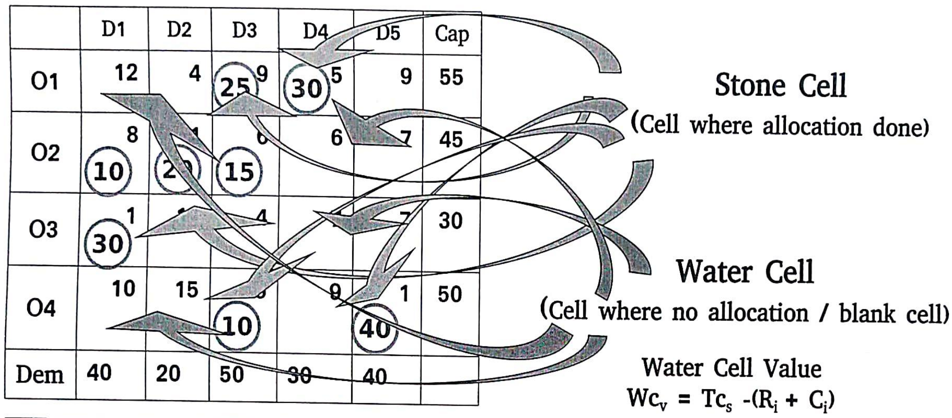
Zmin = 10 + 12 + 3 + 6 + 7 + 0 = 38 rs



North - West rule

	D1	D2	D3	D4	D5
O1	(40) 12	(15) 4	9	5	9
O2	8	(5) 1	(40) 6	6	7
O3	1	12	(10) 4	(20) 7	7
O4	10	15	6	(10) 9	(40) 1

Ans = Z = 12x40 + 4x15 + 1x5 + 6x40 + 4x10 + 7x20 + 9x10 + 1x40



Water Cell Value

$Wc_v = Tc_s - (R_i + C_i)$

	D1	D2	D3	D4	D5	R_i
O1	12	4	9 (25)	5 (30)	9	0
O2	8 (10)	1 (20)	6 (15)	6	7	-3
O3	1 (30)	12	4	7	7	-10
O4	10	15	6 (10)	9	1 (40)	-3
C_i	11	4	9	5	4	

O1D1 = Wc_v = 12 - (0 + 11) = 1

O1D2 = Wc_v = 4 - (0 + 4) = 0

O1D5 = Wc_v = 9 - (0 + 4) = 5

O2D4 = Wc_v = 6 - (-3 + 5) = 4

O2D5 = Wc_v = 7 - (-3 + 4) = 6

O3D2 = Wc_v = 12 - (-10 + 4) = 18

O3D3 = Wc_v = 4 - (-10 + 9) = 5

O3D4 = Wc_v = 7 - (-10 + 5) = 12

O3D5 = Wc_v = 7 - (-10 + 4) = 13

O4D1 = Wc_v = 10 - (-3 + 11) = 2

O4D2 = Wc_v = 15 - (-3 + 4) = 14

O4D4 = Wc_v = 9 - (-3 + 5) = 7

	1	2	3	4	Sup	Row Difference
A	10	8 (50)	7	12	~~50~~	~~1~~ ~~2~~ 4
B	12	13	6 (45)	10 (15)	~~60~~ ~~15~~	~~4~~ ~~2~~ 3
C	8 (70)	10 (5)	12	14 (15)	~~90~~ ~~20~~ ~~15~~	~~2~~ ~~2~~ 4
Dem	~~70~~	~~55~~ ~~5~~	~~45~~	~~30~~ ~~15~~		
Column Difference	2	~~2~~ 3	1	~~2~~ 4		

	1	2	3	4	Ri
A	10	8 (50)	7	12	0
B	12	13	6 (45)	10 (15)	-2
C	8 (70)	10 (5)	12	14 (15)	2
Ci	6	8	8	12	

Replacement Model

1. The replacement is connected with the change of machine or part in accordance with the time and year.

2. The time and year of particular machine replacement have to be determine.

Terms and various cost associated with the replacement are:

1. Purchase cost / Total cost of particular machine = C

2. Scrap value / salvage value / resale value = S

   (Resale value can include Labour cost and spare cost)

3. Running / Operation / Maintenance cost = Rn

4. Depreciation cot = Purchase cost - scrap value

Steps to solve the replacement problem

1. The cost associated with the machine replacement is given in problem

- Purchase cost / Total cost of particular machine = C
- Scrap value / salvage value / resale value = S

  (Resale value can include Labour cost and spare cost)
- Running / Operation / Maintenance cost = Rn
- Depreciation cot = Purchase cost - scrap value

2. Formation of table

Year	Running Cost (Rn)	Cumulative running cost (ΣRn)	Resale / Scrap value (S)	Depreciation cost (D = C - S)	Total cost (ΣRn + D)	Avg total cost (TC / Year)

3. The year in which we get the minimum avg total cost will be the year of replacement of machine

A firm is considering the replacement of machine whose cost price is rs 12,200 and the scrap value is rs 200/-. The running cost are found from the experience as follows. When should the machine be replaced?

Year	1	2	3	4	5	6	7	8
Running cost	200	500	800	1200	1800	2500	3200	4000

Given data :- 1. C = 12200/- 2. S = 200/-

Year	Running Cost (Rn)	Cumulative running cost (ΣRn)	Resale / Scrap value (S)	Depreciation cost (D = C - S)	Total cost (ΣRn + D)	Avg total cost (TC / Year)
1	200	200	200	12000	12200	12200
2	500	700	200	12000	12700	6350
3	800	1500	200	12000	13500	4500
4	1200	2700	200	12000	14700	3670
5	1800	4500	200	12000	16500	3300
6	2500	7000	200	12000	19000	3166.6
7	3200	10200	200	12000	22200	3171.4
8	4000	14200	200	12000	26200	3275

The minimum value of ATC is rs 3166.6/-, so the machine should be replace at the end of 6^{th} year

A computer contains 10,000 resistors. When any resistor fails it is replaced. The cost of replacing a resistor individually is Rs. 1 only. If all the resistors are replaced a the same time, the cost per resistor would be reduced to 35 paise. The percent surviving at the end of month 't' is given in table below. What is optimum period of replacement.

Month	1	2	3	4	5	6
Probability	0.03	0.07	0.20	0.40	0.15	0.15

Given data

1. Number of component given = No = 10000
2. Individual replacement cost = IRc = 1 rs
3. Group replacement cost = GRc = 0.35 rs

1. Calculations for No of component with given probability

N_1 = No x P_1 (First year probability) = 10000 x 0.03 **= 300**

N_2 = No x P_2 + N_1 x P_1 = 10000 x 0.07 + 300 x 0.03 **= 709**

N_3 = No x P_3 + N_1 x P_2 + N_2 x P_1 = 10000 x 0.20 + 300 x 0.07 + 709 x 0.03 **= 2042.27**

N_4 = No x P_4 + N_1 x P_3 + N_2 x P_2 + N_3 x P_1 = **= 4170.89**

N_5 = No x P_5 + N_1 x P_4 + N_2 x P_3 + N_3 x P_2 + N_4 x P_1 = **= 2029.8**

N_6 = No x P_6 + N_1 x P_5 + N_2 x P_4 + N_3 x P_3 + N_4 x P_2 + N_5 x P_1= **= 2589.77**

2. Expected life = Probability x time

= 1 x 0.03 + 2 x 0.07 + 3 x 0.20 + 4 x 0.40 + 5 x 0.15 + 6 x 0.15

= 4.02 months

3. Average number of failure = Number of component (No) / Expected life

= 10000 / 4.02

= 2487.5 ≈ 2488

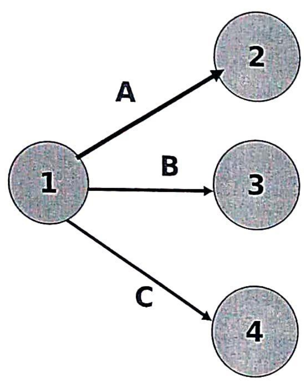
4. Total cost of individual replacement = Average number of failure x Individual cost of replacement (IRc) = 2488 x 1 = 2488/-

5. Table for group replacement

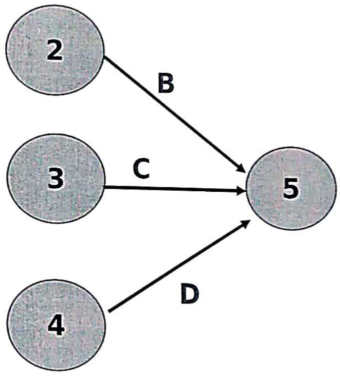
Month/Year	Total cost		Average total cost
1	$(N_1 \times IRc) + (No \times GRc)$	= 3800	3880
2	$(N_1 + N_2) \times IRc + (No \times GRc)$	= 4502	2254.5
3	$(N_1 + N_2 + N_3) \times IRc + (No \times GRc)$	= 6551	2183.66
4	$(N_1 + N_2 + N_3 + N_4) \times IRc + (No \times GRc)$	= 10721	2680.2
5	$(N_1 + N_2 + N_3 + N_4 + N_5) \times IRc + (No \times GRc)$	= 12750	2550
6	$(N_1 + N_2 + N_3 + N_4 + N_5 + N_6) \times IRc + (No \times GRc)$	= 15336	2556.5

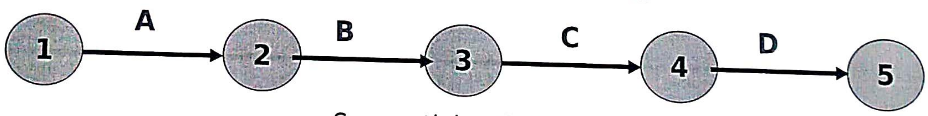
6. Since the minimum average total cost for group replacement is 2183.66 rs at the end of 3rd year and that is lower than individual replacement cost, so group can be preferred after 3rd year.

Critical path Method & Pre Evaluation Review Technique



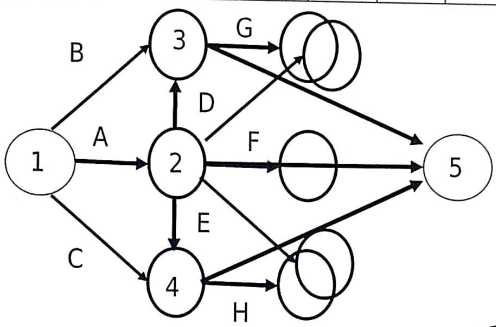
Concurrent Activity

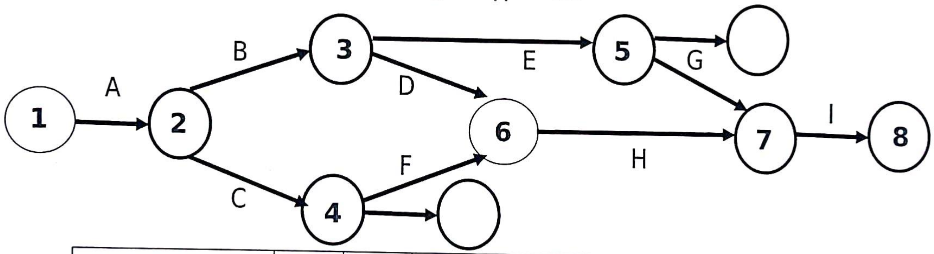




Sequential Activity

Activity	A	B	C	D	E	F	G	H
Depend on	-	-	-	A	A	A	B,D	C,E



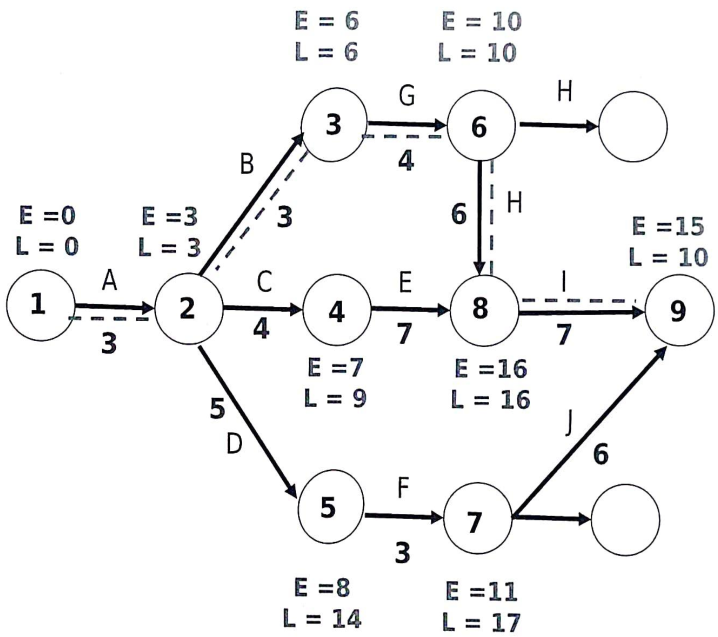


Activity G,H	A	B	C	D	E	F	G	H	I
Depend on	-	A	A	B	B	C	E	D,F	G,H

Activity	Depend on	Optimistic time	Most likely time	Pessimistic time
A	-	1	2	9
B	A	2	3	4
C	A	2	4	6
D	A	3	5	7
E	C	5	7	9
F	D	1	3	5
G	B	1	4	7
H	G	2	6	10
I	E,H	4	8	7
J	F	2	6	10

1. Draw the project network
2. Calculate estimated time
3. Show the critical path
4. find out probability of completion of project in 21 weeks

Activity	Depend on
A	-
B	A
C	A
D	A
E	C
F	D
G	B
H	G
I	E,H
J	F



Critical Path A - B - G - H - I or 1 - 2 - 3 - 6 - 8 - 9

4. Find out the probability of complition of project in 21 weeks & 25 weeks

Project completion time

$$N.D = \frac{Te - Tat}{\sigma p} = \frac{21 - 23}{\sigma p} = \frac{25 - 23}{\sigma p}$$

σp = Standard deviation along critical path (A - B - G - H - I)

$$\sigma p = \sqrt{(\sigma_A)^2 + (\sigma_B)^2 + (\sigma_G)^2 + (\sigma_H)^2 + (\sigma_I)^2}$$

$$\sigma_A = \frac{tp_A - to_A}{6} = \frac{9 - 1}{6} = 1.33$$

$$\sigma p = \sqrt{(1.33)^2 + (0.33)^2 + (1)^2 + (1.33)^2 + (0.33)^2}$$

σp = 2.41

$$N.D = \frac{21 - 23}{2.41} = -0.8298 \qquad N.D = \frac{25 - 23}{2.41} = 0.8298$$

Now with the help of ND chart, find out the probability for value -0.8298 & 0.8298