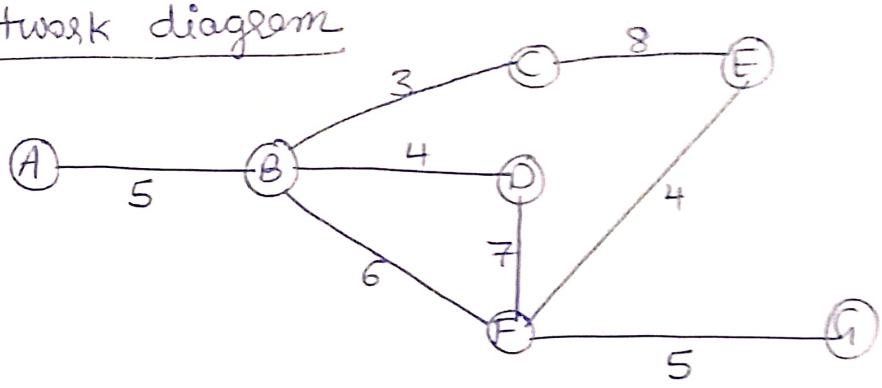
Numerical problems – Unit-4

→ For the given activities, draw the network diagram, identify the critical path and its duration.

A → B = 5 Days
B → C = 3 Days
B → D = 4 Days
B → F = 6 Days
C → E = 8 Days
D → F = 7 Days
E → F = 4 Days
F → G = 5 Days

Solution:-

- Network diagram



- Identify paths and durations:

possible paths from A to G

① A → B → C → E → F → G
5 + 3 + 8 + 4 + 5 = 25 days

② A → B → D → F → G
5 + 4 + 7 + 5 = 21 days

③ A → B → F → G
5 + 6 + 5 = 16 days

- Identify the critical path

The critical path is the longest duration path.

⟹ A → B → C → E → F → G (25 days)

→ For the given activities draw the network diagram, identify the critical path and its duration.

Activity	Optimistic	Most Likely	Pessimistic
1 – 2	4	6	8
1 – 3	2	3	10
1 – 4	6	8	16
2 – 4	1	2	3
3 – 4	6	7	8
3 – 5	6	7	14
4 – 6	3	5	7
4 – 7	4	11	12
5 – 7	2	4	6
6 – 7	2	9	10

Steps to solve the problem:-

- Calculate the time expected (TE) for each activity using the PERT (Program evaluation and technique) formula.

$$TE = \frac{(\text{Optimistic} + 4 \times \text{Most Likely} + \text{Pessimistic})}{6}$$

6 ⇒ indicates total weight (1 + 4 + 1) = 6

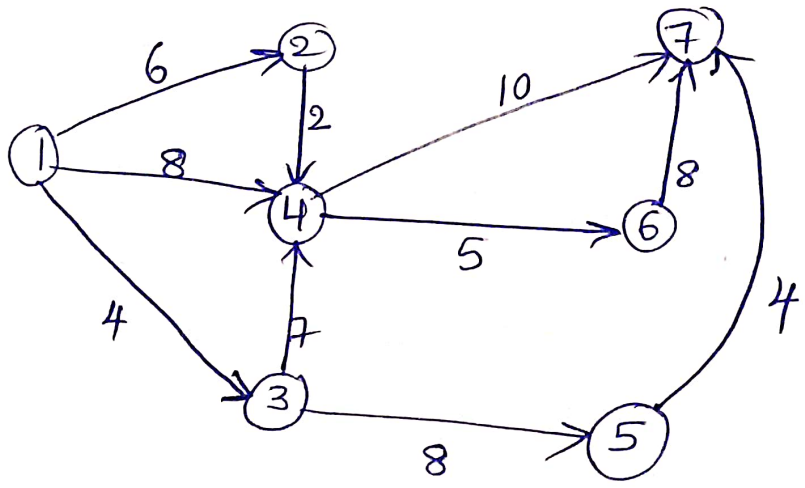
optimistic, Most likely, pessimistic

- Draw the network diagram
- Identify paths and compute durations
- Determine the critical path

Solution :-

Activity	optimistic	Most likely	pessimistic	TE calculation	TE
1 – 2	4	6	8	(4 + 4x6 + 8)/6	6
1 – 3	2	3	10	(2 + 4x3 + 10)/6	4
1 – 4	6	8	16	(6 + 4x8 + 16)/6	8
2 – 4	1	2	3	(1 + 4x2 + 3)/6	2
3 – 4	6	7	8	(6 + 4x7 + 8)/6	7
3 – 5	6	7	14	(6 + 4x7 + 14)/6	8
4 – 6	3	5	7	(3 + 4x5 + 7)/6	5
4 – 7	4	11	12	(4 + 4x11 + 12)/6	10
5 – 7	2	4	6	(2 + 4x4 + 6)/6	4
6 – 7	2	9	10	(2 + 4x9 + 10)/6	8

Network diagram :-



Identify paths and Durations :

possible path from 1 to 7 are

① $1 \rightarrow 2 \rightarrow 4 \rightarrow 6 \rightarrow 7$

$6 + 2 + 5 + 8 = 21$ days

② $1 \rightarrow 2 \rightarrow 4 \rightarrow 7$

$6 + 2 + 10 = 18$ days

③ $1 \rightarrow 3 \rightarrow 4 \rightarrow 6 \rightarrow 7$

$4 + 7 + 5 + 8 = 24$ days

④ $1 \rightarrow 3 \rightarrow 4 \rightarrow 7$

$4 + 7 + 10 = 21$ days

⑤ $1 \rightarrow 3 \rightarrow 5 \rightarrow 7$

$4 + 8 + 4 = 16$ days

⑥ $1 \rightarrow 4 \rightarrow 7$

$8 + 10 = 18$ days

Identify critical path

$1 \rightarrow 3 \rightarrow 4 \rightarrow 6 \rightarrow 7$ (24 days)

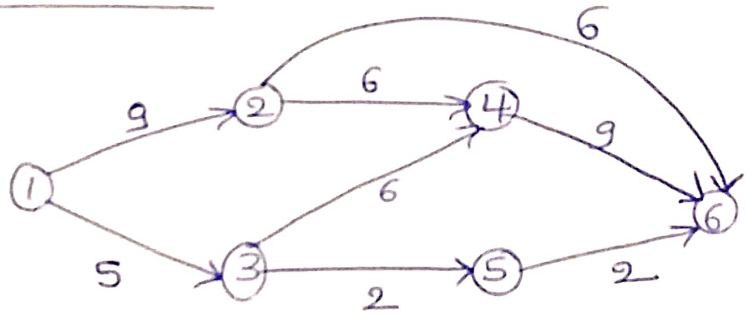
→ For the given activities, draw the network diagram, identify the critical path and its duration

Solution:-

Activity	(O) Optimistic	(ML) Most likely	(P) Pessimistic	TE calculation	TE
1 → 2	6	9	12	6+4(9)+12/6	9
1 → 3	3	4	11	3+4(4)+11/6	5
2 → 4	2	5	14	2+4(5)+14/6	6
3 → 4	4	6	8	4+4(6)+8/6	6
3 → 5	1	1.5	5	1+4(1.5)+5/6	2
2 → 6	5	6	7	5+4(6)+7/6	6
4 → 6	7	8	15	7+4(8)+15/6	9
5 → 6	1	2	3	1+4(2)+3/6	2

$$TE = \frac{O + 4(ML) + P}{6}$$

- Network diagram



- Identify path and compute duration:-

① 1 → 2 → 4 → 6
9 + 6 + 9 = 24 days

② 1 → 2 → 6
9 + 6 = 15 days

③ 1 → 3 → 4 → 6
5 + 6 + 9 = 20 days

(P) 1 → 3 → 5 → 6
5 + 2 + 2
= 9 days

Identify the critical path (longest path)

$\Rightarrow$ 1 $\longrightarrow$ 2 $\longrightarrow$ 4 $\longrightarrow$ 6 (24 days)

duration = 24 days

$\longrightarrow$ Compute Estimate At completion (EAC) and variance At Completion (VAC) if both SPI and CPI influence the project work.

When given variables are

- Budget at completion (BAC) = 50 Lakhs
- Earned value (EV) = 20 Lakhs
- Planned value (PV) = 30 Lakhs
- Actual cost (AC) = 35 Lakhs

Also identify whether project is behind schedule and whether project is within the budget.

Steps to solve :-

step1 : calculate - SPI (Schedule performance index) $= \frac{EV}{PV}$

- CPI (Cost performance index) $= \frac{EV}{AC}$

if SPI < 1 project behind schedule

if CPI < 1 project is over budget

step2 :- Compute Estimate at completion (EAC)

- When SPI and CPI influence the project

$$EAC = \frac{BAC}{CPI \times SPI}$$

Step3:- Compute Variance at completion (VAC)

$$VAC = BAC - EAC$$

Solution:-

Step1:- $SPI = \frac{EV}{PV} = \frac{20}{30} = 0.67$

since $SPI < 1$ the project is behind the schedule

$CPI = \frac{EV}{AC} = \frac{20}{35} = 0.57$

since $CPI < 1$ the project is over budget.

Step2:- $EAC = \frac{BAC}{CPI \times SPI}$

$EAC = \frac{50}{0.57 \times 0.67} = \frac{50}{0.3819} \approx 130.88$ Lakhs

Since BAC is 50 Lakhs the revised estimation is 130.88 Lakhs then the project is over budget.

Step3:- $VAC = BAC - EAC$

$VAC = 50 - 130.88$ Lakhs

$VAC = -80.88$ Lakhs

VAC is negative, project exceed the budget.

Final analysis:-

- $SPI < 1$ (0.67) Project behind the schedule
- $CPI < 1$ (0.57) project is over budget
- $EAC = 130.88$ Lakhs
- $VAC = -80.88$ Lakhs (over budget)

→ Compute EAC and VAC if both SPI and CPI influence the project work when given variables are

BAC = 22 Lakhs

EV = 13 Lakhs

PV = 14 Lakhs

AC = 15 lakhs

Also identify whether the project is behind schedule and whether the project is within the budget

Solution:-

step1:- $SPI = \frac{EV}{PV} = \frac{13}{14} = 0.93$

SPI < 1 (0.93) project behind schedule

$CPI = \frac{EV}{AC} = \frac{13}{15} = 0.87$

CPI < 1 (0.87) project is over budget.

step2:- $EAC = \frac{BAC}{CPI \times SPI}$

$EAC = \frac{22}{0.87 \times 0.93}$

$EAC = \frac{22}{0.8091} = 27.19$ Lakhs

Step3:- VAC = BAC − EAC

VAC = 22 − 27.19

VAC = −5.19 Lakhs

Final analysis:-

- Behind schedule (SPI < 1 → 0.93)
- Over budget (CPI < 1 → 0.87)
- EAC = 27.19 Lakhs
- VAC = -5.19 Lakhs (over budget)

→ You are managing a project which is into six months of its execution. You are now reviewing the project status and you have ascertained the project is behind schedule.

Given:-

Activity A :-

AC = 2 Lakhs

PV = 1.8 Lakhs

completion = 100%

Activity B :-

AC = 1 lakhs

PV = 80000

completion = 75 %

Calculate SPI and CPI of the project review date.

Solution:-

- Calculate activity A Earned value EV (completion 100 %)

EV = 1.8 Laks

activity B

EV (completion 75%)

EV = PV × 75 %

$= PV \times \frac{75}{100} = 80000 \times \frac{75}{100} = 60,000$

EV = 60000

- Total values:-

Total AC = AC(A) + AC(B) = 3 Lakhs

Total PV = PV(A) + PV(B) = 2.6 lakhs

Total EV = EV(A) + EV(B) = 2.4 Lakhs

- $SPI = \frac{EV}{PV} = \frac{2.4}{2.6} = 0.92$

since, SPI < 1 project is behind schedule.

- $CPI = \frac{EV}{AC} = \frac{2.4}{3.0} = 0.80$

since, CPI < 1 project is over budget.

→ A project size of 200 KLOC is to be developed. Software development team has average experience on similar type of projects. The project schedule is not very tight. Calculate Effort, development time, average staff size and productivity of project.
(Hint: Use semi detached model where a1 = 3, a2 = 1.12 b1 = 2.5, b2 = 0.35)

Steps to solve:- Using COCOMO II Model

1] Effort (E) $= a_1 \times \left(\frac{KLOC}{1000}\right)^{a_2}$

2] Development time (T) $= b_1 \times E^{b_2}$

3] Average staff size $S = \frac{E}{T}$

4] productivity $P = \frac{KLOC}{E}$

Solution:- semi detached model

Given $a_1 = 3$ $b_1 = 2.5$

$a_2 = 1.12$ $b_2 = 0.35$

① Effort (E) $= 3 \times \left(\frac{200}{1000}\right)^{1.12}$

$E = 3 \times (0.2)^{1.12}$

$E = 3 \times 0.166$

$E = 0.498$ person-years

② Development time (T):

$T = 2.5 \times (0.498)^{0.35}$

$T = 2.183$ years

③ Average staff size (S):

$S = \frac{0.498}{2.183} = 0.228$ persons

④ Productivity (P):

$P = \frac{200}{0.498}$

$P = 401.61$ KLOC per person-years

⟶ In a software project, three risks were identified

- 75 % chance of losing 50000 due to delayed of reports module
- 5 % chance of spending of 30 lakhs due to customes changing product specifications
- 20 % chance of wasting 2 lakhs due to delay in loading of customes suplied data.

Calculate the combined risk Exposure of the project.

Help: Required formula:-

Risk Exposure = Probability of the risk occuring × Impact of the risk

Solution: Risk 1:

probability = 75% = 0.75

Impact = 50000 rupees

Risk Exposure 1 = 0.75 × 50000 = 37,500 rupees

Risk 2:

Probability = 5% = 0.05

Impact = 30 Lakhs (30,00,000)

Risk exposure 2 = 0.05 × 30,00,000 = 1,50,000 rupees

Risk 3:

probability = 20% = 0.20

Impact = 2 Lakh (2,00,000)

Risk exposure 3 = 0.20 × 2,00,000 = 40,000 rupees

Total risk exposure = 37,500 + 1,50,000 + 40,000

= 2,27,500 rupees

This represents the potential loss due to the identified risks in the project.