PRACTICAL - 8

AIM: Build PERT networks, estimate activity times, and calculate project durations and completion probabilities.

Task:

1. Consider a software development project with the following activities:
   A: Define Requirements,B: Design Database,C: Develop Frontend,D: Implement Backend,E: Perform Testing,F: Deployment
   The dependencies are as follows:
   A depends on nothing,B depends on A,C depends on A,D depends on B and C,E depends on D,F depends on E,
   Construct a PERT network diagram for this project.
   Consider the following PERT estimates for a software development project:
   Activity A: Optimistic Time = 2 weeks, Most Likely Time = 4 weeks, Pessimistic Time = 6 days
   Activity B: Optimistic Time = 3 weeks, Most Likely Time = 5 weeks, Pessimistic Time = 7 days
   Activity C: Optimistic Time = 3 weeks, Most Likely Time = 6 weeks, Pessimistic Time = 9 days
   Activity D: Optimistic Time = 4 weeks, Most Likely Time = 7 weeks, Pessimistic Time = 10 days
   Activity E: Optimistic Time = 2 weeks, Most Likely Time = 4 weeks, Pessimistic Time = 6 days
   Activity F: Optimistic Time = 1 week, Most Likely Time = 2 weeks, Pessimistic Time = 3 days
   Determine estimate activity times, and calculate project durations probabilities of completing the project within 14 weeks.

Solution:

Team Details:

Sr. No.	Enrolment no	Name
Team Leader	Yash Patel	202203103510228
Team Member 1	Gati Shah	202203103510261
Team Member 2	Angat Shah	202203103510097
Team Member 3	Fenil Shilodre	202203103510041
Team Member 4	Sarth Chaudhari	202303103510106

Project Title : Airbnb System

1. PERT Time Estimation

Activity	Description	Optimistic (O)	Most Likely (M)	Pessimistic (P)
A	Requirement Analysis	4	5	6
B	UI/UX Design	6	8	10
C	Backend Development	8	10	12
D	Frontend Development	10	12	14
E	Payment Gateway Integration	5	6	7
F	Testing	6	8	10
G	Deployment	3	4	5

2. Calculation For Expected Time (TE) For Each Activity

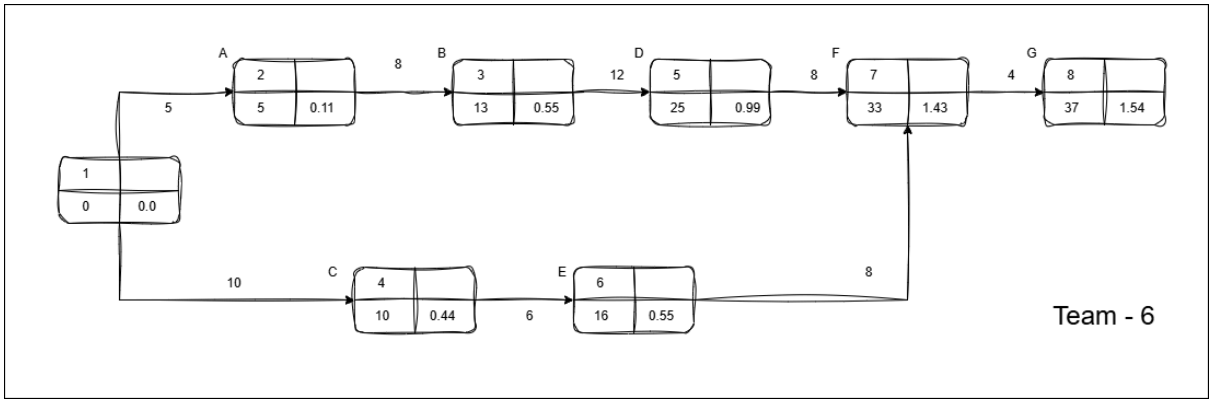
- PERT Formula for Expected Time :

$$TE = \frac{O + 4M + P}{6}$$

Activity	TE Calculation	Expected Time (TE)
A	$\frac{4 + 4(5) + 6}{6} = \frac{30}{6}$	**5 Weeks**
B	$\frac{6 + 4(8) + 10}{6} = \frac{48}{6}$	**8 Weeks**

C	$\frac{8+4(10)+12}{6} = \frac{60}{6}$	**10 Weeks**
D	$\frac{10+4(12)+14}{6} = \frac{72}{6}$	**12 Weeks**
E	$\frac{5+4(6)+7}{6} = \frac{36}{6}$	**6 Weeks**
F	$\frac{6+4(8)+10}{6} = \frac{48}{6}$	**8 Weeks**
G	$\frac{3+4(4)+5}{6} = \frac{24}{6}$	**4 Weeks**

3. Critical Path Analysis (PERT)



PERT Network

- From CPM, the **critical path : A → B → D → F → G**
- Total duration = 5 + 8 + 12 + 8 + 4 = **37 weeks**

(No change from CPM since, TE = original durations.)

4. Probability of Completing Project in 35 Weeks

- **Step 1:** Variance (σ^2) for Critical Path Activities Calculation

  The Formula for Variance :

$$\sigma^2 = \left(\frac{P-O}{6}\right)^2$$

Activity	P - O	σ^2	σ
A	6 - 4 = 2	$\left(\frac{2}{6}\right)^2 \approx$ **0.111**	0.33
B	10 - 6 = 4	$\left(\frac{4}{6}\right)^2 \approx$ **0.444**	0.67
D	14 - 10 = 4	$\left(\frac{4}{6}\right)^2 \approx$ **0.444**	0.67
F	10 - 6 = 4	$\left(\frac{4}{6}\right)^2 \approx$ **0.444**	0.67
G	5 - 3 = 2	$\left(\frac{2}{6}\right)^2 \approx$ **0.111**	0.33

Total Variance ($\Sigma\sigma^2$) = 0.111 + 0.444 + 0.444 + 0.444 + 0.111 = **1.554**

- **Step 2:** Calculation for Standard Deviation (σ)

$$\sigma = \sqrt{1.554} \approx 1.25 \text{ Weeks}$$

- **Step 3:** Computing Z-Score for 35 Weeks

$$z = \frac{T - TE}{\sigma} = \frac{35-37}{1.25} = -1.6$$

- **Step 4:** Find Probability from Z-Table

  From the standard normal distribution table,

Z	0.00
-1.6	.05480

A z-score of **-1.6** corresponds to a ~ **5.5% probability**.

*This makes sense because 35 weeks is **2 weeks shorter** than the expected 37-week duration and the variance is relatively low.*

5. Probability of Completing Project in 39 Weeks

- **Step 1:** Variance (σ^2) for Critical Path Activities Calculation

The Formula for Variance :

$$\sigma^2 = \left(\frac{P - O}{6}\right)^2$$

Activity	P - O	σ^2	σ
A	6 - 4 = 2	$\left(\frac{2}{6}\right)^2 \approx$ **0.111**	0.33
B	10 - 6 = 4	$\left(\frac{4}{6}\right)^2 \approx$ **0.444**	0.67
D	14 - 10 = 4	$\left(\frac{4}{6}\right)^2 \approx$ **0.444**	0.67
F	10 - 6 = 4	$\left(\frac{4}{6}\right)^2 \approx$ **0.444**	0.67
G	5 - 3 = 2	$\left(\frac{2}{6}\right)^2 \approx$ **0.111**	0.33

Total Variance ($\Sigma\sigma^2$) = 0.111 + 0.444 + 0.444 + 0.444 + 0.111 = **1.554**

- **Step 2:** Calculation for Standard Deviation (σ)

$$\sigma = \sqrt{1.554} \approx 1.25 \text{ Weeks}$$

- **Step 3:** Computing Z-Score for 35 Weeks

$$z = \frac{T - TE}{\sigma} = \frac{39-37}{1.25} = 1.6$$

- **Step 4:** Find Probability from Z-Table

From the standard normal distribution table,

Z	0.00
1.6	.94520

A z-score of **1.6** corresponds to a ~ **94.5% probability**.

*This makes sense because 39 weeks is **2 weeks longer** than the expected 37-week duration and the variance is relatively high.*

Project Title : Farfetch E-commerce System

1. PERT Time Estimation

Activity	Description	Optimistic (O)	Most Likely (M)	Pessimistic (P)
A	Requirement Analysis	5	6	7
B	Product Catalog Design	6	7	8
C	Recommendation Engine Dev	12	14	16
D	Payment Gateway Integration	8	10	12
E	UI/UX Design	7	8	9
F	Frontend & Backend Development	16	18	20
G	Testing	10	12	14
H	Deployment	4	5	6

2. Calculation For Expected Time (TE) For Each Activity

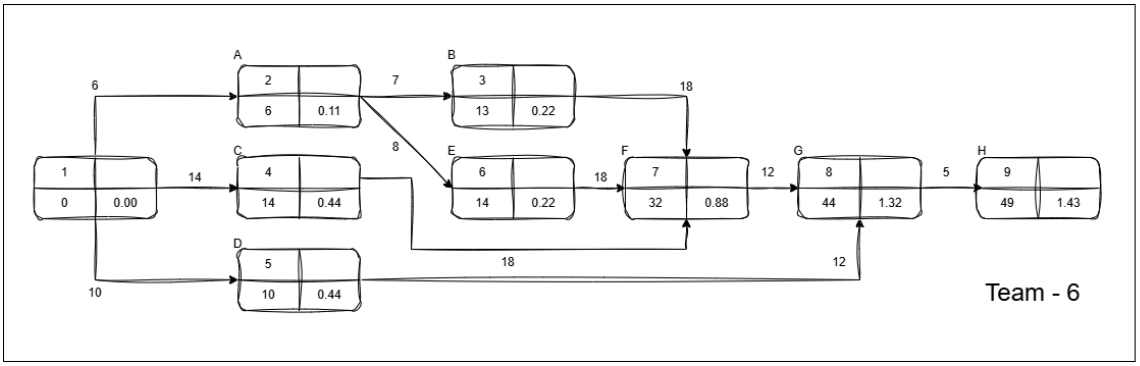
- PERT Formula for Expected Time :

$$TE = \frac{O + 4M + P}{6}$$

Activity	TE Calculation	Expected Time (TE)
A	$\frac{5 + 4(6) + 7}{6} = \frac{36}{6}$	**6 Weeks**

B	$\frac{6+4(7)+8}{6} = \frac{42}{6}$	**7 Weeks**
C	$\frac{12+4(14)+16}{6} = \frac{84}{6}$	**14 Weeks**
D	$\frac{8+4(10)+12}{6} = \frac{60}{6}$	**10 Weeks**
E	$\frac{7+4(8)+9}{6} = \frac{48}{6}$	**8 Weeks**
F	$\frac{16+4(18)+20}{6} = \frac{108}{6}$	**18 Weeks**
G	$\frac{10+4(12)+14}{6} = \frac{72}{6}$	**12 Weeks**
H	$\frac{4+4(5)+6}{6} = \frac{30}{6}$	**5 Weeks**

3. Critical Path Analysis (PERT)



PERT Network

- From CPM, the **critical path** is: **C→ F → G → H**
- Total duration = 6 + 14 + 8 + 18 + 12 + 5 = **49 weeks**.

(Non-critical activities like B and D have slack and won't delay the project.)

4. Probability of Completing Project in 48 Weeks

- **Step 1:** Variance (σ^2) for Critical Path Activities Calculation

  The Formula for Variance :

$$\sigma^2 = \left(\frac{P - O}{6}\right)^2$$

Activity	P - O	σ^2	σ
C	16 - 12 = 4	$\left(\frac{4}{6}\right)^2 \approx$ **0.444**	0.67
F	20 - 16 = 4	$\left(\frac{4}{6}\right)^2 \approx$ **0.444**	0.67
G	14 - 10 = 4	$\left(\frac{4}{6}\right)^2 \approx$ **0.444**	0.67
H	6 - 4 = 2	$\left(\frac{2}{6}\right)^2 \approx$ **0.111**	0.33

Total Variance ($\Sigma\sigma^2$) = 0.444 + 0.444 + 0.444 + 0.111 = **1.443**

- **Step 2:** Calculation for Standard Deviation (σ)

$$\sigma = \sqrt{1.443} \approx 1.20 \text{ Weeks}$$

- **Step 3:** Computing Z-Score for 35 Weeks

$$z = \frac{T - TE}{\sigma} = \frac{48-49}{1.20} = -0.83$$

- **Step 4:** Find Probability from Z-Table

  From the standard normal distribution table,

Z	0.03
- 0.8	.20327

A z-score of - **0.83** corresponds to a ~ **20.3 % probability**.

*This makes sense because 48 weeks is **1 week shorter** than the expected 49-week duration and the variance is relatively low.*

5. Probability of Completing Project in 50 Weeks

- **Step 1:** Variance (σ^2) for Critical Path Activities Calculation

The Formula for Variance :

$$\sigma^2 = \left(\frac{P - O}{6}\right)^2$$

Activity	P - O	σ^2	σ
C	16 - 12 = 4	$\left(\frac{4}{6}\right)^2 \approx$ **0.444**	0.67
F	20 - 16 = 4	$\left(\frac{4}{6}\right)^2 \approx$ **0.444**	0.67
G	14 - 10 = 4	$\left(\frac{4}{6}\right)^2 \approx$ **0.444**	0.67
H	6 - 4 = 2	$\left(\frac{2}{6}\right)^2 \approx$ **0.111**	0.33

Total Variance ($\Sigma\sigma^2$) = 0.444 + 0.444 + 0.444 + 0.111 = **1.443**

- **Step 2:** Calculation for Standard Deviation (σ)

$$\sigma = \sqrt{1.443} \approx 1.20 \text{ Weeks}$$

- **Step 3:** Computing Z-Score for 35 Weeks

$$z = \frac{T - TE}{\sigma} = \frac{50-49}{1.20} = 0.83$$

- **Step 4:** Find Probability from Z-Table

  From the standard normal distribution table,

Z	0.03
0.8	0.79673

A z-score of **0.83** corresponds to a ~ **79.7% probability**.

*This makes sense because 50 weeks is **1 week longer** than the expected 49-week duration and the variance is relatively high.*
