State the assumption made in sequencing model.

Ans 1 Only one operation is carried out on a m/c

2. Each operation once started, must be completed.

3. Only one rn/c of each type is available.

4. A job is processed as soon as possible but only in the order specified.

5. Processing time are independent of order f performing the operation.

6. Transportation time is negligible.

7. Cost of in process inventory is negligible.

Problem. 3.25. There are five jobs each of which just go through two machines A and B in the order of AB.

Processing times are given below. Determine a sequence for five jobs that will

minimize the elapse time and also calculate the total time.

Job	1	2	3	4	5
Time for A	5	1	9	3	10
Time for B	2	6	7	8	4

Determine the sequence for the jobs so as to minimize the process time. Find

total elapsed time.

Solution : Examine the columns of processing time on rn/c A and B and find the

smallest value. If this value falls in column A, schedule the job first on M/c, A, if this

value falls in column B, schedule the jobs last on M/c A. In this way sequence of jobs so as to minimize the process time is

2	4	3	5	1

Job	Machine A		Machine B	
	Time in	Time out	Time in	Time out
2	0	1	1	7
4	1	4	7	15
3	4	13	15	22
5	13	23	23	27
1	23	28	28	30

Ans. Sequence

2	4	3	5	1

Total elapsed time = 30 hours. V

Problem 3.26. Find the sequence that minimize the total elapsed time to complete the following Jobs. Each Job is processed in the order of AB.

		Job (Processing time in minutes)						
		1	2	3	4	5	6	7
m/c	A	12	6	5	11	5	7	6
	B	7	8	9	4	7	8	3

Determine the sequence for the jobs so as to minimize the process time. Find the total elapsed time and idle time of M/c A and M/c B.

Solution : The sequence of jobs so as to minimize the process time is

5	3	2	6	1	4	7

Job	Machine A		Machine B	
	Time in	Time out	Time in	Time out
5	0	5	5	12
3	5	10	12	21
2	10	16	21	29
6	16	23	29	37
1	23	35	37	44
4	35	46	46	50
7	46	52	52	55

Min elapsed time = 55 mins
Idle time of M/c A = 3 mins
Idle time of M/c B = 9 mins.

Define (i) Network (ii) Path terms used in network.

(i) Network: It is the graphical representation of logically and sequentially connected arrows and nodes representing activities and events of a project.

(ii) Path : An unbroken chain of activity ,arrows connecting the initial event to

some other event is called path.

Define critical path and critical activities

Critical path the path containing critical activities (with zero float) is known as critical path.

Critical activity the activity, which can not be delayed without delaying the project duration, is known as critical activity

list four types of floats used in network analysis.

(a) Total float.

(b) Free float

(c) Independent float

(d) Interfering float

Define Free Float, Independent float, Interfering float as used in PERT chart.

Free float : Portion of the total float within which an activity can be manipulated

without affecting the floats of subsequent activities.

Independent float: Portion of the total float within which an activity can be delayed

without affecting the floats of proceeding activities.

Interfering float : It is equal to the difference between the total float and the free float of the activity.

What do you mean by dummy activity?

Dummy activity : An activity, which only determines the dependency of one

activity on the other, but does not consume any time, is called a dummy activity.

Define dummy arrow used in network.

Dummy arrow: It represent the dummy activity in the network. It only represents the dependency of one activity on the other. It is denoted by dash/dotted line.

Define dangling and looping in net-work models.

Dangling : The disconnection of an activity before the completion of all the activities in a network diagram is known as dangling.

Looping (cycling) : Looping error is also known as cycling error in a network diagram. Drawing an endless loop in a network is known as error of looping.

Differentiate between event and activity.

Event: The beginning and end points of an activity are called events or nodes. Event is a point in time and does not consume any resources.

Activity : It is physically identifiable part of a project which require time and resources for its execution. An activity is represented by an arrow, the tail of which represents the start and the head, finish of the activity.

Differentiate between CPM and PERT.

CPM.:

1. CPM is activity oriented i.e., CPM network is built on the basis of activities.

2. CPM is a deterministic model. It does not take into account in uncertainties involved in the estimation of time.

3.

CPM places dual emphasis on project time as well as cost and finds the trade off. between project time and project cost.

4. CPM is primarily used for projects which are repetitive in nature and comparatively small in size.

PERT

1.PERT is event oriented.

2.PERT is a probabilitic model.

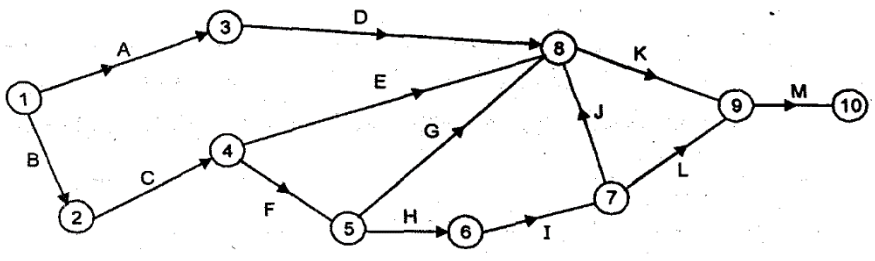
3.PERT is primarily concerned with time only.

4. PERT is used for large one timereserach and development type of projects.

Construct the network for the following activity data:

Activity	Preceded by	Activity	Preceded by
A	-	-	-
B	–	H	F
C	B	I	H
D	A	J	I
E	C	K	D,E,G,J
F	C	L	I
G	F	M	K,L

Solution. Network:



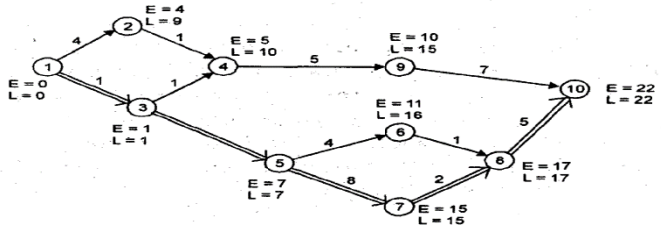
Problem 11.16. A project has the following time schedule :

Activity	1 – 2	1 – 3	2 – 4	3 – 4	3 – 5	4 – 9	5 – 6	5 – 7	6 – 8	7 – 8	8 – 9	8 – 10	9 – 10
Time weeks	4	1	1	1	6	5	4	8	1	2	1	5	7

1. Draw Network diagram and find the critical paths.

2. Calculate float on each activity.

Solution. (*i*)



2.

Activity	Duration (weeks)	Start Time		Finish Time		Total Float
		E	T_{LS}	T_{EF}	L	
1 – 2	4	0	5	4	9	5
1 – 3	1	0	0	1	1	0
2 – 4	1	4	9	5	10	5
3 – 4	1	1	9	2	10	8
3 – 5	6	1	1	7	7	0
4 – 9	5	5	10	10	15	5
5 – 6	4	7	12	11	16	5
5 – 7	8	7	7	15	15	0
6 – 8	1	11	16	12	17	5
7 – 8	2	15	15	17	17	0
8 – 10	5	17	17	22	22	0
9 – 10	7	10	15	17	22	5

Critical path 1—3—5—7—8—10 with project duration of 22 weeks.

The time estimate for the activities of a PERT network are given below :

Activity	t_0	t_m	t_p
1 - 2	1	1	7
1 - 3	1	4	7
1 - 4	2	2	8
2 - 5	1	1	1
3 - 5	2	5	14
4 - 6	2	5	8
5 - 6	3	6	15

(a) Draw the project network and identify all the path through it.

(b) Determine the expected project length.

(c) Calculate the standard deviation and variance of the project length.

(d) What is the probability that the project will be completed

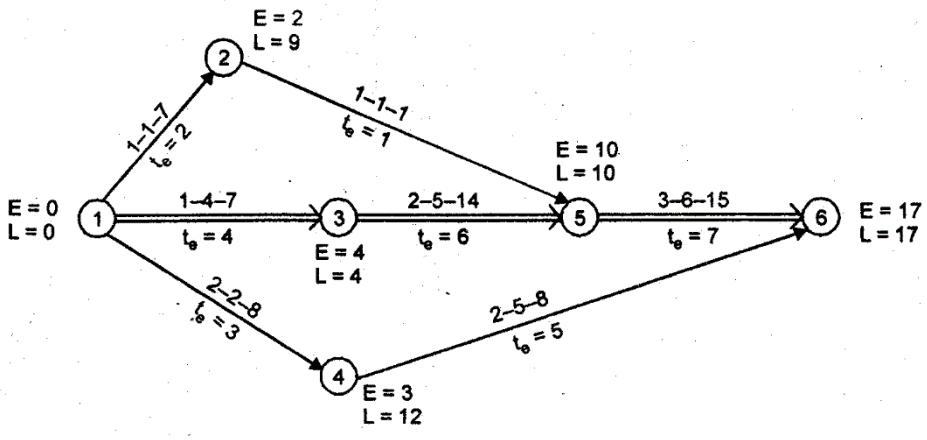
1. At least 4 weeks earlier than expected time.

2. No more than 4 weeks later than expected time.

(e) The probability that the project will be completed on schedule if the schedule completion time is 20 weeks.

(f) What should be the scheduled completion time for the probability of completion to be 90%.

Solution. (a) Network



Activity	t_0	t_m	t_p	$t_e = \frac{t_0 + 4t_m + t_p}{6}$	$\sigma^2 = \frac{(t_p - t_0)^2}{6}$
1 – 2	1	1	7	2	1
1 – 3	1	4	7	4	1
1 – 4	2	2	8	3	1
2 – 5	1	1	1	1	0
3 – 5	2	5	14	6	4
4 – 6	2	5	8	5	1
5 – 6	3	6	15	7	4

Critical path—1 —3—5—6

Project duration = 17 weeks.

(c) Variance of the project length is the sum of the variance of the activities on the critical.

$$V_{cp} = V_{1-3} + V_{3-5} + V_{5-6} = 1 + 4 + 4 = 9$$
$$\sigma^2 = V \Rightarrow \sigma^2 = 9 \Rightarrow \sigma = 3 \text{ weeks.}$$

(d) (i) Probability that the project will be completed at least 4 week earlier than expected time

Expected time (E_p) = 17 weeks
Scheduled time = 17 – 4 = 13 weeks

$$Z = \frac{13 - 17}{3} = -1.33$$

$$P(-1.33) = 1 - 0.9082 = 0.0918$$

2. Probability that the project will be completed at least 4 weeks later than expected

Time

Expected time = 17 weeks Scheduled time =17+ 4 =21 weeks

$$Z = \frac{21-17}{3} = 1.33$$

$$P(1.33) = 0.9082 = 90.8\%.$$

(e) Scheduled time = 20 weeks

$$Z = \frac{20-17}{3} = 1$$

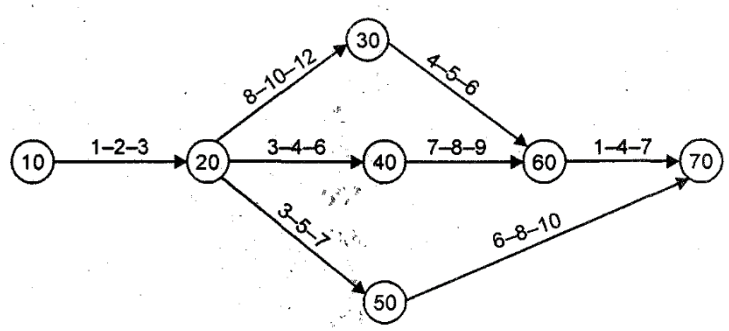
$$P(1) = 84.13\%$$

(f) Value of Z for P = 0.9 is 1.28 (from probability table)

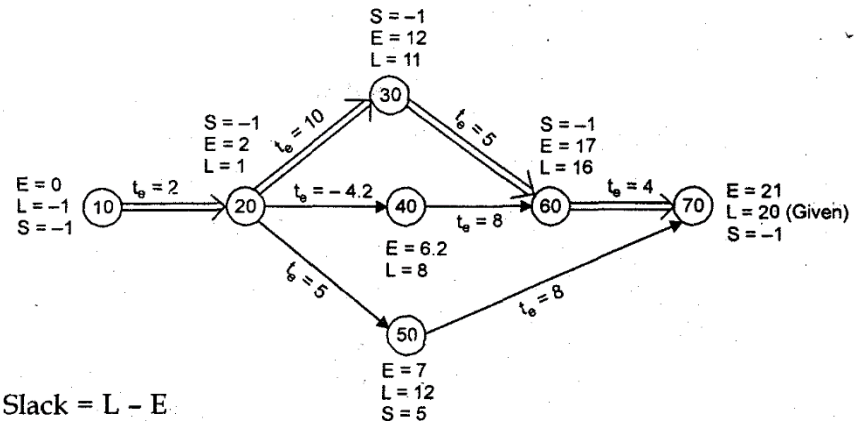
$$1.28 = \frac{T-17}{3}$$

$$T = 17 + 3.84 = 20.84 \text{ weeks.}$$

Problem 11.18. Consider the PERT network given in fig. Determine the float of each activity and identify the critical path if the scheduled completion time for the project is 20 weeks.



Solution.



(s) Slack = L – E

Activity	$t_e = \frac{t_0 + 4tm + t_p}{6}$	Start Time		Finish Time		Total
		E	T_{ES}	T_{EF}	L	Float
10 – 20	2	0	–1	2	1	–1
20 – 30	10	2	1	12	11	–1
20 – 40	4.2	2	3.8	6.2	8	1.8
20 – 50	5	2	7	7	12	5
30 – 60	5	12	11	17	16	–1
40 – 60	8	6.2	8	14.2	16	1.8
50 – 70	8	7	12	15	20	5
60 – 70	4	17	16	21	20	–1

Critical path 10 - 20- 30 - 60 — 70.

I.