IIT ROORKEE

NPTEL ONLINE CERTIFICATION COURSE

Project Management for Managers

Lec – 43

Simulation of Networks- I

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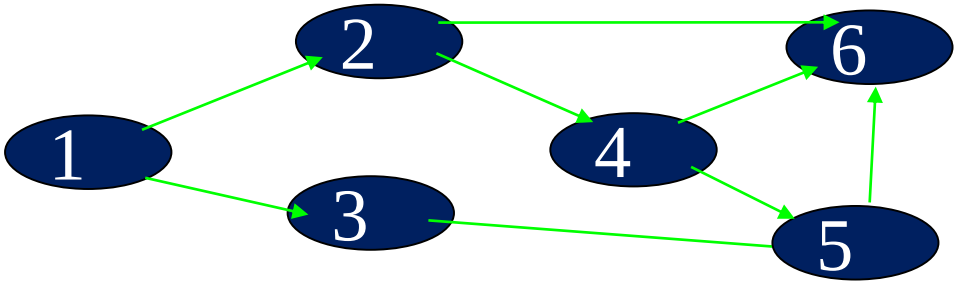
Simulation of PERT network.



The person in charge of the activity feels there is

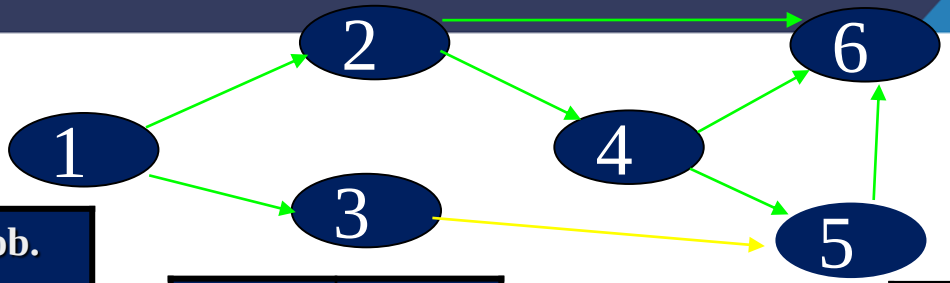
a chance of 20 % that the activity 1-2 will be over in 5 days,

and a 30% chance of completion in 6 days,

a 30% chance of completion in 7 days and

a 20% chance of completion in 8 days.

Let T_{1-2} be the random variable which denotes the duration of activity 1-2. The probability distribution of T_{1-2} is shown in table.



Find the duration of this project?

1-2	Prob.
5	0.2
6	0.3
7	0.3
8	0.2

1-3	Prob.
12	.05
13	0.2
14	0.5
15	0.2
16	0.05

2-4	Prob.
6	0.2
7	0.6
8	0.2

3-5	Prob.
4	0.15
5	0.7
6	0.15

2-6	Prob.
8	0.1
9	0.4
10	0.4
11	0.1

4-5	Prob.
6	0.3
7	0.6
8	0.1

5-6	Prob.
7	0.3
8	0.4
9	0.3

4-6	Prob.
13	0.1
14	0.2
15	0.5
16	0.1
17	0.1

Now we generate random sample for Tij. Let F ij(x) denote the cumulative distribution function (cdf) of Tij that is

$F_{ij}(x) = P(Tij \leq x)$

1-2	Prob.
5	0.2
6	0.3
7	0.3
8	0.2

From table we find that

$F_{12}(x) = 0 \quad x < 5$

$= .2 \quad 5 \leq x < 6$

$= .5 \quad 6 \leq x < 7$

$= .8 \quad 7 \leq x < 8$

$= 1.0 \quad 8 \leq x$ Equation (1)

Let “u” be the random variable which is distributed uniformly over (0,1). Since F ij(x) is uniformly distributed over (0,1) it can be proved that equation (1) implies

$0 \leq u < .2$ corresponds to Tij = 5

$.2 \leq u < .5$ corresponds to Tij = 6

$.5 \leq u < .8$ corresponds to Tij = 7

$.8 \leq u < 1$ corresponds to Tij = 8

.07	.01	.85	.24	.44	.72	.16	.11	.79	.18
.13	.62	.32	.74	.20	.96	.03	.96	.82	.82

The following will the times for activity 1-2 .

5	5	8	6	6	7	5	5	7	5
5	7	6	7	6	8	5	8	8	8

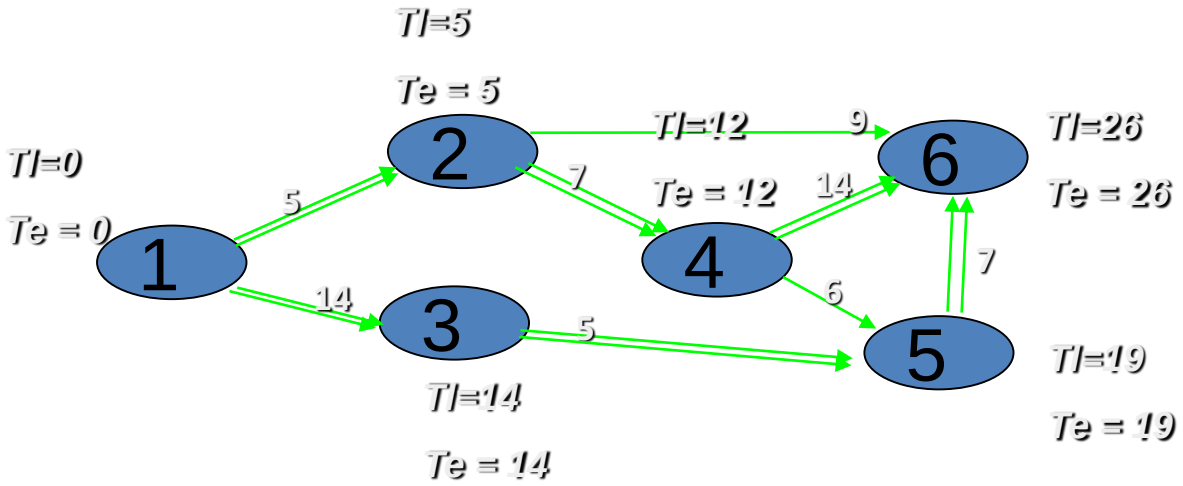
Similarly generate times for other activities.

SN	RN	T12
1	.07	5
2	.01	5
3	.85	8
4	.24	6
5	.44	6
6	.72	7
7	.16	5
8	.11	5
9	.79	7
10	.18	5
11	.13	5
12	.62	7
13	.32	6
14	.74	7
15	.20	6
16	.96	8
17	.03	5
18	.96	8
19	.82	8
20	.82	8

SN	RN	T12	RN	T13	RN	T24	RN	T35	RN	T26	RN	T45	RN	T46	RN	T56
1	.07	5	.54	14	.41	7	.19	5	.34	9	.09	6	.17	14	.21	7
2	.01	5	.26	14	.78	7	.19	5	.96	11	.23	6	.29	14	.33	8
3	.85	8	.26	14	.69	7	.34	5	.89	10	.71	7	.55	15	.89	9
4	.24	6	.62	14	.56	7	.90	6	.96	11	.10	6	.93	17	.88	9
5	.44	6	.90	15	.27	7	.17	5	.96	11	.07	6	.38	15	.88	9
6	.72	7	.53	14	.98	8	.76	5	.55	10	.60	7	.31	15	.21	7
7	.16	5	.34	14	.73	7	.94	6	.28	9	.62	7	.17	14	.47	8
8	.11	5	.83	15	.87	8	.15	5	.23	9	.27	6	.26	14	.72	9
9	.79	7	.44	14	.52	7	.54	5	.13	9	.99	8	.56	15	.75	9
10	.18	5	.82	15	.14	6	.30	5	.37	9	.73	7	.25	14	.44	8
11	.13	5	.99	16	.73	7	.33	5	.94	11	.71	7	.57	15	.39	8
12	.62	7	.26	14	.90	8	.02	4	.12	9	.08	6	.29	14	.04	7
13	.32	6	.89	15	.43	7	.38	5	.80	10	.00	6	.97	17	.44	8
14	.74	7	.53	14	.33	7	.73	5	.65	10	.99	8	.50	15	.27	7
15	.20	6	.42	14	.29	7	.37	5	.11	9	.23	6	.71	15	.58	8
16	.96	8	.38	14	.66	7	.81	5	.69	10	.63	7	.76	15	.98	9
17	.03	5	.55	14	.36	7	.77	5	.98	11	.09	6	.16	14	.71	9
18	.96	8	.63	14	.46	7	.37	5	.12	9	.41	7	.59	15	.59	8
19	.82	8	.91	15	.83	8	.42	5	.37	9	.98	8	.75	15	.71	9
20	.82	8	.59	14	.49	7	.79	5	.01	8	.06	6	.34	15	.78	9

For each case we find critical path and duration of completion of project.

SN	RN	T12	RN	T13	RN	T24	RN	T35	RN	T26	RN	T45	RN	T46	RN	T56
1	.07	5	.54	14	.41	7	.19	5	.34	9	.09	6	.17	14	.21	7



For serial no. 1 , the critical paths are 1-2-4-6 and 1-3-5-6 and the duration is 26. When we do it for 20 runs, we will find next table.

Critical paths for sr. no. 1 are :1-2-4-6 and 1-3-5-6

Sr.No.	1-2	1-3	2-4	3-5	2-6	4-5	4-6	5-6	T
1	1	1	1	1			1	1	26
2		1		1				1	27
3	1		1			1		1	31
4	1		1				1		30
5		1		1				1	29
6	1		1				1		30
7		1		1				1	28
8		1		1				1	26
9	1		1			1		1	31
10		1		1				1	28
11		1		1				1	29
12	1		1				1		29
13	1		1				1		30
14	1		1			1	1	1	29
15	1		1				1		28
16	1		1			1		1	31
17		1		1				1	28
18	1		1			1	1	1	30
19	1		1			1		1	33
20	1		1			1	1	1	30
Crit Ind.	.65	.40	.65	.40	.00	.35	.45	.75	Avg:29.3

Average duration of the project is 29.3 days .The critical index of the activity 5-6 is 0.75, it means that, if we under take this project 100 times, then 75 % of the times it will be a critical activity. From previous table.

T (Days)	26	27	28	29	30	31	32	33
Prob.	2/20	1/20	4/20	4/20	5/20	3/20	0/20	1/20

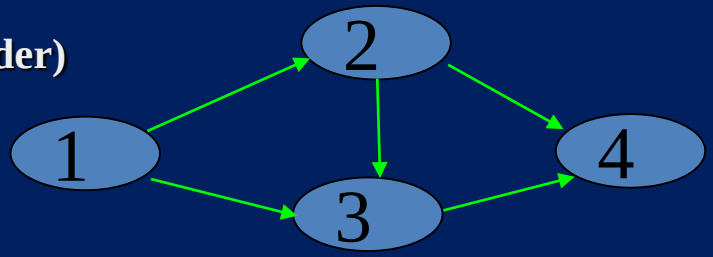
P (project will take more than 29 days) = 9/20.

This approach is better than traditional PERT approach.

Gives information about critical and semi critical activities.

A PERT network consists of five activities (1,2),(1,3),(2,3),(2,4) and (3,4) with following details.

Activity	Description	RN(to be used in order)
1-2	Constant with duration 5	
1-3	Constant with duration 2	
2-3	3/.3 4/.4 5/.3	.2, .1, .9, .3, .2
2-4	6/.3 7/.5 8/.2	.9, .0, .1, .5, .6
3-4	3/.2 4/.7 5/.1	.6, .2, .9, .1, .1



Simulate the network for five times and find

(a) Distribution of T the project duration,

(b) E (T) ,

(c) P(T ≤ 14) and

(d) Critical indexes of all the activities.