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A case Study on the influence of Optimistic time estimate on a network with Arithmetic Progression

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ABSTRACT

The paper is aimed to discuss the positive effect of Arithmetic Progression (A.P) on a Network. Network of Project is framed in a symmetric manner with 22 nodes and 28 activities. A.P is considered on optimistic time estimate among the three time estimates namely optimistic, most likely and pessimistic. PERT analysis is carried out on the network. Pertained conclusions are illustrated.

Keywords: Network, Time estimates, Float, Critical path, Normal distribution.

AMS Classification: **90-08, 90B10, 90C90**

I.INRTRODUCTION

K.V.L.N.Acharyulu et.al [1-5] attempted multifarious Network projects and observed the impact of various progressions on the projects. . S.D.Sarma [9] discussed about different and difficult models in operations research. Many procedures in various topics were established by Billy E.Gillett [8] in 1979. Some other mathematicians like Levin, Kirk Patrick[6], Wiest and Levy[7] concentrated on operations research and developed many concepts to bring them nearer to the applicability of real life situations .

Arithmetic Progression is considered on optimistic time estimate among the three time estimates. It is investigated whether Arithmetic Progression will support a network or not. A network is constructed in a systematic way with 22 nodes and 28 activities. PERT analysis is utilized on the considered network and some results are obtained. Float values are also calculated and critical path is traced. Project analysis and periodical analysis both are used to illustrate the project with standard normal distributive curves.

II. BASIC CONSTRUCTION OF NETWORK:

A network is constructed with 22 nodes and 28 activities in a symmetric way for observing the influence of **Arithmetic Progression** in which A.P is employed on optimistic time estimate (a) in this case among the three estimates. No Dummy activity is taken.

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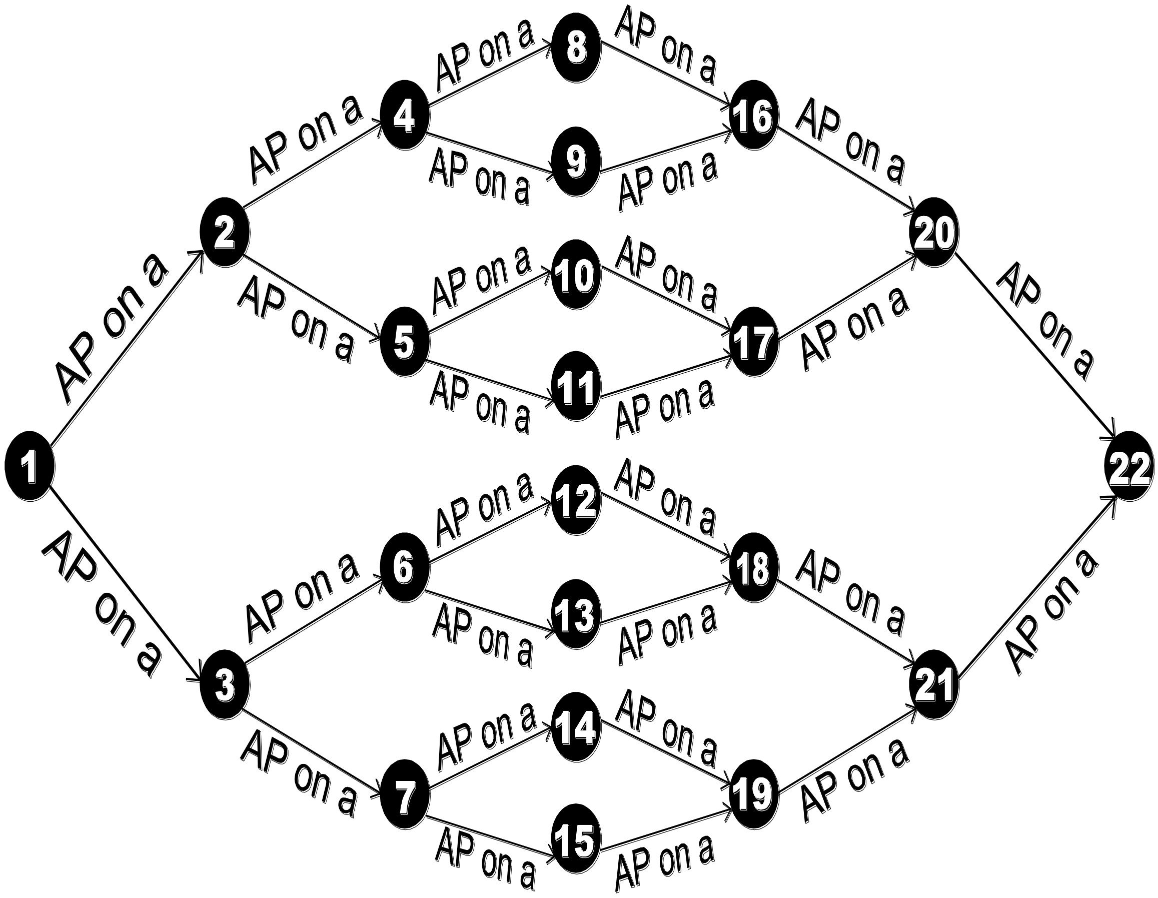


Fig.1: Network with 28 activities & 22 nodes

III. PRELIMINARIES AND NOTATIONS:

(i).**TE**= Earliest excepted completion time of event (TE)

Def: For the fixed value of j=TE(j)=Max[TE(i)+ET(i,j)] which ranges over all activities from i-j.

(ii).**TL**= Latest allowable event completion time (TL)

Def: For the fixed value of i=TL(i)=Min[TL(j)+ET(i,j)] which ranges over all activities from i-j.

(iii).**ET**= Excepted completion time of activity (I,J)

(iv). **a** = Optimistic time estimate

(v). **m** = Most likely time estimate

(vi). **b** = Pessimistic time estimate

(vii). **ES** = Earliest start of an activity

(viii). **EF** = Earliest finish of an activity

(ix). **LS** = Latest start of an activity

(x). **LF** = Latest finish of an activity

(xi). **TF** = Total Float

Def: TF of activity i-j = LF_{i-j}-EF_{i-j} (or) LS_{i-j}-ES_{i-j}

(xii).**FF** = Free Float

Def: FF of activity i-j = TF - (TL-TE) of node j

(xiii).**IF** = Independent Float

Def: IF of activity i-j = FF - (TL-TE) of node i

(xiv)**.SE=**Slack event time

(xv).**CPI**=Critical Path Indicator

(xvi).**SCT**= Scheduled Time

(xvii). σ = Standard deviation of project length

IV. MATERIAL AND METHODS

Step 1: Estimate the project network completion time

Step 2: Compute the excepted duration of each activity by using the formula $ET = \frac{a+4m+b}{6}$.

From the time estimates a,m and p. Also calculate the excepted variance. σ^2 of each activity

Step 3: Calculate TE, TL

Step 4: Find Total Float, Free Float and Independent Float

Step 5: Find the critical path and identify the critical activities

Step 6: Compute project length which is a square root of sum of variance of all the critical activities.

Step 7: Estimate the probability of completing project within specified time,

Using the standard normal variable $z = \frac{SCT - ET}{\sigma}$,Where SCT is scheduled Completion time of event, σ =standard deviation of project length.

V. RESULTS

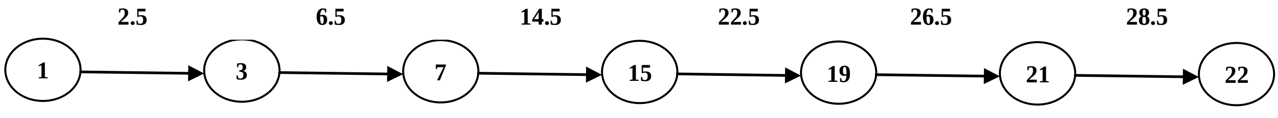
With the help of PERT algorithm, the critical path is obtained as in Table-1. Time estimates, ET, Varience.ES, EF, LS, LF and all Float values are computed and tabulated in the Table-1. The Critical path indicator marked the critical Actives with * in the Table-1.

Table-1

Activity	Time Estimates			ET	σ^2	Earliest		Latest		TF	FF	IF	CPI
	a	m	b			S	F	S	F				
1--2	1.5	2	1	1.75	0.0069	0	1.75	14	15.75	14	0	0	
1--3	2.5	3	2	2.75	0.0069	0	2.75	0	2.75	0	0	0	*
2--4	3.5	4	3	3.75	0.0069	1.75	5.5	20.75	24.5	19	0	-14	
2--5	4.5	5	4	4.75	0.0069	1.75	6.5	15.75	20.5	14	0	-14	
3--6	5.5	6	5	5.75	0.0069	2.75	8.5	8.75	14.5	6	0	0	

3--7	6.5	7	6	6.75	0.0069	2.75	9.5	2.75	9.5	0	0	0	*
4--8	7.5	8	7	7.75	0.0069	5.5	13.25	27.5	35.25	22	0	-19	
4--9	8.5	9	8	8.75	0.0069	5.5	14.25	25.5	34.25	20	0	-19	
5--10	9.5	10	9	9.75	0.0069	6.5	16.25	22.5	32.25	16	0	-14	
5--11	10.5	11	10	10.75	0.0069	6.5	17.25	20.5	31.25	14	0	-14	
6--12	11.5	12	11	11.75	0.0069	8.5	20.25	16.5	28.25	8	0	-6	
6--13	12.5	13	12	12.75	0.0069	8.5	21.25	14.5	27.25	6	0	-6	
7--14	13.5	14	13	13.75	0.0069	9.5	23.25	11.5	25.25	2	0	0	
7--15	14.5	15	14	14.75	0.0069	9.5	24.25	9.5	24.25	0	0	0	*
8--16	15.5	16	15	15.75	0.0069	13.25	29	35.25	51	22	2	-20	
9--16	16.5	17	16	16.75	0.0069	14.25	31	34.25	51	20	0	-20	
10--17	17.5	18	17	17.75	0.0069	16.25	34	32.25	50	16	2	-14	
11--17	18.5	19	18	18.75	0.0069	17.25	36	31.25	50	14	0	-14	
12--18	19.5	20	19	19.75	0.0069	20.25	40	28.25	48	8	2	-6	
13--18	20.5	21	20	20.75	0.0069	21.25	42	27.25	48	6	0	-6	
14--19	21.5	22	21	21.75	0.0069	23.25	45	25.25	47	2	2	0	
15--19	22.5	23	22	22.75	0.0069	24.25	47	24.25	47	0	0	0	*
16--20	23.5	24	23	23.75	0.0069	31	54.75	51	74.75	20	6	-14	
17--20	24.5	25	24	24.75	0.0069	36	60.75	50	74.75	14	0	-14	
18-21	25.5	26	25	25.75	0.0069	42	67.75	48	73.75	6	6	0	
19-21	26.5	27	26	26.75	0.0069	47	73.75	47	73.75	0	0	0	*
20-22	27.5	28	27	27.75	0.0069	60.75	88.5	74.75	102.5	14	14	0	
21-22	28.5	29	28	28.75	0.0069	73.75	102.5	73.75	102.5	0	0	0	*

Critical Path:



$$\text{Project Length} = \sqrt{\text{Sum of Variances of each Critical activity}}$$

$$= \sqrt{0.0069 + 0.0069 + 0.0069 + 0.0069 + 0.0069 + 0.0069}$$

=0.2034

The values of TE, TL and SE corresponding to every node are given in Table (2).

The slack event time may be positive, negative or zero.

It is also observed that the values of slack event time vanish at each critical activity.

Slack event time is defined as the amount of time in which the event can be retarded with out involving the scheduled completion time for the project. Any activity on the critical path necessitates time in excess of its expected completion time and detains the project completion consequently.

Table-2

Nodes	TE	TL	SE	Nodes	TE	TL	SE
1	0	0	0	12	20.25	28.25	8
2	1.75	15.75	14	13	21.25	27.25	6
3	2.75	2.75	0	14	23.25	25.25	2
4	5.5	24.5	19	15	24.25	24.25	0
5	6.5	20.5	14	16	31	51	20
6	8.5	14.5	6	17	36	50	14
7	9.5	9.5	0	18	42	48	6
8	13.25	35.25	22	19	47	47	0
9	14.25	34.25	20	20	60.75	74.75	14
10	16.25	32.25	16	21	73.75	73.75	0
11	17.25	31.25	14	22	102.5	102.5	0

VI. PERIODICAL ANANLYSIS:

The values of probabilities at various levels are shown in the Table-3.

Table-3

SCT	ETC	Z	PROBABILITY	PERCENT OF POSSIBILITY (%)
101	102.5	-7.3746	0	0
102	102.5	-2.4582	0.0071	0.71
103	102.5	2.4582	0.9929	99.29
104	102.5	7.3746	1	100

The Obtained Standard Normal Curves are illustrated from Fig.2-Fig.4

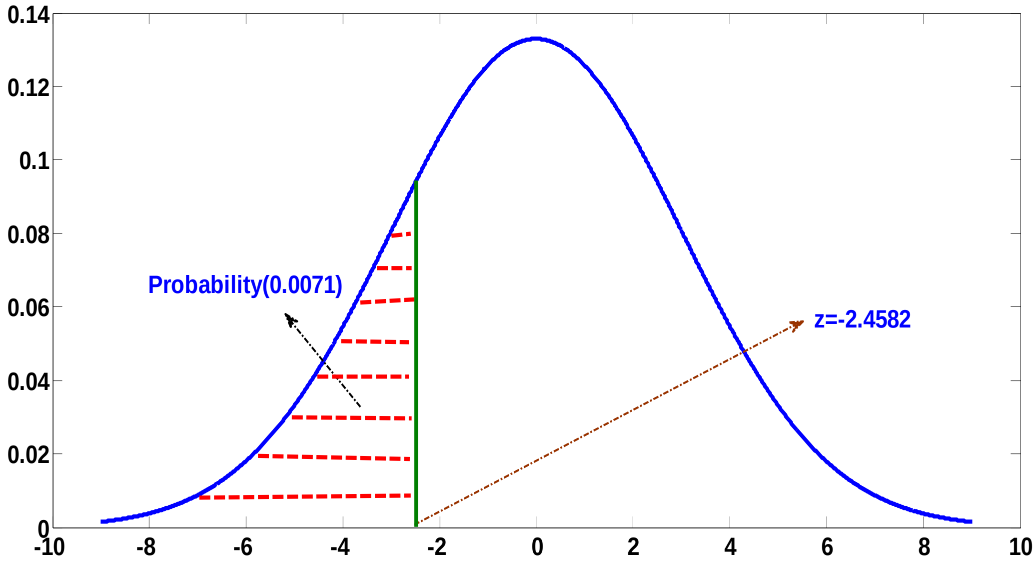


Fig.2: Completion of Project with negligible Probability

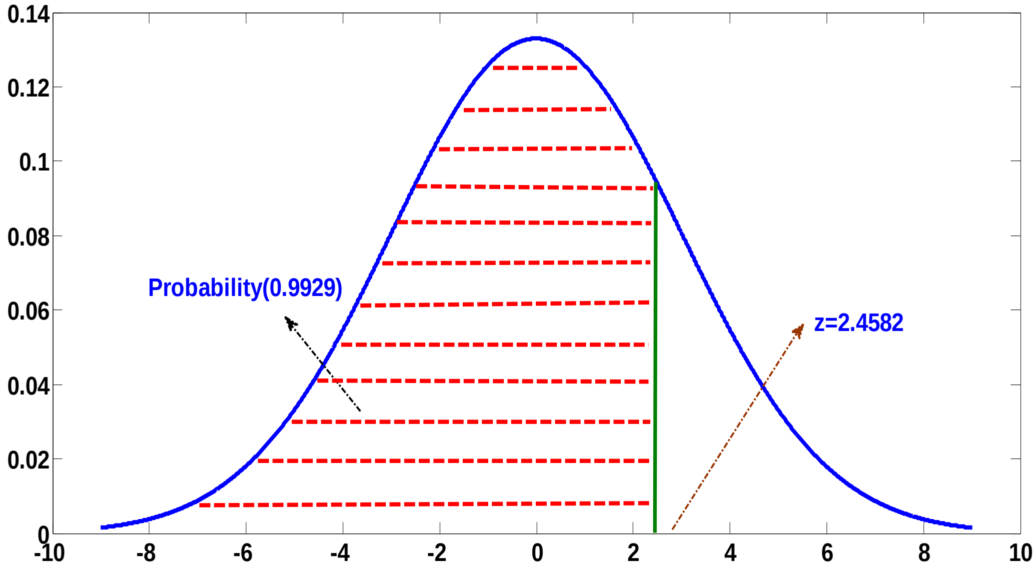


Fig.3: Completion of Project with acceptable Probability

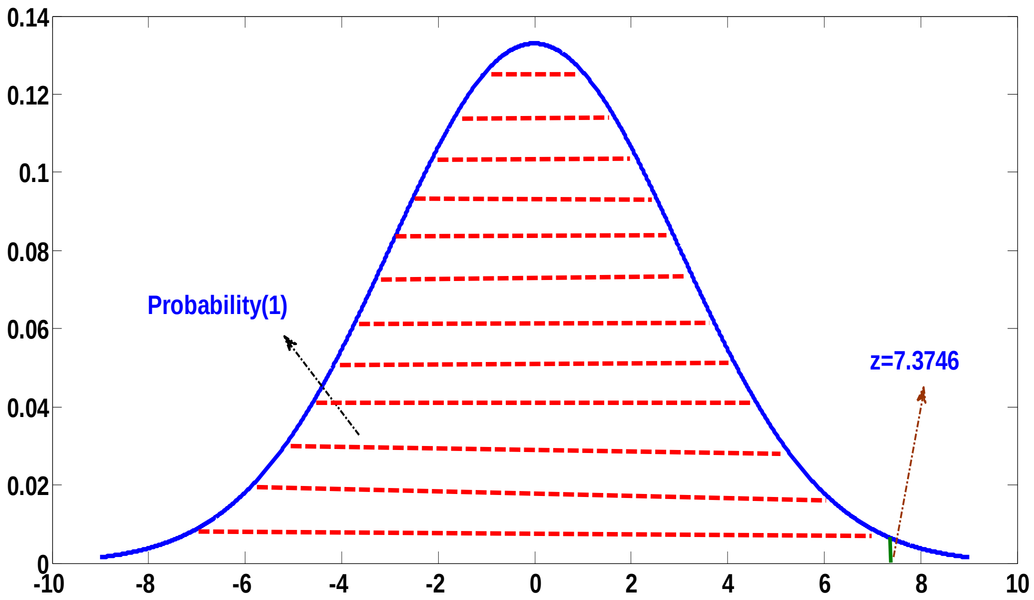


Fig.4: Completion of Project with accurate Probability

VII. CONCLUSIONS

(i).If SCT > ET, then Arithmetic Progression has it's maximum positive influence on the network.

(ii).If SCT < ET, then Arithmetic Progression has no significant impact on the network.

(iv).Unaffected variances are traced.

(v). In the critical path, the total float values are zeroes, slack event of each node is vanished and TE & TL are identical at each node.

(vi).Arithmetic Progression on Optimistic time estimate will strengthen the system for completing the project in an efficient manner.

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