

c.

Activity	Earliest Start	Latest Start	Earliest Finish	Latest Finish	Slack	Critical Activity
A	0	2	6	8	2	
B	0	0	8	8	0	Yes
C	8	8	20	20	0	Yes
D	20	22	24	26	2	
E	20	20	26	26	0	Yes
F	26	26	41	41	0	Yes
G	26	29	38	41	3	
H	41	41	49	49	0	Yes

d. Yes. Project Completion Time 49 weeks.

9. a. A-C-E-H-I

b.

Activity	Earliest Start	Latest Start	Earliest Finish	Latest Finish	Slack	Critical Activity
A	0	0	9	9	0	Yes
B	0	9	6	15	9	
C	9	9	15	15	0	Yes
D	9	12	12	15	3	
E	15	15	15	15	0	Yes
F	15	16	18	19	1	
G	18	19	20	21	1	
H	15	15	21	21	0	Yes
I	21	21	24	24	0	Yes

c. Project completion 24 weeks. The park can open within the 6 months (26 weeks) after the project is

10. a.

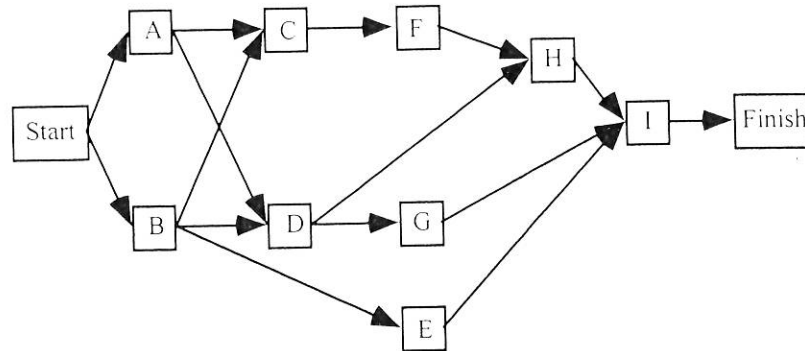
Activity	Optimistic	Most Probable	Pessimistic	Expected Times	Variance
A	4	5	6	5.00	0.11
B	8	9	10	9.00	0.11
C	7	7.5	11	8.00	0.44
D	6	9	10	8.83	0.25
E	6	7	9	7.17	0.25
F	5	6	7	6.00	0.11

b. Critical activities: B-D-F

Expected project completion time:  $9.00 + 8.83 + 6.00 = 23.83$ .

Variance of projection completion time:  $0.11 + 0.25 + 0.11 = 0.47$

11.



12. a.

Activity	Expected Time	Variance
A	4.83	0.25
B	4.00	0.44
C	6.00	0.11
D	8.83	0.25
E	4.00	0.44
F	2.00	0.11
G	7.83	0.69
H	8.00	0.44
I	4.00	0.11

Activity	Earliest Start	Latest Start	Earliest Finish	Latest Finish	Slack	Critical Activity
A	0.00	0.00	4.83	4.83	0.00	Yes
B	0.00	0.83	4.00	4.83	0.83	
C	4.83	5.67	10.83	11.67	0.83	
D	4.83	4.83	13.67	13.67	0.00	Yes
E	4.00	17.67	8.00	21.67	13.67	
F	10.83	11.67	12.83	13.67	0.83	
G	13.67	13.83	21.50	21.67	0.17	
H	13.67	13.67	21.67	21.67	0.00	Yes
I	21.67	21.67	25.67	25.67	0.00	Yes

Critical Path: A-D-H-I

b.  $E(T) = t_A + t_D + t_H + t_I$   
 $= 4.83 + 8.83 + 8 + 4 = 25.66$  days

c.  $\sigma^2 = \sigma_A^2 + \sigma_D^2 + \sigma_H^2 + \sigma_I^2$   
 $= 0.25 + 0.25 + 0.44 + 0.11 = 1.05$

Using the normal distribution,

$$z = \frac{25 - E(T)}{\sigma} = \frac{25 - 25.66}{\sqrt{1.05}} = -0.65$$

From Appendix, area for  $z = -0.65$  is 0.2422.

Probability of 25 days or less =  $0.5000 - 0.2422 = 0.2578$

13.

Activity	Expected Time	Variance
A	5	0.11
B	3	0.03
C	7	0.11
D	6	0.44
E	7	0.44
F	3	0.11
G	10	0.44
H	8	1.78

From problem 6, A-D-F-H is the critical path.

$$E(T) = 5 + 6 + 3 + 8 = 22$$

$$\sigma^2 = 0.11 + 0.44 + 0.11 + 1.78 = 2.44$$

$$z = \frac{\text{Time} - E(T)}{\sigma} = \frac{\text{Time} - 22}{\sqrt{2.44}}$$

a.

Time = 21  $z = -0.64$  From Appendix  
Area  
0.2389  
 $P(21 \text{ weeks}) = 0.5000 - 0.2389 = 0.2611$

b.

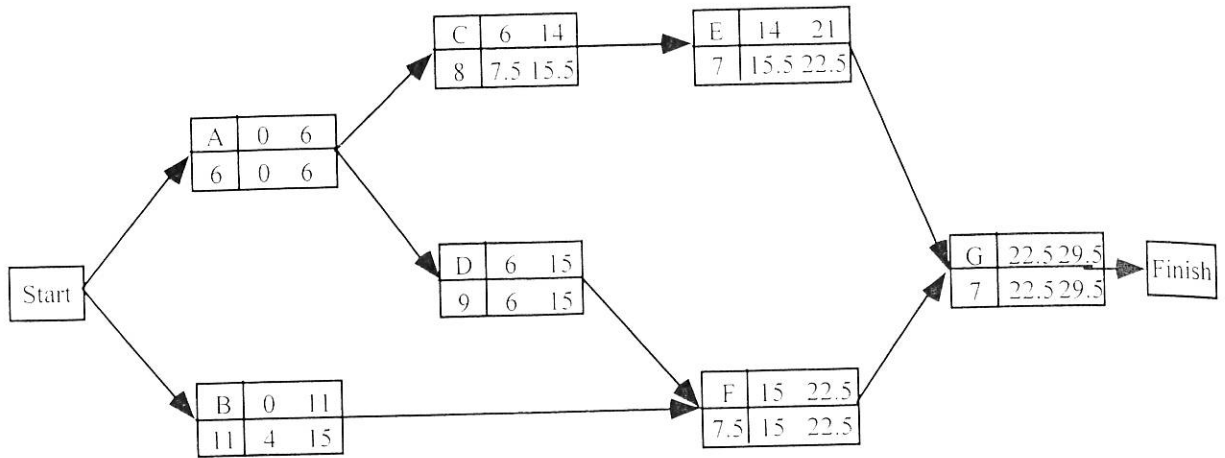
Time = 22  $z = 0$  Area  
0.0000  
 $P(22 \text{ weeks}) = 0.5000$

c.

Time = 25  $z = +1.92$  Area  
0.4726  
 $P(25 \text{ weeks}) = 0.5000 + 0.4726 = 0.9726$

14. a.

Activity	Expected Time	Variance
A	6.0	0.11
B	11.0	1.78
C	8.0	0.44
D	9.0	1.00
E	7.0	1.78
F	7.5	0.25
G	7.0	1.00



Critical Path: A-D-F-G      Time = 29.5

b. Activity C:  
Slack = LS - ES = 7.5 - 6 = 1.5 days

c.  $E(T) = t_A + t_D + t_F + t_G$   
= 6 + 9 + 7.5 + 7 = 29.5 days

$$\sigma^2 = \sigma_A^2 + \sigma_D^2 + \sigma_F^2 + \sigma_G^2$$

$$= 0.11 + 1.00 + 0.25 + 1.00 = 2.36$$

d.

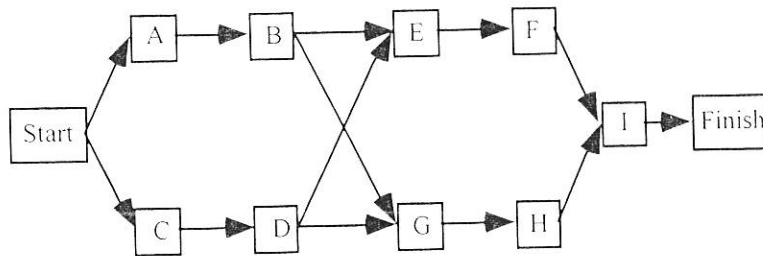
Area

$$z = \frac{30 - E(T)}{\sigma} = \frac{30 - 29.5}{\sqrt{2.36}} = 0.33$$

0.1293

$$P(30 \text{ days}) = 0.5000 + 0.1293 = 0.6293$$

15. a.



b.

Activity	Expected Time	Variance
A	2	0.03
B	3	0.44
C	2	0.11
D	2	0.03
E	1	0.03
F	2	0.11
G	4	0.44
H	4	0.11
I	2	0.03

Activity	Earliest Start	Latest Start	Earliest Finish	Latest Finish	Slack	Critical Activity
A	0	0	2	2	0	Yes
B	2	2	5	5	0	Yes
C	0	1	2	3	1	
D	2	3	4	5	1	
E	5	10	6	11	5	
F	6	11	8	13	5	
G	5	5	9	9	0	Yes
H	9	9	13	13	0	Yes
I	13	13	15	15	0	Yes

- c. Critical Path: A-B-G-H-I  
 $E(T) = 2 + 3 + 4 + 4 + 2 = 15$  weeks

- d. Variance on critical path  
 $\sigma^2 = 0.03 + 0.44 + 0.44 + 0.11 + 0.03 = 1.05$

From Appendix, we find 0.99 probability occurs at  $z = +2.33$ . Thus

$$z = \frac{T - E(T)}{\sigma} = \frac{T - 15}{\sqrt{1.05}} = 2.33$$

or

$$T = 15 + 2.33 \sqrt{1.05} = 17.4 \text{ weeks}$$

16. a. A-D-G-J

$$\begin{aligned} E(T) &= 6 + 5 + 3 + 2 = 16 \\ \sigma^2 &= 1.78 + 1.78 + 0.25 + 0.11 = 3.92 \end{aligned}$$

A-C-F-J

$$\begin{aligned} E(T) &= 6 + 3 + 2 + 2 = 13 \\ \sigma^2 &= 1.78 + 0.11 + 0.03 + 0.11 = 2.03 \end{aligned}$$

B-H-I-J

$$\begin{aligned} E(T) &= 2 + 4 + 2 + 2 = 10 \\ \sigma^2 &= 0.44 + 0.69 + 0.03 + 0.11 = 1.27 \end{aligned}$$

- b. A-D-G-J

$$z = \frac{20 - 16}{\sqrt{3.92}} = 2.02 \quad \text{Area} = 0.4783 + 0.5000 = 0.9783$$

A-C-F-J

$$z = \frac{20 - 13}{\sqrt{2.03}} = 4.91 \quad \text{Area is approximately 1.0000}$$