University of Ottawa – Canada's university

Civil Engineering

CVG 4173 **Construction Management**

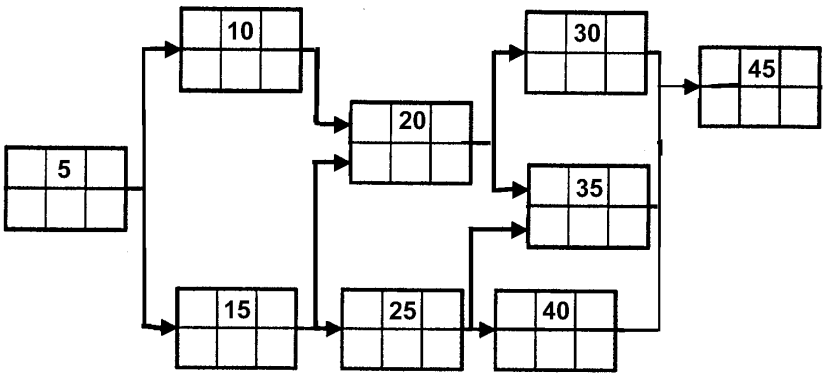
Due on: 29/11/2012 **Solution of Assignment # 4**

Question 1:

Develop a logic network for the sequence of activities listed in the table below.

Activity	Preceded Immediately By (PIB)
5	None
10	5
15	5
20	10, 15
25	15
30	20
35	20, 25
40	25
45	30, 35, 40

Solution:

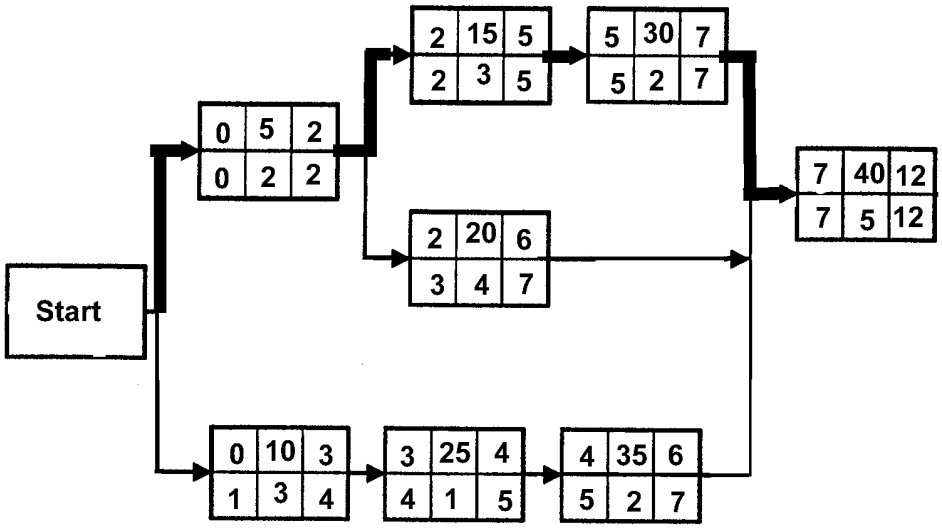


Question 2:

Develop a logic network for the sequence of activities listed in the table below. Calculate the ES, EF, LS and LF times for all activities.
What is the project duration?
What are the critical activities?

Activity	Duration	Preceded Immediately By (PIB)
5	2	None
10	3	None
15	3	5
20	4	5
25	1	10
30	2	15
35	2	25
40	5	20, 30, 35

Solution:



What is the project duration? 12

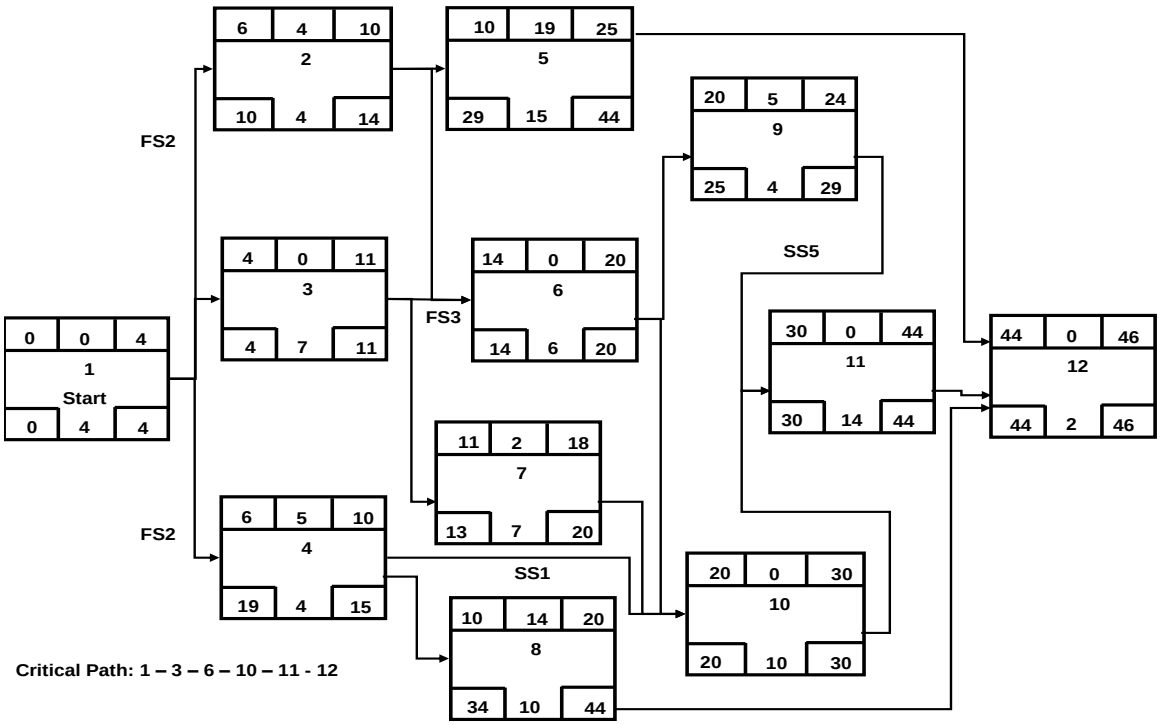
What are the critical activities? 5, 15, 30, and 40.

Question 3:

Draw a precedence diagram representing the logical relationships given below. Calculate the early start and finish, late start and finish, the total float for each activity and identify the critical path(s).

Activity	Duration	Predecessors	Relationship
1	4	---	---
2	4	1	FS 2
3	7	1	FS
4	4	1	FS 2
5	15	2	FS
6	6	2,3	FS & $FS_{3,6}$ 3
7	7	3	FS
8	10	4	FS
9	4	6	FS
10	10	6, 7, 4	FS & $SS_{4,10}$ 1
11	14	9, 10	FS & $SS_{9,11}$ 5
12	2	5, 8, 11	FS

Solution:



Question 4:

In a CPM network, the critical path includes five activities. Their durations are as tabulated below.

Duration (Days)			
Activity	**Optimistic (T_o)**	**Most Likely (T_m)**	**Pessimistic (T_p)**
A	2	4	7
B	5	8	14
C	4	6	8
D	2	2	2
E	7	10	21

Compute the following seven values:

1. The probability that the project will finish by the end of day 32,
2. The probability that the project will finish by the end of day 34,
3. The probability that the project will finish before day 30,
4. The probability that the project will finish on the 32nd day,
5. The probability that the project will finish no later than the 35th day,
6. The probability that the project will finish at least 2 days early,
7. The probability that the project will finish at least 2 days late,

Solution:

	Duration					
Activity	Optimistic (T_o)	Most Likely (T_m)	Pessimistic (T_p)	Expected Duration (T_e)	Standard Deviation (σ_e)	Variance $V_e = \sigma_e^2$
A	2	4	7	4.167	0.833	0.694
B	5	8	14	8.500	1.500	2.250
C	4	6	8	6.000	0.667	0.444
D	2	2	2	2.000	0	0
E	7	10	21	11.333	2.333	5.444
				$T_E = 32$		$V_E = 8.833$

$$T_E = 32 \text{ days}$$

$$V_E = 8.833 \text{ days}$$

and

$$\sigma_E = \sqrt{8.833} = 2.972 \text{ days}$$

Note that $\sigma_E \neq \sum_{i=1}^{n} (\sigma_E)_i$

1. *The probability that the project will finish by the end of day* 32. Using equation 11.7, we find that $Z = (32 - 32)/2.972 = 0$ From the Z table (Table 11.1). we find that

$$\Pr(T_S \leq 32) = 0.5 = 50\%$$

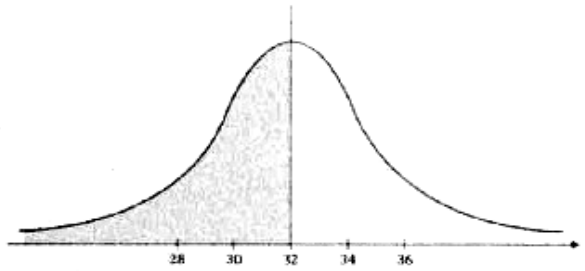


Figure 11.2 Solution to example 11.1, part 1

2. The probability that the project will finish by the end of day 34.

$$Z = (34 - 32)/2.972 = 0.67$$

From Table 11.1, we find that

$$\Pr(T_S \leq 34) = 0.749 = 74.9\%$$

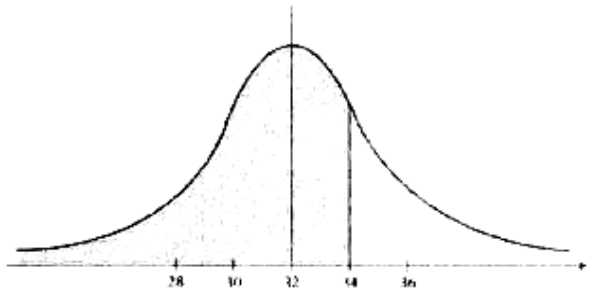


Figure 11.3 Solution to example 11.1, part 2

3. *The probability that the project will finish before day 30.* This probability is the same as the probability of finishing by the end of day 29:

$$Z = (29 - 32)/2.972 = -1.01$$

When $Z < 0$, take the probability that corresponds to the positive value of Z, then subtract it from 1.0 (100%):

$$\Pr(T_S \leq 29) = 1 - 0.844 = 0.156 = 15.6\%$$

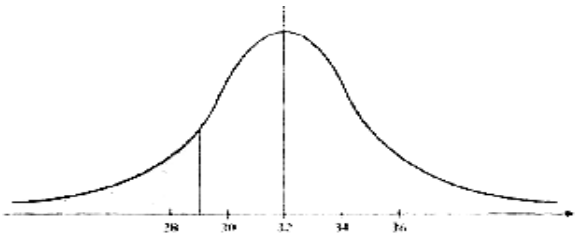


Figure 11.4 Solution to example 11.1, part 3

4. The probability that the project will finish on the 32nd day.

$$\Pr(T_S = 32) = \Pr(T_S \leq 32) - \Pr(T_S \leq 31)$$

We already calculated $\Pr(T_S \leq 32) = 0.5 = 50\%$ (part 1). For $\Pr(T_S \leq 31)$,

$$Z = (31 - 32)/2.972 = -0.34$$

$$\Pr(T_S \leq 31) = 1 - 0.633 = 0.367 = 36.7\%$$

and

$$\Pr(T_S = 32) = \Pr(T_S \leq 32) - \Pr(T_S \leq 31) = 50\% - 36.7\% = 13.3\%$$

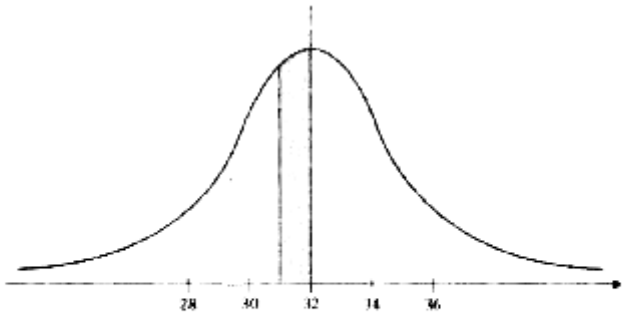


Figure 11.5 Solution to example 11.1, part 4

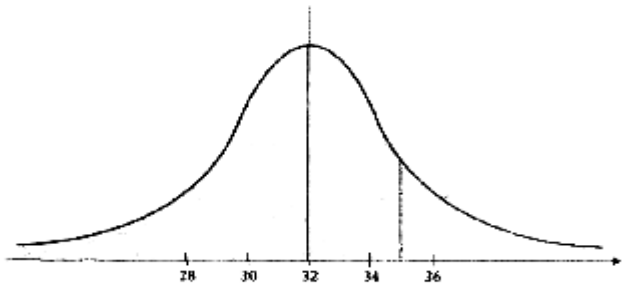
5. *The probability the project will finish no later than the 35th day.* This probability is the same as the probability that the project will finish by the end of day 35:

$$Z = (35 - 32)/2.972 = 1.01$$

and

$$\Pr(T_S \leq 35) = 0.844 = 84.4\%$$

See Figure 11.6.



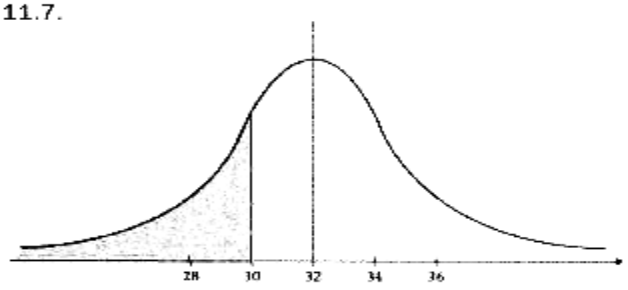
6. *The probability that the project will finish at least 2 days early.* This probability is the same as the probability of finishing on the 30th day or earlier, or the same as the probability that the project will finish by the end of day 30:

$$Z = (30 - 32)/2.972 = -0.67$$

and

$$\Pr(T_S \leq 30) = 1 - 0.749 = 0.251 = 25.1\%$$

See Figure 11.7.



7. *The probability that the project will finish at least 2 days late.* This probability is the same as the probability of finishing by the 34th day or later, or the same as the probability that the project will finish after day 33:

$$\Pr(T_S > 33) = 1 - \Pr(T_S \leq 33)$$

For $\Pr(T_S \leq 33)$,

$$Z = (33 - 32)/2.972 = 0.34$$

and

$$\Pr(T_S \leq 33) = 0.633 = 63.3\%$$

Thus,

$$\Pr(T_S > 33) = 1 - 0.633 = 0.367 = 36.7\%$$

See Figure 11.8.

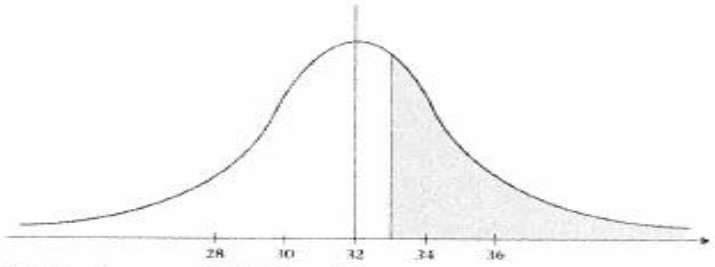


Figure 11.8 Solution to example 11.1, part 7

Note that if the instruction had said "the probability that the project will finish *more than* [rather than *at least*] 2 days late," it would have meant $\Pr(T_S > 34)$.