Appendix 7.1

PERT and PERT Simulation

Appendix 7.1

PERT—Program Evaluation Review Technique

- Assumes each activity duration has a range that statistically follows a beta distribution.
- Uses three time estimates for each activity: optimistic, pessimistic, and a weighted average to represent activity durations.
  - Knowing the weighted average and variances for each activity allows the project planner to compute the probability of meeting different project durations.

Activity and Project Frequency Distributions

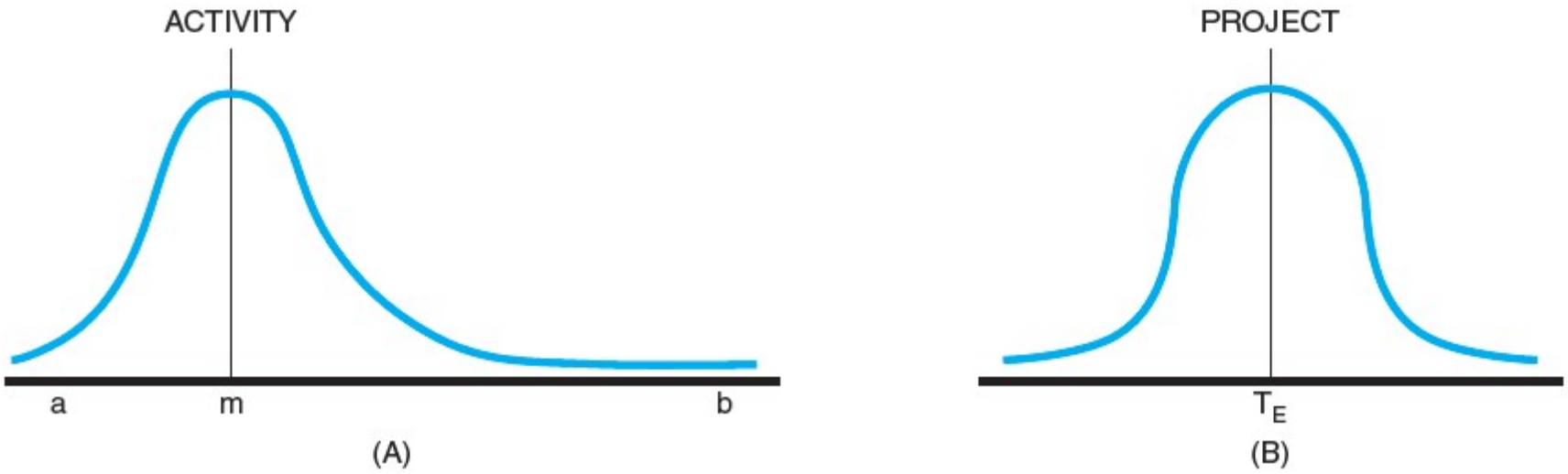

FIGURE A7.1

Activity Time Calculations

The weighted average activity time is computed by the following formula:

$$t_e = \frac{a + 4m + b}{6} \qquad (7.1)$$

where t_e = weighted average activity time

a = optimistic activity time (1 chance in 100 of completing the activity earlier under *normal* conditions)

b = pessimistic activity time (1 chance in 100 of completing the activity later under *normal* conditions)

m = most likely activity time

Activity Time Calculations (cont'd)

The variability in the activity time estimates is approximated by the following equations:

The standard deviation for the activity:

$$\sigma_{t_e} = \left(\frac{b - a}{6}\right) \qquad (7.2)$$

The standard deviation for the project:

$$\sigma_{T_E} = \sqrt{\Sigma \sigma^2_{t_e}} \qquad (7.3)$$

Note the standard deviation of the activity is squared in this equation; this is also called variance. This sum includes only activities on the critical path(s) or path being reviewed.

Activity Times and Variances

Activity	a	m	b	t_e	$[(b-a)/6]^2$
1–2	17	29	47	30	25
2–3	6	12	24	13	9
2–4	16	19	28	20	4
3–5	13	16	19	16	1
4–5	2	5	14	6	4
5–6	2	5	8	5	1

TABLE A7.1

Hypothetical Network

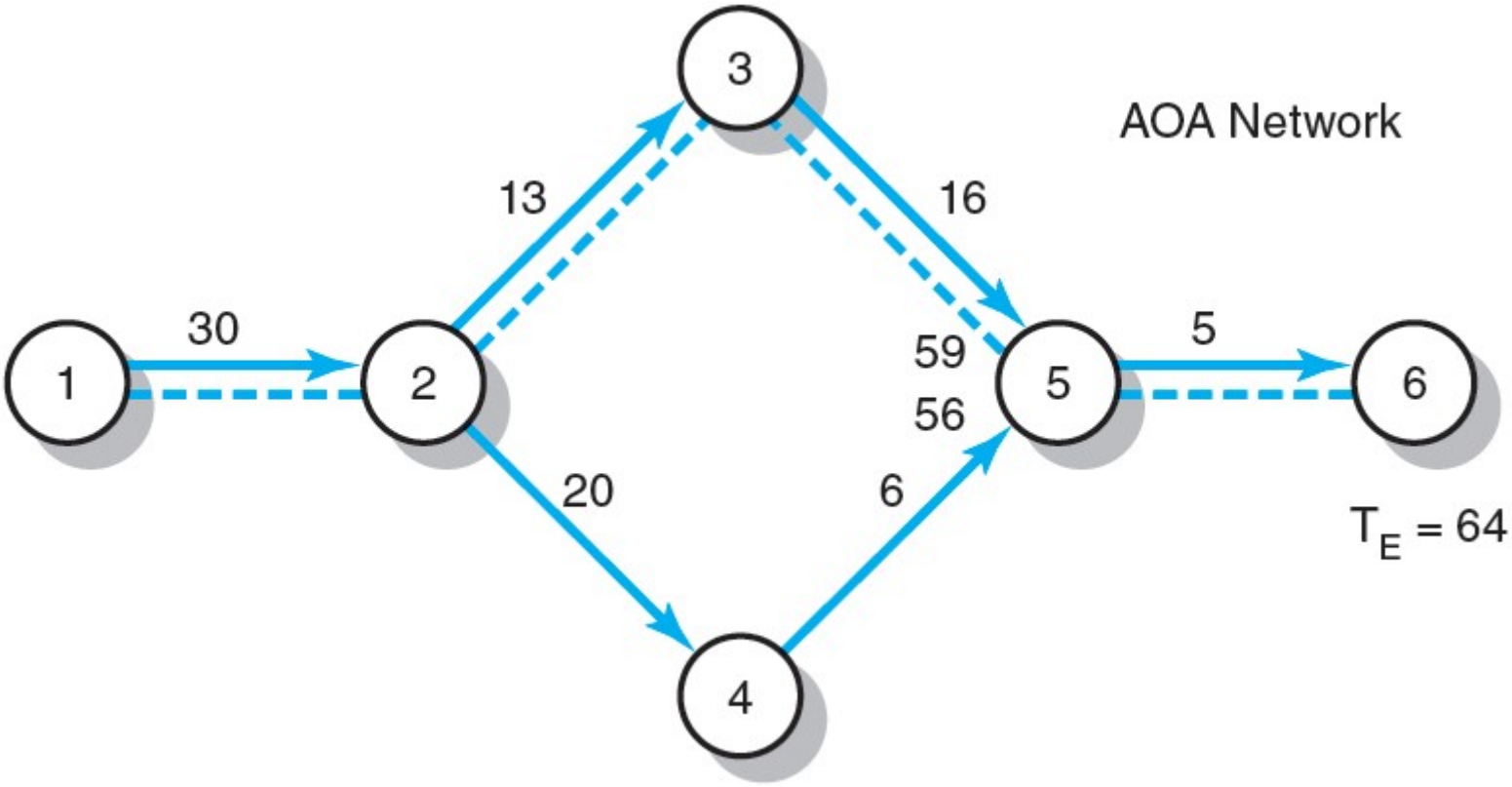

FIGURE A7.2

Hypothetical Network (cont'd)

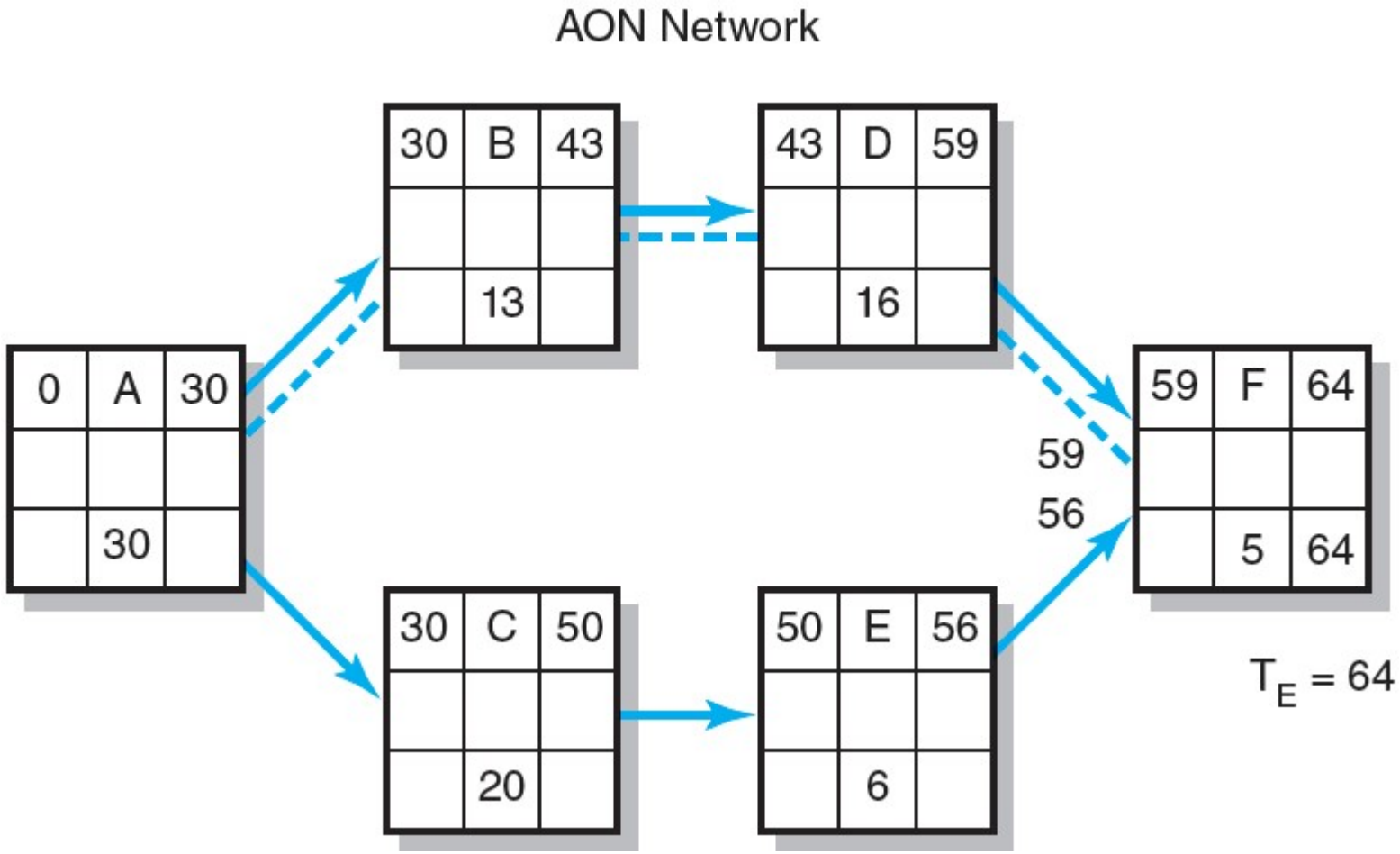

FIGURE A7.2 (cont'd)

Possible Project Duration

Probability project is completed before scheduled time (T_S) of 67 units

$$Z = \frac{T_S - T_E}{\sqrt{\Sigma\sigma^2_{t_e}}}$$

$$= \frac{67 - 64}{\sqrt{25 + 9 + 1 + 1}}$$

$$= \frac{+3}{\sqrt{36}}$$

$$= +0.50$$

$$P = 0.69$$

Probability project is completed by the 60th unit time period (T_S)

$$Z = \frac{60 - 64}{\sqrt{25 + 9 + 1 + 1}}$$

$$= \frac{-4}{\sqrt{36}}$$

$$= -0.67$$

$$P \approx 0.25$$

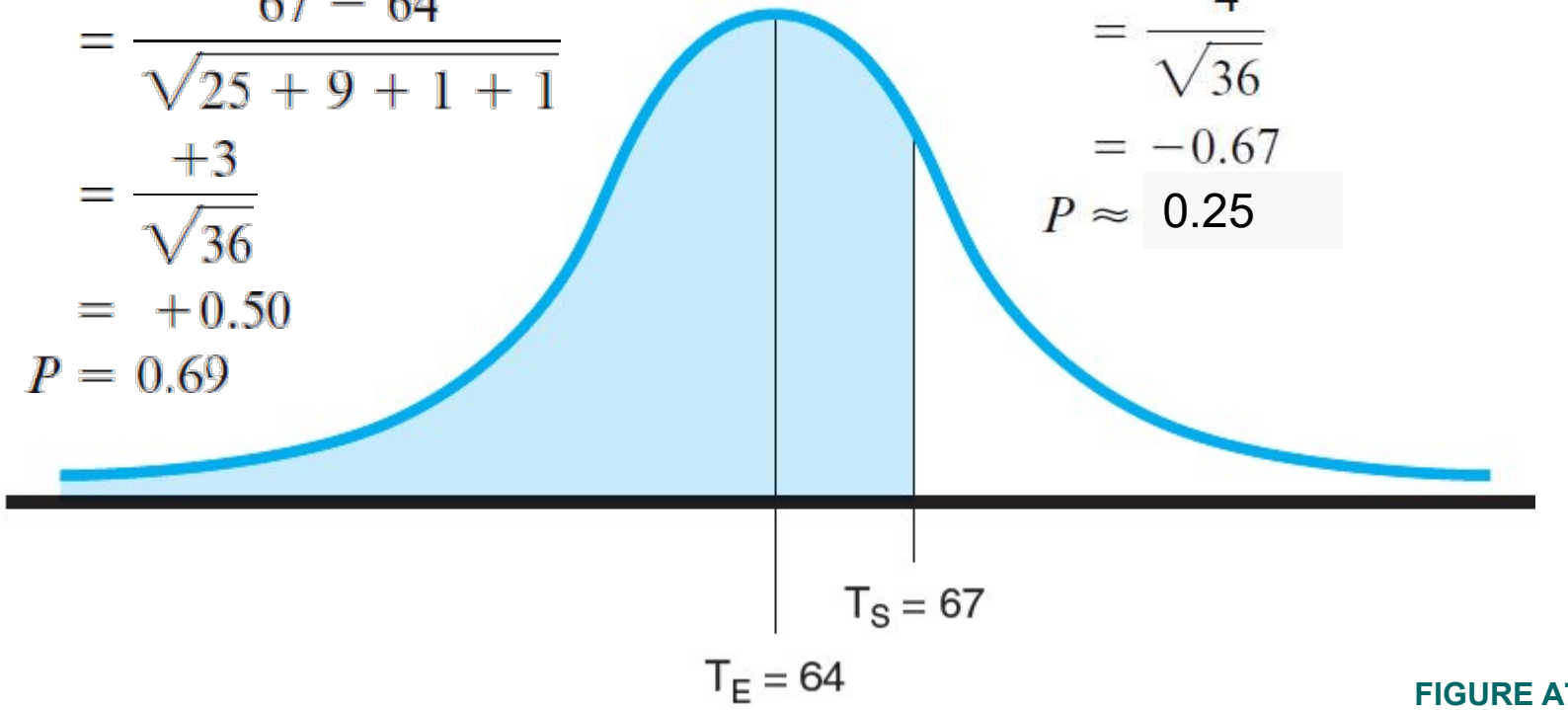

FIGURE A7.3

Z Values and Probabilities

Z Value	Probability	*Z* Value	Probability
−3.0	.001	+0.0	.500
−2.8	.003	+0.2	.579
−2.6	.005	+0.4	.655
−2.4	.008	+0.6	.726
−2.2	.014	+0.8	.788
−2.0	.023	+1.0	.841
−1.8	.036	+1.2	.885
−1.6	.055	+1.4	.919
−1.4	.081	+1.6	.945
−1.2	.115	+1.8	.964
−1.0	.159	+2.0	.977
−0.8	.212	+2.2	.986
−0.6	.274	+2.4	.992
−0.4	.345	+2.6	.995
−0.2	.421	+2.8	.997

TABLE A7.2