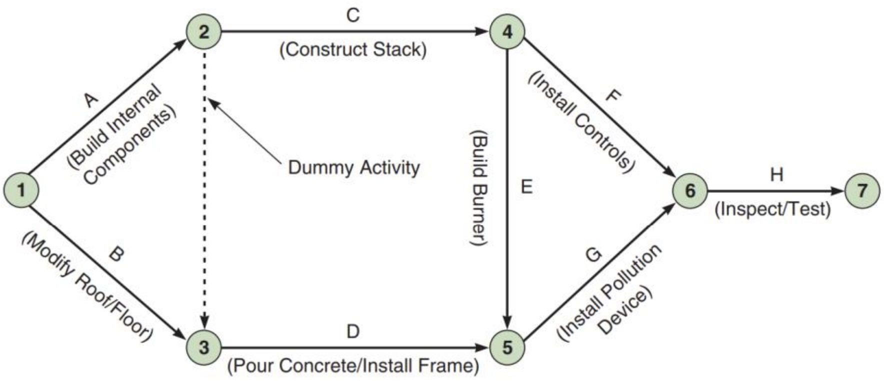
PERT MILWAUKEE PAPER

TABLE 3.1 Milwaukee Paper Manufacturing's Activities and Predecessors

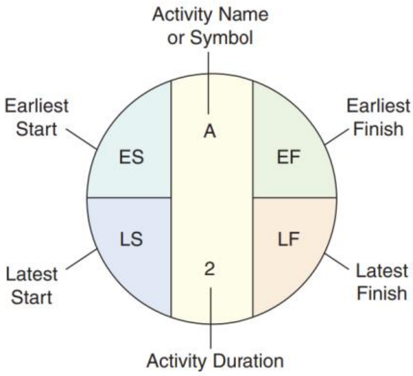
ACTIVITY	DESCRIPTION	IMMEDIATE PREDECESSORS
A	Build internal components	—
B	Modify roof and floor	—
C	Construct collection stack	A
D	Pour concrete and install frame	A, B
E	Build high-temperature burner	C
F	Install pollution control system	C
G	Install air pollution device	D, E
H	Inspect and test	F, G



INSIGHT ▶ Dummy activities are common in AOA networks. They do not really exist in the project and take zero time.

TABLE 3.2 Time Estimates for Milwaukee Paper Manufacturing

ACTIVITY	DESCRIPTION	TIME (WEEKS)
A	Build internal components	2
B	Modify roof and floor	3
C	Construct collection stack	2
D	Pour concrete and install frame	4
E	Build high-temperature burner	4
F	Install pollution control system	3
G	Install air pollution device	5
H	Inspect and test	2
	Total time (weeks)	25



company's project, along with the ES and EF values for all activities. SOLUTION c With the help of Figure 3.10 , we describe how these values are calculated. Because activity Start has no predecessors, we begin by setting its ES to 0. That is, activity Start can begin at time 0, which is the same as the beginning of week 1. If activity Start has an ES of 0, its EF is also 0, since its activity time is 0. Next, we consider activities A and B, both of which have only Start as an immediate predecessor. Using the earliest start time rule, the ES for both activities A and B equals zero, which is the EF of activity Start. Now, using the earliest finish time rule, the EF for A is 2 (= 0 + 2), and the EF for B is 3 (= 0 + 3). Since activity A precedes activity C, the ES of C equals the EF of A (= 2). The EF of C is therefore 4 (= 2 + 2). We now come to activity D. Both activities A and B are immediate predecessors for D. Whereas A has an EF of 2, activity B has an EF of 3. Using the earliest start time rule, we compute the ES of activity D as follows: ES of D = Max{EF of A, EF of B} = Max (2, 3) = 3 The EF of D equals 7 (= 3 + 4). Next, both activities E and F have activity C as their only immediate predecessor. Therefore, the ES for both E and F equals 4 (= EF of C). The EF of E is 8 (= 4 + 4), and the EF of F is 7 (= 4 + 3). Activity G has both activities D and E as predecessors. Using the earliest start time rule, its ES is therefore the maximum of the EF of D and the EF of E. Hence, the ES of activity G equals 8 (= maximum of 7 and 8), and its EF equals 13 (= 8 + 5). Finally, we come to activity H. Because it also has two predecessors, F and G, the ES of H is the maximum EF of these two activities. That is, the ES of H equals 13 (= maximum of 13 and 7). This implies that the EF of H is 15 (= 13 + 2). Because H is the last activity in the project, this also implies that the earliest time in which the entire project can be completed is 15 weeks.

COMPUTING PROJECT VARIANCE AND STANDARD DEVIATION FOR MILWAUKEE PAPER

Milwaukee Paper's managers now wish to know the project's variance and standard deviation.

APPROACH ▶ Because the activities are independent, we can add the variances of the activities on the critical path and then take the square root to determine the project's standard deviation.

LEARNING EXERCISE ▶ If the variance for activity A is actually 0.30 (instead of 0.11), what is the new project standard deviation? [Answer: 1.817.]

RELATED PROBLEMS ▶ 3.17e (3.24 is available in MyOMLab)

PROBABILITY OF COMPLETING A PROJECT ON TIME

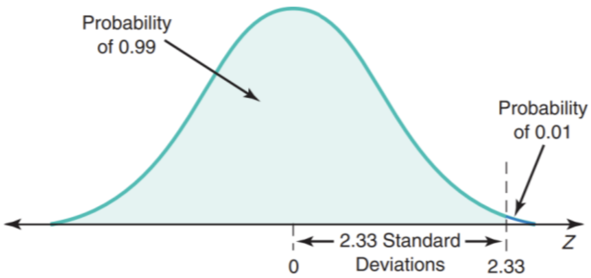
Julie Ann Williams would like to find the probability that her project will be finished on or before the 16-week Earth Day deadline.

APPROACH ▶ To do so, she needs to determine the appropriate area under the normal curve. This is the area to the left of the 16th week.

COMPUTING PROBABILITY FOR ANY COMPLETION DATE

Julie Ann Williams wants to find the due date that gives her company's project a 99% chance of *on-time* completion.

APPROACH ▶ She first needs to compute the Z-value corresponding to 99%, as shown in Figure 3.14. Mathematically, this is similar to Example 10, except the unknown is now the due date rather than Z.



PROJECT CRASHING TO MEET A DEADLINE AT MILWAUKEE PAPER

Suppose the plant manager at Milwaukee Paper Manufacturing has been given only 13 weeks (instead of 16 weeks) to install the new pollution control equipment. As you recall, the length of Julie Ann Williams's critical path was 15 weeks, but she must now complete the project in 13 weeks.

APPROACH ▶ Williams needs to determine which activities to crash, and by how much, to meet this 13-week due date. Naturally, Williams is interested in speeding up the project by 2 weeks, at the least additional cost.

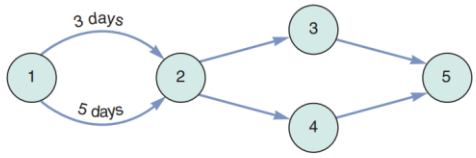
SOLVED PROBLEM 3.1

Construct an AON network based on the following:

ACTIVITY	IMMEDIATE PREDECESSOR(S)
A	—
B	—
C	—
D	A, B
E	C

SOLVED PROBLEM 3.2

Insert a dummy activity and event to correct the following AOA network:



To complete the wing assembly for an experimental aircraft, Jim Gilbert has laid out the seven major activities involved. These activities have been labeled A through G in the following table, which also shows their estimated completion times (in weeks) and immediate predecessors. Determine the expected time and variance for each activity.

ACTIVITY	*a*	*m*	*b*	IMMEDIATE PREDECESSORS
A	1	2	3	—
B	2	3	4	—
C	4	5	6	A
D	8	9	10	B
E	2	5	8	C, D
F	4	5	6	D
G	1	2	3	E

The following information has been computed from a project:

$$\text{Expected total project time} = T = 62 \text{ weeks}$$

$$\text{Project variance } (\sigma_p^2) = 81$$

What is the probability that the project will be completed 18 weeks *before* its expected completion date?