

**2. The Global Tea and Organic Juice companies have merged.**

**1 Compute the expected time for each activity.**

**2 Compute the variance for each activity.**

Activity	Opt. (a)	ML. (m)	Pess. (b)	$t_e$	Variance $[(b - a)/6]^2$	Critical?
1	16	19	28	20	4	x
2	30	30	30	30	0	
3	60	72	90	73	25	
4	18	27	30	26	4	
5	17	29	47	30	25	x
6	4	7	10	7	1	
7	12	15	18	15	1	x
8	6	12	24	13	9	x
9	18	27	30	26	4	
10	20	35	50	35	25	
11	40	55	100	60	100	
12	11	20	29	20	9	x
13	14	23	26	22	4	
14	13	16	19	16	1	x
15	0	0	0	0	0	

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

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

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

## 2. The Variance for each activity

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

**The standard deviation for the activity:**

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

**The standard deviation for the project:**

$$\sigma_{T_E} = \sqrt{\sum \sigma_{t_e}^2} \quad (7.3)$$

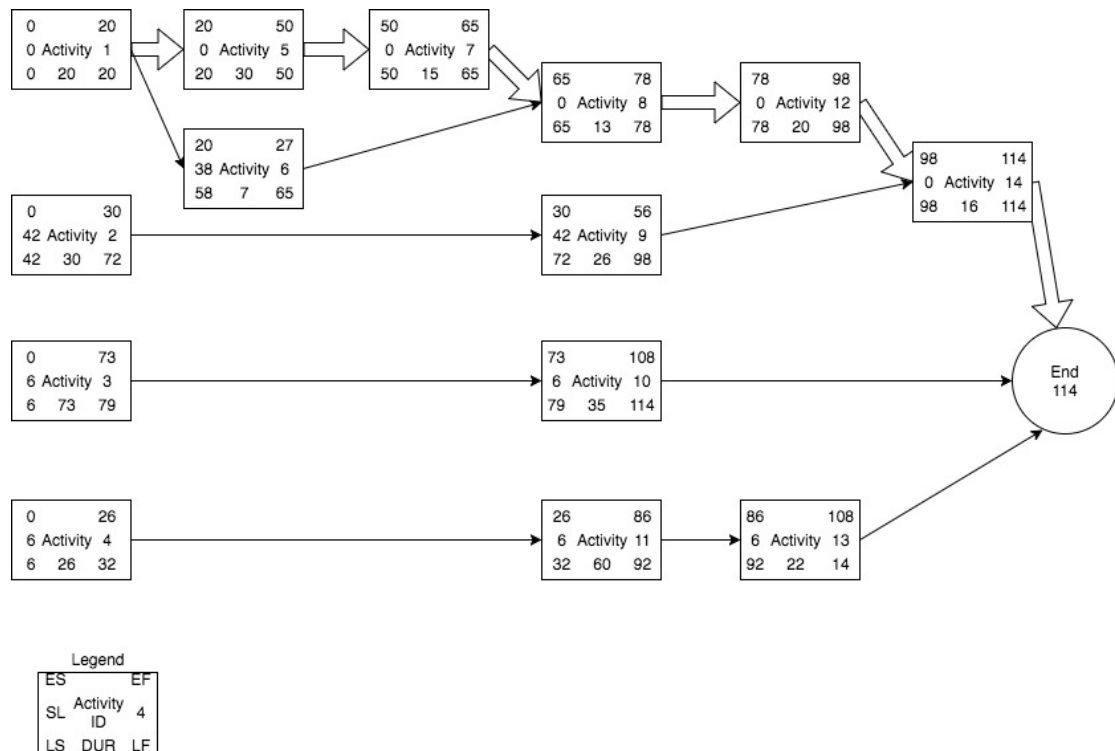
Note the standard deviation of the activity is squared in this equation; this is also called variance. This sum includes only activities on the critical path(s) or path being reviewed.

Activity	Opt. (a)	ML. (m)	Pess. (b)	$t_e$	Variance $[(b - a)/6]^2$	Critical?
1	16	19	28	20	4	x
2	30	30	30	30	0	
3	60	72	90	73	25	
4	18	27	30	26	4	
5	17	29	47	30	25	x
6	4	7	10	7	1	
7	12	15	18	15	1	x
8	6	12	24	13	9	x
9	18	27	30	26	4	
10	20	35	50	35	25	
11	40	55	100	60	100	
12	11	20	29	20	9	x
13	14	23	26	22	4	
14	13	16	19	16	1	x
15	0	0	0	0	0	

### 3. Compute the expected project duration.

Duration = 114 days

Activity	Opt. (a)	ML. (m)	Pess. (b)	$t_e$	Variance $[(b - a)/6]^2$	Critical?
1	16	19	28	20	4	x
2	30	30	30	30	0	
3	60	72	90	73	25	
4	18	27	30	26	4	
5	17	29	47	30	25	x
6	4	7	10	7	1	
7	12	15	18	15	1	x
8	6	12	24	13	9	x
9	18	27	30	26	4	
10	20	35	50	35	25	
11	40	55	100	60	100	
12	11	20	29	20	9	x
13	14	23	26	22	4	
14	13	16	19	16	1	x
15	0	0	0	0	0	



#### 4. What is the probability of completing the project by day 112?

The equation below is used to compute the 'Z' value found in statistical tables (Z = number of standard deviations from the mean), which in turn tells the probability of completing the project in the time specified.

$$Z = \frac{T_S - T_E}{\sqrt{\sum \sigma_{t_e}^2}} \quad (7.4)$$

where  $T_E$  = critical path duration  
 $T_S$  = scheduled project duration  
 $Z$  = probability (of meeting scheduled duration)

$$\frac{T_S - T_E}{\sqrt{\sum \sigma_{t_e}^2}} = \frac{112 - 114}{\sqrt{4 + 25 + 1 + 9 + 9 + 1}} = \frac{-2}{\sqrt{49}} = \frac{-2}{7} = -.28 \quad \mathbf{P \approx .39}$$

#### Within 116 days?

$$\frac{T_S - T_E}{\sqrt{\sum \sigma_{t_e}^2}} = \frac{116 - 114}{\sqrt{4 + 25 + 1 + 9 + 9 + 1}} = \frac{+2}{\sqrt{49}} = \frac{+2}{7} = +.28 \quad \mathbf{P \approx .61}$$

#### 5. What is the probability of completing 'Negotiate with Unions' (11) by day 90?

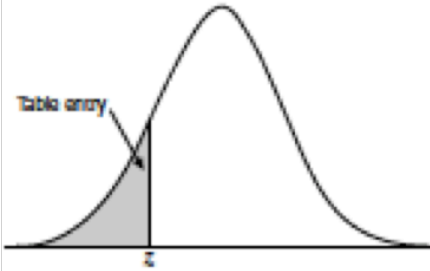
Critical path duration = 86 days

$$\frac{T_S - T_E}{\sqrt{\sum \sigma_{t_e}^2}} = \frac{90 - 86}{\sqrt{4 + 100}} = \frac{+4}{\sqrt{104}} = \frac{+4}{10} = +.40$$

Probability of within 90 days  $\approx .65$

Activity	Opt. (a)	ML. (m)	Pess. (b)	$t_e$	Variance $[(b - a)/6]^2$	Critical?
1	16	19	28	20	4	x
2	30	30	30	30	0	
3	60	72	90	73	25	
4	18	27	30	26	4	
5	17	29	47	30	25	x
6	4	7	10	7	1	
7	12	15	18	15	1	x
8	6	12	24	13	9	x
9	18	27	30	26	4	
10	20	35	50	35	25	
11	40	55	100	60	100	
12	11	20	29	20	9	x
13	14	23	26	22	4	
14	13	16	19	16	1	x

15	0	0	0	0	0	
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Standard Normal Probabilities										
 <p>Table entry for <math>z</math> is the area under the standard normal curve to the left of <math>z</math>.</p>										
$z$	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
-3.4	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0002
-3.3	.0005	.0005	.0005	.0004	.0004	.0004	.0004	.0004	.0004	.0003
-3.2	.0007	.0007	.0006	.0006	.0006	.0006	.0006	.0005	.0005	.0005
-3.1	.0010	.0009	.0009	.0009	.0008	.0008	.0008	.0008	.0007	.0007
-3.0	.0013	.0013	.0013	.0012	.0012	.0011	.0011	.0011	.0010	.0010
-2.9	.0019	.0018	.0018	.0017	.0016	.0016	.0015	.0015	.0014	.0014
-2.8	.0026	.0025	.0024	.0023	.0023	.0022	.0021	.0021	.0020	.0019
-2.7	.0035	.0034	.0033	.0032	.0031	.0030	.0029	.0028	.0027	.0026
-2.6	.0047	.0045	.0044	.0043	.0041	.0040	.0039	.0038	.0037	.0036
-2.5	.0062	.0060	.0059	.0057	.0055	.0054	.0052	.0051	.0049	.0048
-2.4	.0082	.0080	.0078	.0075	.0073	.0071	.0069	.0068	.0066	.0064
-2.3	.0107	.0104	.0102	.0099	.0096	.0094	.0091	.0089	.0087	.0084
-2.2	.0139	.0136	.0132	.0129	.0125	.0122	.0119	.0116	.0113	.0110
-2.1	.0179	.0174	.0170	.0166	.0162	.0158	.0154	.0150	.0146	.0143
-2.0	.0228	.0222	.0217	.0212	.0207	.0202	.0197	.0192	.0188	.0183
-1.9	.0287	.0281	.0274	.0268	.0262	.0256	.0250	.0244	.0239	.0233
-1.8	.0359	.0351	.0344	.0336	.0329	.0322	.0314	.0307	.0301	.0294
-1.7	.0446	.0436	.0427	.0418	.0409	.0401	.0392	.0384	.0375	.0367
-1.6	.0548	.0537	.0526	.0516	.0505	.0495	.0485	.0475	.0465	.0455
-1.5	.0668	.0655	.0643	.0630	.0618	.0606	.0594	.0582	.0571	.0559
-1.4	.0808	.0793	.0778	.0764	.0749	.0735	.0721	.0708	.0694	.0681
-1.3	.0968	.0951	.0934	.0918	.0901	.0885	.0869	.0853	.0838	.0823
-1.2	.1151	.1131	.1112	.1093	.1075	.1056	.1038	.1020	.1003	.0985
-1.1	.1357	.1335	.1314	.1292	.1271	.1251	.1230	.1210	.1190	.1170
-1.0	.1587	.1562	.1539	.1515	.1492	.1469	.1446	.1423	.1401	.1379
-0.9	.1841	.1814	.1788	.1762	.1736	.1711	.1685	.1660	.1635	.1611
-0.8	.2119	.2090	.2061	.2033	.2005	.1977	.1949	.1922	.1894	.1867
-0.7	.2420	.2389	.2358	.2327	.2296	.2266	.2236	.2206	.2177	.2148
-0.6	.2743	.2709	.2676	.2643	.2611	.2578	.2546	.2514	.2483	.2451
-0.5	.3085	.3050	.3015	.2981	.2946	.2912	.2877	.2843	.2810	.2776
-0.4	.3446	.3409	.3372	.3336	.3300	.3264	.3228	.3192	.3156	.3121
-0.3	.3821	.3783	.3745	.3707	.3669	.3632	.3594	.3557	.3520	.3483
-0.2	.4207	.4168	.4129	.4090	.4052	.4013	.3974	.3936	.3897	.3859
-0.1	.4602	.4562	.4522	.4483	.4443	.4404	.4364	.4325	.4286	.4247
-0.0	.5000	.4960	.4920	.4880	.4840	.4801	.4761	.4721	.4681	.4641