Mansoura University
Faculty of Computers and Information
Department of Computer Science
Second Semester- 2024-2025

Software Cost Estimation

Grade : 4 (SWE)

Week : 4

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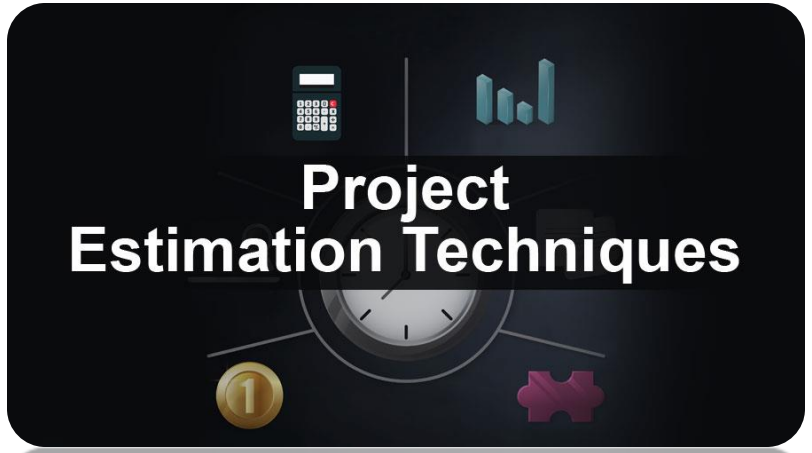
Software Cost Estimation

Agenda

- Three Point Estimation Method
- Project Evaluation and Review Technique Estimation method (PERT)
- Examples



Three Point Estimation Method

- **Three-points Estimation looks at three values:**
  - the most optimistic estimate (**O**),
  - a most likely estimate (**M**), and
  - a pessimistic estimate (least likely estimate (**L**))

- **Three-point Estimate (E) is based on the simple average and follows triangular distribution.**

$$E = (O + M + L) / 3$$

Three Point Estimation Method

- **Three Point Estimation Steps:**

Step 1 : **Arrive at the WBS (Wideband Delphi Estimation Sheet).**

Step 2 : **For each task, find three values : O , M , L**

Step 3 : **Calculate the Mean of the three values:**

$$\text{Mean E} = (O + M + L) / 3$$

Step 4 : **Calculate the Standard Deviation of the three values:**

$$\sqrt{[((O - E)\,\hat{}\,2 + (M - E)\,\hat{}\,2 + (L - E)\,\hat{}\,2)/2]}$$

Step 5 : **Repeat Steps 2, 3, 4 for all the Tasks in the WBS.**

Step 6 : **Calculate the Three-point Estimate of the project.**

$$\text{E (Project)} = \Sigma\ \text{E (Task)}$$

Step 7 : **Calculate the Standard Deviation of the project.**

$$\text{SD (Project)} = \sqrt{(\Sigma\ \text{SD (Task)}\hat{}2)}$$

Three Point Estimation Method

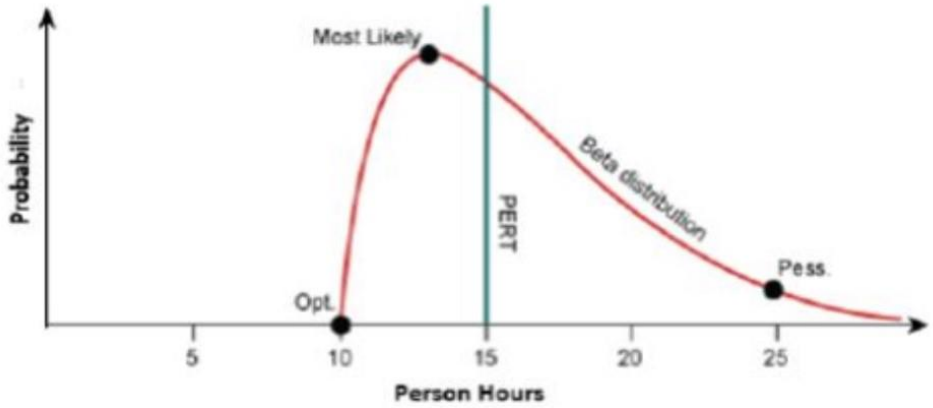
- **Convert the Project Estimates to Confidence Levels:**

The conversion is based such that:

- **Confidence Level in E value +/– SD is approximately 68%.**
- **Confidence Level in E value +/– 1.645 × SD is approximately 90%.**
- **Confidence Level in E value +/– 2 × SD is approximately 95%.**
- **Confidence Level in E value +/– 3 × SD is approximately 99.7%.**

Project Evaluation and Review Technique Estimation method (PERT)

- **PERT Estimation looks at three values:**
  - the most optimistic estimate (**O**),
  - a most likely estimate (**M**), and
  - a pessimistic estimate (least likely estimate (**L**))



- **PERT Estimate (E) is based on the weighted average and follows beta distribution:**

$$E = (O + 4 \times M + L)/6$$

Project Evaluation and Review Technique Estimation method (PERT)

- **PERT Estimation Steps:**

Step 1 : **Arrive at the WBS (Wideband Delphi Estimation Sheet).**

Step 2 : **For each task, find three values : O , M , L**

Step 3 : **Calculate the Mean of the three values:**

$$\text{PERT Mean} = (O + 4 \times M + L)/6$$

Step 4 : **Calculate the Standard Deviation of the three values:**

$$(SD) = (L - O)/6$$

Step 5 : **Repeat Steps 2, 3, 4 for all the Tasks in the WBS.**

Step 6 : **Calculate the PERT estimate of the project.**

$$E\ (\text{Project}) = \Sigma\ E\ (\text{Task})$$

Step 7 : **Calculate the Standard Deviation of the project.**

$$SD\ (\text{Project}) = \sqrt{(\Sigma\ SD\ (\text{Task})\text{^}2)}$$

Project Evaluation and Review Technique Estimation method (PERT)

- **Convert the Project Estimates to Confidence Levels:**

The conversion is based such that:

- **Confidence Level in E value +/– SD is approximately 68%.**
- **Confidence Level in E value +/– 1.645 × SD is approximately 90%.**
- **Confidence Level in E value +/– 2 × SD is approximately 95%.**
- **Confidence Level in E value +/– 3 × SD is approximately 99.7%.**

Example 1

Given the most optimistic estimate (O), the most likely estimate (M), and the least likely estimate (L) values of effort in a project as: 295 PM ,730 PM , and 2305 PM (person month) respectively. (Approximate to nearest integer)

(a) Use COCOMO 2 formula: to estimate the corresponding values of the calendar time in each case, where the exponent **B = 1.17**: **TDEV = 3 * PM ^(0.33+0.2 * (B-1.01))**… (in calendar months)

(b) Calculate the three-point Estimate (E) of both **effort and calendar** time based on the **simple average.**

(c) Calculate the standard deviation of both **effort and calendar time**.

(d) Find the confidence interval for both **effort and calendar** time at **68 % confidence level.**

Solution

Solution :

(a)

TDEV (O) = 3 * (295)^ (0.33 + 0.2 (1.17-1.01)) = 24 calendar months

TDEV (M) = 3 * (730)^(0.33 + 0.2 (1.17-1.01)) = 33 calendar months

TDEV (L) = 3 * (2305)^(0.33 + 0.2 (1.17-1.01)) = 49 calendar months

(b)

Three points estimate: E = (O + M + L) / 3

E1 = (295 + 730 + 2305)/3 = 1110 person months

E2 = (24 + 33 + 49)/3 = 35 calendar months

Solution

Solution :

(c)

Standard Deviation = $\sqrt{[((O - E)\ \hat{}2 + (M - E)\ \hat{}2 + (L - E)\ \hat{}2\ )/2]}$

SD of effort = $\sqrt{[(295 - 1110)\ \hat{}2 + (730 - 1110)\ \hat{}\ 2 + (2305 - 1110)\ \hat{}2]/2}$ **= 1058person months**

SD of schedule = $\sqrt{[(24 - 35)\ \hat{}2 + (33 - 35)\ \hat{}2 + (49 - 35)\ \hat{}2]/2}$ **= 13 months**

(d)

Confidence Level in E value +/– SD is approximately 68%.

Confidence interval of effort: 1110 +/– 1058 = (1110-1058 , 1110+1058) = (52, 2168)

Confidence interval of schedule: 35 +/– 13 = (35-13 , 35+13) = (22, 48)

Example 2

For the values of effort and calendar time in the previous problem:

(a) Calculate the **PERT Estimate** (E) of both **effort and calendar** time based on the **weighted average**.

(b) Calculate the standard deviation of both **effort and calendar** time.

(c) Find the confidence interval for both **effort and calendar** time at **95 % confidence level.**

Solution

Solution :

(a)

Pert estimate: E = (O + 4M + L) / 6

E1 = (295 + 4*730 + 2305)/6 = 920 person months

E2 = (24 + 4*33 + 49)/6 = 34 calendar months

(b)

Standard Deviation = (L − O)/6

SD of effort = (2305 − 295)/6

SD of effort = 335 person months

SD of schedule = (49 − 24)/6

SD of schedule = 4 months

Solution

Solution :

(c)

Confidence Level in E value +/– 2 × SD is approximately 95%.

Confidence interval of effort: 920 +/– 2*335 = (920-670 , 920 + 670) = (250, 1590)

Confidence interval of schedule: 34 +/– 2*4 = (34-8 , 34+8) = (26, 42)

Revision

(Q1) Choose True or False

1. As the number of rounds in the Wideband Delphi Estimation decreases the range of estimation will be narrower, and Results are converged to an acceptable range. (F) ----→ increases
2. The moderator generates a detailed (Wideband Delphi Estimation Sheet), estimates each task in the WBS, and documents the assumptions made. (F) ----→ Estimation team members
3. Estimation team members prepare a structured document containing problem specification, high level task list, assumptions, and the units of estimation. (F) ----→ moderator
4. Analogous estimation is a better way of estimation in the initial stages of the project, even if the project is new, and no past project is similar. (T)

Revision

(Q2) Choose the right answer

1. In the Wideband Delphi Estimation, the process is stopped after:

a) Certain number of rounds and Achievement of consensus

b) Achievement of consensus and Stability of results

c) Stability of results, Achievement of consensus, and Certain number of rounds

d) Certain number of rounds, achievement of consensus, or stability of results

Any Question ?

Next ….