An Experiment Measuring the Effects of Personal Software Process (PSP) Training

Prechelt and Unger
IEEE TOSE May 00

Output reliability

Surprising data (no digit)

Effort estimation error

Estimated/actual productivity

Productivity
An Empirical Study Using Task Assignment Patterns to Improve the Accuracy of Software Effort Estimation

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IEEE TOSE March 01

Goal
This paper reports the results of an empirical study exploring the impact of four task assignment factors, team size, concurrency, intensity, and fragmentation, on software development effort. By adding these factors to the Intermediate COCOMO I model (hereafter simply referred to as COCOMO), its' estimates are improved significantly for the study project.

What is basic formula?

\[ E = a(E_{DSI})^b \times EAF. \]

E is an effort estimate, expressed in man-months (MM). EDSI refers to the number of Estimated Delivered Source Instructions. The parameters a and b are determined by the application complexity mode; both of these values increase with application complexity. The effort adjustment factor, EAF, is equal to 1 for the basic level and equals the product of 15 cost factors for the intermediate and advanced levels.
Model of Process

Using these concepts, the development process may be characterized by the tuple \( <M, P, T, W> \) where:

- \( P \) is the set of all programmers employed on the project \( p_i, i = 1 \ldots |P| \).
- \( M \) is the set of all modules contained within the completed project \( m_j, j = 1 \ldots |M| \).
- \( T \) is the set of all time units required to complete the project \( t_k, k = 1 \ldots |T| \).
- \( W \) is the “work set” consisting of tuples of the form \( (p_i, m_j, t_k) \). Each tuple of this form means that programmer \( p_i \) worked on module \( m_j \) during time unit \( t_k \). \( W_{ijk} \) is 1 if \( (p_i, m_j, t_k) \) is in \( W \) and 0 otherwise.

TEAM

More formally, let \( Q_{ij} = 1 \) mean that programmer \( p_i \) worked on module \( m_j \) during at least one time unit. That is:

\[
Q_{ij} = \begin{cases} 
1 & \text{if } \sum_{k} W_{ijk} \geq 1 \\
0 & \text{otherwise}.
\end{cases}
\]

Then TEAM is defined as follows:

\[
TEAM_j = \sum_{i} Q_{ij}.
\]

INTS

The intensity (INTS) factor measures the degree of schedule compression. It is defined as follows:

\[
INTS_j = \frac{\sum_{i} W_{ijk}}{|A_j|}.
\]

CONC

\[
CONC_j = \frac{\sum_{i} \sum_{k} W_{ijk}}{|A_j|}.
\]

That is, for a particular module \( m_j \), CONC is defined as the mean number of programmers reporting work on \( m_j \) during the active time units for \( m_j \). For example, suppose

PFRAG

\[
PFRAG_{ij} = \sum_{k} W_{ijk}.
\]

That is, \( PFRAG_{ij} \) is the number of modules that programmer \( p_i \) is working on at time \( t_k \). To compute

Models

Model 1.

\[
E_j = a(EDSL_j)^b \times \prod_{i} C_{ij}.
\]

Model 2.

\[
\ln E_j = \alpha + \sum_{i \in T} \beta_i C_{ij} + \beta_a \times \ln EDSL_j.
\]
Models

Model 3.
\[
\ln E_j = \alpha + \sum_{i=1}^{n} \beta_i C_{ij} + \beta_6 \ln EDS_{ij} \\
+ \beta_7 \text{TEAM}_{ij} + \beta_8 \text{INT}_{ij} + \beta_9 \text{CONC}_{ij} + \beta_{10} \text{FRAG}_{ij}.
\]

Model 4.
\[
\ln E_j = \alpha + \beta_1 \times UFP_j + \beta_2 \text{EXP}_j + \beta_3 \text{TEAM}_{ij} \\
+ \beta_4 \text{INT}_{ij} + \beta_5 \text{CONC}_{ij} + \beta_6 \text{FRAG}_{ij}.
\]

Experiment

For Tues 9/24

- A Reference Model for Requirements and Specifications
- Carl Gunter, Elsa Gunter, Michael Jackson and Pamela Zave