PROBABILITY DISTRIBUTIONS IN COST RISK ANALYSIS

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Abstract:
A risk analysis involves identifying the most probable threats to an organization (or a project) and analyzing the related vulnerabilities of the organization (project) to these threats. The risk analysis process provides the foundation for the entire recovery planning effort. The probability distributions and correlation are often used in Quantitative Cost Risk Analysis.

Key words: *cost, risk, risk analysis, probability distribution*

JEL classification: *C10, D24*

Cost refers to the monetary value or financial pricing of a specific project activity. This cost includes all anticipated expenditures that are expected to be part of the entire project, as well as the monetary value of the total sum of resources to be expended during the process. A specific cost can be broken down into sub costs, which can be made up of a number of unique categories. These can include direct labor hours, indirect labor hours, other direct costs, and other indirect costs. These can also include the purchased price of any specific materials and/or equipment. It is important to keep in mind that in the methodology of earned value management, in some cases the term cost represents labor hours but does not factor in a conversion to monetary value.

Risk analysis is a technique to identify and assess factors that may jeopardize the success of a project or achieving a goal. This technique also helps to define preventive measures to reduce the probability of these factors from occurring and identify countermeasures to successfully deal with these constraints when they develop to avert possible negative effects on the competitiveness of the company.

A formal risk analysis is putting on the table those problems and fears which heretofore were recognized but intentionally hidden.

The purpose of a cost uncertainty analysis is to provide the project manager with a cost that has an acceptable probability of being exceeded.

The purpose of a risk analysis is:

- Promote the language of probability and use of its mathematics in risk analysis;
- Examine elements of a project in detail, determining relationships and formulating a model;
- Most are less able to comprehend the whole of a problem than the elements individually;
- The essence is a statement of the probability of program outcomes.

The formal quantitative risk analysis is characterized through mathematical integration of detailed information from experts while maintaining their uncertainty and complex relationships between elements.

The compositions of Quantitative Cost Risk Analysis are:

- Framework
  - Examine project in small component parts, how the work will be done
  - Model the project, e.g. Work Breakdown Structure (WBS)

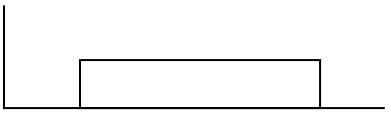
- Input assumptions
  - Ranges of possible outcomes
  - Probability distributions of outcomes
  - Correlation between cost elements
- Combine distributions of elements to determine risk at the total project level
  - Monte Carlo Simulation
  - Analytical (method of moments, convolutions)
- Results
  - Total project overrun risk
  - Risk at subtotals (indenture levels or functions)
  - Identification of highest-risk cost elements
- Risk Management
  - Mitigate risk in program
  - Bid or no-bid the program

The range of possible costs is:

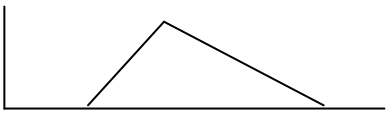
- Low, optimistic outcome,
- Most likely outcome,
- High, pessimistic outcome,
- Average (compute from distribution)

The confidence in the most likely determines the distribution type to be used. The probability distributions most used are present in the next examples:

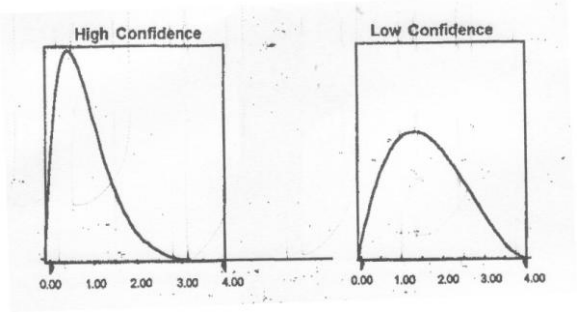
- Uniform distribution – little information early in project, cannot determine "most likely" cost:



- Triangular distribution – often preferred, easy to use, conservative:



- Beta distribution – flexible, less conservative than triangular:



An example of problem with single point cost estimated based on triangular distribution is present in [3].

One of the more popular methods to perform a risk analysis in the computer field is called *Facilitated Risk Analysis Process* (FRAP).

FRAP analyzes one system, application or segment of business processes at time.

FRAP assumes that additional efforts to develop precisely quantified risks are not cost effective because:

- such estimates are time consuming
- risk documentation becomes too voluminous for practical use
- specific loss estimates are generally not needed to determine if controls are needed.

After identifying and categorizing risks, a team identifies the controls that could mitigate the risk. The decision for what controls are needed lies with the business manager. The team's conclusions as to what risks exist and what controls needed are documented along with a related action plan for control implementation.

Three of the most important risks a software company faces are: unexpected changes in revenue, unexpected changes in costs from those budgeted and the amount of specialization of the software planned. Risks that affect revenues can be: unanticipated competition, privacy, intellectual property right problems, and unit sales that are less than forecast. Unexpected development costs also create risk that can be in the form of more rework than anticipated, security holes, and privacy invasions.

Narrow specialization of software with a large amount of research and development expenditures can lead to both business and technological risks since specialization does not necessarily lead to lower unit costs of software. Combined with the decrease in the potential customer base, specialization risk can be significant for a software firm. After probabilities of scenarios have been calculated with risk analysis, the process of risk management can be applied to help manage the risk.

Methods like *Applied Information Economics* (AIE) add to and improve on risk analysis methods by introducing procedures to adjust subjective probabilities, compute the value of additional information and to use the results in part of a larger portfolio management problem.

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