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Design and Development of Simulator for Risk Analysis

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Abstract- *In software designing every phase consumes some resources and some cost which is associated with these resources. In every case the cost of software, vary with the development duration of the software. The most important work done by the project manager is to maintain the balance between time and cost and adjust the optimal project schedule. To resolve the schedule and cost risk of the software the Monte Carlo Simulation method is used with the help of Program Evaluation and Review Technique (PERT) . With this technique the Schedule and cost risk will be analyzed so the project manager can apply or implement some mitigation process on software on the right time.*

Keywords- *Scheduling; Risk analysis; Program Evaluation and Review Technique; Beta Distribution;*

I. Introduction

In software development the one of the important work of project manager is planning and decision making. This duty of project manageris to complete the whole software work within the time and within the budget which is preplanned. If there is risk in schedule this means there will be also some risk in cost. The achievement depends upon the nature of planning, scheduling and controlling the different activities of software project**.** Program Evaluation and Review Technique (PERT) is a guide to assist and control the assets to meet the calendar date of the activities which include the high level of instability. it is acknowledged that venture calendar assumes a key part in task administration. To control the instability in planning procedure we apply the probabilistic mc simu. Monte Carlosimu is concept that gives a numerical estimation of the stochastic highlight of the framework reaction.

Traditional Probability Analysis Method

Duration Risk means the likelihood and loss of in culmination in the aggregate specified duration utmost. As per the meaning of span hazard, the numerical articulation of duration risk can be characterized as takes after:

$$SR = (P_f, U)$$

Where SR is schedule risk, p_f is probability of incompletion in the overall specified timelimit, and U is loss for in completion,

When the overall specified time limit is H_s, it's probability of completion can be given by formula.

$P(H \leq H_s) = \int_{-\infty}^{H_s} f(t)dt$

Where f(t) give the probability density function of project.

The probability density function will be as follow for Beta Distribution:

$$f(t) = \frac{\tau(K_1+K_2)(t-a)^{k_1-1}(b-t)^{k_2-1}}{\tau(k_1)\tau(k_2)(b-a)^{k_1+k_2-1}}$$

$$a \leq 1 \leq b; a, b > 0$$

In which $\tau(k) = \int_0^{\infty} z^{k-1}e^{-Z}dz$

For each activity *J*, we have to estimate optimistic duration ad_j, pessimistic duration bj_j, and most likely duration md_j. Then we can find the mean μ_i the variance σ_i^2 of duration by the following formula:

$\mu_j = \frac{ad_j+4md_j+b_j}{6}$, $\sigma_j^2 = \frac{(bd_j-ad_j)^2}{36}$

Then we can determine p (completion probability)for the total stipulated duration limit *Hs* and consulting standard normal distribution.

II. Proposed Work

2.1 Schedule/Cost Risk Analysis Simulator (SCRAS)

This will be based on one of the two popular methods i.e. CPM and PERT. A simulation based software project scheduling tool where duration of each activity in software project is generated stochastically assuming it to be belonging to beta distribution. Simulations are mainly performed by technique, known as Monte Carlo . In a simulation, the model is computed many times (iterated), with the input values randomized from a probability distribution function chosen for each iteration from the probability distributions of each variable.

The method, used is called SCRAS, has several steps:

I. Each iteration begins by selecting duration for each risky activity at random from its range and distribution

II. The total key milestone completion dates and budget for that iteration are calculated using CPM for that particular configuration of durations and cost. Those are only possible dates for completion of the project and its milestones.

III. To determine the entire pattern of possible completion dates for the project and it is important the milestones, the risk analyst iterates the work many times. At the end of each and every iteration, the completion dates for the total project and for any important milestone are collected . The program also records which activities were on the critical path for that iteration.

2.2 **Network Representation:**

With respect to each of the software project activity three parameters namely optimistic, pessimistic and most likely is established. It can be cost or duration for the activity.

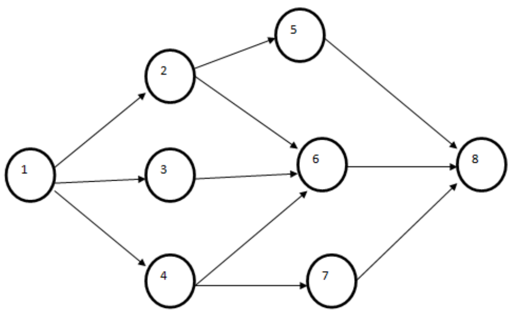

Figure 1.1

These three time values provide a measure of uncertainty associated with each activity.

Optimistic time/cost is the lowest possible time/cost in which the activity can be finished.

Most Likely time/cost is the estimate of the normal time/cost the activity would take.

Pessimistic time/cost represents the longest time and highest cost the activity could take if everything goes wrong.

Notations and Definitions: The following notations and terms are used:

starting node START[K],FINISH[K],ES[I] earliest starting ,EF[I] earliest finishing, LS[I] latest starting, LF[I] latest finishing, TIME[I] expected, A[I] optimistic estimate, M[I] most likely, B[I] most pessimistic estimate.

Algorithm: SCRAS_INFORMAL

Step-1: Allocates random time samples for all the activities. Store them in array TIME.

Step-2: Traverse the network in forward direction to find the length of the critical path.

Step-3: Trace the network in backward direction to identify the activities lying on critical path.

Step-4: Repeat steps 2 and 3 for a number of times to calculate the criticality index for each activity.

1. Time samples of activities: The activity durations are decided by generating the time samples for activities using beta distribution as follows:

Generate pseudorandom numbers r1 and r2 and calculate $g\ (A_k+ (B_k-A_k)*r1)$:

$g\ (A_k+(B_k-A_k)*r1)=(r1)^{k1-1}*(1-r1)^{k2-1}/ (B_k-A_k)$ where k1=4 and k2=4.

Calculate $g\ (M_k) = (M_k-A_k)^{k1-1}*(B_k-M_k)^{k2-1}/ (B_k-A_k)^{(k1+k2-1)}$

Compare $g\ (A_k+ (B_k-A_k)*r1)/ g\ (M_k)$ and r2. If $g\ (A_k+ (B_k-A_k)*r1)/ g\ (M_k) >= r2$ then TIME [K] = $(A_k+ (B_k-A_k)*r1)$ else repeat the procedure for K=1, 2...N

2. Forward Pass: Following equations are used during forward pass:

a) EF [K] = ES [K] + TIME [K] where K=1, 2...N (1)

b) EN [J] = MAX {EF [all activities terminating in J]} where J=1, 2...M (2)

c) ES [K] = EN [START_NODE [K]] where K = 1, 2...N (3)

The forward pass starts with EN [K] = 0. Using equation (3) we get EN[K] = ES[K] = 0. Using equation (1) we get EF[K] = TIME[K]. Proceeding this way, by using equations (2), (3) and (1) respectively, we reach the last node of the network and calculate the length of the critical path i.e. Tmin (total completion time of the project).

3. Backward Pass: Following equations are used during backward pass:

a) LS [K] = LF [K] - TIME [K] where K = 1, 2...N (4)

b) LN [J] = MIN {Ls [all activities originating in J]} where J = 1, 2...M (5)

c) LF [every activity terminating in node J] =LN [J] where J = 1, 2...M (6)

The backward pass starts with LN [K] = Tmin. Using equation (6), we get LN[K] = LF[K] = Tmin. Using equation (4), we get LS [K] = Tmin – TIME [K]. Proceeding this way, by using equations (5), (6) and (4) respectively, we reach the first node of the network and identify critical path for which LS[K] - ES[K] <= ERROR holds, where ERROR = 0.001 (say).

4. Criticality Index: Following condition is satisfied for an activity to be a critical activity

LS [K] - ES [K] = LF [K] - EF [K] (latitude) is ZERO

But sometimes, the condition above is not found to be exactly equal to ZERO. This is because of the presence of some error. In such a case, the above condition is refined as follows:

LS [K] - ES [K] <= ERROR where, ERROR = 0.001(assume)

III. Conclusion

In this worldwide competition, project management is paid higher attention. In software managing risks has been recognized as a very important process in order to achieve project objectives in terms of time and cost. On the basis of calculating the accumulative probability distributed data of duration and cost for each activity in project, Monte Carlo method is applied to simulate the duration and cost for each activity and the overall project to accurately determine the completion probability of the project under considering of the changeability and randomness of duration for each activity. This method can give scientific quantitative basis and information for project management. To some extent, it can also helps to project manager in decision makers easily make control with duration risk and cost risk of project and make fair decision.. The encouragement for wanting to incorporate simulation into Schedule and cost risk Analysis is clear as finding critical activities with simulated data yields fruitful information such as estimation of software project/activity completion time and cost. Simulation offers the likelihood for speaking to the unpredictability that is vital for sensible thinking around a product undertaking, including the intrinsic instability.

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