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Analysis and Evaluation of (β) Beta Distribution or Three Point Estimation for PERT Technique in Project Management

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Abstract: ***Schedule Management is one of the key aspects of project management in view to ensure how effectively and efficiently the work gets delivered. There are various software's which are primarily used for the planning and scheduling of the activities with respect to various methodologies used. One of the widely used defined as Three Point Estimation and beta Distribution model. Three Points is a technique used by professionals in estimating. This technique use the three figures that are produced initially for every distribution that is required, based on prior experience or best-guesses. The first is a most likely (M)/best guess (BG) which is the average amount of work the task might take if the team member performed it 100 times. The second estimate is the pessimistic (P) estimate which is the amount of work the task might take if the negative factors they identified do occur. The third estimate is the optimistic (O) estimate which is the amount of work the task might take if the positive risks they identified do occur. You may use the beta distribution method to calculate the three point estimating. As the most likely scenario has a more significant impact on the outcome, you multiply the value by 4 while the overall divisor increases to 6 which is further versed in the paper***

Keywords: Three Point Estimating, Beta Distribution, Factors, Schedule Management

1. Introduction

Accurate estimating is the backbone of success when it comes to project management. Traditional methods of estimating often fall short, leading to unforeseen costs a project manager's worst nightmare. This is where 3-point estimating comes in handy. Project management software can be beneficial when using 3-point estimation. These tools give project managers a structured approach to planning, tracking, and managing and valuable insights into each task's progress and the whole project.In three point estimating we will have a look into various aspects it takes into account while its projection of scheduling .It is a formula based .In project management it is important to be able to assess the total time for a project's completion. Since projects can be very complex, methodologies such as the Program Evaluation and Review Technique (PERT) have been developed to assist in these assessments. PERT has been used for many decades but in recent years. academics, managers, and policy makers have increasingly being using it.

Hence there is a growing appreciation of the need for more robust models that assign greater probability to more extreme events .one of the models is the one which has been researched in this paper with its application being done in recently completed project. The goal of this research stream has been to extend the PERT framework to accommodate greater likelihood to extreme tail-area outcomes. This has led to the ability to provide wider confidence intervals for activity and project duration times and hence more conservative results, while still retaining the classic PERT results as an important special case. The ability to increase distributional uncertainty is an important first step towards robust project management estimation; however, one consideration that has been underexplored is that one extreme may be more likely or more important than another. For example, as documented below, project managers tend to provide positively biased time estimates. (1)

2. Literature Survey

Well it has been found out there has been wide array of researches being done in the past regarding the relevance of this paper with the objectives being as to examine the methods and find out the betterments which can be done and the following has been found out with the history of there researches and those are (1) (2) (3):-

1) Robust project management with the tilted beta distribution by Eugene D. Hahn and Mar´ıa del Mar L´opez Mart´ın
2) Project Management: Techniques and Methodologies by Youssra RIAHI
3) Farnum, N. R., & Stanton, L. W. (1987). Some results concerning the estimation of beta distribution parameters in PERT. Journal of the Operational Research Society, 38(3), 287-29

3. Methodology

Here in this paper we are going to examine the method which is called as Three point estimation or beta distribution model. It uses the statistical analysis . Any task filled with uncertainties can have a wide range of estimates in which the task actually will get completed. Uncertainties include both favorable conditions (opportunities) as well as unfavorable conditions (threats). PERT includes statistical analysis.(4)

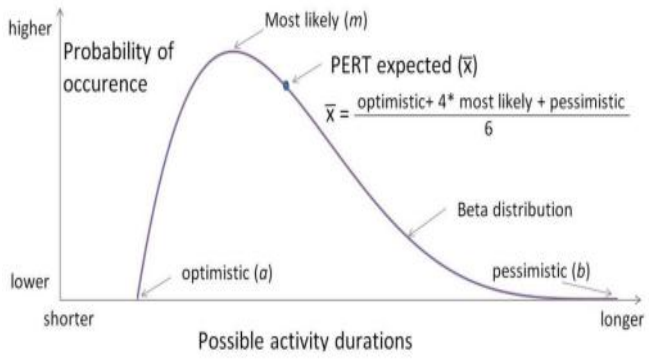

Figure 1: Typical density function of the PERT-beta distribution

The 3 points of the estimate are as below:

1) **Optimistic estimate** – Estimate when all favorable things will happen (all opportunities happen and no threats take place)
2) **Pessimistic estimate** – Estimate when all unfavorable conditions happen (all threats happen and no opportunities take place)
3) **Most Likely estimate** – Estimate when both favorable and unfavorable conditions will happen

This information should be gathered from those people on the project team who will perform the activity. (Note: This example uses time, but the steps can also be applied to cost or work effort.)

With the three estimates, practitioners can calculate the expected time, or weighted average of an activity, and a probability estimate of a completion time for the entire project. The following equations are used to estimate the mean (μ) and variance (σ^2) of each activity ,the formula

Understanding the formula

Expected duration = (optimistic estimate + 4 x most likely estimate + pessimistic estimate) ÷ 6

The most likely estimate has the most weight (4/6), while the optimistic and pessimistic estimates contribute 1/6 each.
Additionally, there are other 3-point estimating formulas to estimate a task or project's duration, cost, or effort.

1) **Triangular distribution** is another standard formula that assumes possible outcomes. This formula takes the optimistic, pessimistic, and most likely durations and calculates the expected duration using the following formula: **(optimistic + pessimistic + most likely) / 3**
2) **Beta distribution** is a more complex 3-point estimating formula commonly used in project risk analysis. This approach assumes that the possible outcomes follow a beta distribution, defined using the optimistic, pessimistic, and most likely durations. The formula for the expected duration is as follows:
(optimistic + 4 x most likely + pessimistic) / 6

After taking out the mean from the given or any assumed data we will find out the standard deviation of the same which is very pivotal. Standard Deviation is an important concept in Statistics. It is based on probability principles. The empirical rule is often used in statistics for forecasting final outcomes. After calculating the standard deviation and before collecting exact data, this rule can be used as a rough estimate of the outcome of the impending data to be collected and analyzed. Each approach has its strengths and weaknesses, and project managers should choose the most appropriate option for their project. (2) (4)

To better understand how to use the formula we will underwent some examples in both the models in our results data.

4. Results

Say in the triangular distribution model we have the following data i.e:_
Optimistic duration (o) = 10 days
Most Likely Period (m) = 13 days
Pessimistic duration (p) = 25 days

By using the formula as stated in the triangular distribution we use it as
(O+M+P)/3

Here we calculate the data as
(10+13+25)/3
(48) / 3 = 16 Days

Where as if the same is taken as in beta distribution we will use the formula as
(O+4M+P)/6

Here we calculate the data as
(10+4x13+25)6
(87) / 6 = 14.5 days we will round up to nearest .5 so 15 days (E)

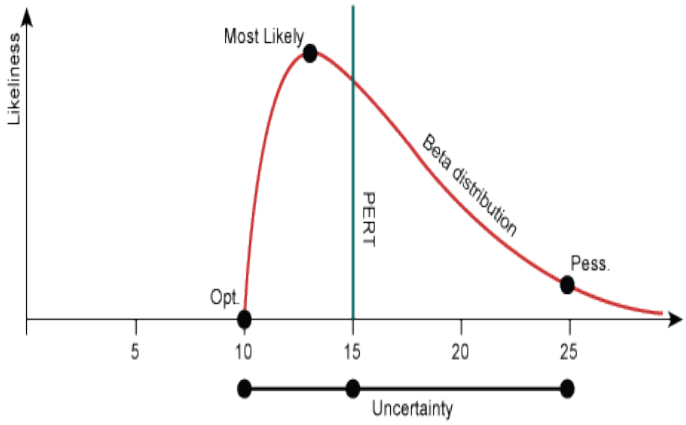

Figure 2: Illustrated data

Finding out the standard deviation with the formula of
(P-O) / 6
Here the standard deviation is
(25-10) / 6
= 2.5 Days (SD)

We can take out the probabilities of the same as well after extracting the standard deviation that can be done with the formula as the calculate data with the multiplication of Standard deviation with 1xSD,1.65Xsd,2xSD,3xSD For e.g here we got the value of 15 days so 15 - + 1x2.5 = 12 & 18 so there is an probability of 68 % that the activities will be

completed inbetween this time frame these probabilities are also called as confidence intervals and is explained as under. The E and SD values are used to convert the project time estimates to confidence intervals as follows:

1) The 68% confidence interval for the true project work time is approximately E(project) ± 1xSD(project)
2) The 90% confidence interval for the true project work time is approximately E(project) ± 1.645 × SD(project)
3) The 95% confidence interval for the true project work time is approximately E(project) ± 2 × SD(project)
4) The 99.7% confidence interval for the true project work time is approximately E(project) ± 3 × SD(project)

5. Discussion

It has to be noted that the uses of three point estimating does allow a wide range of array in the project management scheduling ,it does has various benefits in terms of Improved task scheduling, Minimize and prioritize risk, Minimize expenses, Strategic planning whereas there are various aspects which are to be kept in consideration while its use does prove various challenges those are over-optimism, in-accurate assumptions, in-consistent estimates, changing scopes these challenges are there to be kept into consideration and accurate data analysis should be carried out and inputed in the estimates with consistent estimates. whereas any scope changes should also be amended in the data of the estimate to ensure no deviations or in accurate estimates are carried out. Communication and collaboration with the project teams and any internal or external stakeholders should be properly collaborated to ensure that the estimates are well versed and accurate.

6. Conclusion

The introduction of different activity distributions has played an important part in the PERT methodology. Regarding the current paper, this debate has parallels in statistical practice. Some authors use robust statistical methods to handle outliers while other authors adopt less formal techniques. In this paper there has been few of the examples which has been solved with respect to the triangular and beta distribution model. Followed by taking out the standard deviations to figure out the probabilities to extract how much probability the activity will fall into.This is one of the estimating model in project management which comprises of scheduling the activities effectively if the data is given and inputed with proper analysis.

7. Summary

This paper represents the evaluation and analysis of the three point estimation or beta distribution model in project management, both the models has been well versed and explained in the results section. Well it has to be kept into consideration that there is an constant need of further evaluation of the topic with enhanced or same scope to keep the progression and in depth explanations of the methods of estimation of scheduling of activities in project management going.

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