PROJECT MANAGEMENT: CRASHING AND SIMULATION OPTIMIZATION

Kal. Namit, Winston-Salem State University, North Carolina, U.S.A.
Susita A. Carrol, Winston-Salem State University, North Carolina, U.S.A.
Jim Chen, Norfolk State University, Virginia, U.S.A.

dx.doi.org/10.18374/JABE-21-2.6

ABSTRACT

To reduce a project's completion time, crashing is performed which requires additional resources for activities on the critical path of the project. This paper demonstrates a simulation optimization on a project involving crashing using Excel with Analytic Solver Platform (ASP). The objective is to complete the project at the minimum cost. It is assumed that the activities follow the PERT distributions. Our approach is very useful not only for teaching purposes but also for managing real projects.

Keywords: *Analytic Solver Platform, PERT/CPM, PERT distribution, Simulation Optimization.*

1. INTRODUCTION

Program evaluation and review technique (PERT) and critical path method (CPM) are two important techniques that help project managers to manage and execute projects. Both techniques were developed concurrently, but independently, during the 1950s. CPM identifies the most critical step and the longest path needed to complete a project. The function of PERT is to analyze and represent the tasks involved in a given project. The task completion time required in PERT is a random variable, generally assumed to come from independent Beta distributions in which expected values and variances can be easily estimated from three parameters of the underlying distributions, a – the optimistic completion time, m – the most likely completion time, and b – the pessimistic completion time.

Over the years, the combination of the two techniques has been used by practitioners and academicians. These two techniques have made significant contributions in the area of project management (Dougherty et al., 1984; Kazan, 2005; Davis, 2008) and thus have been widely included in the business school curriculum. Among available software to teach these techniques, Microsoft Excel seems to be very popular. The use of Excel has helped instructor to teach project management in a context which students can easily follow. Albright and Winston (2005) used @RISK, an Excel add-in, to run the project simulation. Later Dan Fyltra and his crew at Frontline Systems developed Analytic Solver Platform (ASP), another Excel add-in, which is much more powerful than @RISK. According to Ragsdale (2015), ASP is the most development in OR/MSD education since the creation of personal computer. We will use the simulation optimization engine of ASP to solve our project crashing problem. There are several probability distributions one could choose for the random activity times. Our demonstration assumes the activity duration time follows the PERT distribution due to its popularity in project scheduling.

In practice, project managers are as much concerned with the cost to complete the project as with the time to complete the project. For this reason, time-cost component will be included in the project scheduling. There are two kinds of costs. The direct costs are the costs which can be traced directly to the activities in a project in a cost-effective way such as direct materials and direct labor.

The costs associated with a project but cannot be traced to it in a cost-effective war are termed indirect costs. They usually include administration, facilities, supervision, and under certain contractual situations, penalty costs and lost incentive payment during the project. In general, direct and indirect costs have an inverse relationship; the direct costs increase as the project time decreases while the indirect costs increase as project time increases. Due to the random activity times and the nonlinearity of the costs in the project problem, both linear programming method and regular nonlinear method cannot be used to solve the