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A New Approach for Solving Fully Fuzzy Multi-objective Project Scheduling Problem to Maximize Project Net Present Value

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***Abstract*— Project scheduling is one of the most important aspects of project planning and management. In real world project scheduling is confronted with a lot of uncertainties and imprecise. To cope with these uncertainties and lack of information, implementing fuzzy sets can be sufficient. In this paper we consider fully fuzzy project scheduling problem with discounted cash flows. The duration of activity, the cash flows of each activity and the interest rate are assumed to be triangular fuzzy numbers. Two objective functions which are to maximize the net present value (NPV) of the project and to minimize the project duration are considered. The method of LP-Metric as a technique of multi objective decision making (MODM) and fuzzy mathematical programming are used to transform the fully fuzzy multi objective model to a crisp model. Finally Taylor expansion is used to transform the nonlinear objective function to linear one for solving the problem and an example is considered for better explanation.**

Keywords- Fuzzy project scheduling- Fuzzy discounted cash flow- Net present value- Makespan

I. INTRODUCTION

Project scheduling is one of the important aspects of project management. There exist different goals based on time, resource, budget, …, that managers of projects are attracted to achieve them. Among all of these objective functions, the important target is to get a maximum cash flow. Because there maybe lack of information for estimating the project's parameters, researchers attracted to use probability theory. For example the duration of activities can be considered as stochastic variables. By this way Project Evaluation and Review Technique (PERT), which considered three estimation based on beta distribution was proposed in [1].

Project scheduling with stochastic activity duration times was presented in [2]. Due to the uniqueness characteristic of projects, historical data about activity duration or other parameters often are not available. So advocates willing to use fuzzy set approach instead of probability theory [3]. By this way, fuzzy PERT method (project evaluation and review technique), and fuzzy CPM (critical path method) were introduced [4,5]. As an example of survey, fuzzy project scheduling was reviewed in [6]. Some scientists optimize different goals in each project scheduling. Scheduling the projects when the objective function was considered maximizing net present value were proposed in [7,8]. Researchers added deadline to the constraints of the aforementioned assumption [10] and scheduling the project by considering fuzzy discounted cash flows and crisp activity duration to maximize fuzzy NPV were introduced in [11]. Scheduling a project with fuzzy activity duration and crisp discounted cash flows to maximize NPV was supposed in [12]. In this paper, discounted cash flows and activity duration and interest rate are assumed to be fuzzy numbers and two objective functions which minimize the project's makespan and maximize the project's NPV are considered. In section two, we define the problem precisely and formulate it. In section three, we use mathematical programming to transform the fuzzy model to crisp one, and one of the MODM techniques are applied for this multi objective problem. Finally Taylor expansion and linear programming method for solving the problem and an example for more explanation are considered.

II. PROBLEM FORMULATION

Suppose a project has *n* activities indexed from *1* to *n*. Activities *1* and *n* are dummies which are the start and the end of the project. Assume activity on node networks, without any loops. Also assume $\tilde{C}_i$ is the fuzzy cash flow associated with activity i and it occurs at the finish of activity i. In addition, $\tilde{\alpha}$ is the fuzzy interest rate, $\tilde{d}_i$ is