

Estimation of f-COCOMO Model Parameters Using Optimization Techniques

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Abstract

The COCOMO Model is well known as the currently predominate model for software cost estimation. It allows one to work from linguistic variables to estimate software project effort and schedule. This basis in linguistic variables encourages research of the COCOMO Model as a fuzzy system. As is known in fuzzy circles and is shown here, fuzzy arithmetic based on the popular fuzzy extension principle may produce unacceptable results under fuzzy multiplication. This makes fuzzy results of some computations too fuzzy to be useful. Nevertheless, in the case of software cost estimation using COCOMO, we find and show that this characteristic of fuzzy arithmetic may be used to advantage.

If a project parameter is fuzzy, the associated COCOMO Model becomes a fuzzy COCOMO Model (f-COCOMO Model) with a fuzzy result (schedule and effort). Most software projects have deadlines dictated by management or market. However, even deadlines are fuzzy objects. For example, if a project must be complete by March 15, there is some possibility that it will not complete until the end of March. There is some possibility that it will complete in February.

With a fuzzy project schedule, or effort (budget), some one or more parameters necessarily must be fuzzy. Of course this is all sensible, since standard COCOMO parameters begin with linguistic variables.

An example which demonstrates how fuzzy parameters affect f-COCOMO results is presented. When a project is planned, software management uses prior history and software engineers' opinions to estimate some parameters of the proposed project. Current resources and/or policy may determine other parameters. Other forces, such as time-to-market pressure or corporate goals, determine an estimated (fuzzy) schedule and budget even before conceptualization is complete. It is not likely that the fuzziness of the project parameters (linguistic variables) will produce a COCOMO result that is contained within the forces-estimated schedule or budget. This paper demonstrates how one may use a dictated fuzzy schedule and budget to improve an f-COCOMO Model, or plan a project. By application of constraints created by dictated fuzzy results, and back propagation, better estimates of project parameters are obtainable. Such a project scenario is presented and the method is applied to demonstrate its use.

Given such a project for which the method is applied, one may ask whether some augmentation of one or more parameters might optimize the COCOMO result toward a desired combination of schedule and effort. Specification of appropriate constraint functions and an objective function allows application of fuzzy optimization methods. The example provided continues the project scenario to demonstrate optimization of parameters to satisfy the objective.

Keywords: COCOMO, fuzzy, optimization.