Chapter XI

Simulating Theory-of-Constraint Problem with a Novel Fuzzy Compromise Linear Programming Model

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Abstract

This chapter demonstrates development of a novel compromise linear programming having fuzzy resources (CLPFR) model as well as its simulation for a theory-of-constraints’ (TOC) product mix problem using MATLAB® v. 7.04 R.14 SP.2 software. The product-mix problem considers multiple constraint resources. The developed CLPFR model helps in finding a robust solution with better profit and product mix solution in a non-bottleneck situation. The authors simulate the level of satisfaction of the decision maker (DM) as well as the degree of fuzziness of the solution found using the CLPFR model. Simulations have been carried out with MATLAB® v. 7.04 R.14 SP.2 software. In reality, the capacities available for some resources are not always precise. Some tolerances should be allowed on some

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constraints. This situation reflects the fuzziness in the availability of resources of the TOC product mix problem.

Introduction

Simulation is a method that allows the analysis of complex systems through mathematically valid means. Through a software interface, the user creates a computerized version of a model (Peterman, 2006). Among other things, “model abstraction is a method for reducing the complexity of a simulation model while maintaining the validity of the simulation results with respect to the question that the simulation is being used to address” (Frantz, 2006). Model abstraction is the intelligent capture of the essence of the behaviour of a model without all the details of how that behaviour is implemented in code (Frantz, 1996). Researchers in the field of artificial intelligence (AI) have also been developing techniques for simplifying models, determining whether model results are valid and developing tools for automatic model selection and manipulation (Frantz, 2006).


It is to be noted that simulation and modelling has a wide applicational range in military sciences. Sisti and Farr (2005) dealt with the wide variety of research issues in simulation science addressed by government, academia and industry, and their application to the military domain, specifically to the problems of the intelligent analyst.

Advancement in model abstraction research deals with the application and adaptation of the concept of “qualitative reasoning” which is borrowed from the field of AI (Sisti & Farr, 2005). Qualitative simulation concerns itself with getting away from the idea of “exactness” (Sisti & Farr, 2005). Some of the ancillary topics of research in qualitative simulation, as suggested by Sisti & Farr (2005), are: fuzzy modelling, random set theory, possibility theory, rough sets and Dempster-Shafer theory (DS theory) and ordinal optimisation. The common factor among all of these fields is that all of these strive to represent “intermediate degrees of truth” (uncertainty) in such a way as to attain optimal answers, or ranges of answers, as opposed to an optimum answer to 10-decimal place precision (Sisti & Farr, 2005).

In this chapter the authors present, first, a novel fuzzy compromise linear programming (CLPFR) model to solve a product mix problem under theory of constraint (TOC). The problem contains multiple constraint resources. The developed CLPFR model helps in finding a robust solution with better profit and product mix solution. Later, the authors simulate the level of satisfaction of the decision maker (DM) as well as the degree of fuzziness of the solution found using the CLPFR model. Simulations have been carried out with MATLAB® v. 7.04 R.14 SP.2 software. A thorough interpretation and discussion of the outcome of the product mix decision using the CLPFR model has also been presented in this chapter.
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