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A new method for robustness in rolling horizon planning

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Abstract

In this paper we describe a new method to solve Linear Programming (LP) problems with uncertain parameters. We apply this to planning problems where a rolling planning horizon is used. The method is based on a decomposition scheme where we iteratively solve an upper level problem for the first time period where the parameters are assumed to be known. The lower level problem uses the upper level solution and computes a worst case scenario for an anticipation period with uncertain parameters. Information in how the worst case scenario is affected by the upper level decisions is given back as a valid inequality. This process is repeated until the upper level solution satisfy the last generated valid inequality. We test the proposed method on an integrated production, transportation and inventory planning problem. We compare our approach with a deterministic approach with and without safety stocks. The result shows that the method works well and perform better than the deterministic approach with safety stocks.

Key words: Robust optimization, Uncertainty, Transportation, Distribution, Production planning

1 Introduction

There are many industrial applications where decisions are made on a rolling planning horizon. Typically this is used in tactical models where the planning horizon is one to several months and where the demand is uncertain. We will study a general problem for integrated production, transportation and inventory planning problem. The decisions to make are how much to produce, how much to store and how to transport products between production units to customers. In the tactical planning, the planning horizon, say one year, is divided into time periods, say 12 months. For each time period, we need information on production, transportation and storage capacities and demand. In addition we need information about transportation and inventory costs. Once we have solved the planning problem, we only implement the decisions for the first period as the situation may change for the remaining periods. During this month we may use the tactical decisions and use other operational models, for example, routing and production planning models to decide the short term operational decisions. Towards the end of the period we again go back and solve the tactical model which now covers the next 12 months. Any information collected during the month is used to update the model. In tactical planning there is some data that is more uncertain than others. Production data is typically known whereas demand information is more uncertain. At the same time, demand can be uncertain over the next 12 months but fixed through contracts for the next 1-2 months.

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