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Queuing based Analysis of Inventory Control in a Multi-Level Supply Chain

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Abstract

The network supplier of an end-product manufacturer company who receives customer orders and organizes his production and supply policy so as to minimize the sum of his average stock-out cost is analyzed from the viewpoint of queuing models in two categories, first same costs for suppliers and then different costs. For each main component to be ordered, we consider the producer has two possible suppliers. The arrivals of customers' orders are random and delivery times from suppliers are also supposed random. This supply system is represented as a queuing network where the producer uses a base-stock inventory control policy that keeps constant the inventory position level (current inventory level& pending replenishment orders). The decision variables are the reference inventory position level and the percentages of orders sent to the different suppliers. In the queuing network model, the percentages of orders are implemented as Bernoulli branching parameters. In first step we find an exact solution with assumption of same costs for supplier's costs. Solving the optimization problem in next step leads us to have an approximate result. The quality of the approximate solution is evaluated by comparison to the solution of first phase, which can be computed numerically in some simple cases, in particular in the two-supplier case. Numerical applications show the important economic advantage for the producer of sending orders to several suppliers rather than to a single one.

Keywords
Inventory control; Supply chain; stochastic models; Queuing