Component Commomality and Shortage Reduction under a Mixed Erlang Distributed Demand

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Abstract⸺This paper addresses an inventory control problem when common components are allowed and the goal is to minimize the expected units shortage subject to a budget constraint. A two-level assemble-to-order product structure is analyzed when the demands for two end products follow independent mixtures of Erlang distributions. Closed form expressions for the objective function under various scenarios are presented and efficient algorithms for computing the optimal inventory stock levels are developed. Relative reductions in the expected units shortage under different demand patterns and budget availability situations when introducing commonality are evaluated and compared. It is found that, for all demand patterns considered, the relative reduction can be substantial when the inventory budget is large. Thus, if a company wants to improve an already high service level for an essential item, introducing commonality may be an option without having to increase the inventory to an unbearable level. Also, given a fixed budget, our numerical results suggest that the case of independent and identically distributed demands produces the largest relative reduction in expected units shortage. Benefits from employing commonality can be insignificant, however, where the demands are very different.

Keywords⸺Inventory models, Component commonality, Erlang demand distributions

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