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论文与报告

按单装配系统中组件生产和库存分配控制策略研究

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摘要

针对由两种组件、三类顾客需求组成的按单装配系统, 本文研究了其中的组件生产控制与库存分配问题. 在各类顾客需 求是泊松到达过程, 各种组件加工时间服从指数分布的假设下, 我们运用马尔科夫决策理论建立了无限期折扣总成本模型, 根据Lippman转换得到了相应归一化后的离散最优方程, 在此基础之上分析了生产和库存分配联合最优控制策略的结构性质. 本文证明了最优策略是依赖于系统状态的动态策略. 组件的最优生产策略是动态基库存策略, 其中基库存水平是关于系统中其他组件库存水平的非减函数. 而最优的分配策略是动态的阈值策略, 对于只需一种组件构成的顾客需求, 组件的分配阈值是系统中另一组件库存水平的增函数; 而对于同时需要两种组件组成的顾客需求, 其各组件的分配阈值是另一组件库存水平的减函数. 最后通过数值试验给出了各个参数对联合最优控制策略的影响, 并得到了相应的管理启示.

关键词 按单装配 多类需求 马尔科夫决策 最优控制策略

分类号

Joint Control of Component Production and Inventory Allocation in an Assemble-to-order System with Lost Sales

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Abstract

This paper considers a joint control problem of combined component production and inventory allocation in an assemble-to-order system which consists of two components and three demand classes with lost sales. Each demand class arrives according to a Poisson process, and the production time of each component follows an exponential distribution. By formulating the system as a Markov decision process under the expected total discounted cost criterion, we obtain the optimality equation following the Lippman transformation, from which we derive the structural properties of the optimal control policy. Specially, the optimal production policy for each component is shown to be a base stock policy with the base-stock level non-decreasing in the inventory level of the other component, and the optimal inventory allocation for each component is a state-dependent threshold policy, where the threshold point for the demand for one kind of components is non-decreasing in the inventory level of the other component, while the threshold point for the demand for both components is non-increasing in the inventory level of the other component. Finally, we give some numerical examples to show how the optimal control policy changes with the system parameters, and we also provide some managerial insights.

Key words Assemble-to-order system multi-class demand Markov decision process optimal control policy

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