World Academy of Science, Engineering and Technology
International Journal of Industrial and Systems Engineering
Vol:9, No:03, 2015

Scheduling Jobs with Stochastic Processing Times or Due Dates on a Server to Minimize the Number of Tardy Jobs

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Abstract : The problem of scheduling products and services for on-time deliveries is of paramount importance in today's competitive environments. It arises in many manufacturing and service organizations where it is desirable to complete jobs (products or services) with different weights (penalties) on or before their due dates. In such environments, schedules should frequently decide whether to schedule a job based on its processing time, due-date, and the penalty for tardy delivery to improve the system performance. For example, it is common to measure the weighted number of late jobs or the percentage of on-time shipments to evaluate the performance of a semiconductor production facility or an automobile assembly line. In this paper, we address the problem of scheduling a set of jobs on a server where processing times or due-dates of jobs are random variables and fixed weights (penalties) are imposed on the jobs' late deliveries. The goal is to find the schedule that minimizes the expected weighted number of tardy jobs. The problem is NP-hard to solve; however, we explore three scenarios of the problem wherein: (i) both processing times and due-dates are stochastic; (ii) processing times are stochastic and due-dates are deterministic; and (iii) processing times are deterministic and due-dates are stochastic. We prove that special cases of these scenarios are solvable optimally in polynomial time, and introduce efficient heuristic methods for the general cases. Our computational results show that the heuristics perform well in yielding either optimal or near optimal sequences. The results also demonstrate that the stochasticity of processing times or due-dates can affect scheduling decisions. Moreover, the proposed problem is general in the sense that its special cases reduce to some new and some classical stochastic single machine models.

Keywords : number of late jobs, scheduling, single server, stochastic
Conference Title : ICOR 2015 : International Conference on Operations Research
Conference Location : Rome, Italy
Conference Dates : March 05-06, 2015