

An uncertain programming model for preventive maintenance scheduling

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Preventive
maintenance
scheduling

111

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Abstract

Purpose – The purpose of this paper is to illustrate an uncertain programming model for scheduling of preventive maintenance (PM) actions. The PM scheduling, in which PM actions are performed under fixed intervals, is solved by grey systems theory.

Design/methodology/approach – The paper applied the grey evaluation method based on triangular whitening weight functions which includes two classes: endpoint evaluation method and center-point evaluation method.

Findings – Two methods give the same results based on endpoint and center-point triangular whitening weight functions. For validation, the results were compared by Cassady's method.

Originality/value – The scheduling of PM is crucial in reliability and maintenance engineering. Hundreds of parts compose complex machines that require replacement and/or repairing. It is helpful to reduce the outage loss on frequent repair/replacement parts and avoid lack of maintenance of the equipment by controlling the equipment maintenance frequency.

Keywords Uncertainty, Failure, Grey systems theory, Preventive maintenance scheduling

Paper type Research paper

Nomenclature

β	Weibull shape parameter for probability distribution of T	$N(r)$	number of machine failures in r time units of machine operation
η	Weibull scale parameter for probability distribution of T	$x(t)$	hazard function of T
r	PM interval for the machine	t_r	time required to repair the machine
$A(r)$	steady-state machine availability	t_p	time required to perform PM on the machine
$w(r) E\{N(r)\}$			

1. Introduction

Timely and cost-effective production is becoming increasingly important in today's global competitive markets. For the manufacturers, it is vital to optimize the machine resource utilization by ensuring an efficient and stabilized schedule at the operational level. Traditional literatures on scheduling assume that machines are available at all times. However, in many realistic situations, machines may be unavailable during the scheduling horizon for different reasons, such as breakdowns and scheduled maintenances in typical industrial settings. This availability consideration adds complexity to any scheduling problem, even in a single machine environment (Lu *et al.*, 2015).

In a long-term scheduling, production system is always subject to deterioration with usage, which will affect the availability of machines and the stability of the system.



Uncertain Programming

Baoding Liu



Uncertain Programming:

Theory and Practice of Uncertain Programming Baoding Liu, 2013-04-17 Real life decisions are usually made in the state of uncertainty randomness fuzziness roughness etc How do we model optimization problems in uncertain environments How do we solve these models In order to answer these questions this book provides a self contained comprehensive and up to date presentation of uncertain programming theory It includes numerous modeling ideas hybrid intelligent algorithms and various applications in transportation problem inventory system facility location allocation capital budgeting topological optimization vehicle routing problem redundancy optimization and scheduling Researchers practitioners and students in operations research management science information science system science and engineering will find this work a stimulating and useful reference

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Uncertain Graph and Network Optimization Bo Zhang, Jin Peng, 2022-05-03 This first book focuses on uncertain graph and network optimization It covers three different main contents uncertain graph uncertain programming and uncertain network optimization It also presents applications of uncertain network optimization in a lot of real problems such as transportation problems dispatching medical supplies problems and location problems The book is suitable for researchers engineers teachers and students in the field of mathematics information science computer science decision science management science and engineering artificial intelligence industrial engineering economics and operations research

Uncertainty Theory Baoding Liu, 2014-11-03 When

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Special Issue on Uncertain Programming Modeling, Algorithms and Applications,2013 Proceedings of 2021 Chinese Intelligent Systems Conference Yingmin Jia,Weicun Zhang,Yongling Fu,Zhiyuan Yu,Song Zheng,2021-10-06 This book presents the proceedings of the 17th Chinese Intelligent Systems Conference held in Fuzhou China on Oct 16 17 2021 It focuses on new theoretical results and techniques in the field of intelligent systems and control This is achieved by providing in depth study on a number of major topics such as Multi Agent Systems Complex Networks Intelligent Robots Complex System Theory and Swarm Behavior Event Triggered Control and Data Driven Control Robust and Adaptive Control Big Data and Brain Science Process Control Intelligent Sensor and Detection Technology Deep learning and Learning Control Guidance Navigation and Control of Flight Vehicles and so on The book is particularly suited for readers who are interested in learning intelligent system and control and artificial intelligence The book can benefit researchers engineers and graduate students

Advanced Materials and Computer Science Garry Zhu,2011-04-19 Selected peer reviewed paper from 2011 International Conference on Advanced Materials and Computer Science ICAMCS 2011 May 1 2 2010 in Chengdu China

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