An uncertain programming model for preventive maintenance scheduling

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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 whitenization 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 whitenization 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	$N(\tau)$	number of machine failures in τ time units of machine operation
η	Weibull scale parameter for probability distribution of T	$z(t)$	hazard function of T
τ	PM interval for the machine	t_r	time required to repair the machine
$A(\tau)$	steady-state machine availability	t_p	time required to perform PM on the machine
$m(\tau)$	$E[N(\tau)]$		

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

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