Repairable System Analysis Using the Discrete Weibull Distribution *

Danilo G. O. Valadares [1], Roberto C. Quinino [1],
Frederico R. B. Cruz [1], and Linda L. Ho [2]

[1]*Departamento de Estatística*
Universidade Federal de Minas Gerais
31270-901 - Belo Horizonte - MG, Brazil

[2]*Departamento de Engenharia de Produção*
Universidade de São Paulo
05508-220 - São Paulo - SP, Brazil

dgovaladares@gmail.com, roberto@est.ufmg.br,
fcruz@est.ufmg.br, lindalee@usp.br

Abstract

In many practical circumstances, a repair can be performed when a system fails to restore to a condition before a failure. This type of repair is known as minimal repair and one of the most used models is the power law process (PLP). It is common to consider equipment failure time as a continuous variable in this model, assuming a high degree of accuracy in the measurement tool. However, in practical situations, failures are usually observed and recorded as integer numbers of time units, such as the number of days and hours, indicating a discrete process. In this study, we used a discrete Weibull distribution instead of a continuous Weibull distribution. Since both Weibull models have similar complexities, some benefits are observed in the usage of the discrete model, as lower standard deviation of the parameter related to the system deterioration and also lower AIC. For illustrative purposes, the use of a discrete Weibull distribution was applied to a data set related to the failures of concrete mixer trucks. Moreover, an approach using a Markov chain with discrete states to obtain the average number of failures and the respective optimum maintenance policy was included. Additionally, six cases (found in the literature) fitted by the PLP model were reanalyzed and compared under the discrete model perspective.

Keywords: Repairable systems; minimum repair; continuous Weibull distribution; discrete Weibull distribution; Maximum likelihood estimation; Markov chain

*IEEE Transactions on Reliability (in press), 2023. DOI: doi. The final publication is available at somewhere.