Utilizing Weibull Distribution for Fitting System Data and Time Between Maintenance Operations to Derive Maintenance Schedules and Parameters for Critical Equipment in a Textile Industry

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Abstract

In the context of a textile industry, where inconsistent maintenance scheduling and disjointed maintenance strategies could lead to breakdowns, reduced efficiency, and safety concerns, the need for reliable maintenance schedules and coherent strategies became paramount. This study endeavored to address this challenge by harnessing the power of the Weibull distribution. Its application involved scrutinizing system data and the time intervals between maintenance operations for critical equipment, with the overarching goal of deriving maintenance schedules and parameters that amplified both reliability and performance. To realize this objective, a methodological approach rooted in the Weibull distribution was employed. The analysis encompassed not only failure data examination but also the calculation of the Mean Time Between Failures (MTBF), offering insights into the system's reliability. The study delved into the intricate connections among Weibull distribution parameters, hazard functions, and reliability functions. To validate the derived models, an array of techniques such as data fitting, probability plots, and regression analysis were systematically undertaken. Consequently, the study unveiled a spectrum of failure patterns contingent upon the shape parameters identified. These patterns encompassed premature, random, and wear-out failure modes, each necessitating specific maintenance strategies tailored to optimize equipment performance and ensure safety. The calculated MTBF values shed light on the equipment's reliability, while the derived probability density functions, survival functions, and hazard functions enriched the comprehensive understanding of the system's behavior. It was established that a shape of 1.46503 implies that most of the failures are associated with early wear-out failure. By pinpointing the failure modes and aligning corresponding maintenance approaches, the study not only enhanced equipment performance but also elevated safety standards.The study also proposed avenues for improving analysis accuracy through diverse data collection, real-time monitoring, and exploring dynamic parameter adjustments to accommodate evolving operational conditions.

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