Comparisons between Parallel and Series Models in a Reliability-Queueing-Inventory System- a Concise Discussion

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Abstract

In this talk, we consider an integrated Reliability-Queueing-Inventory (RQI) system; and briefly discuss a comparative study between a parallel system (Model I) and a series system (Model II) concerning the repair and replenishment of failed components. These systems are composed of independent and identical components. In Model I, we investigate a parallel system (1-out-of-n: G), where the repair of failed components precedes the placing of the replenishment order. Failed components form a queue awaiting for repair, where the repair starts when the number of operational components reaches L $(L < n)$. Upon further reduction to N $(N < L)$, an order of n units is placed for replenishment. Whereas, in Model II, we analyze a series system (n-out-of-n: G), assuming that repair commences immediately when the number of working components decreases to $n-1$. Here, the replenishment order ensures precisely n operational and 1 spare components in the system. We explicitly derive the steady-state probabilities using Chapman-Kolmogrov difference-differential equations. Various key performance measures are calculated for both models, facilitating a comprehensive comparison to determine the most reliable system. Optimization problems are thoroughly explored, with achieved results facilitating the identification of the model that optimally balances reliability and cost efficiency.

Keywords:
Parallel System, Series System, Component Repair, Replenishment, System Reliability