

@page{margin:1in}body{font-family:DejaVu
Sans,Arial,sans-serif;color:#111;font-size:12pt;line-height:1.6}h1{font-size:20pt;margin:0 0 10pt}h2{font-size:14pt;margin:18pt 0 6pt}p{margin:0 0 10pt}.meta{color:#444}Analysis of a discrete-time Geo^X/G/1 repairable queue with multiple vacations, feedback and p-entering disciplineDOI:

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2026-06-22AbstractThis paper considers a discrete-time Geo^X/G/1 repairable queue with server's multiple vacations, customer feedback and p-entering discipline. The arriving batch enters the system with probability p or is lost with probability 1-p during server vacations. The customer who has just been served returns to the queue with probability 1-q for another service or leaves permanently with probability q. The server may break down during service and does not continue to work until it is repaired. Using the z-transform and renewal process theory, the reliability indices of the transient and steady-state unavailability, the expected failure number during (0⁺, n⁺] and the steady-state failure frequency of server are studied. The transient structure of the server reliability indices is characterized. As a real-world application the reliability indices of the proxy server in a network access proxy system are analyzed numerically.
Content1.

Introduction
<p>Discrete-time vacation queues have been widely studied over the past decades due to their wide applications in broadband integrated service digital networks (BISDN), asynchronous transfer mode (ATM) and computer telecommunication systems. For a comprehensive review of the main results, methods and applications, readers may refer to the papers [1-7], the books [8-9] and their references. Based on the fact that the sever of a queueing system is subject to unpredictable breakdowns and repairs when serving a customer, some researchers, such as Tang et al.[10], Liu and Gao[11], Lan and Tang[12,13], Kulshrestha et al.[14] and so on, analyzed the reliability of the server in some discrete-time repairable queueing systems. However, existing studies have mainly focused on the discrete-time repairable queues with a constant arrival rate. In fact, the customer arrival rate may have something to do with server states. For example, in a telecommunication network the arrival rate of a message may vary when the server is under a maintenance activity (e.g. virus scan). On the other hand, the feedback is a common phenomenon in real world, e.g., in telecommunication systems the messages that produce errors at the destination need to be sent again. In a call center a user may call again when their problem is not completely solved. Thus the reliability study of discrete-time repairable queues with vacations, feedback and variable arrival rate is not only significant for theoretical investigations but also valuable for practical applications. In this paper, we consider the reliability of the server for a discrete-time Geo^X/G/1 queue with vacations, feedback