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The Matrix-Geometric Solution of the M/E$_k$/1 Queue with Balking and State-Dependent Service

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Abstract: In this paper, we present an analysis for an M/E$_k$/1 queuing system with balking and state-dependent service. Customers are served with two different rates depending on the number of customers in the system. If a customer on arrival finds other customers in the system, it either decides to enter the queue or balks with a constant probability. We first formulate the queuing model as a quasi-birth and death (QBD) process. Then, we obtain the equilibrium condition of the system. By using the matrix geometric solution method, we obtain the explicit expressions for steady-state probability vector via the rate matrix $\boldsymbol{R}$. The computation of the rate matrix $\boldsymbol{R}$ is also discussed. Then, we derive explicitly some performance measures of the system. Based on these performance analysis, we develop a cost model to determine numerically the optimal cost and optimal critical value. Finally, we perform sensitivity analysis through numerical experiments.

Keywords: *Balking; state-dependent; matrix geometric solution; steady-state probability.*

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