

Priority Allocation in the Context of Low-Cost Booking Queues: A Utility Comparison of First-Come, First-Served and Token Bidding-Based Queueing Systems

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ABSTRACT

In low-cost digital booking environments where access opens simultaneously and entry carries virtually no monetary or travel cost, the First-Come, First-Served (FCFS) rule often functions as a near-random allocation mechanism, as negligible arrival-time differences rather than willingness to wait determine priority. Although procedurally neutral, FCFS fails to account for heterogeneous urgency and differences in individuals' marginal valuation of service. This study examines whether a Token Bidding-Based (TBB) Queueing System designed with equal initial token endowments can achieve higher welfare efficiency than FCFS in such frictionless booking contexts. By replacing monetary bids with non-transferable tokens, the mechanism preserves equity at the starting point while allowing users to strategically signal urgency across time.

A multi-round simulation framework is developed to capture intertemporal demand heterogeneity and constrained strategic allocation. Agents allocate a fixed budget of 100 tokens across three rounds based on expected demand, with utility modeled as a rank-based disutility function reflecting waiting costs. Using a Monte Carlo design (1,000 trials per scenario) across four population sizes (5, 25, 50, and 100 agents), aggregate welfare outcomes under TBB and FCFS are systematically compared.

Results show that the TBB system consistently reduces welfare loss relative to FCFS by approximately 27-29% across all population sizes. Sensitivity analysis varying the curvature of the utility function confirms the robustness of these findings. The study contributes to the literature by integrating queueing theory, auction-based prioritization, and welfare economics within a low-cost booking context, demonstrating that non-monetary strategic prioritization can improve allocative efficiency while preserving equal initial access rights.

Keywords: Token Bidding-Based Queueing System, First-Come, First-Served Queueing System, Social welfare