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Bridging Optimization and Operational Reality: A Simulation-Optimization Approach for Airline Ground Staff Scheduling

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Efficient workforce scheduling is essential for airline ground operations, where flight delays and fluctuating workloads create uncertainty in staffing requirements. Although stochastic programming (SP) provides a structured approach to scheduling under uncertainty, its aggregated representation of operational processes may not fully capture the complexities of real-world operations.
This study investigates how discrete-event simulation (DES) can be integrated with SP to evaluate and improve workforce schedules for airline baggage handling operations. First, we assess the operational performance of SP-generated schedules and calibrate the model using simulation feedback. Next, we propose a simulation-based optimization (SimOpt) approach that iteratively improves shift and break schedules through neighborhood search guided by DES evaluations. We further investigate the effects of heuristic design choices, initialization strategies, and flight-task demand characteristics.
Computational experiments show that DES-based calibration reduces operational costs by approximately 27% on average, while SimOpt achieves an additional average reduction of 7.17% compared with calibrated SP schedules. The findings demonstrate the potential of combining mathematical optimization and detailed operational simulation to develop more cost-efficient workforce schedules under uncertainty.