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Fixed Interval Scheduling with Random Delays: Distributionally Robust and Multi-stage Approaches

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In logistics and transportation, scheduling tasks with fixed start times is a common challenge, often complicated by unpredictable delays. To tackle these issues, we need robust optimization techniques that can adapt to real-world uncertainties.
Initially, we explore an operational FIS problem where job completion times are influenced by random delays, modeled using Archimedean copulas to capture known dependencies. We aim to maximize the worst-case probability that a schedule remains feasible under stress conditions affecting some marginal delay distributions. By reformulating the problem, we connect it to established risk measures, paving the way for efficient solutions through decomposition.
The second strategy involves a dynamic framework that allows for job reassignment at key decision points, responding to observed delays. This creates a complex mixed-integer stochastic program, requiring novel methods to simplify and solve.
A practical application for these models is the gate assignment problem at airports, where flights must be allocated to gates while considering arrival delay uncertainties. The diverse compatibility between aircraft and gates, along with the ability to adjust assignments over time, makes this an intriguing case study. We provide computational results for the initial problem and discuss methodological progress and future prospects for the latter.

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