# Robust Integrated Airline Scheduling with Chance Constraints

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Abstract— During planning and execution of their flights, airlines face complex decision-making processes: The operation of all aircraft according to a minimum-cost plan poses tremendous difficulties even for medium-sized airlines. Accordingly, the airline scheduling problem is historically decomposed into a collection of four subproblems: Schedule design, fleet assignment, aircraft routing, and crew pairing problems. The decomposition into subproblems reduces the required computational costs; the airline performance, however, often greatly deteriorates, given the sub-optimality of the solution or, in the worst case, infeasible solutions. With the incorporation of robustness into scheduling, solving the problem becomes further intractable. In this study, we design an integrated robust scheduling problem, which integrates the first three steps into a complex optimization problem, while considering chance constraints to ensure the overall on-time performance. An exact column generation-based algorithm and a fast hybrid algorithm that combines variable neighborhood search with column generation are developed to efficiently solve the problem. Based on a real schedule from a Chinese airline, the benefits of this fully integrated robust model and computation results are presented and validated. Our results demonstrate that the proposed hybrid algorithm can quickly derive high quality solution within an optimality gap of no more than 0.7%.