

Optimizing Railroad Operating Plans: A Compound Freight Routing and Train Scheduling Model

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Abstract

The aim of this research was to present a mathematical optimization model to determine freight routing and train scheduling (timetable) simultaneously. The objective is to minimize total fixed cost of a train, yard costs, car-time cost, and demand-specific costs to penalize delivery before and/or after a specified due date, subject to limits on train size, number of cars and trains formed by yards, and number of trains run on track sections. This compound model produces a transportation plan that completely describes the routing of freight, the set of trains to be operated, and their respective frequency and departure time. The model, which is an integer program with deterministic dynamic service network design structure, has been applied to a specific actual example and the results are presented.

1. Introduction

Railroads typically develop operating plans to govern the movement of cars. Car movements are performed by assembling cars in trains through successive classification. In order to achieve efficiency through economies of scale, cars having the same travel direction are classified (i.e. grouped) into blocks according to a *grouping* or *blocking plan*. Blocks with the same general travel direction are then organized into trains according to a *train makeup* or *train formation plan*. After sufficient cars have been accumulated, trains will be dispatched from terminals according to *train schedules* (timetables), which may be represented on a time-space graph.

The operating plans are developed for a medium-term (tactical) planning horizon, and must be updated as traffic conditions and customers need change. The objective of this research was to present an optimization model to determine freight routing and train scheduling (timetable) simultaneously for general commodity, and single carload traffic. The model is constructed to answer the following important questions: (1) on what routes should trains run, at what speed priority and at what

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