TU Wien
Institute for Management Sciences Research
Unit of Industrial Engineering
Research Group of Logistics and Quality Management

Call for Seminar Work

Preliminary title: Toward Realistic Estimation of Freight Train Velocities: Deviation Analysis and Predictive Methodology

Background and motivation: In freight logistics, accurately estimating travel times is crucial for optimising operations, planning, and customer satisfaction. Traditionally, average velocities are assigned uniformly across countries, significantly oversimplifying the complexities of real rail operations. In practice, train speed varies due to numerous influencing factors, such as topology, weather conditions, infrastructure constraints, and operational disruptions (e.g. temporary capacity restrictions, rerouting). Rail Cargo Group (RCG), a member of ÖBB, provides access to a large statistical dataset, including information on departure/ destination locations, start and end times, and related movement data for thousands of freight trains. This project seeks to analyse deviations in velocity and develop a methodology to model realistic freight travel times better, supporting more accurate operational planning.

Objectives: (1) analyse and quantify the deviations between actual and expected freight train velocities, (2) identify and understand the underlying causes of these deviations, (3) develop a robust methodology, potentially incorporating machine learning (ML) and statistical techniques, for estimating more realistic travel times, and (4) propose a framework for a continuously improving model based on new data inputs.

Project overview: The project will begin with a statistical and literature-based exploration of factors affecting freight train speed. Students will apply mathematical, heuristic, and ML approaches to: (1) calculate average and deviation-based velocities, (2) identify outliers and anomalies in the dataset, (3) explore possible clustering of velocity-reducing factors, (4) integrate external parameters, (5) propose and test predictive models to estimate realistic speeds and travel times.

Tasks: (1) literature review, e.g. identification of comparable studies, (2) data exploration and preprocessing, e.g. cleaning, understanding the dataset, calculating velocities, etc., (3) deviation analysis, e.g. clustering recurring deviation patterns, and (4) model development, e.g. baseline model using heuristics and averages.

Deliverable | Learning Outcomes:

- A detailed 10-page report summarising the findings on the literature review, data analysis methodology, results of deviation and cluster analysis, proposed predictive model, and discussion
- Functional model with data preprocessing and analysis scripts, and implemented models

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