

assignment_02

January 18, 2025

1 Assignment 2

1. Holiday-Special Train Scheduling Problem

The operations team of the Southern Indian Railways wants to schedule holiday-special trains, each with a capacity of 1500 passengers and operational cost of 150/km, between Chennai and Hyderabad to cater to the increased passenger demand during the Pongal festival. The surge in passenger demand for the three days prior to the festival is expected to be 10k, 15k, and 12k passengers, respectively. Using the formulation developed in the previous assignment, answer the following questions.

- Transform the constraints into a system of equations. (2)
- Relaxing the integer constraint on x_i 's, apply the Simplex method. (4)
- Report the optimal solution assuming that x_i 's hold integer values. (2)

2. Delhi-Chennai High-Speed Rail Problem

The National High Speed Rail Corporation (NHRC) plans to operate two types of high-speed bullet trains, T_1 and T_2 , between Delhi and Chennai, cutting down travel time between two cities from 32 hours to less than 12 hours. Here, T_1 is an executive service train with a capacity of 800 passengers and an operational cost of 250/km, stopping at Vijaywada, Nagpur, Bhopal, and Agra on its way from Chennai to Delhi. On the other hand, T_2 is an economy service train with a capacity of 1200 passengers and an operational cost of 200/km, having additional stops at Gudur, Balharshah, and Jhansi. To ensure a smooth level of service (95%) against an uncertain demand that follows a normal distribution with a mean of 5000 passengers and a standard deviation of 500, and yet maintain operational profitability, NHRC plans to run at most 3 trains daily, for both, executive and economy service. For this problem,

- Formulate the primal optimisation problem. (3)
- Formulate the dual optimisation problem. (3)
- Attach two spreadsheets, one solving the primal optimisation problem and the other solving the dual optimisation problem. (10)
- Interpret the resulting dual variables. (3)
- With integer constraints relaxed, perform cost sensitivity analysis on the primal problem. [Hint: draw the isocost lines and feasible region to answer the following questions]

- Find the ratio $c_1/c_2 = r$ that renders infinite solutions (1)
- For $c_1/c_2 < r$, find the optimal solution (1)
- For $c_1/c_2 > r$, find the optimal solution (1)