Part 1: Problem Analysis

1. What can be done to address this problem?

To optimize the procurement and maintenance of a fleet of Type A, Type B, and Type C buses, we aim to achieve the following objectives:

\* Adhere to a fixed budget of $10 million.

\* Meet or exceed the fuel efficiency requirement.

\* Conform to the maximum total fleet size of 450 buses.

\* Provide sufficient seating capacity for all 15,000 students.

2. What decisions are required?

The decisions are:

\* Number of Type A buses to purchase (variable x)

\* Number of Type B buses to purchase (variable y)

\* Number of Type C buses to retain in service (variable z, subject to a maximum of 400)

3. What objectives are set forth?

The objectives are :

\* Minimize costs (subject to the fixed budget of $10 million)

\* Maximize average fuel efficiency

\* Enhance student comfort and reduce environmental impact by replacing old buses and minimizing the number of Type C buses in service

4. What required constraints or conditions must be met?

The constraints are:

Budget Constraint: 50,000x + 70,000y <= 10,000,000

Fleet Size Constraint (maximum total fleet size of 450 buses): x + y + z <= 450

Total Seating Capacity Constraint: 25x + 50y + 50z <= 15,000

Fuel Efficiency (AFE) Constraint: (25x + 50y + 50z) / ((25x / 10) + (50y / 8) + (50z \* 5)) >= 6

Limit on Old Buses: 0 <= z <= 400

Non-negativity and Integer Constraints: x, y, z ∊ Z+

Part 2: Real-World Optimization Application

Example from Experience:

A small events company needed to allocate staff to multiple events each weekend. They needed to ensure everyone received adequate rest between shifts, avoid overbooking, and adhere to labor budget constraints.

Did they use optimization? Not formally. The company conducts this process manually using spreadsheets and estimations.

How could optimization have been beneficial? The company could have utilized the Optimization model to minimize labor costs, ensure shift fairness, avoid double-booking, and enhance scheduling speed and accuracy.

Tools for Optimization: Excel Solver or Python’s jPuLP/OR-Tools could have resulted in significant weekly time savings and reduced scheduling conflicts.