**Task 1: Business Case Analysis**

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D605: Optimization Task 1

April 8, 2025

1. **Identify a business need in the given scenario that could benefit from an optimization approach**

In Task 1 Scenario, ABC Logistics, a trucking company, is struggling to maintain profit margins while meeting customer demands for on-time deliveries. A business need that could benefit from an optimization approach is improving the allocation of deliveries to trucks and planning the most efficient delivery routes. This would help reduce fuel and maintenance costs, improve on-time deliveries, use truck space more effectively, and lower carbon emissions.

**A1. Explain why the business need you have identified can be addressed using an optimization approach**

The business need of improving delivery allocation and route planning at ABC Logistics can be addressed using an optimization approach because it involves making the best decisions while considering limits like delivery times, truck capacities, travel distances, and fuel use. Optimization methods are good at balancing these factors and can work with large amounts of data, such as delivery locations, time windows, and truck capacities. This helps the company create efficient delivery plans that save time and money, increase customer satisfaction, and reduce its environmental impact.

**A2. Identify the linearity of the optimization problem you have found**

The optimization problem at ABC Logistics is considered linear because both the goal and the constraints can be described using linear equations. For example, costs like fuel, driver salaries, and maintenance increase at a steady rate as distance increases, which can be shown with straight-line formulas. In the same way, constraints like truck capacity, delivery time windows, and travel distances can also be written using linear expressions. Since both the company’s goal and the limits it has to follow can be represented this way, the problem is a linear optimization problem.

**A3. Identify the type of optimization problem you have found**

The optimization problem at ABC Logistics is a Multi-Objective Vehicle Routing Problem (MOVRP). This problem involves “finding the most effective way to distribute goods or services to numerous places while satisfying various objectives” (Patel, 2025, par. 1). In this case, the company wants to lower costs like fuel, maintenance, and driver salaries, while also improving delivery times, using truck space efficiently, and reducing carbon emissions. The problem also includes constraints such as truck capacities, delivery time windows, and distances between delivery points and the depot. Because there are multiple goals to balance along with important constraints, this problem is a good example of a multi-objective optimization problem in vehicle routing.

1. **Identify the optimization objective, decision variables, and two or more constraints that are components of your optimization approach**

There are multiple objective functions in the optimization approach. The first objective is to minimize delivery costs, including expenses such as fuel, maintenance, and driver salaries. The second objective is to reduce carbon emissions by improving route efficiency and how vehicles are used. The third objective is to improve delivery times by planning routes that meet customer time windows. These goals are combined in a multi-objective optimization model to help the company operate more efficiently while supporting customer satisfaction and environmental goals.

There are three decision variables the company needs to consider in the delivery process. First is truck assignment, which means deciding which trucks will go to which delivery locations. The second is delivery sequence, which refers to the order and route each truck should follow. Third is cargo allocation, which involves determining how much cargo each truck will carry.

There are three constraints in this optimization problem. The first is the truck capacity constraint, which means each truck has a maximum load it can carry, and that limit can’t be exceeded. The second is the delivery time window constraint, where each delivery must happen within a set time frame to meet customer expectations. The third is distance constraint, which ensures each truck’s total travel distance stays within limits based on fuel and driver hours.

**B1. Explain any end point considerations in your optimization approach**

There are multiple endpoint considerations in the optimization approach. First is customer satisfaction, which means deliveries must be made within each customer’s time window. A route that saves money is not useful if it results in late deliveries. Second is operational feasibility, where the delivery routes and truck assignments must be realistic. This means that no truck exceeds its load capacity or maximum travel distance, and that drivers can complete routes within working hours. Third is cost savings, where the plan should lower delivery costs and help increase profit margins. Fourth is environmental impact, which means the solution should help reduce carbon emissions by using more efficient routes and making better use of vehicles.

1. **Recommend an optimization method that is appropriate for the problem you identified**

An optimization method that is appropriate for the problem at ABC Logistics is Mixed-Integer Linear Programming (MILP). This method works well for complex delivery problems because it can handle both continuous variables, like distance and time, and integer variables, like assigning trucks to delivery locations. MILP can also handle multiple constraints, like truck capacity, delivery time windows, and maximum travel distances. Additionally, it supports multiple goals, like lowering delivery costs, reducing carbon emissions, and improving delivery times. Since the problem is based on clear data and rules, MILP is a good choice for finding the best delivery plan.

**References**

Patel, R. (2025, January 3). *Multi-objective Vehicle Routing Problem (MOVRP): Complete Guide (2025).* Upper Route Planner. https://www.upperinc.com/glossary/route-optimization/multi-objective-vehicle-routing-problem-movrp