# 3 Experiment and Res

This section displays the results, instance parameters, and data of the small experiment used to run the optimization model.

## 3.1 Experiment and Problem Instance Description

Tables 1, 2, and 3 display the demand, parking, and processing node coordinates. Specifically, there are five demand nodes, two parking nodes, and two processing nodes.

| X Coordinate | Y Coordinate |
|---|---|
| 10 | 10 |
| 20 | 15 |
| 30 | 25 |
| 15 | 30 |
| 5 | 20 |

Table 1: Demand Node Coordinates

| X Coordinate | Y Coordinate |
|---|---|
| 5 | 5 |
| 35 | 30 |

Table 2: Parking Node Coordinates

The fleet comprises two vehicles with speeds of 3 and 4 units per time step. Each vehicle starts from one of the parking nodes. The vehicle capacities range randomly between 20 and 30 units

| X Coordinate | Y Coordinate |
|---|---|
| 25 | 20 |
| 10 | 15 |

Table 3: Processing Node Coordinates

(obtaining the value of 22 for both of them), and the traveling costs vary between 1 and 3 per unit distance (obtaining the values of 3 and 1).

The time horizon for this experiment, denoted as $t_f$, is calculated as:

$$t_f = \left\lceil \frac{\text{Average Distance Between All Nodes}}{\text{Average Speed}} \times \text{Number of Nodes} \right\rceil$$

For this instance, we got a value of $t_f = 41$.

The values used for $\alpha$ were randomly generated between 0 and 1, obtaining values of 0.77, 0.02, 0.63, 0.74, and 0.49. The values for the exposure risk factor in each production center, $\beta$, are values of 0.1, 0.2, 0.15, 0.25, and 0.3.

This experiment does not utilize a multi-objective approach. Instead, the objective was to minimize the sum of the two objective functions.

## 3.2 Results

The model got a optimal objective function value of 494.79. Tables 4 and 5 shows the routes of each vehicle:

| Departure Time | Departure Node | Destination Node |
|---|---|---|
| 1 | 6 | 1 |
| 3 | 1 | 2 |
| 7 | 2 | 3 |
| 12 | 3 | 4 |
| 17 | 4 | 5 |
| 22 | 5 | 9 |
| 24 | 9 | 6 |

Table 4: Route for Vehicle 1

| Departure Time | Departure Node | Destination Node |
|---|---|---|
| 1 | 7 | 3 |
| 3 | 3 | 8 |
| 5 | 8 | 4 |
| 9 | 4 | 5 |
| 13 | 5 | 9 |
| 15 | 9 | 1 |
| 16 | 1 | 2 |
| 19 | 2 | 8 |
| 21 | 8 | 3 |
| 23 | 3 | 4 |
| 27 | 4 | 5 |
| 31 | 5 | 9 |
| 33 | 9 | 6 |

Table 5: Route for Vehicle 2

Finally, Figure 1 displays the uncollected wastes in the demand nodes over time.

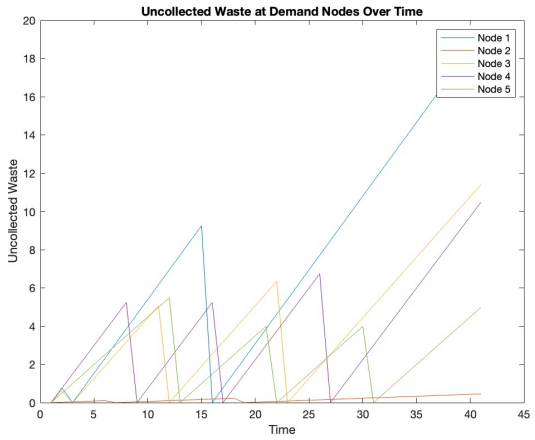


Figure 1: Uncollected Wastes in the Demand Nodes Over Time