Route visualisation

Group 16 – Karl Zhu, Nicholas Whitlock, Minxing Miao, Derek Long

1. Visualisation

In order to visualise the model, we generated two different sets of truck routes for weekdays and Saturdays – there is no demand on Sunday.

1.1 Weekday:

Figure 1. A map of truck routes during weekdays. The black line represents Mainfreight truck routes and the coloured line indicate the routes of Foodstuff trucks.

The map in Fig. 1 shows the optimal solution for Foodstuffs and Mainfreight truck routes during weekdays. In general, we see that Mainfreight truck routes are longer than Foodstuffs trucks routes. Interestingly, Foodstuffs truck routes did not extend to stores/nodes in far northern, eastern or southern areas in our optimal solution. These were left for Mainfreight trucks.

Figure 2. A map of Foodstuffs truck routes (left) and a map of Mainfreight truck routes (right).

1.1 Saturday:

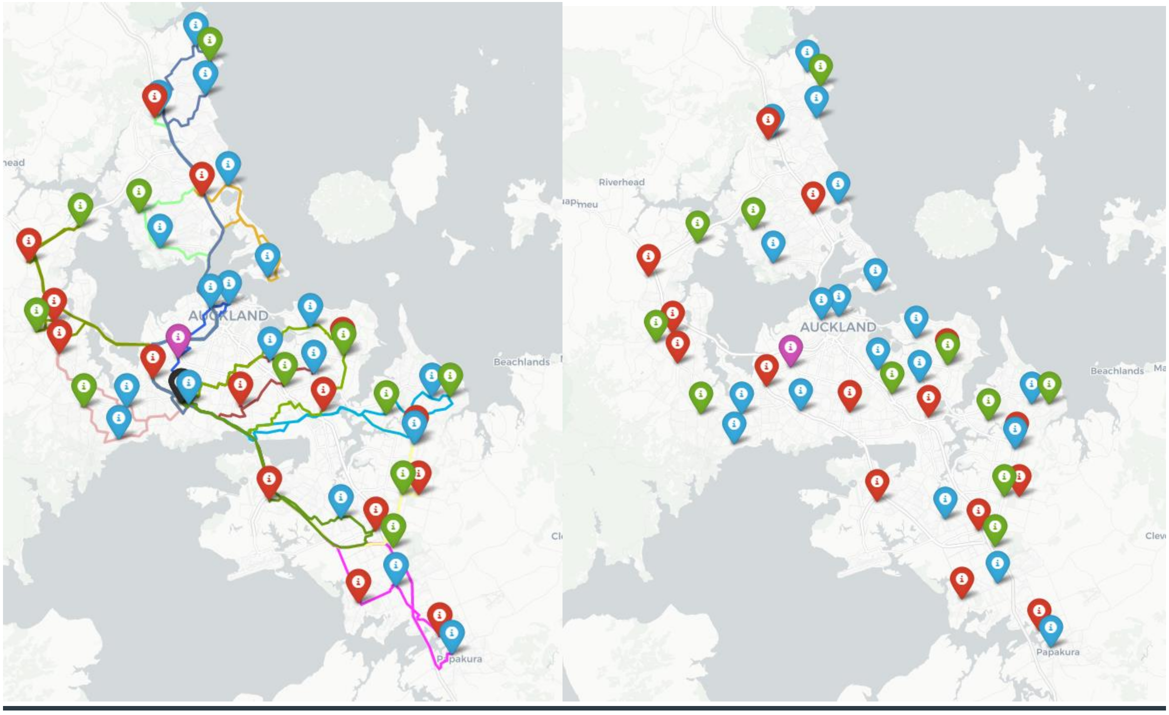

Figure 3. A map of Foodstuffs truck routes (left) and a map of Mainfreight truck routes (right). There are no Mainfreight truck routes on Saturday.

There are no Mainfreight trucks needed for the Saturday solution since the median demand of each store on Saturday is approximately half of that during weekdays. This means that the 10 Foodstuffs trucks, essentially 20 routes, will likely be enough to supply all required demand for each store.

Since it is quite difficult to see the total distance of each route from the previous figures, we have generated 'abstract' maps for both weekdays and Saturday trucks routing. The abstract maps visualise routes between each pair of nodes as a straight line, with each line representing the displacement between two stores. From this we can have a basic idea of the length of each truck route.

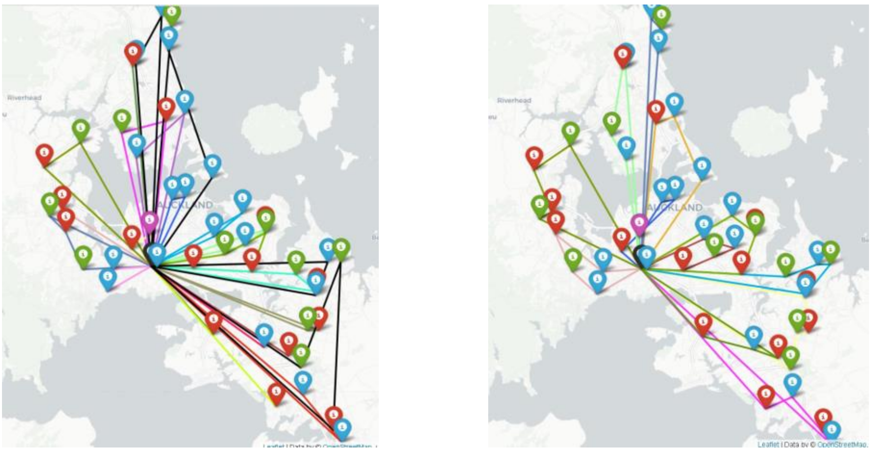

Figure 4. Abstract map for weekday truck routes (left) and one for Saturday truck routes (right).

2. Simulation

We have conducted 500 simulations each for both weekdays routes and Saturday routes to estimate the actual cost of satisfying the pallet demand at each store. The simulation involved random variations in demand by each stores and random fluctuations in traffic conditions.

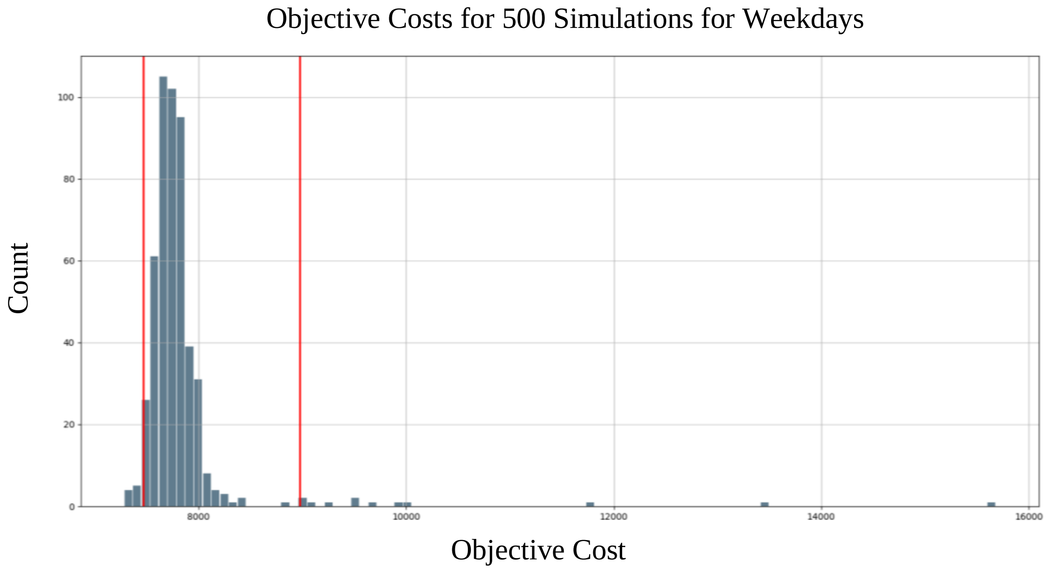

Figure 5. A histogram with the objective costs for 500 simulations for weekdays routes. The red lines represent the edges of the confidence interval.

The median objective cost for our weekday simulation was $7743.38. A 95% confidence interval was constructed and has lower and upper bounds of 7466.3 and 8976.9 respectively. We also see that there are several values having much higher cost than expected. This is likely due to using too many Mainfreight trucks when supplying demand to stores. We expect the high costs to occur roughly 2.5% of the time.

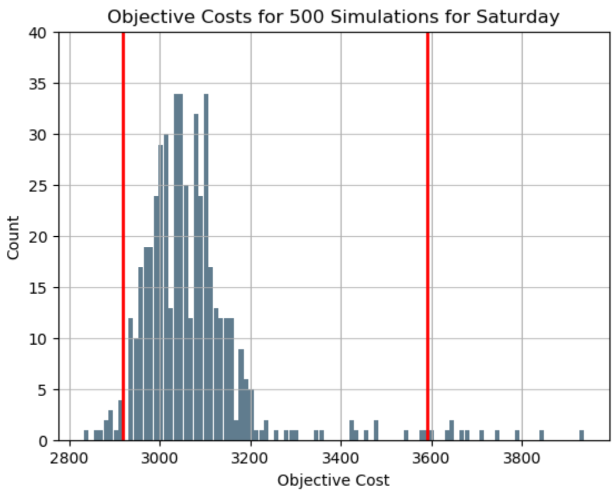

Figure 6. A histogram with the objective costs for 500 simulations for Saturday routes. The red lines represent the edges of the confidence interval.

The median objective cost for our Saturday simulation was $3050.47. A 95% confidence interval was constructed and has lower and upper bounds of 2918.5 and 3591.1 respectively. The upper bound for the confidence interval for Saturday is roughly in the middle of the higher than expected values. Therefore we expect the optimal solution to be wrong around 5% of the time.