As the time-dependent two-echelon truck and drone routing problem is a new extended problem, there is no benchmark instance that exactly fits the problem. This problem is proposed for city logistics, so our test instances also should consider road distances for transportation of the truck. For that matter, we considered Boujnord city, which is the capital of north Khorasan province located in the northwest of Iran. The population of this city is about 320,000, and it is around 36 km2. National Post Company of the Islamic Republic of Iran has approximately 30 carriers for this city, who distribute 1800 parcels per day on an annual average, where the weight of 65 percent of them is below 1 lb, 30 percent of them is around 1 and 3 lbs, and 5 percent of them are heavier than 4 lbs. To prepare a realistic data instance, we randomly selected locations of 300 customers from march 2022 customers and generated a parking station in their vicinity. Using GIS software and a municipal map, road distances for the truck between each pair of parking stations and Euclidean distances for the drone between each couple of customers or customers and parking stations are calculated. In city logistics, for each pair of parking stations, there is more than one road and it would be more practical to consider all of them. Still, our model is not a multigraph problem and only considers one road between each pair of nodes, so we randomly selected one road among all possible roads.

Due to the narrow streets of Bojnourd city, truck speed for the rise of traffic is considered 20 km per hour and for out of the traffic peak it's assumed 40 km per hour. Based on municipal data, there are two major traffic peaks in Boujnord city, once around 8 AM, once around 2 PM, and once around 8 PM.

But considering the same peak traffic for all roads will not help us to demonstrate the performance of the model, so for each city road, we randomly selected an hour between 8 AM and 4 PM for starting and finishing the traffic peak and calculated for each pair of nodes. Similar to (Kyriakakis et al. 2022), we assumed the capacity of the drone to be equal to 5 lbs and converted customers' parcel weight with a coefficient of 1 lb and a maximum of 5 lbs. For example; a real parcel with a weight of 0.8 lbs is converted to 1 lb, and a real parcel with a weight of 4.4 lbs is converted to 5 lbs.

Nowadays, delivery drones can even fly at speeds more than 100 km per hour. Still, similar to (Pina-Pardo et al. 2021), we consider the drone speed equal to 60 km/ hr, which is equal to (16.6 m/s). Raj and Murray (2020) presented a comparison of the flight range of a drone with different payloads and speeds, where a drone with a speed of 16.6 m/s with a payload of 5 lbs can fly 10000 meters, and it can fly more than 20000 meters with a payload of 3 lbs. Considering this, we assumed the flight range to be 15000 meters for all drone routs. In this paper, we assumed the drone sight radius is 1000 meters. Similar to (Murray and Raj 2020) we assumed 60 seconds for drone launch time, and 60 seconds for drone service time. We also assumed that drone recovery time for the next flight is equal to 120 seconds, which is mostly for landing and battery replacement.

Due to confidentiality of customers locations, we are not allowed to share UTM of their location, so we eliminated that, and just share the parameters needed in the model. In this data, each instance folder is demonstrated with three numbers. For example, 3.7.2 is an instance with 3 first class customers, 7 second class customers and 2 parking stations. The name of excel files for each instance is defined in following table:

|  |  |
| --- | --- |
| Customer-list | List of all customers included their demand |
| Customer-list1 | List of first-class customers included their demand |
| Customer-list2 | List of second-class customers included their demand |
| d-matrix-cc2 | Spatial distance among second-class customers |
| d-matrix-cp2 | Spatial distance among second-class customers and parking stations |
| r-matrix-c1p | Road distance of first class-customers and parking stations |
| r-matrix-pp | Road distance of parking stations |
| r-list-dp | Road distance of parking stations and depot |
| L2-list-dp | Starting time of traffic from depot to parking stations |
| L2-list-pd | Starting time of traffic from parking stations to the depot |
| L2-matrix-pp | Starting time of traffic among parking stations |