Topics in Optimization Competition

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Problem Statement: Your company dominates the market of deliveries of small packages to home consumers in Portugal, and it currently needs to increase its capacity of distribution. For that purpose, the company will position its distribution centers (DCs) in strategic places, with the objective of minimizing total delivery costs. Each town in Portugal (characterized by its latitude and longitude) is potentially a location for a distribution center. The cost of opening a DC is 25000 euros, and due to logistic reasons, the maximum number of DCs that the company can afford to open is 20.

In continental Portugal, the forecasts for the number of daily deliveries in each town are 0.2 deliveries per thousand inhabitants (rounded up to an integer). For each delivery, consider a cost of 1 euro per kilometer. Consider that distance can be approximated by the L1 norm: the sum of the distance along a meridian plus the distance along a parallel of latitude (the so-called Manhattan distance). Consider the Earth as a sphere with a radius of 6371.009 km.

Your objective is to minimize the total cost of distribution.

Harder variant: Besides deciding where to place the distribution centers, you are also in charge of planning the route for delivering these packages. Each distribution center can have up to 20 vans, each with an associated cost of 2500 euros. Assume that the van travels at a constant speed of 100 kilometers per hour, and has a maximum capacity of 300 items. The objective remains the same, minimize the cost of delivering all the packages. If an instance is infeasible, minimize the number of packages that have to be delayed. The time it takes to detect infeasibility should be included in the solving time. (This problem is quite a bit harder, it's just for fun).

For data concerning the towns considered and the respective population, see the annexed file PopulationContPT-2020.csv.

Your code will be tested by me on randomly sampled subsets of cities in the above csv.

The competition is divided into two streams.

The **exact** stream, where the objective is to find the best solution. This stream will be graded in accordance with the time it takes to find an optimal solution. Non-optimal solutions will be penalized.

The **heuristic** stream, where PySCIPOpt, if used, can only be used to solve linear relaxations. This stream will be graded in accordance with the quality of its objective value, with a time limit of 30 minutes.

In both cases, visualization of the obtained solutions can increase the obtained grade (maximum 5% increase).