Métodos de Apoio à Decisão – Assignment 2

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Your company dominates the market of deliveries of small packets 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 yearly 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 1.

In continental Portugal, the forecasts for the number of yearly deliveries in each town are 3 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 radius 6371.009 km.

For data concerning the towns considered and the respective population, see `https://www.dcc.fc.up.pt/~jpp/mad1920/PopulationContPT-2020.csv`.

1. Write a mathematical optimization model for the problem of minimizing the total cost of distribution (total fixed costs and delivery costs, using the Manhattan distances, from the DC to each of the cities. Solve the problem and report the solution obtained. Identify the location of the DC and the town with largest delivery costs.

2. Repeat the previous exercise, but consider that the company may open up to 5 DCs.

Describe all the assumptions you have considered.

Note 1: *depending on your model, the time required for solving the problem may be large. You may use the commercial software AMPL (`https://ampl.com`); a version with a licence for this course is available in `https://www.dcc.fc.up.pt/~jpp/AMPL`.*

Note 2: *the deadline for handing the report is 26/APR. Your report should ideally have 4 pages. Each working group should use the Moodle pages of this class to submit a report and the programs used as tar/zip archive. Please use students code in the name (e.g., up201900001up201900002.tgz).*