IE400 PROJECT
2020-2021 Fall

Deadline: 28.12.2020, 23:59

It is time for Santa to send presents to the well-behaved children! Santa will start his journey from Neverland where there are 30 villages in it. During December, Neverland faces huge snowstorms which slows down the process of delivering gifts. It is your job to help Santa make decisions so that the children can receive their gifts before Christmas. In data.xlsx, you are provided the distance between the villages in kilometers (d). Also, for each road between any two villages, you are given a value between [0,1] which is the probability that the road is out of use due to the snow (p).

(a) Huge snowstorms make it impossible for Santa to visit all the villages by himself in a short time because there are millions of well-behaved children in the world. Therefore, he decides to choose only 4 centers among these 30 villages to leave the gifts so that the parents can walk to the closest one of these centers to receive the gifts for their children. Construct a model that chooses the 4 centers while minimizing the longest distance that a parent should walk.

(b) Santa decides to consider the availability of the roads, because the parents may be stuck in the snow while walking. This time, Santa wants to choose the 4 centers considering that the parents from other villages can walk to a center only if the probability that the road is out of use is less than 0.60. (Again, Santa wants to minimize the longest distance that a parent walks.)

(c) Suppose Santa decides to make an exception for Neverland and visit all villages by himself with his new snowplow. The snowplow travels with an average speed of 40 km/h. Suppose Santa is currently at village 1 (node 1 of data.xlsx) and he does not want to use the roads where the probability that the road is out of use is greater than 0.60. Construct a model that minimizes the time it takes for Santa to visit all the villages and turn back to his initial position.

(d) Some volunteers realize that Santa needs help. While Santa visits other districts on the globe, these volunteers can visit the villages of Neverland with their own snowplows and give gifts to the children (the speed of the snowplows are identical with an average of 40km/h) . Suppose that the volunteers are currently at village 1 (node 1 of data.xlsx). Santa wants every village to be visited and puts a time limit (10 hours) for the volunteers to turn back to their initial positions. How many volunteers should help Santa so that every village is visited?

(1) Formulate the models in each part separately.

(2) Solve the models using CPLEX or any other solver (Xpress, GAMS etc.)

(3) Prepare a written document including your precise mathematical models. Explain your objective values, constraints, decision variables and parameters explicitly.

(4) Submit your report (including members full names and ID's) as well as your CPLEX model (or your choice of solver) and **all of your codes** as a .zip file to *irem.keskin@bilkent.edu.tr*. The name of the .zip file should be your **group number** (Do not add names, ID's etc. to the file name).

(5) You will have an oral exam where you will be asked random questions about the project. (**We will run your code for our data as well, so your models and codes should work for any input**.)