INDR 460 HOMEWORK-3

(Due at beginning of the class on 26 March)

EDISON is a California based electric vehicle (EV) manufacturer, who wants to establish its own fast charging infrastructure to promote the sales of its new cars. As an initial step, EDISON plans to establish p number of fast charging stations in California to cover long range trips of EVs which has a range of 200 miles with a fully charged battery. The company wants to locate its fast charging stations such that it can cover the highest possible percentage of the long range trips within California state.

A recharging demand forecast team of EDISON has determined 51 potential cities between which a nonnegligible amount of EV traffic is expected in the near future. The attached CaliforniaData.xls file includes the following data:

- California highway road network data (Arc Set)
- Set of cities that are expected to be either the origin or the destination of an EV trip (O-D Node Set)
- Expected percentage of EV trips to occur between any given origin destination pair

It is assumed that EV drivers would follow the shortest path to complete their trips, and an EV trip is considered to be covered if at least one of the nodes in the shortest path has a fast charging station installed. All of the nodes in the California road network are candidate locations for the fast charging stations.

Work on groups of **two people** to complete the following tasks. Upload the written answers, code you write to solve the models you develop and the screen outputs for your solutions.

a) Formulate an IP model to find the optimal locations of fast charging stations that maximize the total percentage of the EV flow covered. Code your model in your favorite software and find the optimal fast charging station locations for $p \in \{3, 6, 9, 12, 15\}$. How much of the total EV trips are covered in the optimal solution at each case? Comment on the insights you derive from these results.

b) Now assume that the cost of building a fast charging station depends on its location. The city centers will have a cost of \$300K, if the population is higher than 100.000 and \$200K otherwise. Stations that are built on other nodes (which are not city centers) would just cost \$100K. Describe how you would modify your model in part a to handle this new assumptions. Solve the problem if EDISON has a budget of $B \in \{0.5, 1, 2, 4\}$ million dollars to set up fast charging stations. Comment on how does your solution in part a changes.

c) EDISON wants to find out at least how many recharging stations needed to cover all EV trips. Formulate an MIP model for this variant of the problem and solve it with your favorite solver. Comment on the differences of the solution you get in parts a and c.