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Optimization Final

Summary

1. In p1, the optimal value of maximum flow is 28 for all transactions between 8 nodes.
   In this problem, the important things to keep in mind is to include every passible route and its capacity, and make sure that the total inflow equals to the total out flow. In order to be optimal, our goal is to find the shortest total path by utilizing every possible route.

2. In p2, the optimal value of max flow is 62, and it reaches its optimal level when factor k = 3, and then it stays the same as k increases, so there is no need to consider for any k value that is greater than 3.
3. In p4, the goal is to find the mileage value between each distribution center and the stores each distribution center transports to. In order to achieve this, I first need to find the location for each distribution center and store by combining their latitudes and longitudes, and then get the distances between them by using the "haversine" function. Lastly, I combine the distances with each distribution id and store id.
   In result, I get a table of 3 columns and 208610 rows.
4. In p5, the optimal value of the minimum total cost is $190,282.78 from the sample data. In this problem, I created binary decision variables to decide which stores each distribution is delivering to. The trick to calculate the costs and mileages is to use "sumproduct" function for calculations between matrixes.
5. In p6, the optimal value of the minimum total cost is $190,283. I used the same method as in p5, but the trick is that I created an array for decision variables by using np.array from the numpy package, and also list of lists for mileage and trailers.
6. In p7, the optimal value is: `3.004490264956e+07`. I retrieved data from the database tables in MySQL, but the tricky part is that the data is in tuples, but my model wants list of lists, so I first convert the mileage tuples into list of lists; but there is another issue, I need to make a matrix of 1100*10, but the original one I had was 10*1100, so I did some extra steps to achieve the conversion. Then I did the similar steps to create the mileage matrix. Finally, when all matrixes are successfully done, I used the previous model from p6 to get the optimal value. Lastly, I made a new table of all the dc index for store index if there is a transaction between them, and inserted into MySQL.
7. In p8, I exported data from my distribution schema.
8. In p9, the optimal value of the minimum total cost is: $274,282.78. I created a new matrix to identify the additional cost that should be included in each transaction happened between the distribution centers and stores, by using the "sumif" function, and then use "sumproduct" function to calculate the total additional cost and add it into the total cost.