STOR 415, Fall 2019
Homework Assignment No. 9

For each problem that requires Jupyter-GAMS coding:

- Create an ipynb file with exactly the same name as required in the problem. In the GAMS code, declare variables with names given in the problem. Then, in the last cell of your notebook, write the following codes to display values of all variables (replace "var1", "var2" and "var3" with names of variables in the problem):

  %gams display var1.l, var2.l, var3.l;

  %gams_lst -e

- Download your ipynb file(s) to your local computer, and then submit them on Sakai as attachments to this assignment.

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1. Each year, Data Corporal produces 400 computers in Boston and 300 computers in Raleigh. Los Angeles customers must receive 400 computers, and Austin customers must receive 300 computers. Data Corporal can ship computers from each production city to each demand city directly, or through Chicago. The costs of sending a computer between pairs of cities are shown below.

	To		
From	Chicago	Austin	Los Angeles
Boston	\$80	\$220	\$280
Raleigh	\$100	\$140	\$170
Chicago	-	\$40	\$50

   (a) **Non-coding.** Suppose that no more than 200 computers can be shipped between each pair of cities. Formulate an minimum-cost-network-flow-problem (MCNFP) to minimize the total shipping cost; write down the mathematical formulation including the definition of variables, the objective function and all constraints. Then draw a graph to include all information about the MCNFP.

   (b) **Coding.** Create a Jupyter notebook named *datacorporal.ipynb* to solve the problem formulated in part (a). Display values of all variables. (The optimal value is \$118,000.)

(c) **Non-coding.** Suppose now that the total amount of computers shipped through Chicago cannot exceed 100 (that is, the total amount of computers entering Chicago cannot exceed 100). Formulate the problem as an MCNFP by adding a dummy city next to Chicago. There is no need to write down the mathematical formulation again; simply draw another graph to include all information about the new MCNFP.

(d) **Coding.** In the same file *datacorporal.ipynb*, create another GAMS cell below cells for part (b) with the following code:

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%gams_reset
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Then, create one more cell below it, to solve the problem formulated in part (c). Display values of all variables. (The optimal value is $133,000.)

2. Oilco has oil fields in San Diego and Los Angeles. The San Diego field can produce 500,000 barrels per day, and the Los Angeles field can produce 400,000 barrels per day.

   Oil is sent from the fields to a refinery, in either Dallas or Houston (assume each refinery has unlimited capacity). To refine 100,000 barrels costs \$700 at Dallas and \$900 at Houston.

   Refined oil is shipped to customers in Chicago and New York. Chicago customers require 400,000 barrels per day, and New York customers require 300,000 barrels per day.

   The costs of shipping 100,000 barrels of oil (refined or unrefined) between cities are shown below.

	To(\$)			
From	Dallas	Houston	New York	Chicago
Los Angels	300	110	-	-
San Diego	420	100	-	-
Dallas	-	-	450	550
Houston	-	-	470	530

   (a) **Non-coding.** Formulate an minimum-cost-network-flow-problem (MCNFP) to minimize the total cost of meeting all demands; write down the mathematical formulation including the definition of variables, the objective function and all constraints. Then draw a graph to include all information about the MCNFP.

   (b) **Coding.** Create a Jupyter notebook named *oilco.ipynb* to solve the problem formulated in part (a). Display values of all variables. (The optimal value is \$10,470.)