

### OPRE 6304 Fall 2024 Homework 5 (80 points)

(Homework 5 will be due on Nov 14<sup>th</sup>, Thursday, 11:59pm (CT). Please submit a single PDF write-up including answers to all questions on eLearning, and attach the Excel/R script files to your submission)

1. **Locating DCs for Toy Stores (Adapted from exercise 8.1 in Synder & Shen, 2020) (40 points)** A toy store chain operates 8 retail stores in Texas. The company currently ships all products from a central distribution center (DC) to the stores, but it is considering closing the central DC and instead operating multiple regional DCs that serve the retail stores. It will use the CFLP to determine where to locate DCs. Planners at the company have identified 5 potential cities in which regional DCs may be located. The file toy-stores.xlsx lists the longitude and latitude for all of the locations (stores and DCs), as well as the annual demand (measured in pallets) at each store and the fixed annual location cost at each potential DC location. Using optimization software of your choice, implement the CFLP model and solve it using the data provided. Assume that transportation from DCs to stores costs \$1 *per mile per pallet*, as measured by the [great circle distance](#) between the two locations. Report the optimal cities to locate DCs in, the assignment of stores to the opened DCs, and the optimal total annual cost.
2. **Modifications of CFLP (40 points)** Write a modified formulation of CFLP with the following changes. If you introduce any new notation, define it clearly. Explain your modification in words.
  - (a). (10 points) Shipping each item from a supplier to warehouse  $j$  incurs a unit cost  $\alpha_j$ . (The cost may be different for each  $j$ .)
  - (b). (10 points) Processing each item at warehouse  $j$  incurs a unit cost  $\beta_j$ . (The cost may be different for each  $j$ .)
  - (c). (10 points) There is a fixed cost  $w_{ij}$  to ship items from warehouse  $j$  to customer  $i$ . (The cost is independent of the quantity shipped but may be different for each  $i$  and  $j$ .)
  - (d). (10 points) A fixed capacity-expansion cost  $p_j$  is incurred if the demand served by facility  $j$  exceeds a threshold  $t_j$ . (Hint: you may have to introduce new decision variables to represent whether facility  $j$  needs an expansion.)