**Assignment 1**

Due: By midnight on Thursday, November 14th, via Canvas. Have one person from each group submit one Cohort\_Group#\_HW1.ipynb (e.g., BA1\_Group3\_HW1.ipynb) file to the Assignments area of Canvas, which provides the solutions and discussions for the below problems. Indicate the full names and student numbers of your team members at the top of the notebook.

**1. Loggy Lumber**

Loggy Lumber company has 15 source locations of lumber and 10 market locations they deliver to. They deliver wood by truck or rail (possibly both). Key problem input data is in the file “Loggy\_Lumber\_Data.xlsx.” This includes the annual wood supply at each source location[[1]](#footnote-1), the annual demand at each market location, the unit costs to send wood by truck or rail, and limits of how much wood they can load onto the trains[[2]](#footnote-2).

1. Write out an algebraic formulation of the optimization problem that minimizes the annual cost of meeting the demand at each market location. Instead of writing out the entire full formulation, take the generalized “shortcut” approach discussed in class, which uses indices of sets, summation notation, and reference to parameters, the values of which can be looked up in the input data sheet.
2. Solve the problem using Python and Gurobi. Report the minimum cost achievable, alone with the decisions of how much to send, by which mode (truck or rail), between each source and market location.
3. Provide any high-level observations or managerial take-aways you would communicate to Loggy Lumber’s management when presenting the results of your baseline model to them.
4. Loggy is considering negotiating with the train companies to acquire more space each year for transporting lumber. Perform some analyses to help them prioritize which train routes to try negotiating, and how much they should be willing to pay for more space (the routes with an “X” should remain as an “X”).

**2. Shortest Path**

The file Shorest\_Path.xlsx provides a color-coded map of a region that is 20 km in length and 10 km in width. Each line segment shown represents 1 km of distance between major intersections in this region. The color-coding represents current traffic conditions, with traffic moving at 40 km/hr over green segments, 25 km/hr over orange segments, and 10 km/hr over red segments. For this problem, assume that bi-directional travel is allowed on each road segment, and that the traffic conditions are the same in both directions.

Formulate and solve an optimization problem to construct the “shortest time” routes between my home, at the intersection indicated by “H”, and each of the locations indicated by “A”, “B”, “C”, and “D”. In other words, let me know the minimum time it would take to drive from H to A, and the route to take. Similarly, from H to B, H to C, and H to D.

1. Consider a unit of lumber to represent one million “board feet”, a common measure of lumber volume. [↑](#footnote-ref-1)
2. Because of stiff competition with other logistics companies also contracting with the train companies, there is limited space available on the various train lines for Loggy’s products. On the other hand Loggy owns a large fleet of trucks and has ample space to send things by truck. [↑](#footnote-ref-2)