**[Course Number]**

**[Course Name]**

**Assignment 5: Cyclic Bus Operations**

**Assigned: [Assigned Date]**

**Due: [Due Date]**

# Instructions

This assignment provides you with experience analyzing operations on a single bus route. You should work individually for this assignment. Submit a 2 page report (maximum) answering the 5 questions in class (hard copy). Please upload an Excel spreadsheet showing your calculations to the class website.

# Dataset

Nashville’s transit agency (WeGo) has asked you to conduct an analysis of bus running times on a single route. The data can be found in an Excel spreadsheet on the class website. The spreadsheet includes end-to-end running times for the two directions of a bus route during several weekdays between 7am and 6pm. Only data from workdays is included (i.e. data from weekends and holidays is excluded). In the data file, there are two worksheets (one per direction), each with the time of day that an observed trip started (in decimal hours from midnight[[1]](#footnote-1)) in the first column and the observed trip duration (in minutes) in the second column.

# Questions

1. Calculate the mean, median, minimum, maximum, and 95th percentile running times using all observations of each direction. (You should have two sets of statistics, one per direction.)
2. The cycle time c of a simple route is calculated as follows:

***c = t1 + r1 + t2 + r2***

where t1 and t2 are the running times of directions 1 and 2, respectively, and r1 and r2 are the recovery times of each direction, respectively. The sum of the running time and the recovery time for each direction is referred to as the half cycle time for that direction. The scheduling team at WeGo says that they set the “design running time” to be the median of observed running times and the half cycle time is set to be the 95th percentile of observed running times. Using these rules and your calculations from the previous question, determine the design running time, the half cycle time, and the recovery time for each direction on this route.

1. Using the cycle time (c) from question 2, calculate the number of vehicles (n) required to provide service for a headway (h) of 10 minutes. (Please *round up* to the nearest whole number, since the number of vehicles must be an integer.)
2. Sort the data by time of day. Generate a scatter plot of running times as a function of time of day for each direction. What do you observe? If there are differences, what might be causing them?
3. Now analyze only the midday period (from 9am until 4pm). Determine the design running time (median), the half cycle time (95th percentile), and recovery time for each direction. Then, determine the total cycle time and the number of vehicles to provide to provide service for a headway of 10 minutes. Compare your answer to the number of vehicles calculated in question 3 and discuss any differences.

*Reference: This homework is adapted from Professor Nigel Wilson at MIT.*

1. Decimal Hours to minutes: <https://exceljet.net/formula/time-difference-in-hours-as-decimal-value> [↑](#footnote-ref-1)