Engineering 13300 - HW 13 MA 5
Fall 2021 - Individual Tasks

Guidelines for Tasks 4-5:
Task 4 and 5 are individual tasks. You may seek help from classmates, the instructional team or others but the work you submit should be your own. If you collaborate with others and use information developed together or by someone else, ALWAYS document and reference that material. Each individual is responsible for submitting their own assignment on Gradescope.

Individual Task 4 (of 5) Wabash River Streamflow

Image reference: http://www.wabashriver.net/.

Problem Setup:

The Wabash River Enhancement Corporation (WREC) is creating a strategic plan to develop the Wabash riverfront and needs to understand how the river's flow rate changes as the water level increases. This information will help engineers and designers find safe, durable solutions to enhance both Lafayette and West Lafayette river areas.

The nearest United States Geological Survey (USGS) streamgage to Lafayette is located at the Brown Street Bridge, which is gage for the whole Greater Lafayette area. A gage reading of 11 ft indicates minor flood stage - a water level that mainly affects low-lying agricultural land. Moderate flood stage is at 18 ft, which starts to affect usage of North River Road. A major flood would begin at 26 ft.

Continuous measurement of river streamflow is not feasible. So, the USGS measures river height and uses that, along with information about a river's shape, size, slope, and channel roughness, to model streamflow. You have been provided with several months of USGS daily river height measurements and estimated streamflow rate values generated from the USGS model, in a data file named **Data_Wabash_River.csv**. Your task is to create your own model of the relationship between river height and streamflow for this area of the Wabash River, which will allow you to predict streamflow rates given river height.

Problem Steps:

Open the Excel file named **Ma5_ind_*username*.xlsx.** Go to worksheet ***Ind_Task4_Streamflow*** and fill out the appropriate header information. Use this workbook to complete all of your computational work for this problem.

Complete your work in the appropriate section of the sheets. You can add extra columns to a section as needed, but do not change the order of the sections.

The data have been inserted into the spreadsheet for you.

1. Create four plots to visualize how river height affects streamflow. Plot the data using appropriate linear and/or log scaling. Organize your plots on the ***Ind_Task4_Streamflow*** sheet. Be sure to label the plots for technical presentation, paying particular attention to the labels on the x- and y-axes.
    - Plot 1: linear scale on the x- and y-axes
    - Plot 2: log scale on the x-axis, linear scale on the y-axis
    - Plot 3: linear scale on the x-axis, log scale on the y-axis
    - Plot 4: log scale on the x- and y-axes
2. Use the plots to diagnose the type of function that best represents the relationship between the data. On the ***Ind_Task4_Analysis Questions*** sheet of your Excel workbook answer the following
3. Based on your plots of the data using the four different axis scaling options, which type of function do you think best represents the data? Provide a reason for your selection by making reference to the plots and the axes' scaling.
4. In the Linearization section of ***Ind_Task4_Streamflow*** sheet, linearize the data and plot it on linear x- and y- axes scales. Be sure to label the plots for technical presentation, paying particular attention to the labels on the x- and y-axes. This will be Plot 5.
5. Use Excel to add a regression line to the data on Plot 5. Show the trendline equation and r-squared value on the plot. Use clear, appropriate variable names in place of x and y in the equation.

Task files to submit:

- `Ma5_ind_username.xlsx`
- `Ma5_ind_username.pdf` (refer to **ExcelToPDF.pdf** file for instructions to convert .xlsx to .pdf - *Table of Contents > Start Here > Course Specific Tool Documents> Excel to PDF conversion tutorial > ExcelToPDF*)

Individual Task 5 (of 5) Speaker Design Volume Control

Problem Setup:

Designing control systems for electronic devices requires an engineer to understand the relationships between power and device output, such as heat, light, or sound. Many of these relationships are not linear; however, an engineer may want a control system, like a volume knob or a dimmer switch, to produce a linear response that meets the expectations of users.

You and your teammate work for an audio electronics company, which is designing two new speaker prototypes that need volume control systems. The company has collected experimental data in their testing lab for the two prototype designs (Design SPK3 and Design SPK4) and has sent it to you in a file named **Data_speaker_volume_power.csv**.
They need you to determine the relationship between power and volume for each design.

Problem Steps:

1. Open the MATLAB file named **ENGR133_MATLAB_Template.**m and fill out the appropriate header information. Save it as **Ma5_Ind_Task5_*username*.m**. Use proper programming standards to place code in the appropriate sections within the template.
2. Create a figure with 2x2 subplots (i.e. 2 rows and 2 columns) that contain plots of the data on linear, semilogx, semilogy, loglog scales. Each subplot must display the data for both headphone designs. Format the subplots for technical presentation, paying particular attention to the labels on the x- and y-axes.
3. Depending on your version of MATLAB, you may have the `suptitle` and/or `sgtitle` built-in functions. These commands allow you to put one overarching title on the figure window or mini titles on each plot, thus permitting you to use short, scale-specific titles on each subplot.
4. Hint: You can also control the font size of all subplot elements by using the *FontSize* property on the current axis (gca) within the set command. For example, the command to use 8-point font on one subplot is `set(gca,'FontSize',8)`.
5. Use the subplots to determine the type of function that best represents the relationship between volume and power. Create an `%ANALYSIS` section beneath the `%OUTPUTS` section in your *.m file and answer the following question in your code using comments:
    - What type of function best represents the relationship between the data? Justify your answer by making reference to the plots and the axes' scaling.

Task 5 files to submit:

- `Ma5_Ind_Task5_`*`username`*`.m`