**Lab 2: Plotting and Graphical Solutions**

**I. Getting Started**

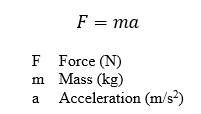
1. ***Save*** this document to your own computer – preferably in that Models I folder you created in recitation last week.
2. As you work through the lab, fill in tables and copy and paste results from MATLAB as needed.
3. Start MATLAB. Make your current folder the Models I folder you created in recitation last week.
4. Create a new script file. At the top of the script file, put the following information (remember % means comments):

% Lab 2: Plotting and Graphical Solutions

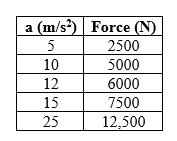
% Your First and Last Name

**II. Newton’s 2nd Law of Motion**

Newton’s 2nd Law of Motion states that the force on an object is equal to the product of the mass of the object and the acceleration of the object.



The table below shows the force on an object with a mass of 500 kg for several different values of acceleration.



In your script file:

1. Add another comment line: % Newton’s Law.
2. Create a vector, a, with the values from the table above for a.
3. Create a vector, F, with the forces from the table above.
4. Use the plot command to plot the data points with the acceleration on the x-axis and force on the y-axis. Use the 3rd argument in the plot command to add formatting so the data points are marked as squares and connected with a dashed black line.
5. Use xlabel, ylabel, and title to label your plot appropriately. Include units in your labels.
6. Run your script and paste the resulting plot in the space below. To copy a plot do the following: in the Figure Window, Click on Edit then Select Copy Figure. Then paste it in the space indicated below. Note: if your Figure Window is docked (happens often with MACs), undock it first.

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1. Copy the commands from your script file used to complete this part and paste them below.

%Newton's Law

clear; clc;

%Acceleration Vector

a = [5 10 12 15 25];

%Force Vector

F = [2500 5000 6000 7500 12500];

%Plot

figure(1)

plot(a,F,'ks--');

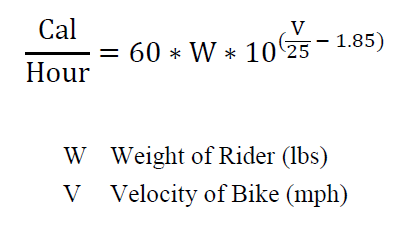
title('\bfRelationship of Force and Acceleration for an Object','FontSize',20);

xlabel('\bfAcceleration (ms^-2)','FontSize',14);

ylabel('\bfForce (N)','FontSize',14);

**III. Calories Burned While Biking**

There are quite a variety of equations around for calculating calories burned during various physical activities. Here is one for biking:



Add the following to your script file:

1. A comment line: % Calories Burned While Biking
2. Create a vector, V, of velocities starting at 3 mph, ending at 20 mph, and incrementing by 0.5 mph.
3. Assuming a rider weight of 125 lbs, calculate the rate at which calories are burned (cal/hr) for each of the velocities in vector V and save the results in a new vector, Rate\_125.
4. Assuming a rider weight of 175 lbs, calculate the rate at which calories are burned (cal/hr) for each of the velocities in vector V and save the results in a new vector, Rate\_175.
5. Use the plot command to create two plots on the same graph. Velocity should be on the x-axis and Rate\_125 and Rate\_175 should be on the y-axis.
6. Add a legend to distinguish between the two graphs.
7. Add labels to the x-axis and y-axis and add a title. Include units in your labels!
8. Use the data cursor tool to determine how many calories/hour are burned for each of the weights at a velocity of 15 mph. Put your answer in the table below.

|  |  |  |
| --- | --- | --- |
| **Velocity (mph)** | **Weight (lbs)** | **Calories/Hr** |
| 15 | 125 | 421.8 |
| 15 | 175 | 590.5 |

1. Paste your plot and your script for this part in the spaces indicated below.

****

%Calories Burned While Biking

clear;

%Velocity Vector

V = 3:0.5:20;

%Weights and Rates

%W = 125

Rate\_125 = 60\*125\*10.^((V\*25.^-1)-1.85);

%W = 175

Rate\_175 = 60\*175\*10.^((V\*25.^-1)-1.85);

%Plot

figure(2)

plot(V,Rate\_125,'rs--',V,Rate\_175,'bs--');

legend('Red -> W=125','Blue -> W=175');

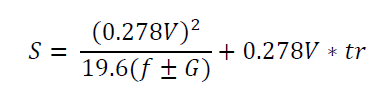
title('\bfCalories Burned While Biking','FontSize',20);

xlabel('\bfVelocity (mph)','FontSize',14);

ylabel('\bfRate of Calorie Burn (Cal/h)','FontSize',14);

**IV. Stopping Sight Distance**

Stopping sight distance is the distance that a driver must be able to see in order to be able to come to a complete stop in the event of a hazard in the road. The equation for stopping sight distance is:



|  |  |
| --- | --- |
| S | Stopping sight distance (m) |
| V | Vehicle speed (km/h) |
| f | Coefficient of friction |
| G | % Grade divided by 100 |
| tr | Reaction time (s) |
| + | Use + for uphill and – for downhill |

Add the following to your script file:

1. Right after your code for the previous part, add a comment line: % Stopping Sight Distance
2. Create the following variables:

* f1 = 0.69 (typical for a dry road and decent tires)
* f2 = 0.4 (typical for a wet road and decent tires)
* G = 0.02
* tr = 2.0

1. Create a vector, V\_mph, that starts at 10, increments by 2.5, and ends at 75. Vector V\_mph is a vector of vehicle speeds in units of mph.
2. Calculate a vector, V, that converts all of the velocity values in vector V\_mph to velocity values in the units of km/h.
3. Assume the driver is going downhill and the road is dry. Calculate the stopping sight distance for each of the values in vector, V, and save them in a vector called S\_Dry.
4. Assume the driver is again going downhill but the road is wet. Calculate the stopping sight distance for each of the values in vector, V, and save them in a vector called S\_Wet.
5. Convert the values in S\_Dry from units of meters to units of ft. Do the same for S\_Wet.
6. Plot V\_mph on the x-axis and the stopping distances (in ft.) for dry and wet conditions on the y-axis. Add a legend. Label the x-axis and the y-axis and add a title to your plot. Include units in your labels!
7. Use the data cursor tool to determine the stopping sight distance on a dry road and a wet road assuming a velocity of 60 mph downhill on a 2% grade. Enter the results in the following table:

|  |  |  |
| --- | --- | --- |
| **Velocity (mph)** | **Road Condition** | **Stopping Sight Distance (ft)** |
| 60 | Dry | 32.15 |
| 60 | Wet | 43.04 |

1. Paste your plot and your MATLAB command for this part in the spaces indicated below.

****

%Stopping Sight Distance

clear;

%Given Variables

f1 = 0.69; %dry roads and decent tires

f2 = 0.4; %wet roads and decent tires

G = 0.02;

tr = 2.0;

%Vehicle Speeds Vector (mph)

V\_mph = 10:2.5:75;

%Convert to km/h

V = V\_mph\*1.60934;

%Dry Stopping with V

S\_Dry = (((0.278\*V).^2)\*((19.6\*(f1+G)).^-1))+(0.278\*V\*tr);

%Wet Stopping with V

S\_Wet = (((0.278\*V).^2)\*((19.6\*(f2+G)).^-1))+(0.278\*V\*tr);

%Conversion of S\_Dry and S\_Wet from meters to feet

S\_DryFeet = S\_Dry\*0.3048;

S\_WetFeet = S\_Wet\*0.3048;

%Plot

figure(3)

plot(V\_mph,S\_DryFeet,'rs--',V\_mph,S\_WetFeet,'bs--');

legend('Red -> Dry','Blue - > Wet');

title('\bfStopping Distance in Varrying Conditions','FontSize',20);

xlabel('\bfVehicle Speed (mph)','FontSize',14);

ylabel('\bfStopping Distance (ft)','FontSize',14);

**Submit the following to your section Blackboard site (not the metacourse site) prior to your next recitation section:**

* **Your completed Lab 2 document (this document must be either a Microsoft Word document or a pdf file. Do not submit in any other format.**
* **Your script (.m) file**
* **Both files can be submitted in a single submission in Blackboard.**