Assignment 5: VBA Programming and Excel Macros

Date Due: February 24, 2023   Instructor: Trani

Problem 1

Use three bus equipment files (see example below) provided to answer the following problems.

	A	B	C	D
1	City	Bus Type	Miles	Route length
2	San Francisco	Orion V	240,893	34.1
3	Los Angeles	New Flyer 40/60LF	152,458	23.0
4	Los Angeles	GMC RTS II	136,201	14.4
5	Oakland	GMC RTS II	396,545	16.3
6	New York	New Flyer 40/60LF	314,789	33.0
7	New York	New Flyer 40/60LF	397,850	31.7
8	New York	GMC RTS II	281,388	10.9
9	New York	GMC RTS II	150,636	22.2
10	San Francisco	GMC RTS II	303,616	16.5

Record a Macro to do the following tasks in the **bus company file 1**.

1. Add your name to the file in cell F2.

2. Add the time stamp and date to the file in cell F3.

3. Change the color in the header row of the file to light blue.

4. Format individual columns with numerical data (i.e., last two columns) using conditional formats using the color scales (green = lowest value, red - highest value).

5. Change the number of significant figures to the right of the decimal point to zero for the miles of the equipment and two decimal places for the route lengths.

6. Create a pivot table to count the bus equipment by type and city (two dimensional pivot table).

7. Create a second pivot table to take the average number of miles of bus equipment by type and city (two dimensional pivot table).

8. Create a pivot chart to plot the average route length by bus equipment and city.

9. Record the macro and show me with a screen capture the top 20 lines of the macro created.

Problem 2

This is a follow-up problem using the Excel macro created in Problem 1. Include screen captures to show your answers.

1. Apply the macro created in the first file to the bus company files 2 and 3. Show a screen capture the first 20 rows of each file to demonstrate that the macro worked correctly.

2. Find the average route length for buses New Flyer 40/60LFA operated in Los Angeles. Highlight your answer in yellow in the pivot table.

3. How many buses of type Van Hol AG500 are operated in San Francisco? Highlight your answer in yellow in the pivot table.

4. Find the average number of miles of Orion V operated in Boston. Highlight your answer in yellow in the pivot table.

5. Find the average route length of GMC RTS II buses operated in Denver. Highlight your answer in yellow in the pivot table.

6. Find the city with the highest route length. Highlight your answer in yellow in the pivot table.

Problem 3

Civil engineers are involved in planning and design of rail systems that move freight. A simple approximation to estimate the total rail resistance (including friction and aerodynamic) is:

$$R_{total} = 0.6 + 20/w + 0.01V + KV^2/(wn)$$

Where:

R_{total} is the total resistance measured in lbs/ton

w is the weight of car per axle (ton)

n is the number of axles per car

K is the aerodynamic coefficient

V is the train speed (in miles per hour)

Create VBA code using subroutines to do the following tasks.

1. Create a VBA subroutine to estimate the train resistance R_{total} (output) given parameter values w, n, K, and V. Your Excel spreadsheet should include cells to specify the values of w, n, K, and V. The Excel spreadsheet should include a drop-down list (see CRB example discussed in class) that selects the value of the aerodynamic K according to the table shown below.

Type of Train	Aerodynamic Coefficient (dim)
Regular trains	0.07
Container trains	0.0935
Truck trailers	0.16

2. Test the VBA code to estimate the train resistance (lbs/ton) using the following values;

V = 55;   % mile per hour

K of Container trains;

$n = 4;$ % train with four axles

$w = 18;$ % 18 tons per axle

3.   Improve the VBA code by adding a For-Loop to estimate the train resistance (in lbs/ton) for speeds ranging from 0 to 70 miles per hour. The code should produce a table of train resistances at steps of 5 miles per hour. Write code to send the results of the For-loop to the Excel spreadsheet.

4.   Add a form control to allow the user of the Excel spreadsheet to select the step size used in the calculations inside the loop. Allow step sizes of 1, 5, and 10 mile per hour increments.

5.   Add a second for control (combo box) to allow the user to specify the maximum speed (V) used in the For-loop calculation. Allowable maximum speeds are 10, 20, 30, 40, 50, 60 and 70 mph.

Problem 4

A ballistic pendulum is constructed from a block of wood attached to two vertical cables. The ballistic pendulum is used to measure the speed of a bullet (v_{bullet}) knowing its mass (m_{bullet}) and the vertical displacement of the wood pendulum (h). The equation to estimate the speed of the bullet is:

$$v_{bullet} = (M_{pendulum} + m_{bullet})/m_{bullet}\sqrt{2gh}$$

Where:

v_{bullet} is the bullet speed (m/s)

$M_{pendulum}$ is the mass of the ballistic pendulum (kilograms)

m_{bullet} is the mass of the bullet (kilograms)

g is the gravity constant (9.8 m/s²)

h is vertical distance traveled by the ballistic pendulum (meters)

Create VBA code using subroutine(s) as needed to do the following tasks.

1.   Create a VBA subroutine to estimate the speed of a bullet v_{bullet} (output) given parameter values m_{bullet}, $M_{pendulum}$, h, and g. Your Excel spreadsheet should include cells to specify the values of the input parameters used to estimate v_{bullet} and send the computation results to the Excel spreadsheet.

2.   Test the VBA code using the following values;

$M_{pendulum}$ = 6 kilograms

m_{bullet} = 8.8 grams;

h = 7.1 centimeters;

3.   Improve the VBA code by adding another sub route to calculate the kinetic energy of the bullet (in Joules).

Recall from Physics that:

$$K = 1/2mv_{bullet}^2$$

4. Estimate the kinetic energy of the bullet example in part (3).