Assignment 5: VBA Programming and Excel Macros

Date Due: February 19, 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	Miami	Van Hol AG500	196,639	18.7
3	Miami	New Flyer Xcelsior	423,917	16.0
4	Miami	Volvo 7900	435,355	18.9
5	Atlanta	New Flyer Xcelsior	194,822	16.6
6	Orlando	Volvo 7900	142,574	14.9
7	Charlotte	Volvo 7900	99,315	15.8
8	Miami	New Flyer Xcelsior	251,359	20.1
9	Atlanta	New Flyer Xcelsior	211,559	17.2
10	Miami	Van Hol AG500	237,475	19.7
11	Charlotte	BYD K11M	326,170	18.2
12	Atlanta	Van Hol AG500	359,956	15.4
13	Atlanta	Volvo 7900	220,095	21.8

Figure 1. Bus Inventory Table.

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

1. Add your name to the file in cell E1.
2. Add the time stamp and date to the file in cell E2.
3. Change the cell color in the City column to light green.
4. Independently 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. Create a pivot table to count the Bus Type by city (two dimensional pivot table).
6. Create a second pivot table to take the average number of miles of every bus model (type) by city.
7. Create a pivot chart to plot the average route length by bus equipment and city.
8. Record the macro and show me with a screen capture the top 15 lines of the macro created.
9. Show me the first 20 lines of code created by the macro.

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 15 rows of each file to demonstrate that the macro worked correctly.
2. Find the average number of miles for buses New Flyer Excelsior in the Los Angeles area. Highlight your answer in yellow in the pivot table.
3. How many buses of type BYD K11M are operated in Sacramento? Highlight your answer in yellow in the pivot table.
4. Find the average number of miles of Volvo 7900 operated in San Diego. Highlight your answer in yellow in the pivot table.
5. Find the average route length of every bus model in the bus company files 2 and 3.
6. Find the city with the highest number of miles per bus of type BYD K11M.

Problem 3

A simple formula used in highway engineering to estimate the horizontal radius of a road is:

$$R = \frac{v^2}{g(e+f)}$$

Where:

R is the road horizontal radius (in meters)

v is the road design speed (m/s)

g is the gravitational constant (9.81 m/s^2)

e is the superelevation rate of the road (%/100). For example, a road with a superelevation rate of 0.06 implies the road of inclined at a lateral slope of 0.06 meters for each one meter in horizontal distance.

f is the lateral friction force coefficient developed between the vehicle tires and the pavement.

A) Create a Public Function using VBA to estimate the radius of the curve (R) given the design speed (v) and the superelevation rate (e). The calculation of f is performed inside the Public Function according to the linear regression model using the data in the tale below.

Road Design Speed (m/s)	Lateral Friction Coefficient f (dim)
8.34	0.17
16.70	0.15
25.00	0.12
33.34	0.09

B) Test your function created in VBA doing calculations of the radius of curvature in the spreadsheet using the following values of e and v.

Road Design Speed (m/s)	Road Superelevation Rate (m/m)
15	0.05
20	0.05
30	0.06
15	0.07
25	0.09
30	0.03

C) Use the function created in part (a) to plot radius of the curve versus speed for speeds ranging from 0 to 35 m/s. Assume a constant value of superelevation rate at 0.05. Make a plot in Excel with appropriate labels.

Declare all your variable using Option Explicit.

Problem 4

The equation to estimate the orbital speed of a satellite orbiting the Earth is:

$$v_{orbit} = \sqrt{GM_E/r}$$

where:

v_{orbit} is the orbital speed (in m/s)

G is the gravity constant (6.67×10^{-11}) in N m^2 / kg^2

M_E is the mass of he Earth (5.96×10^{24} kilograms)

r is the radius of the satellite orbit measured from the Earth's center (meters). The average distance from Earth's center to the surface is 6.36×10^6 meters. For example, a satellite orbiting 1,000 kms above the Earth's surface would have an orbital radius of 7.36×10^6 meters (measured from the Earth's center).

$$T = 2\pi\sqrt{\frac{r^3}{GM_E}}$$

where:

T is the orbital period (in seconds)

G is the gravity constant (6.67×10^{-11}) in N m^2 / kg^2

M_E is the mass of he Earth (5.96×10^{24} kilograms)

r is the radius of the satellite orbit measured from the Earth's center (meters).

Create VBA code using a single subroutine to do the following tasks.

1. The subroutine calculates the orbital speed orbital speed and the period of the satellite orbit given the altitude of satellite from the Earth's surface (in kilometers). The subroutine has one input parameter - the altitude of the satellite from the Earth's surface in kilometers and two output arguments (orbital speed and orbital period).

2. The VBA code inside the subroutine handles the conversion from kilometers to meters.
3. Test the VBA code using the following values of satellite orbits:

Satellite Orbital Altitude (kilometers) from the Earth's Surface	Orbit Type
300	Low-Earth Orbit
3,500	Medium-Earth Orbit
10,000	Far-Earth Orbit
25,000	Far-Earth Orbit

4. Improve the VBA code by adding another subroutine to calculate the kinetic energy (K) of the satellite.

$$K = 1/2 m v_{orbit}^2$$

Where:

m is the satellite mass (kilograms)

v_{orbit} is the orbital speed (in m/s)

4. Estimate the kinetic energy of a 200 kg satellite orbiting at distances shown in the previous table. State the units of (K) in your solution.

Declare all your variable using Option Explicit.