California State University Northridge

College of Engineering and Computer Science
Mechanical Engineering Department

Mechanical Engineering 209
Programming for Mechanical Engineers

Spring 2017 Number: 15832 Instructor: Larry Caretto

Third Programming Assignment – Due Thursday, March 16, 11:59 pm[1]

Objective

This assignment introduces the use of if statements to make choices in program logic. You will construct a macro (a sub procedure with no arguments that can be run from the worksheet) to find the roots of a quadratic equation.

Background

The solution of the quadratic equation, $ax^2 + bx + c$, is $x = \left[-b \pm \sqrt{b^2 - 4ac}\,\right]/2a$. This has two real, distinct solutions if $b^2 - 4ac > 0$ and a repeated real root (sometimes called a double root) if $b^2 - 4ac = 0$. If $b^2 - 4ac < 0$, the solution has two roots which are complex conjugates, $-b/2a \pm i\sqrt{4ac - b^2}/2a$, where $i^2 = -1$.

Approach

A computer program that is given values of a, b, and c has to account for other possible outcomes from erroneous input. Your first check should be for non-numeric values of a, b, and c. Use the VBA function IsNumeric, which is true if its argument it numeric, to make sure that the cells for a, b, and c all contain numeric data. This can be done in a VBA statement like the following.

```
If Not IsNumeric(Range("a1").Value) Then
```

If your program finds non-numeric data, it should print a warning message, using the MsgBox function, and use the Exit Sub command to stop execution of the sub. Once you know that you have numeric data, your program will have to check for the following situations:

1. If a = b = c = 0, the result is known as an infinite solution. Any value of x will satisfy the equation.
2. If a = b = 0 and $c \neq 0$, there is no possible solution because the input data are saying that a non-zero value, c, equals zero.
3. If a = 0 and $b \neq 0$ the equation is a linear equation with the solution x = -c/b.
4. After checking for the anomalous situations just listed, you have determine which of the three possibilities in the background section obtains: complex roots, two distinct real roots or a duplicate root.

Exercise

Start with a new workbook. On a worksheet enter a title, "Quadratic Equation Solver", and enter the data labels a, b, and c in three cells in a single column or row. The three cells in the next column (or row) will contain the data.

Below the input cells, create an output region. The first item in this region should be a description of the output situation, which will be one of the following: "a=b=c=0, infinite solutions", "a=b=0, c<>0, no solution", "Linear equation, only one solution", "duplicate real root", "two real roots", or "complex roots". If there is numeric output for the situation, you will have to print that output and some description of what the output means. The table below outlines the information that should be sent to the worksheet in the various situations. (The shaded cells would simply be blank cells.)

[1] It may be submitted by 11:59 pm, Sunday, March 19, with a 30% penalty. No later submissions accepted

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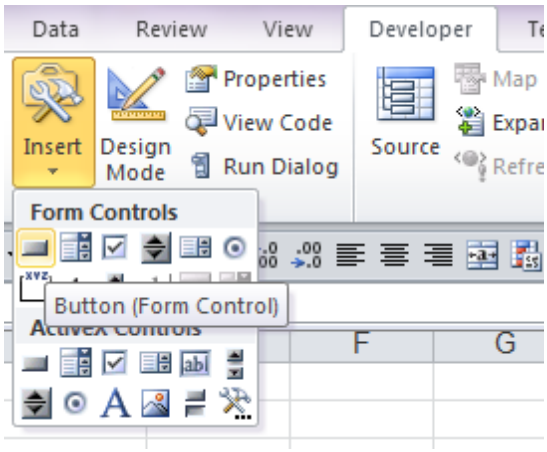
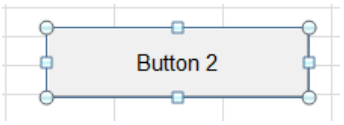
Output Requirements Table				
Description of Result	Output 1 Descriptor	Equation for Output 1	Output 2 Descriptor	Equation for Output 2
a=b=c=0, infinite solutions				
a=b=0, c<>0, no solution				
Linear equation , only one solution	x	-c/b		
Duplicate real root	x	-b/(2a)		
Two real roots	x1	$\frac{-b+\sqrt{b^2-4ac}}{2a}$	x2	$\frac{-b-\sqrt{b^2-4ac}}{2a}$
Complex Roots, real ± i(complex)	Real part	$\frac{-b}{2a}$	Complex part	$\frac{\sqrt{4ac-b^2}}{2a}$

Follow the instructions below, which are a slightly modified version of the ones in the last exercise, to set up a command button to run the macro.

1. Select **Insert** from the Controls group in the **Developer** tab. You will see a menu with **Form Controls** as shown at the right.
2. Select the first control from this menu, the **Button (Form Control)**, by left clicking on the button icon.
3. Move the mouse to the worksheet and note that the icon changes to a cross.
4. Click and drag the mouse to give the shape of the button you desire.
5. As soon as you release the mouse, you should see the **Assign Macro** dialog. The name you gave your macro should appear in "Macro name:" part of that dialog. Select your macro and click **OK**.





After you do this, your command button should look like the figure shown at the left. Note the circles surrounding the outline of the button. So long as these as in place, the button in in the edit mode. **Rename the button from the default name to a more meaningful one (e.g., Solve Equation.)** You can resize it or move it to any other location on the worksheet. When you are ready to use the button, click the mouse anywhere on the worksheet off the button location and the circles will disappear. Now, left-clicking the button will execute the macro you assigned. (If you want to return to the edit mode for the button, simply right-click it.)

Requirements for this assignment

Run your program for all seven (7) sets of input data shown in the table at the right. When you run the macro for a new set of input data, the input and results from the new run overwrite those results from the previous run. To keep a record of your work, you should copy all the input and results from the section used by the macro into another part of the worksheet. When you submit your workbook, it should have the input and results for all cases shown in the table at the right. (You should also test your program to make sure that it identifies non-numeric data.)

a	b	c
3	4	1
3	1	1
1	2	1
1	3	2
0	2	1
0	0	0
0	0	1