SPREADSHEETS MAKE EXCELLENT TOOLS FOR EXPLORING MATHEMATICS: OPTION BUTTONS

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For MS Excel 2003 and earlier, the Control Toolbox Toolbar contains ActiveX Controls, check and text boxes, clickable buttons, option buttons, scrollbars and spin buttons, text and pictures, and combo boxes, providing extended design and additional control options as well as limiting user modifications to the Design Mode. The Forms Toolbar contains
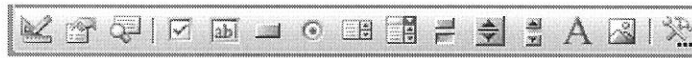

Figure 1 The Control Toolbox Toolbar for MS Excel 2003 and earlier.

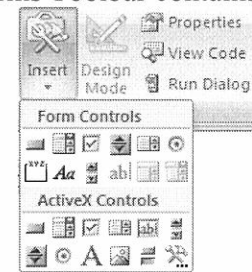Figure 2 The Forms Toolbar for MS Excel 2003 and earlier.

Figure 3 The Forms and ActiveX controls accessed using the Insert button for MS Excel 2007.

similar tools but without color options for versions of MS Excel 2003 and earlier and without the extended control options.

There are some differences for MS Excel 2007. A major difference is the location for the Forms elements and the ActiveX controls: these are displayed on the Developer tab on the ribbon. The Developer tab must be turned on from within the Excel Options. We left-click the Office Button, , to open the main menu and then left-click the Excel Options button. On the Popular tab of the Excel Options dialog box, we check the "Show Developer tab in the Ribbon" option and left-click the Ok button; then, Developer tab is available. The Developer tab provides groups for macros, whether recorded on the sheet or entered using Visual Basic and the controls, both Forms elements and ActiveX controls. The ActiveX controls and Forms elements are accessed using the Insert button.

For all versions of MS Excel, the design mode button, , must be engaged in order to add, modify, and delete ActiveX controls; Forms Toolbar elements can be edited and deleted using a right-click if the worksheet is not protected. For this discussion, we will consider the option button on the Control Toolbox Toolbar.

Suppose we have created a basic tool that allows the user to graph the linear function $y = Ax + B$, Figure 4, and we would like to use option buttons to switch between the linear

function $y = Ax + B$ and the quadratic function $y = Ax^2 + B$. We can use a coupled pair of option buttons to switch between function types and the IF function to change the data and the displayed function equation.

Option buttons, ⊙, operate on a True/False basis: the button deposits the value TRUE into a linked cell if the button is selected and the value FALSE into the linked cell if the button, coupled with another, becomes deselected; a single button remains selected once the button is clicked. Grouping buttons allows them to operate as a unit with only one button "turned on" at a time. To select the Option Button, we left-click the Option Button on the Control Toolbox Toolbar, Figure 1, or among the ActiveX controls displayed after left-clicking the Insert Button, Figure 3. Then, we left-click, hold and drag the cursor on the worksheet to draw the Option Button to the desired size, Figure 5. Releasing the left mouse button, will produce the Option Button, initially named OptionButton1. The selected option button, indicated by the circular handles in Figure 6,
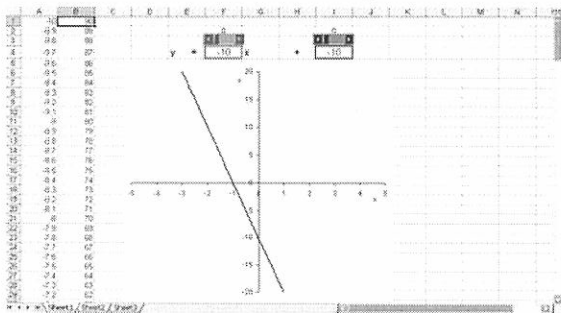

Figure 5 The trace of the Option Button on the worksheet.

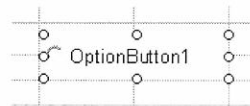Figure 4 Basic tool with scrollbars for coefficients A and B.

Figure 6 The selected Option Button after it is traced on the worksheet.

can be resized by moving the cursor to one of these handles where the cursor will change to a double-headed arrow, left-clicking, holding and dragging the option button the desired size; using a handle at a corner allows us to modify the length and the width of the button simultaneously. In addition to changing the button size by visually, we can modify the size of the button while we set the button properties.

To set the properties for the Option Button, we right-click the button and select Properties on the pop-up menu, or select the Properties button, ▦, on the Control Toolbox Toolbar for MS Excel 2003 or earlier or use the Properties button, Figure 3, for MS Excel 2007.

Using the Properties dialog box, Figure 8, we set the properties of the control: the options are grouped alphabetically on one tab and by category on the other. There are two alignment options, left-alignment, with the text on the left and the button on the right, and right-alignment, with the text on the right and the button on the left; here, we select right-alignment. The BackColor and ForeColor options are used to set the background color for the button and the text color for the button, respectively. To activate the drop-down color menu, we left-click the region to the right of BackColor or ForeColor or simply enter the desired color code between two ampersands, &. Left-clicking the region to the right of the option, next to the color code, opens the color menus: the System colors, Figure 9, are the base grays, white and black, and the Palette colors, Figure 10,

provide other hues. There are two special effects available, the flat button and the sunken button, as well as two back styles, transparent and opaque. We use the caption to change the text displayed on the button. For this button, we change the caption to Linear. Autosize is set to False since we set the size of the button. The TextAlign option can be used to align the text on the button to the left, right, or center. For longer captions, the WordWrap can be set. The font for the caption is set using the Font option. For worksheets containing multiple option buttons, the (Name) property is helpful for identifying the function of controls. Since this worksheet will contain two option buttons
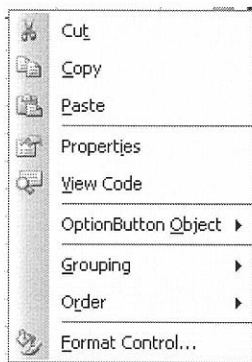

Figure 9 The System colors.

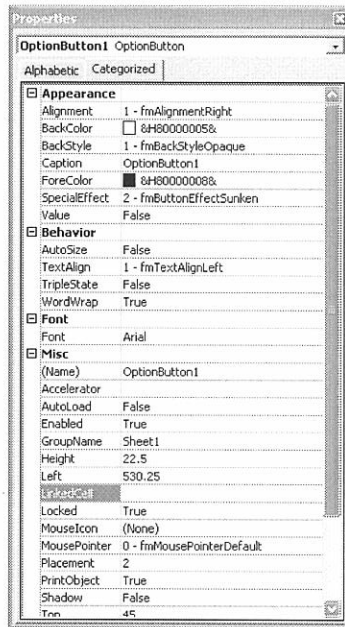Figure 7 The pop-up menu displayed when we right-click OptionButton1 on the worksheet.

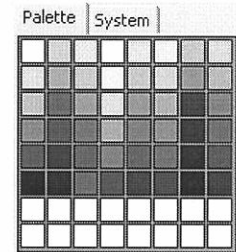Figure 8 The Properties dialog box.

Figure 10 The Palette colors.

we name this option button OptionButton_Lin; we name the other option button OptionButton_Quad; we use the underscore since spaces cannot be used in the names for controls. The height and the width for the button can be fine-tuned using the Height and Width options, respectively, in the Misc category. The LinkedCell is the cell into which the TRUE or FALSE value for the selected or unselected button will be deposited. Here, we use cell L1 as the linked cell; we will use cell L2 as the linked cell for the Quadratic option button. The MouseIcon and MousePointer options can be used to select the cursor icon that will be displayed when the cursor is moved near the button. Left-clicking the section to the right of the MousePointer prompt, opens the MousePointer pull-down menu. We can select one of the mouse pointed listed or select the last option "99 – fmMousePointerCustom" to select our own cursor from the Windows cursors or any cursors that we might have available. Left-clicking the region containing (none) to the right of MouseIcon, produces a button, ⌐, and left-clicking the button allows us to navigate to a folder containing cusors. The Windows folder on the C drive (other name if you have multiple drives or have named your hard drive) contains a Cursors folder from which you can select a variety of Windows cursors. The Shadow option can be used to display a shadowed button. The Visible option can be used to make the button visible or

invisible when the Design Mode has been turned off, and the PrintObject option can be used to make the button printable or unprintable when the worksheet is printed. The Picture option can be used to display a picture on the button in addition to or instead of text; the PicturePosition sets the position of the picture on the button. With the properties for the button set, we close the Properties dialog box and turn off the Design mode by left-clicking the Design Mode button, . Left-clicking the button then enters the value TRUE in cell L1. The option button is turned on once the button is clicked and the button cannot produce the value FALSE unless it is grouped with at least one other button.

We create the Quadratic button in the same manner in which we created the Linear button. Turning on the Design Mode and selecting the Linear button, we can also copy the Linear button to create the Quadratic button with similar properties. We must use a unique linked cell; here, again, we will use cell L2.

Having created the second option button, Figure 12, we see that they work together with only one button being selected at one time and either the value of L1 or L2 being TRUE while the other's value is FALSE. Grouping the buttons allows us to move them together as a unit on the sheet. Turning on the Design Mode, left-clicking one option button and simultaneously pressing the Cntrl button and left-clicking the other option button to select both (indicated by handles around each button, Figure 13) and then right-clicking the selected region, we select the Grouping and Group options on the pop-up menu, Figure 13, to group the buttons; if we later choose to add buttons or to modify the buttons, we can use the Ungroup or Regroup options.

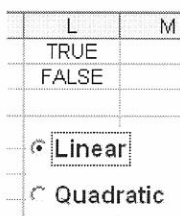Figure 11 Left-clicking OptionButton_Lin.
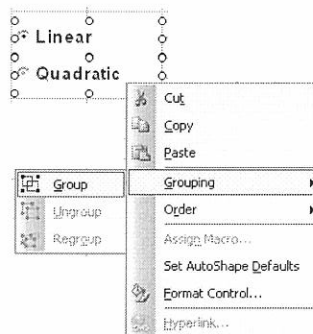
Figure 12 The two Option Buttons.

Figure 13 Grouping the buttons.

Since the buttons work as a unit, we can now use an IF function to change the function that is being graphed from the linear function to the quadratic function, referencing only one of these cells; here, we will reference cell L1. We use "=IF($L$1=TRUE,$F$4*A1+$I$4,$F$4*A1^2+$I$4)" in cell B1 and drag this formula to fill the cells used to generate the y-values for the graph. Since we want to examine L1 as well as use the values of the coefficients stored in cells F4 and I4, the locations for the values for the coefficients A and B, respectively, we must be careful to fix these cells in the formula. For the function equation displayed around the scrollbars, we use the formula "=IF(L1=TRUE,"x","x^2")"; note the use of the quotation marks around the x

and x^2 in the formula and that we do not need to fix the cell for L1 since we are not copying this formula to other cells.
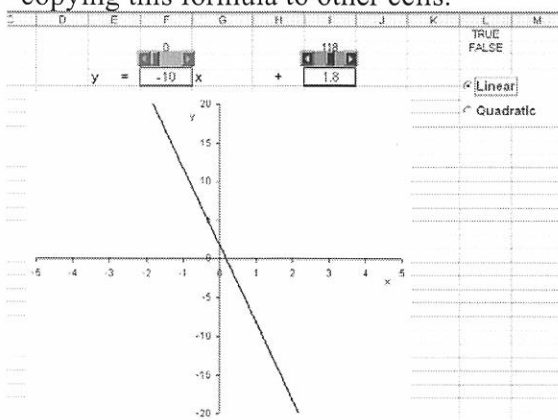

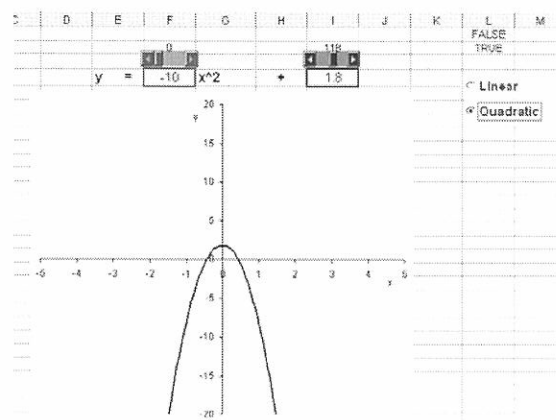Figure 14 The linear function displayed.

Figure 15 The quadratic function displayed.

Figure 14 and Figure 15 display the nearly completed tool with linear and quadratic functions displayed, respectively. To complete the tool, all we need to do is hide any information that we do not want to display, for example the TRUE or FALSE values in cells L1 and L2 and the values for the linked cells for the scrollbars, F2 and I2 as well as the data that is graphed in columns A and B, in the window for the tool as well as provide any desired instructions to the user. We hide the values in columns A and B and cells F2, I2, L1, and L2 by making them the same color as the background of the sheet, here, white and then turn off the grid line. Finally, we delete the unused worksheets and name the sheet(s) that we have used, producing our completed tool in Figure 16.
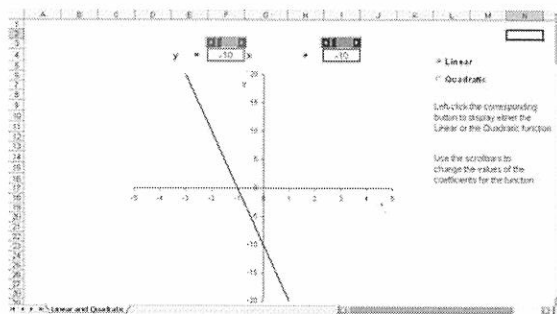

Figure 16 The completed tool.

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As you explore/experiment with creating interactive workbooks, save the workbooks that you create so that you can compare, study, and refer to them in the future – we learn through trial and error, and we can learn a lot by studying our mistakes.

Other elements such as buttons with macros can be added to worksheets, however, due to the page limitation on this paper, these cannot be discussed here. You are welcome to visit my web site, http://www.framingham.edu/faculty/smabrouk to examine additional examples of interactive worksheets. Additional interactive workbooks are available on the Interactive MS Excel Workbooks page and handouts providing instructions on how to create interactive workbooks are available on the Conference Handouts page.

Please feel free to contact me, smabrouk@frc.mass.edu, if you have any questions – I am always glad to help.