CREATING INTERACTIVE WORKBOOKS USING MS EXCEL

Sarah Mabrouk
Framingham State College
100 State Street, P.O. Box 9101, Framingham, MA 01701-9101
smabrouk@frc.mass.edu

MS Excel provides powerful calculation, statistical, graphing, and general data analysis and organizational tools for education, research, and business. When most people think of MS Excel, they think of spreadsheets, statistics, curve fitting, and graphing of data. For scrollbars, buttons, pop-ups, and general computer manipulatives, people think of Java or JavaScript applets. Since most educators do not know Java and JavaScript, they believe that they cannot create interactive workbooks that can be used for demonstrations, student assignments, and concept exploration. While one can create web pages that can be used to display "movies" created using a series of images, in general, the user must watch the preprogrammed sequence, unable to change or to control the variable aspects of the graphs. MS Excel can be used to create interactive workbooks that allow the user to control the variables features of data and graphics using scrollbars and buttons but that do not require the user to know how to use MS Excel. Some of the advantages to using MS Excel are that students can use the workbook without an Internet connection and they do not need any plug-ins to use the workbooks, MS Excel is an available on most college and university campuses, and workbooks corrupted by "play" can be easily replaced. Interactive MS Excel workbooks can be used for demonstrations and assignments, and these workbooks can be designed to include questions, graphs, equations, and explanations with the interactive aspects provided by buttons and scrollbars that can be used for projects.

To create interactive workbooks using MS Excel, you need a basic knowledge of MS Excel, and you can use the Forms Toolbar or the Control Toolbox Toolbar. This basic knowledge of MS Excel includes general data entry and manipulation, use of functions for calculations, and graphing of data. While the Forms Toolbar has many of the same type of control components, the Control Toolbox Toolbar, Figure 1, allows you to have move control over the properties of these components and it allows you to create these components using color; the components created using the Forms Toolbar are limited to shades of gray.

Figure 1: The Control Toolbox Toolbar

To display the Control Toolbox, you can use the Customize dialog box displayed in Figure 2, accessed through Customize on the Tools menu, or Control Toolbox on the Toolbars sub-menu accessed through the View menu displayed in Figure 3. Once you have added the Control Toolbar, you can move it to any position on your screen or place it at the top of your screen with any other toolbars that you ordinarily use. The first button on the toolbar allows you to open and close the design mode. You use the design mode to create and to edit the components generated using the Control Toolbox Toolbar.
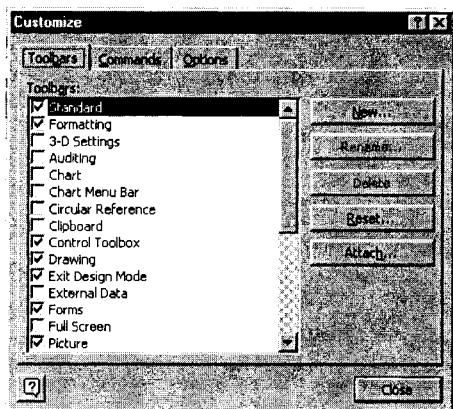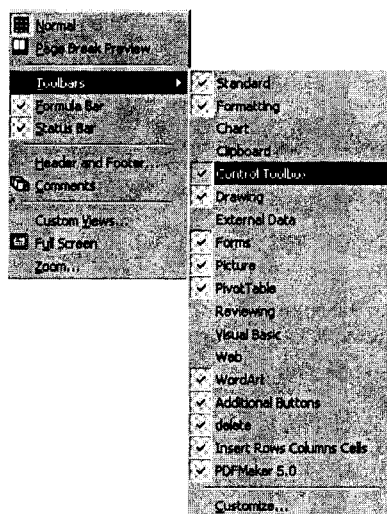
Figure 2: The Customize Dialog Box

Figure 3: The Toolbars submenu access through the View menu.

The second button allow you to view the properties of any selected components on the page of the workbook while the third button allows you to edit the Visual Basic code associated with the components. The next buttons are used to create the check boxes, text boxes, command buttons, option buttons, list boxes, combo boxes, spin buttons, scroll bars, labels, images, and assorted additional controls. The Control Toolbox Toolbar buttons are labeled in Figure 4 below.
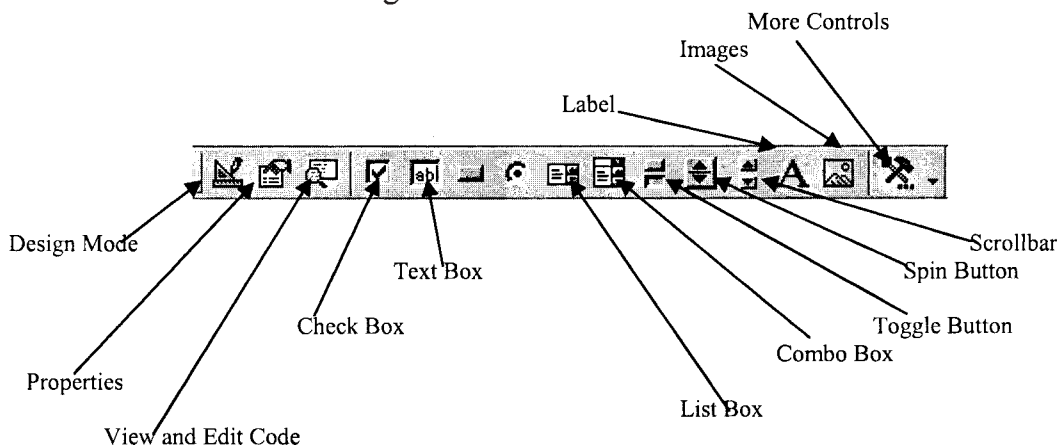

Figure 4: The Control Toolbox Toolbar Elements

Suppose we want to create an interactive workbook that will allow students to explore the slope of the tangent line to a cubic function, the traditional changing of the secant line into a tangent line. To do this, we first must create the graph of the function for our analysis. Here, we will use $y = x^3 - x$ on the interval [-2, 2]. We create the graph, Figure 5, in the same way in which we would create any other MS Excel graph. For this example, let us examine the slope of the tangent line to the graph of the function at x = 1. So, when completed, this tool will allow the user to explore the slope of the secant line as the second point varies as x changes from –2 to 2 in the interval, of course not allowing x to be 1. After adding the point (1, 0) to the graph,, Figure 6, we can add a scrollbar that will allow us to change the x-coordinate of the second point so that this second point varies along the curve. To do this, we enter design mode by left-clicking the Design
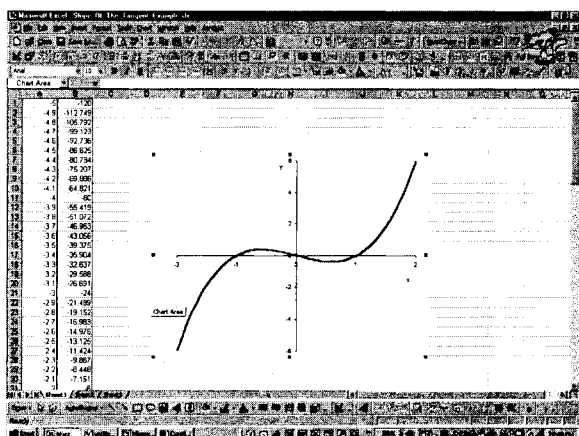
164

Figure 5: The graph and data for a slope of the tangent line analysis for the function $y = x^3 - x$.
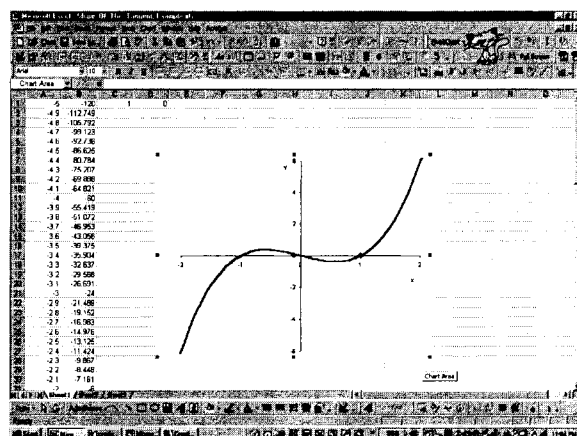

Figure 6: The point (1, 0) added to the graph.

Mode button on the Control Toolbox Toolbar; this is the first button on the Control Toolbox Toolbar as displayed in Figure 4. Then, we select to create a scrollbar by left-clicking the scrollbar button. To create the scrollbar on the worksheet, we left-click the worksheet, hold and drag the cursor to trace the rectangular scrollbar on the worksheet, Figure 7, to the desired size and in the desired direction, vertical or horizontal; we can use the scrollbar properties to control the size of the scrollbar as well. Once you have created the outline of the desired size with the desired orientation, you release the mouse button to generate the scrollbar, Figure 8.
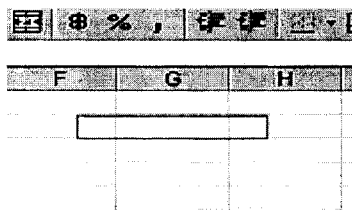

Figure 7: Creating the scrollbar by tracing it on the
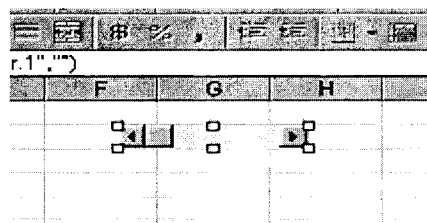

Figure 8: The scrollbar.

Having created the scrollbar, we use the properties to "connect" the scrollbar to a cell, the fixed cell, on the worksheet, to begin to set how the values generated by the scrollbar will change as well as set the limitations of the scrollbar values, and at the same time, we can change the color of the scrollbar as well as the size and orientation of the scrollbar. To change the properties for the scrollbar, we left-click the scrollbar if the handles (the white rectangles/circles at the corners) of the scrollbar are not displayed, and we can left-click the properties button on the Control Toolbox Toolbar or right click the scrollbar and select the Properties on the pop-up menu; either will open the Properties dialog box for the scrollbar. We can edit the properties using the alphabetical or the categorical listing of the properties; here, we will use the categorical listing of the properties. Here, we will use the categorized listing, Figure 9. To change any of these values, we will either left-click to select the property and enter the desire information or we will left-click to open the pull-down menu and select the desired entry.
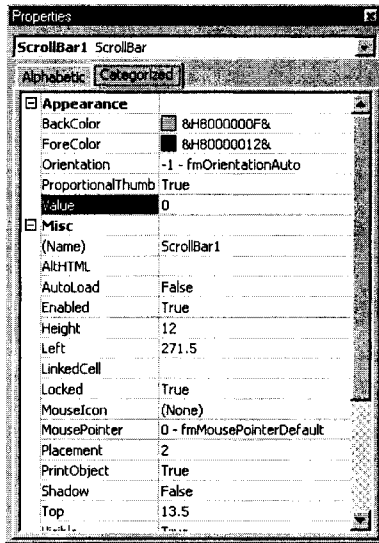
165

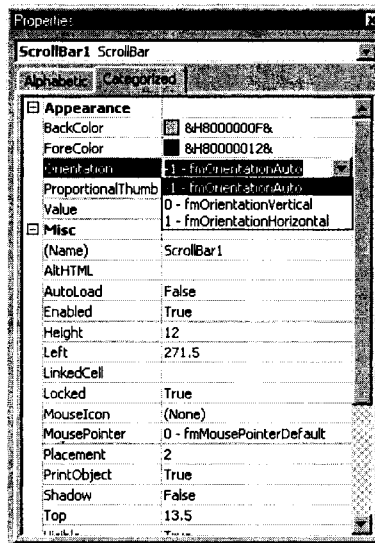**Figure 9**: The Categorized tab of the Properties dialog box.

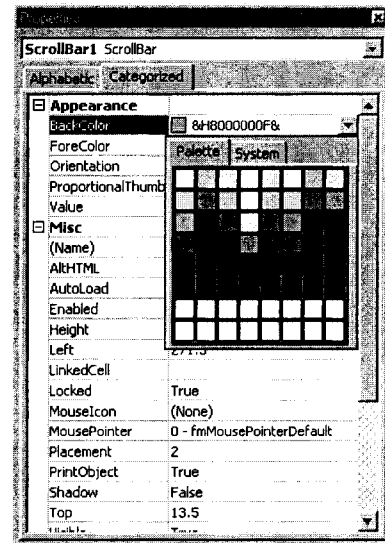**Figure 10**: Changing the orientation for the scrollbar.

Figure 11: Changing the back color for the scrollbar using the pallet tab.

Left-clicking the back color and the fore color entries allows us to select the colors for the scrollbar, Figure 11; if you would like to select colors other than shades of gray then use the Pallet tab as displayed in Figure 11.
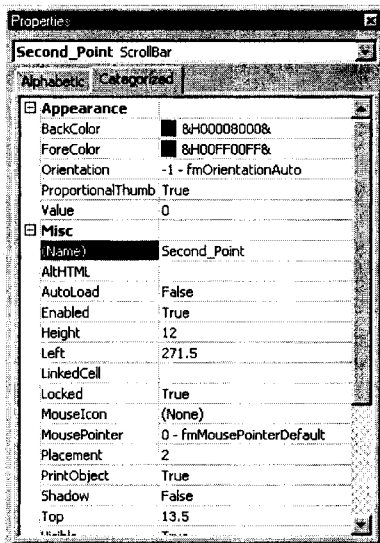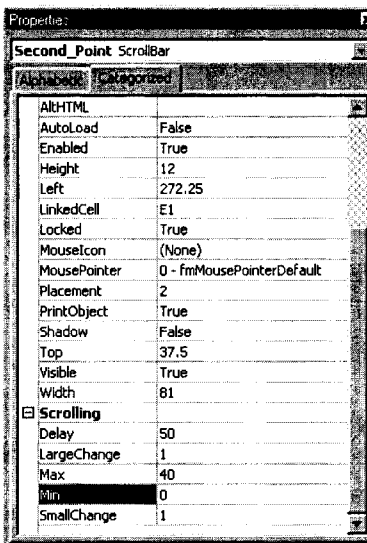

Figure 12: Naming the scrollbar.

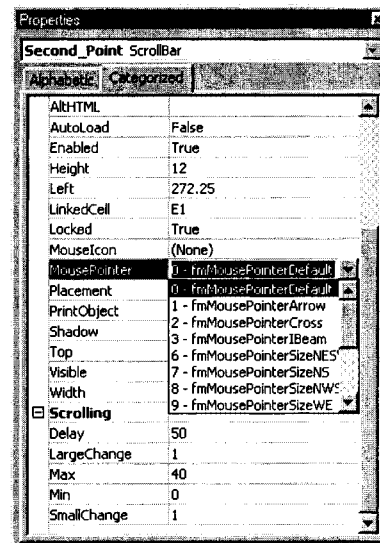**Figure 13**: Setting the linked cell, the maximum value, and the

Figure 14: Changing the pointer.

After selecting these colors, we can name the scrollbar using the Name entry, Figure 12; we left-click and enter the desired name. While it is not necessary to name the objects as you create them, you will find it helpful if you have multiple scrollbars on a worksheet. Next, we set the maximum, minimum, and change values for the scrollbar. These must be positive numbers for which the maximum larger than the minimum and the change value must be a natural number; try using negative numbers for an interesting surprise when you "run" the scrollbar. Here, we select a change of 1, a minimum of 0 and a maximum of 40, Figure 13. We will change these to the desired values using one of the

166

cells. We must also choose a linked cell into which to put the value generated by the scrollbar. You may find it helpful to use a cell near the scrollbar as the linked cell; here, we will use cell E1 as the linked cell. If you would like to change the pointer, you can do that by selecting a pointer on the mouse pointer menu. In addition to the listed pointers, you can select a pointer using the last entry on the menu; for this, you must select a pointer from the available Windows pointers or an image that you have saved on your hard drive.

Once we have set the desired properties, we close the Properties dialog box and exit design mode by left-clicking the design mode button on the toolbar. Then, we examine the values generated by the scrollbar to verify that they vary from 0 to 40 in steps of 1 as set, and create the desired values from -2 to 2 in steps of 0.1 using a formula, $(e1 - 20)/10$, in another cell, G2. We can use similar formulas to allow the values to change using other increments as desired.

Figure 15: Creating the values that range from -2 to 2.

Figure 16: Creating the slope of the tangent line

Figure 17: Create the data to graph the secant line.

Once we have the scrollbar values set, we can format and color the displayed number and use it to create the slope, Figure 16, as well as data with which to graph the secant line.

In Figure 17, we set up the data for the secant line. As with any graph, you can choose how much data to use. Here, we will graph the scrollbar from x = -2.3 to x = 2.3 so that it will be easy to see on the graph for all values. To eliminate the erroneous secant line that is displayed when the points coincide, you can use an If function when you enter the formula for the y-coordinate of the secant line data; to do this simply set the y-coordinate to be a value that is outside the output range of the graph, for example -100. It is important to remember to use appropriate notation, $'s, to keep the scrollbar value and the slope value from changing when you use the automatic fill on the spreadsheet. Having created the data for the secant line, you can add this series to the graph to display the secant line. With the scrollbar complete, we can hide the graph data, and eliminate the grid. To hide the data, we make the background and the font colors the same. Here, we use a white font since the worksheet has a white background. To turn off the grid lines, we select the View tab in the Options dialog box accessed using Options on the Tools menu.

As mentioned, there are other elements that you can add to these worksheets, however, due to page limitation, they cannot be discussed here. You are welcome to visit http://www.framingham.edu/faculty/smabrouk to see additional examples of interactive worksheets on the Interactive MS Excel Workbooks page as well as handouts on how to create these workbooks available on the Conference Handouts page.

167