MS Excel and Winplot Graphing for Instructor Documents and Student Assignments
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Overview: With the convenience of the Internet for posting course documents and the popularity of online courses, instructors need to be able to make readable, comprehensible graphs for course documents, assignments, quizzes, and examinations and students need to be able to make graphs for projects and assignments to be turned in electronically or posted online as part of online presentations. These do not necessitate the use of specialized software: the readily available software MS Excel and the free software Winplot will suffice for graphing for developmental mathematics, college algebra, Precalculus, calculus, and statistics courses.

One consideration in adding elements to MS Word documents is the size of the element. Why do I say "element" as opposed to picture or graphics?   Well, frequently, folks copy and paste elements from software such as MS Excel and paste these elements into documents created using software such as MS Word, for example. While some elements may paste into documents as images of small size such as gif, jpeg, or png images, other elements may not save as images, such as graphs copied directly from MS Excel and pasted directed into MS Word documents; paste special must be used to convert such elements as images/pictures.

Let us explore this aspect of MS Excel by creating MS Word documents into which several MS Excel graphs are directly pasted. Suppose we create a MS Excel workbook that contains one graph and suppose that the size of this workbook is 33 KB as displayed in Figure 1 below. If we select this graph and paste this graph directly into a MS Word document that contains no text, the size of this file will be larger than the original MS Excel file: the file size is 69 KB as displayed in Figure 1. If we save two, three, or four copies of this same graph in a MS Word file, the file size becomes 127 KB, 192 KB, or 250 KB, respectively. Of course, as we add text to this file, the file size increases as well.
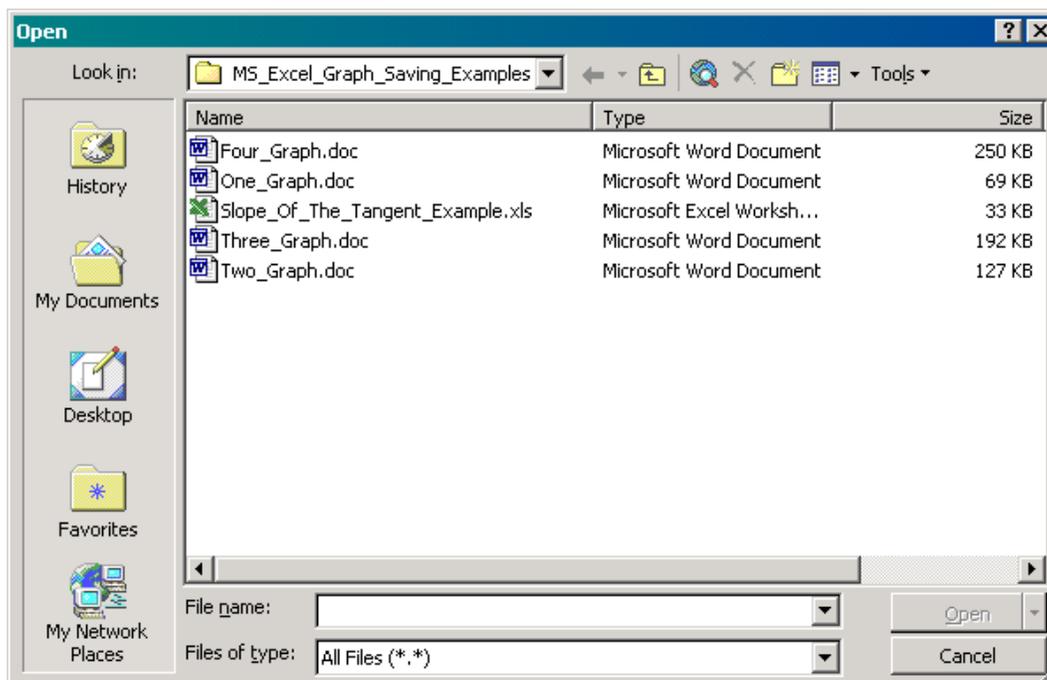

Figure 1: Comparison of file sizes for files containing MS Excel graph elements

If we paste the MS Excel graph elements in the MS Word document using the Paste Special option on the Edit menu and select Picture option in the Paste Special dialog box then the file size for the MS Word document will not be as large as it was when we saved the MS Excel element directly. Examining Figure 2, we see that using the same 33 KB MS Excel file that contains one graph element, copying this graph but using the Paste Special option produces files that are considerably smaller than before: MS Word files containing one, two, three, or four graphs are 24 KB, 27 KB, 30 KB, or 33 KB, respectively.

So, using the Paste Special option to save the MS Excel graph as a picture only increases the file size by 3 KB for each picture added.
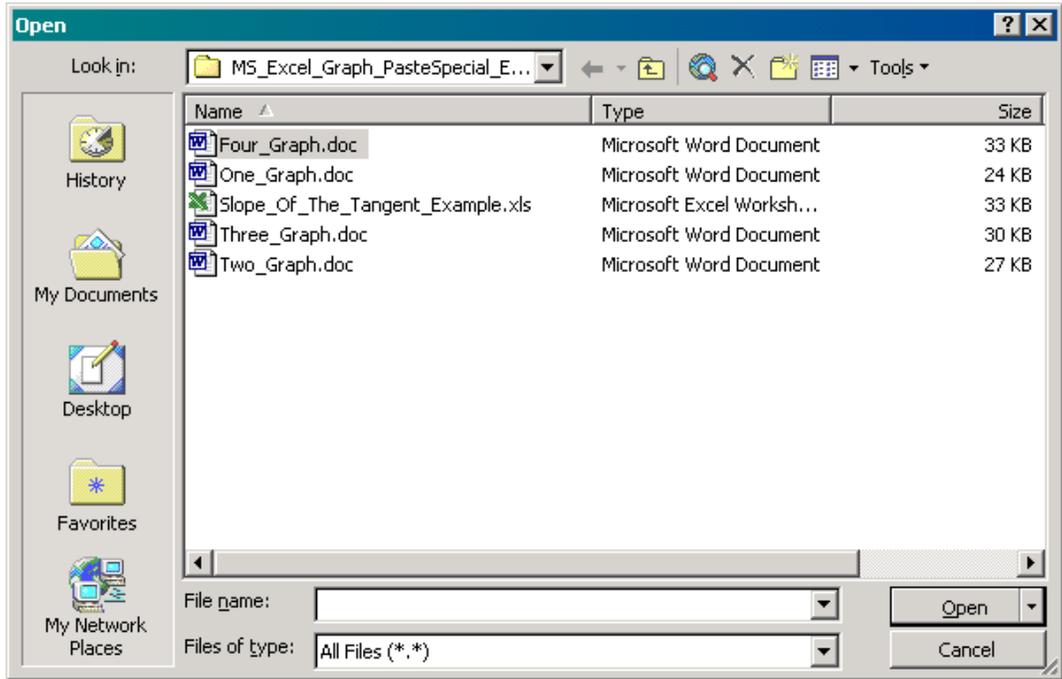
Figure 2: Comparison of file sizes for files containing MS Excel graph elements
pasted using paste special

Why are these so different? They are different because when we copy and paste the MS Excel graph directly into MS Word, we are copying and saving the MS Excel worksheet into the MS Word file as well.
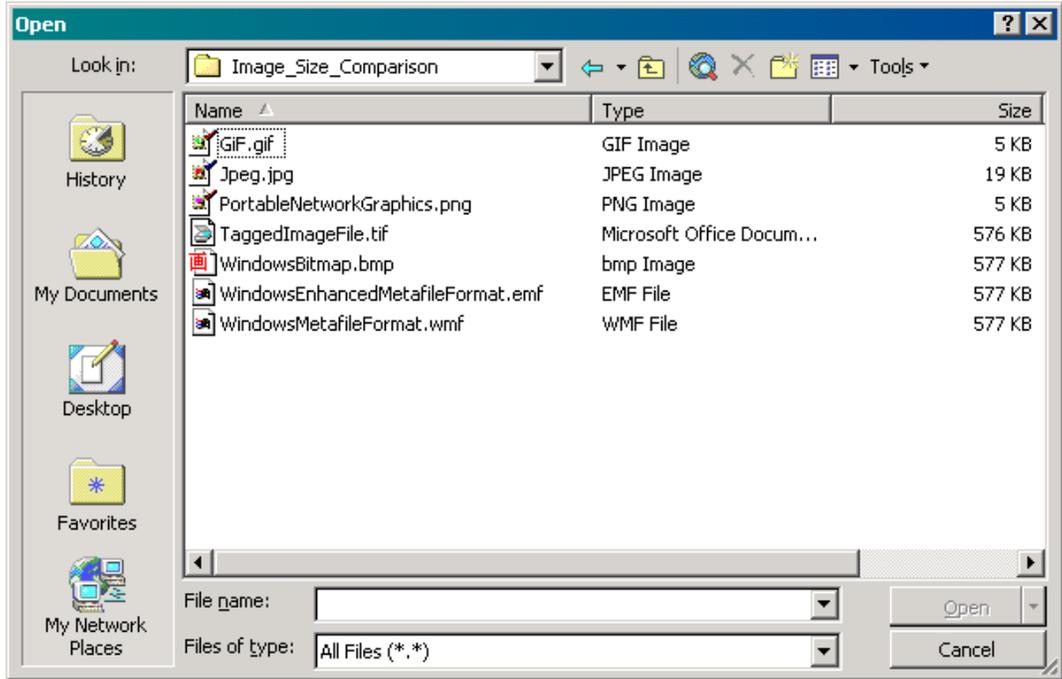

Figure 3: Comparison of file sizes for various image types

Double left-clicking any of the graphs saved into these MS Word files allows us to change the attributes of these graphs and the data used to generate these graphs as well. However, if we use Paste Special, we cannot edit the graph: the graph is saved as an fixed image. So, although using Paste Special does not allow us to edit/update the graph image as we change the original MS Excel file, the MS Word file will not become considerably larger as we include additional graphic elements.

When creating images with other software, whether graphs or images created with graphics software such as Macromedia Fireworks or image capture software such as TechSmith's SnagIT, it is important to consider the file type that we use. File types such as Tagged Image File (tif), Windows Bitmap (bmp), Windows Metafile Format (wmf), and Windows Enhanced Metafile Format (emf) have a very large file size in comparison to graphics saved as JPEG, GIF, and Portable Network Graphics (png) files; these file types are mentioned since file size is important for both print documents and for files posted on the Internet. To compare the sizes of these file types, I used the same image capture software, TechSmith's SnagIT to create a screen capture of a graph created using MS Excel and I saved this graph using each of the file types mentioned above: the file size for these images is displayed in Figure 3. Comparing these images, we see that the GIF and PNG images have a file size of 5 KB and the JPEG image has a file size of 19 KB; these are the smallest, and they are considerably smaller than the rest. The file size for the TIF image is 576 KB while the file size for the BMP, WMF, and EMF images are all 577 KB. Using TIF, BMP, WMF, and EMF images will considerably increase the size of the file into which they are pasted.

So, when using graphics in a MS Word file, or any file in which text and graphics are to be used, we must be careful to consider how the software saves the file since this will affect the size of the document that we create. For software such as MS Excel, it is important to use the Paste Special option in MS Word, especially if we plan to use several graphs created using MS Excel. If we plan to use several images in a print or web document, we should avoid using image files such as BMP, EMF, TIF, and WMF since they will increase the file size greatly in comparison to file types such as GIF, JPEG, and PNG. If we are not familiar with how a particular software creates images then we should test the software in a similar manner to that discussed/illustrated here: create files containing one, two, three, and/or four images created using the software so that the file size can be explored. If the images created with this software are larger than desired, we can use the Paste Special option in MS Word to save the image as a picture just as we can with the MS Excel graph.

So, what about creating graphs using software such as Winplot and pasting these graphs into a MS Word document? Let us explore these by using the Copy to Clipboard option on the File menu in Winplot to copy the graph image onto the Clipboard and then paste the image directly into MS Word, to paste the image as a picture into MS Word, and then to paste the image into MS Word as an enhanced metafile picture. For comparison, we will also create files containing one, two, and three graphs of each type, Figure 4. Using the Copy to Clipboard option on the File menu in Winplot and directly pasting the captured images directly into a MS Word file or doing the same but selecting the Paste Special option on the Edit menu in MS Word and selecting the enhanced metafile picture option in the Paste Special dialog box, we find that a MS Word file containing one, two, or three graphs saved either way has a file size of 49 KB, 78 KB, or 107 KB, respectively. So, using the enhanced metafile picture option in the Paste Special dialog box in MS Word does not affect the file size. However, if we select the picture option

Direct save from Winplot
- One graph: 49 KB
- Two graphs: 78 KB
- Three graphs: 107 KB

Paste Special as enhanced metafile picture
- One graph: 49 KB
- Two graphs: 78 KB
- Three graphs: 107 KB

Paste Special as picture
- One graph: 79 KB
- Two graphs: 139 KB
- Three graphs: 198 KB

rather than the enhanced metafile picture option in the Paste Special dialog box in MS Word then the files sizes are larger: the file sizes for files containing one, two, or three files saved in this manner are 79 KB, 139 KB, or 198 KB, respectively.
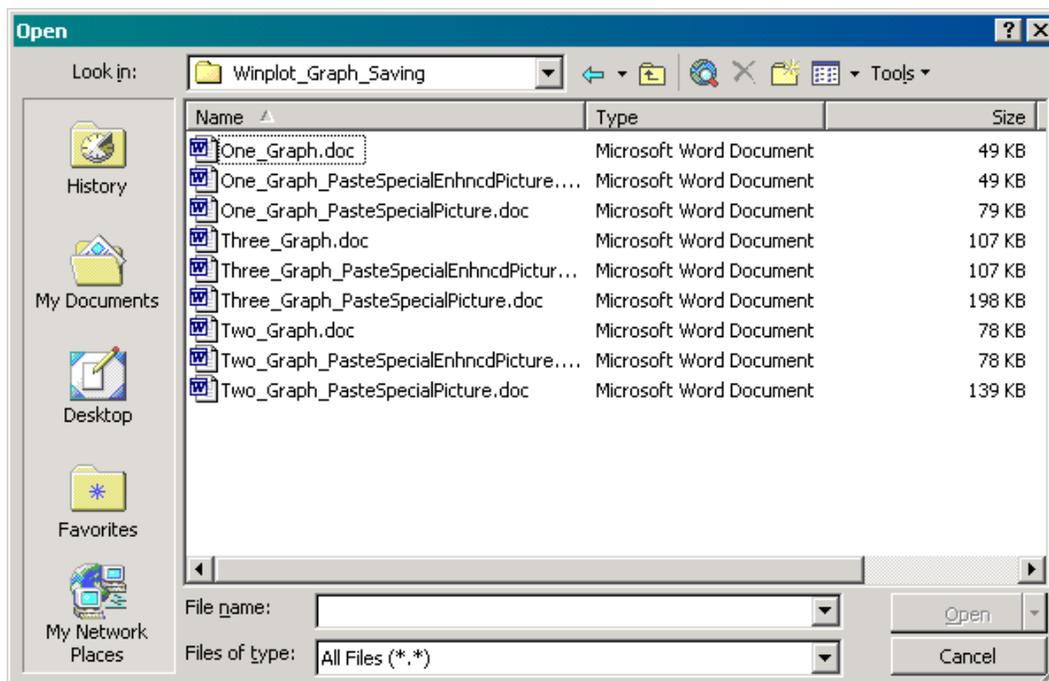
Figure 4: File size comparison for MS Word files containing Winplot graphs

Through this comparison, we see that we can paste graph elements copied from Winplot to the Clipboard directly into a MS Word document: we do not need to use Paste Special. However, it is important to note that the file size for documents containing images created using Winplot is larger than the file size for the document containing images created using MS Excel and pasted into a MS Word document using Paste Special.   Since each software has its advantages and disadvantages in creating graphs for documents, we will find use for each in creating graphs for course documents and assignments.