

## Senior 4 Applied Mathematics 40S Additional Instructions for use of *Winmat*

Please use these instructions with Lesson 5 in Module 1 dealing with Performing Calculations with Matrices Using Technology. These instructions will explain how to use the newest version of the *Winmat* program.

In the first four lessons of this module, you have performed manually calculations with matrices. Now you will learn how to perform these calculations using technology in the form of *Winmat*. *Winmat* is computer freeware that is found on the CD that came with your course. There are many other programs that will do the same, but this course will make use of *Winmat*. Most graphing calculators will also perform these calculations with ease, but, as indicated earlier in this module, the methods involved will be left to you to experiment with.

When using *Winmat*, there are features that you must be aware of in order to perform the required calculations. There are also many features that you will not use unless you were to study matrices beyond this course level.

The process of performing calculations with matrices involves two steps. The first step is to enter the matrices to be calculated, and the second is to perform the required calculations.

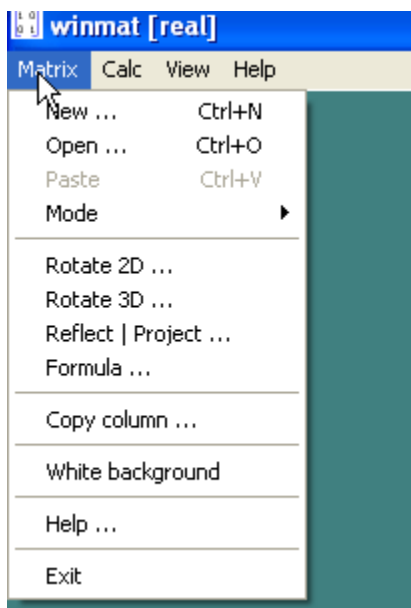
### Entering Matrices

1. Open *Winmat*.

When you first open *Winmat*, a toolbar will appear as follows:

MATRIX CALC          VIEW          HELP

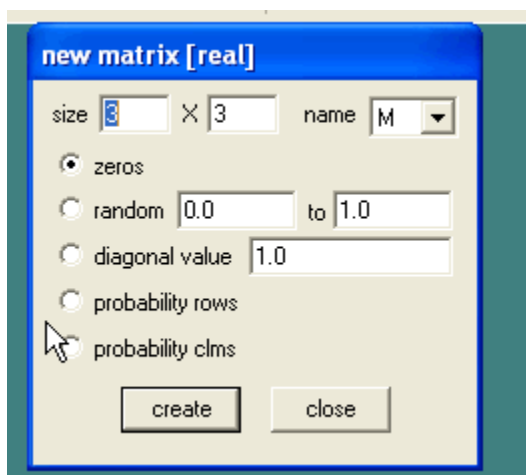
Each menu item has a pull down menu with other options. The Help menu is available for you to use if necessary, but the required features of the program will be discussed here.



Here is a screen shot of the Matrix Menu. To enter a new matrix, you will use the New command.

Note the Mode option. You can set the mode to real, complex or integer. Most matrices for this course will require the real mode. If all the entries in a matrix are integers, you may want to change the mode to integers.

2. Click on New



This menu allows you to set the dimensions of the matrix (row by column), name the matrix, and set the values of the matrix. Since you will be entering predetermined matrices or matrices you have created from an application, you will want to select the zeros option. If for some reason you wanted the program to create matrices randomly for you, you would select Random. However, this feature, along with the others in this menu will not likely be used in this course.

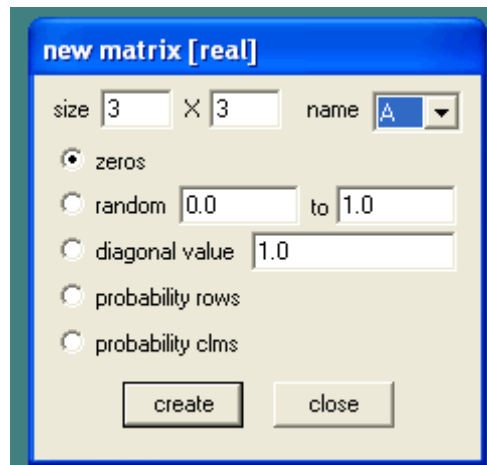
One other menu item found under the Matrix tool may also be used for personal preferences. The White Background feature may be used if you prefer to have all matrices show with a white background for their cells. If not, *Winmat* will colour the backgrounds with a different colour for each matrix entered. This may help keep the matrices organized. If you would like this feature, do not highlight White Background.

3. You are now ready to enter the matrices:

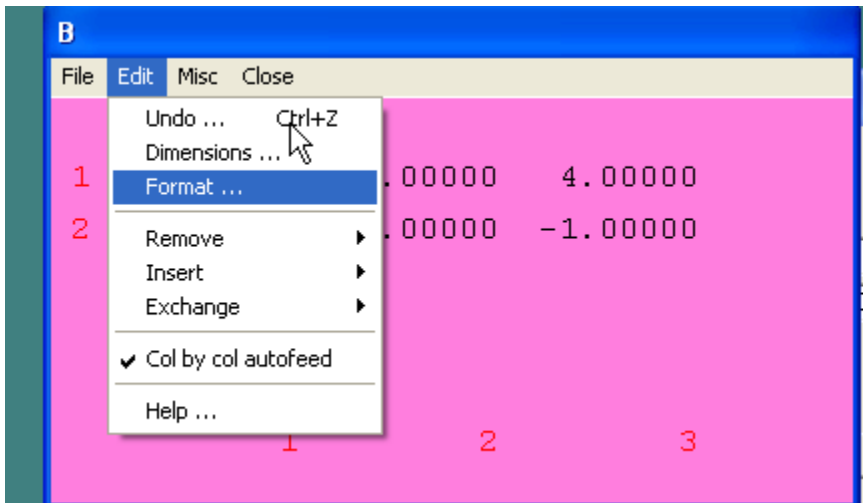
$$A = \begin{bmatrix} 1 & 2 & 1 \\ -3 & 0 & 4 \\ 5 & 3 & 6 \end{bmatrix}; B = \begin{bmatrix} 2 & -3 & 4 \\ 0 & 1 & -1 \end{bmatrix}; C = \begin{bmatrix} 5 & 6 & -2 \\ 3 & -4 & 7 \\ 10 & 8 & -9 \end{bmatrix}$$

Enter Matrix A

1. You may choose to set the mode to Integers since all the entries are integers.
2. Click on New. When the pop-up window comes up, enter 3, 3 for the dimensions, select the letter A for the name and make sure that zeros is selected. Click on Create.



3. A new window opens with a blank matrix. With your cursor on entry  $A_{11}$ , **right click** and then enter 1 and press <Enter>. This will move the cursor automatically to the next row. If you do not right click on the first entry, the cursor will not automatically move to the next entry and you will have to move the cursor and click on the next entry before entering the next value. Watch the order in which *Winmat* automatically enters numbers. You need to go down the rows and then across to the next column. If *Winmat* has gone to the next entry, you should be at  $A_{21}$  so you would enter -3 and press <Enter>. Continue entering the values, watching to make sure *Winmat* and you are looking at the same entries.
4. You may want to format the matrix so you don't have a lot of decimal places. In the matrix window, there is a menu item called Edit. Go to Format and change the decimal places to 0 and the width to at least 3.



Enter Matrix B

1. Go back to the new matrix window and make the changes necessary to create a different matrix. The dimensions will have to change to 2 by 3 and the name will have to change to B. Click on Create when you have made those changes.
2. Repeat step 3 above to enter all cells for Matrix B.

Enter Matrix C

1. Go to the New Matrix window and repeat the steps above.

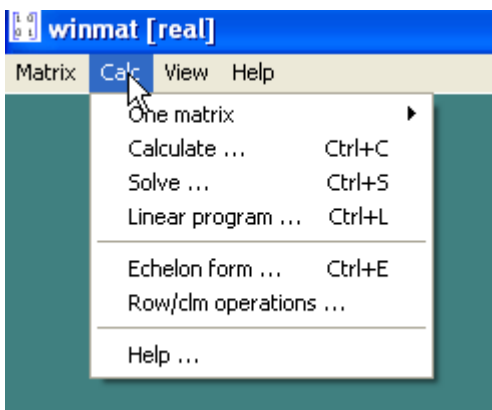
## Performing Calculations

If you were asked to perform calculations with the matrices, you will begin to use the CALC menu.

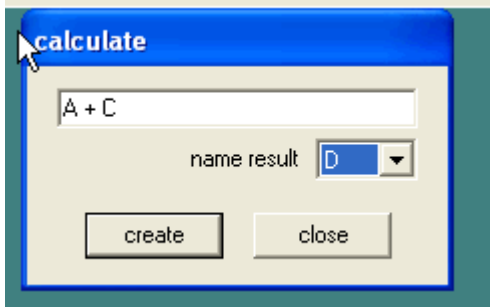
### Example 1

$A + C$

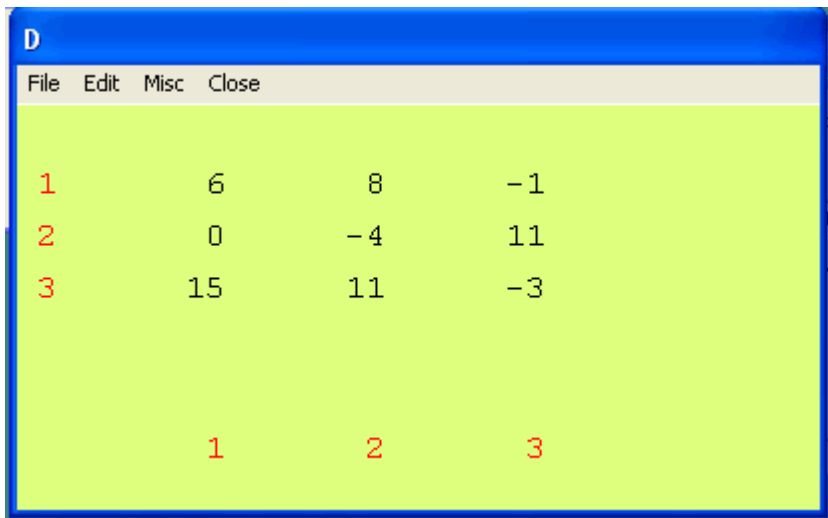
1. Click on CALC



2. Choose Calculate.



3. Enter the formula and select a name for the resulting matrix. When you click on create, the answer will appear in a new matrix window.



Note that the format was changed to 0 decimal places again.

### Example 2

B x A

1. If the Calculate window is still open, return to it and put in the new calculation and choose a new name for the resulting matrix. To do multiplication, you can enter B\*A or BA.

The resulting matrix should be:

$$E = \begin{bmatrix} 31 & 16 & 14 \\ -8 & -3 & -2 \end{bmatrix}$$

**Example 3** $A^2$ 

1. Return to the calculate window and enter  $A^2$  and choose a new name for the resulting matrix.

The resulting matrix should be:

$$F = \begin{bmatrix} 0 & 5 & 15 \\ 17 & 6 & 21 \\ 26 & 28 & 53 \end{bmatrix}$$

**Example 4:** $4C - A$ 

1. Return to the calculate window, enter  $4C-A$  and select  $G$  as the new name for the resulting matrix.

The result should be:

$$G = \begin{bmatrix} 19 & 22 & -9 \\ 15 & -16 & 24 \\ 35 & 29 & -42 \end{bmatrix}$$

**Example 5:** $B^2$ 

When you try this calculation the program responds with:



Since  $B$  is not a square matrix, you cannot multiply it by itself.

**Example 6:** $B + C$ 

When you try this calculation the program responds with:



Since  $B$  and  $C$  do not have the same dimensions, they cannot be added.

Examples 5 and 6 cannot be completed because of dimension problems. *Winmat* will let you know when this occurs if you have not noticed it yourself.

All of the matrices including the answer matrices can be saved. When you try to exit from the program, *Winmat* will ask if you want to save requests. IF you do wish to do the save, you will be prompted once more for a name and a place to save them. You will not likely need to save the matrices very often in this course, but the option is there if necessary.