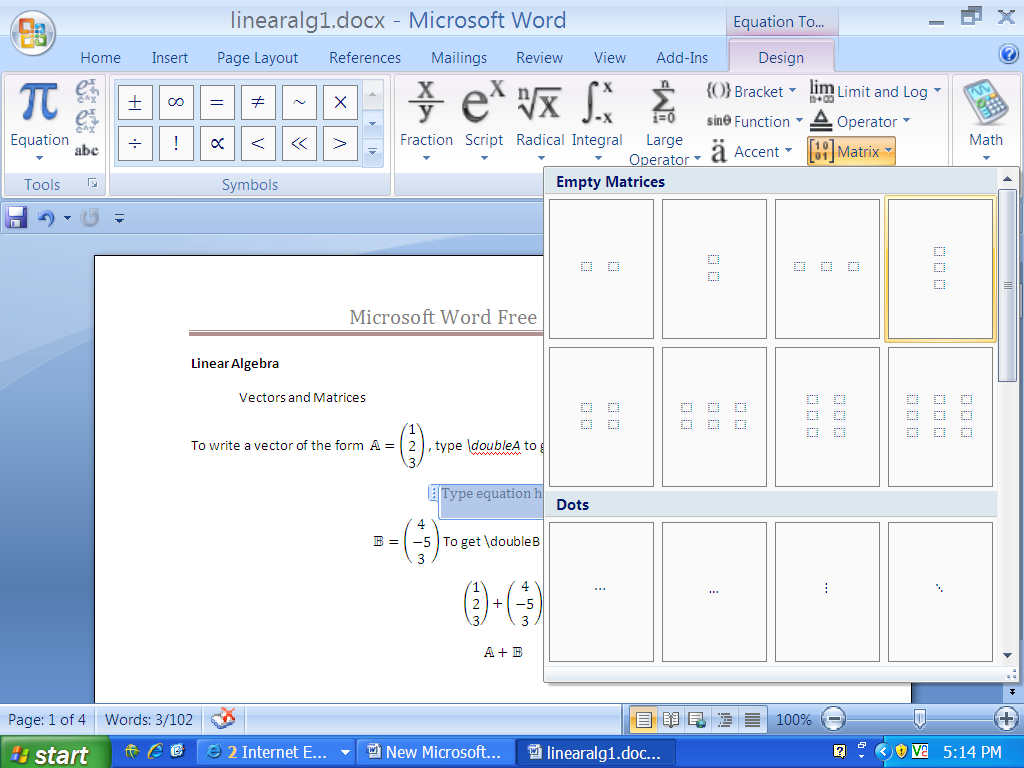
**Linear Algebra**

Vectors and Matrices

To write a vector of the form , type *\doubleA* followed with the space barto get the optional character font for A and use the *Matrix* feature.



Similarly, the vector requires *\doubleB* for the font for B. After entry of a vector or matrix, select *Calculate* to place the parentheses.

Example 1: Add two vectors.

The command *Calculate* gives the resultant vector,

Unfortunately, the input does not give the answer. The software does not assign the vectors to what was previously defined.

Example 2: Find the magnitude of a vector.

Enter a vector as a string with { }. Separate components of the vector with a comma. Use the command *Calculate* to find the answer:

Example 3: Find the inner product.

Separate vectors with a comma. Use the command *Calculate* to yield:

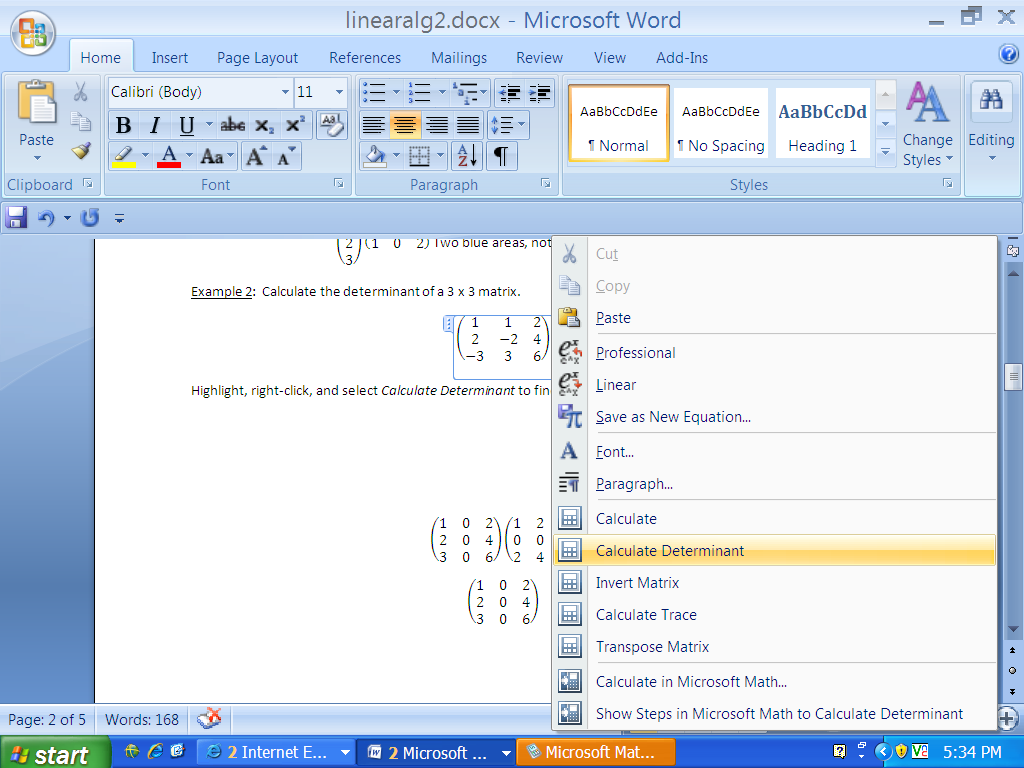
Example 4: Find the cross product where and

Enter the vectors as strings. Separate vectors with a comma. Use the command *cross.* The strings are . The input is:

Select *Calculate* to give the vector that is the cross product.

Example 5: Calculate the determinant of a 3 x 3 matrix.

Highlight, right-click, and select *Calculate Determinant* to find the answer of for our example.

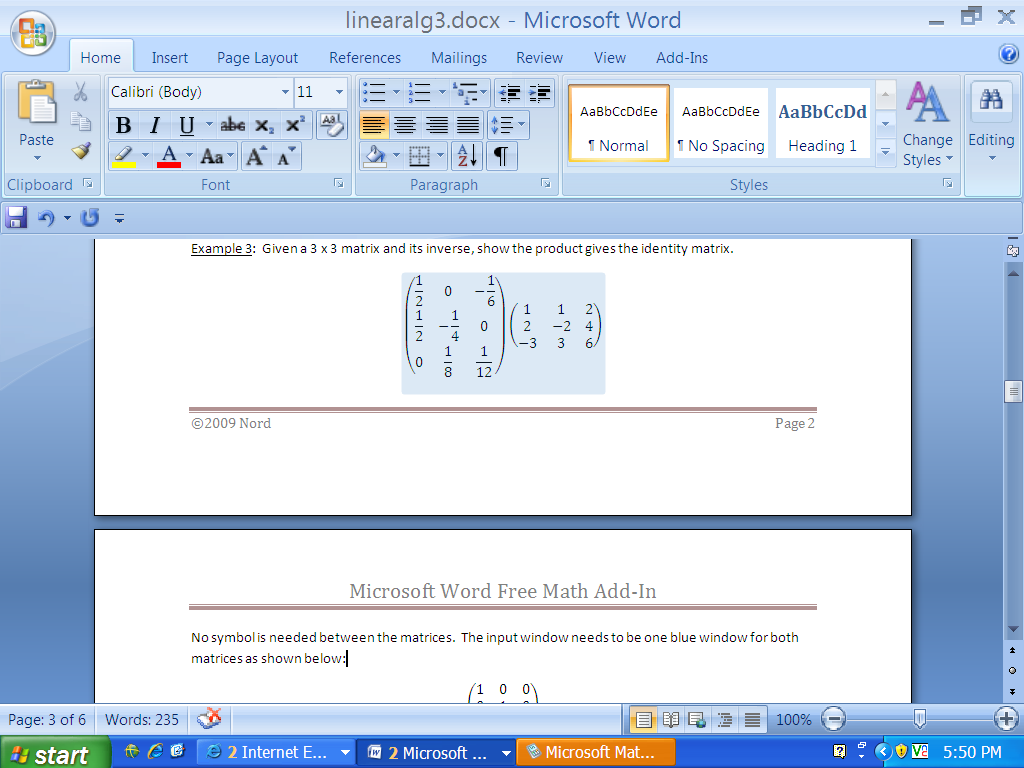


Using the other options, find the trace of the matrix is *5*, the inverse matrix is

and the transpose of the matrix is .

Example 6: Given a 3 x 3 matrix and its inverse, show the product gives the identity matrix.

No symbol is needed between the matrices. The input window needs to be one blue window for both matrices as shown below:



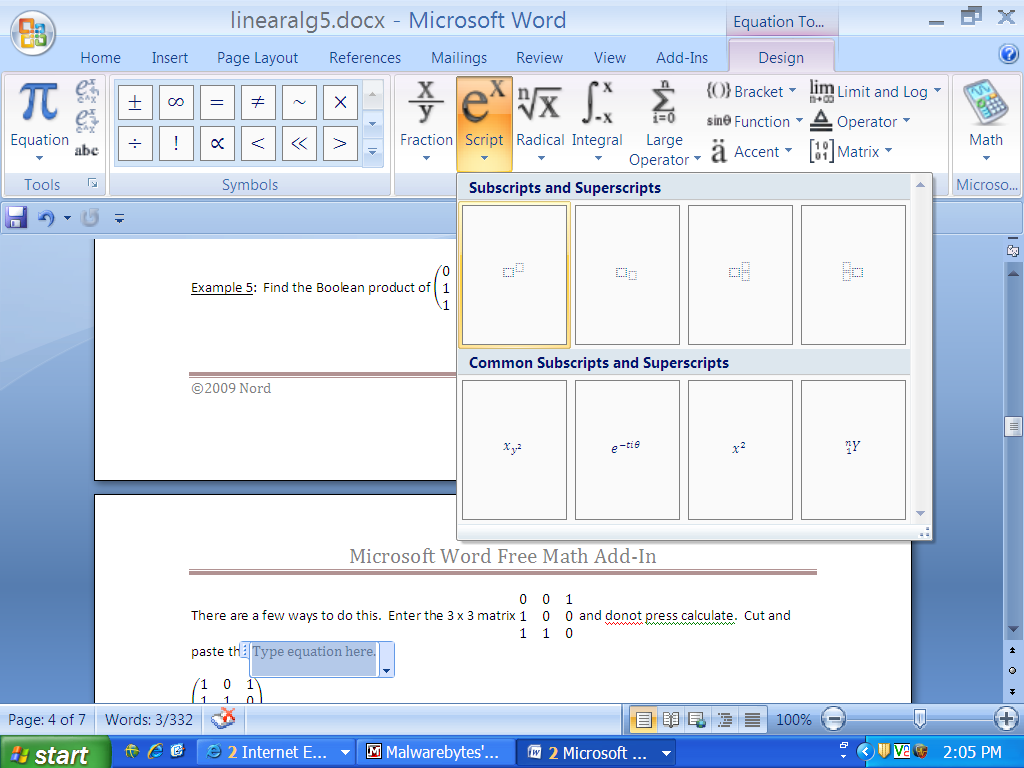
The command *Calculate* gives the answer of the identity matrix below:

Example 7: Find the identity 8 x 8 matrix.

The command *identityMatrix(n)* gives the identity *n x n* amatrix where *n* is from one to fifteen. The *Calculate* option gives our answer:

Example 8: Find the Boolean product of.

There are a few ways to do this. For one approach, enter the 3 x 3 matrix and do not press *Calculate*. The insertion of a pasted object with spaces or parentheses often gives an error message. Without pressing *Calculate,* the matrix, will contain no parentheses. Cut and paste this matrix and place as the ‘base’. Insert the three as a superscript using this feature:



The command *Calculate* from the drop-down menu gives the desired result of:

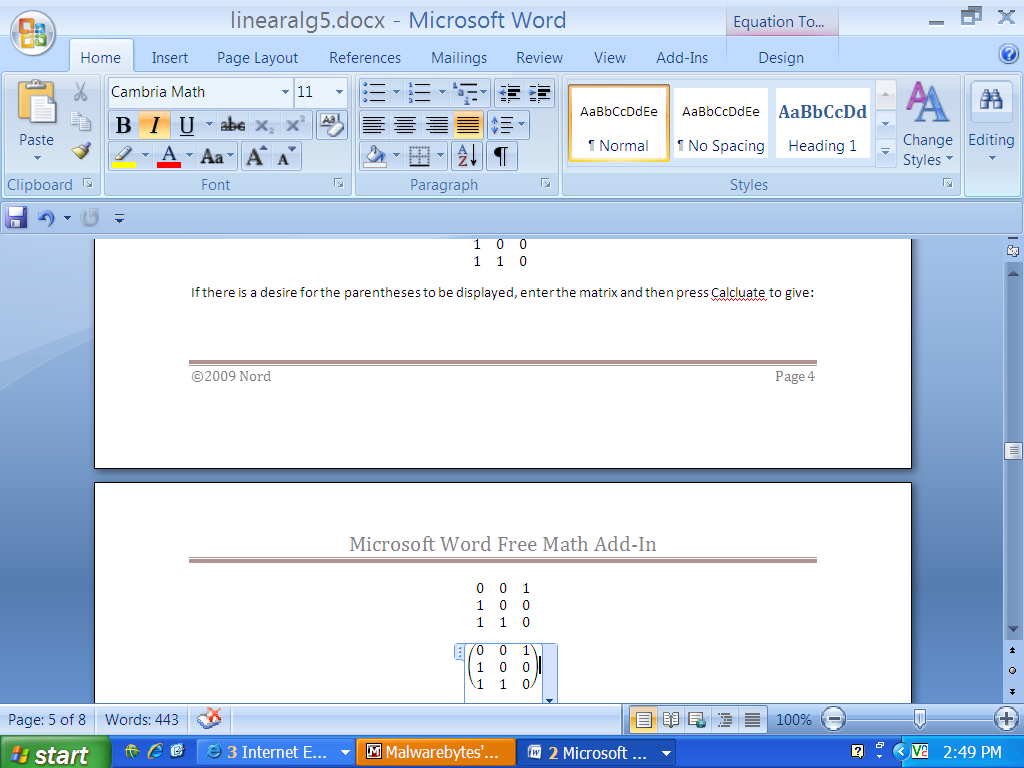
The superscript may be toggled to be 7, and the new Boolean product can be found to be:

=

Another approach is to enter the matrix and superscript directly without cutting and pasting to give:

If there is a desire for the parentheses to be displayed, enter the matrix and then press *Calcluate* to give:

With the cursor inside the blue box, press *^3* followed by a space bar.



This will move the three to the desired location and give:

Press *Calculate* to simplify.

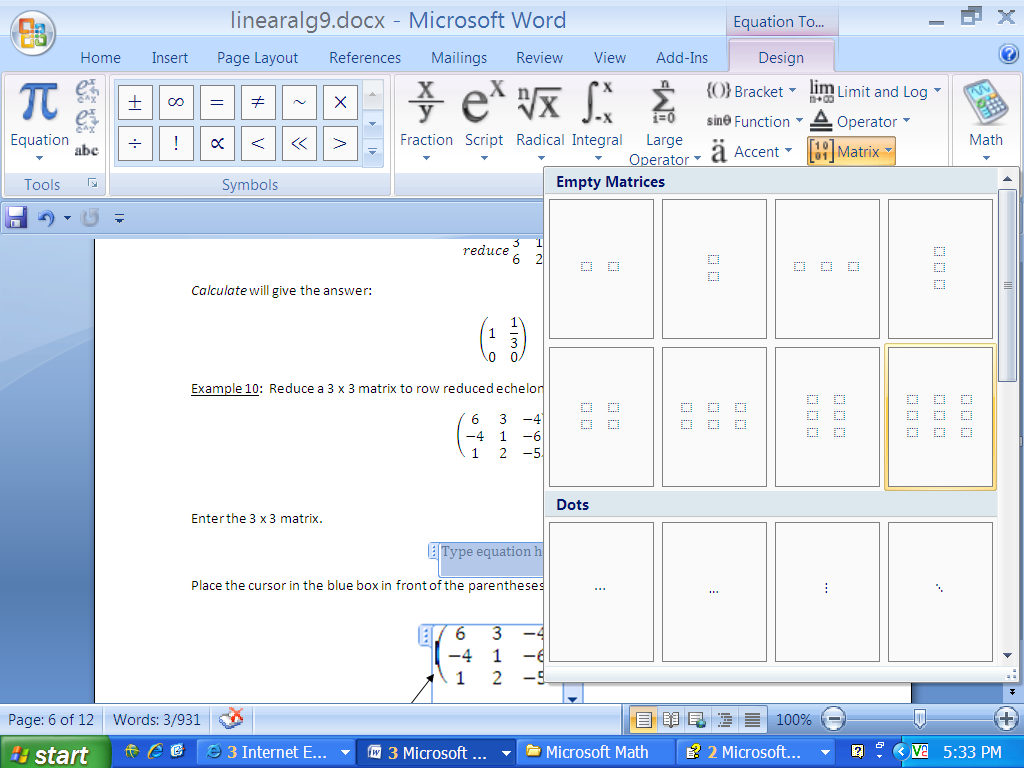
Example 9: Row reduce the 2 x 2 matrix.

Use the command *reduce* followed by the matrix.

*Calculate* will give the answer:

Example 10: Reduce a 3 x 3 matrix to row reduced echelon form (Lipschutz, 1968,p. 53).

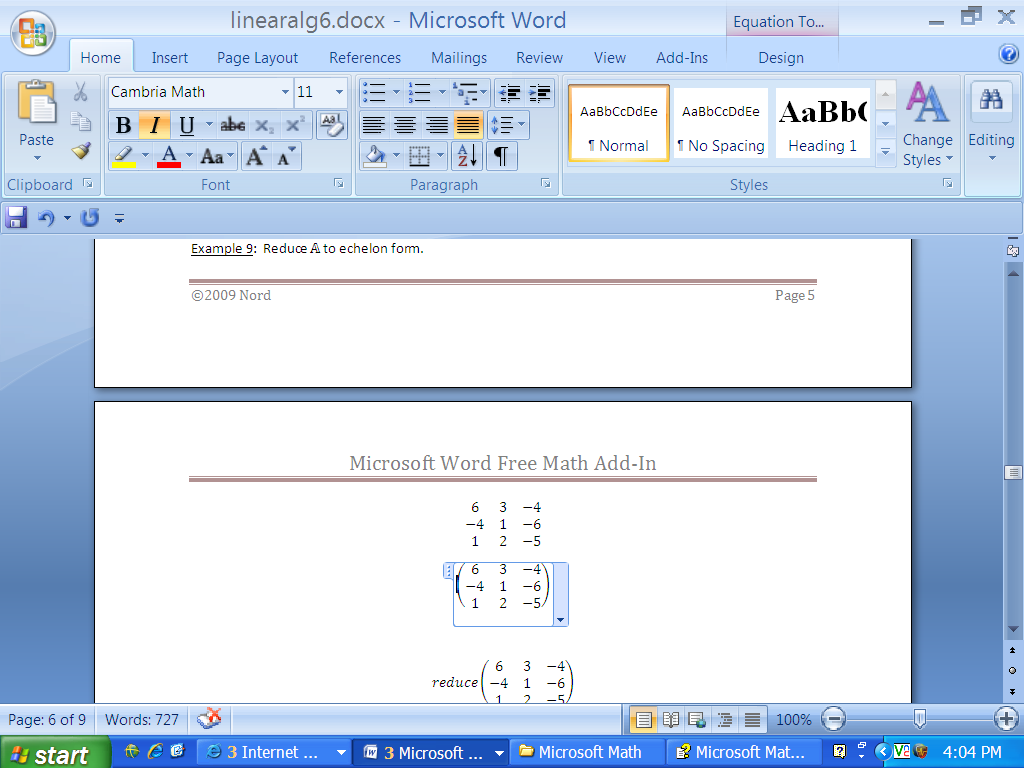
Enter the 3 x 3 matrix using *Matrix:*



The input will look like this:

Press *Calculate* to obtain the parentheses.

Right-click to bring open a blue box. Place the cursor within the blue box and in front of the parentheses.

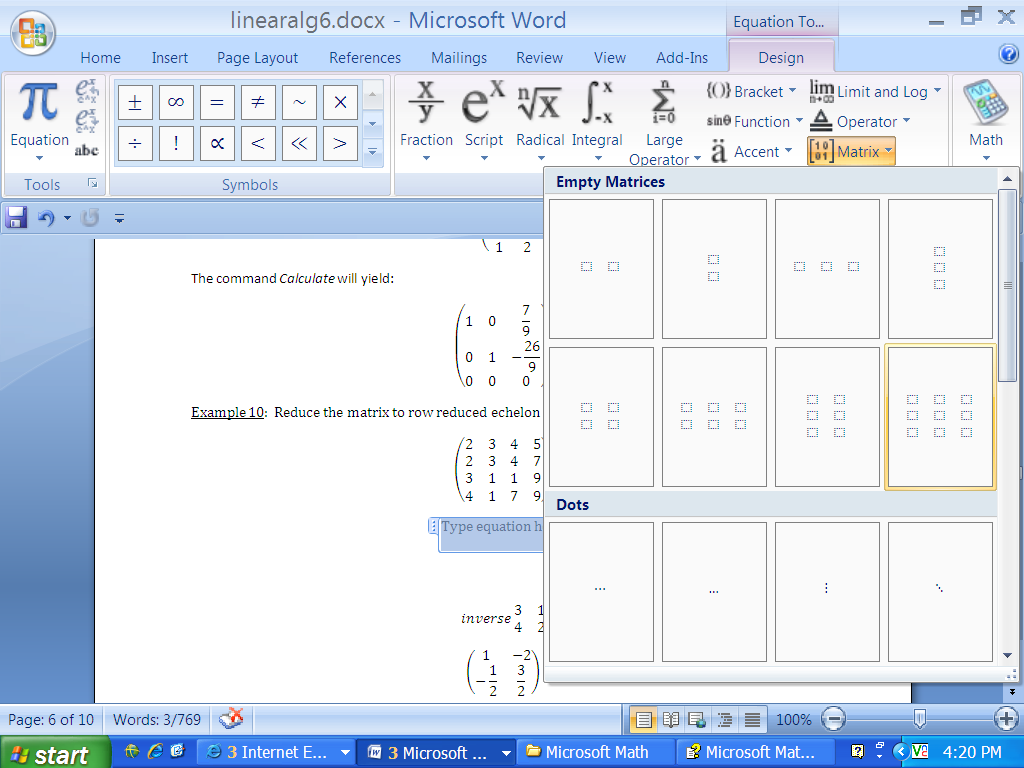


Type *reduce.*

The command *Calculate* will yield:

Example 11: Reduce the matrix to row reduced echelon form (Lipschutz, 1968, p.52).

There is a problem entering this size of matrix from the menu since it is larger than a 3 x 3 matrix.

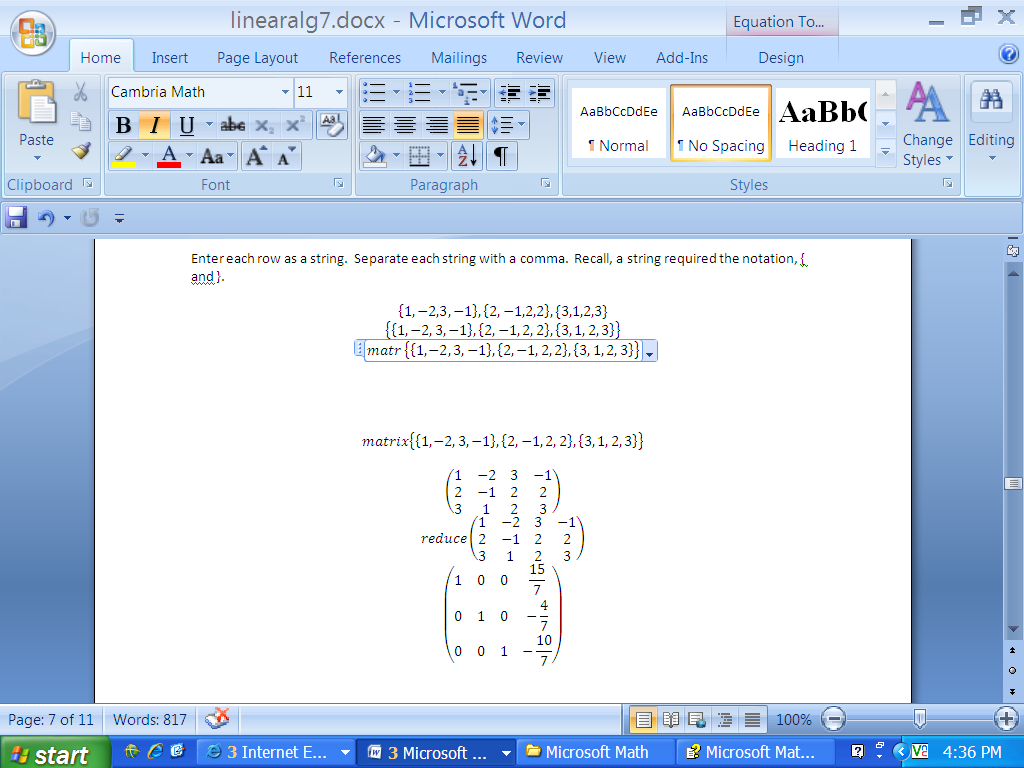


Enter each row as a string. Separate each string with a comma. Recall, a string requires the notation, { and }. With *Insert New Equation*, type:

*Calculate* will place { } around the input.

With the cursor in the blue box, type *matrix*

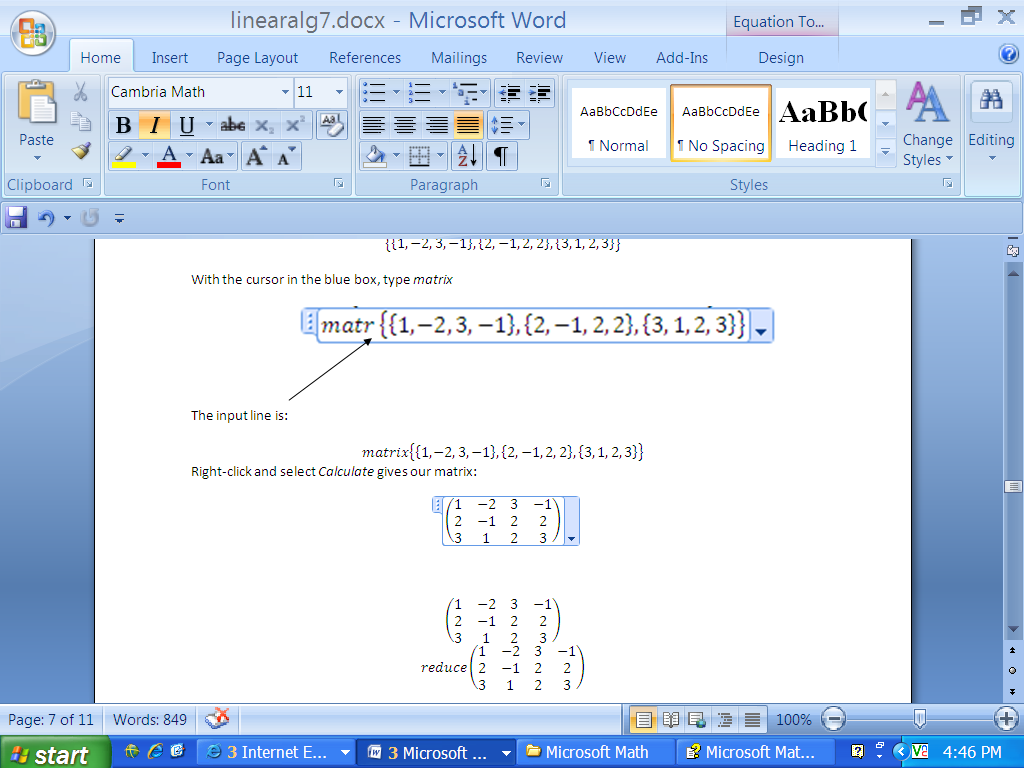
Type in here *matrix.*



The input line is:

Right-click and select *Calculate* gives our matrix:

With the cursor within the blue box and in front of the first parenthesis, type *reduce*.

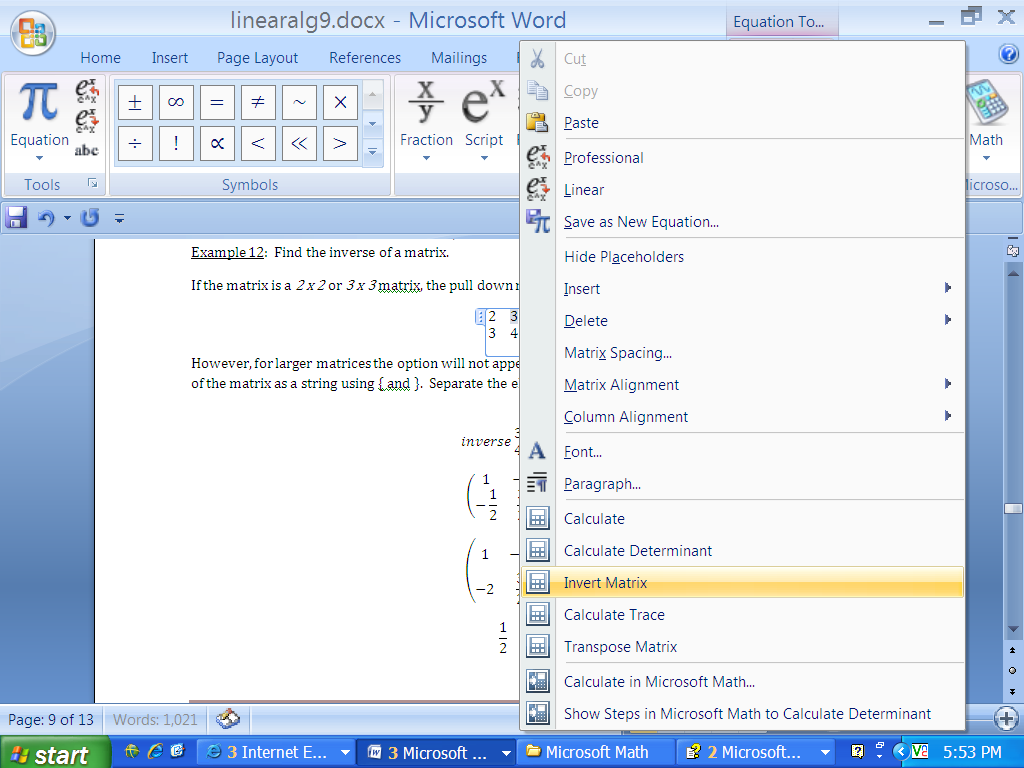


Right click and press *Calculate* to execute:

The answer is:

Example 12: Find the inverse of a matrix.

If the matrix is a *2 x 2* or *3 x 3* matrix, the pull-down menu will contain the option, *Invert Matrix.*



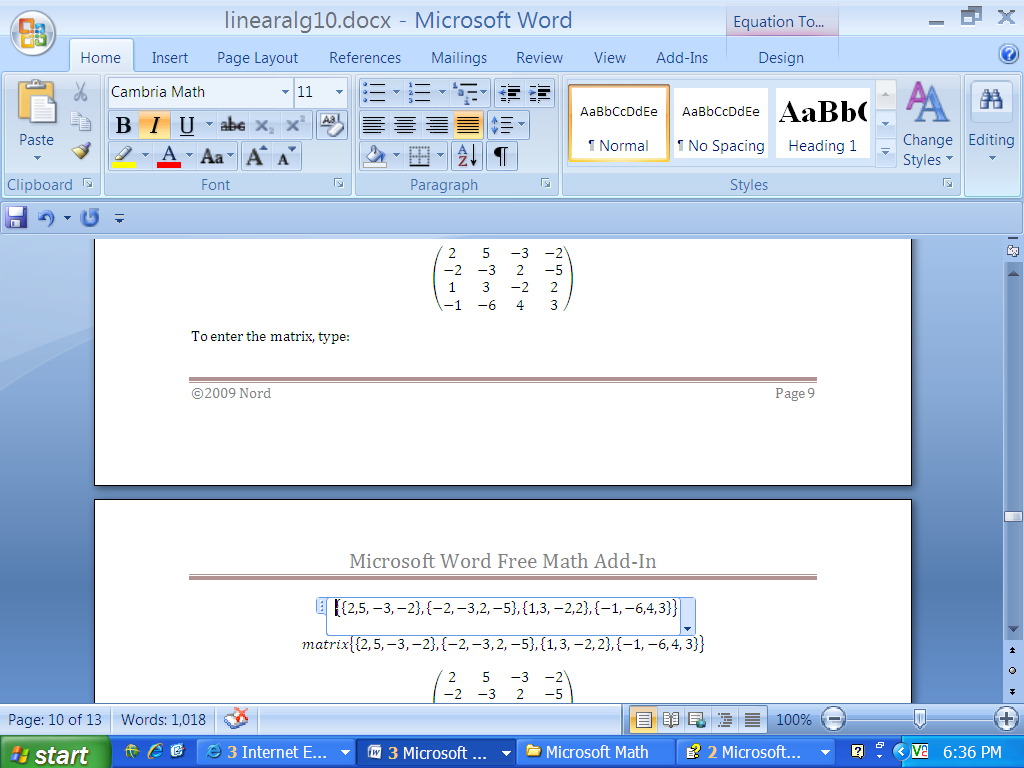
However, for larger matrices the option will appear with the command, *matrix,* in the *Insert New Equation*  line.

Enter each row of the matrix as a string using { and }. Separate the elements with a comma.

Consider the matrix

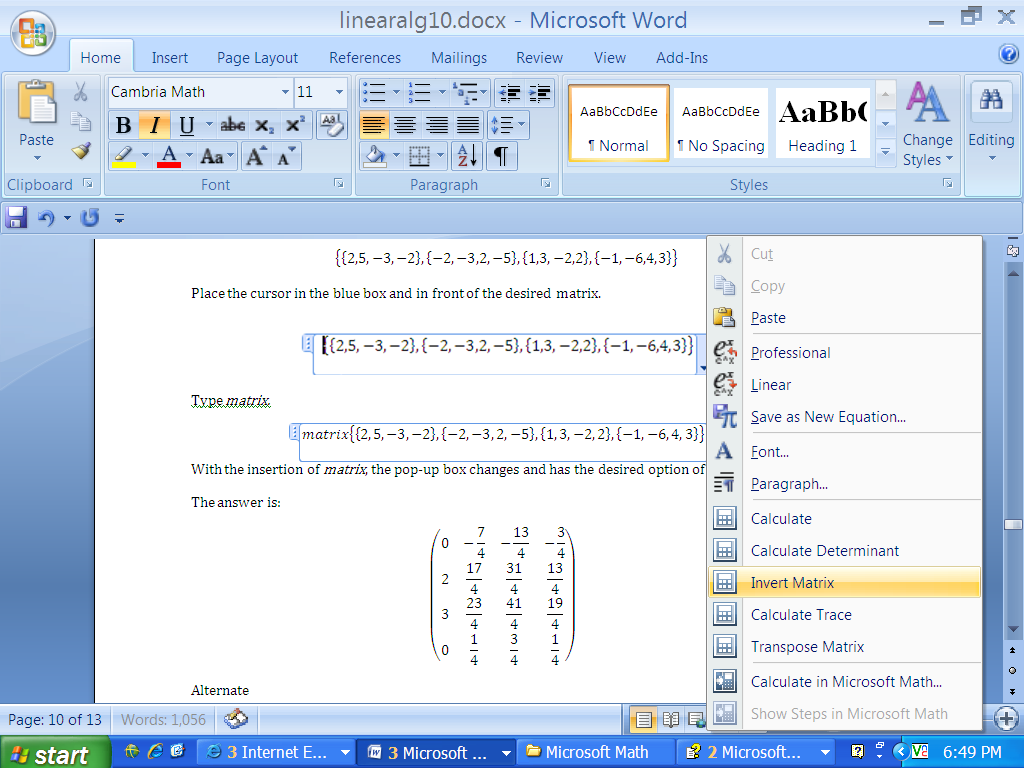
To enter the matrix, type:

Place the cursor in the blue box and in front of the desired matrix.



Type *matrix.*

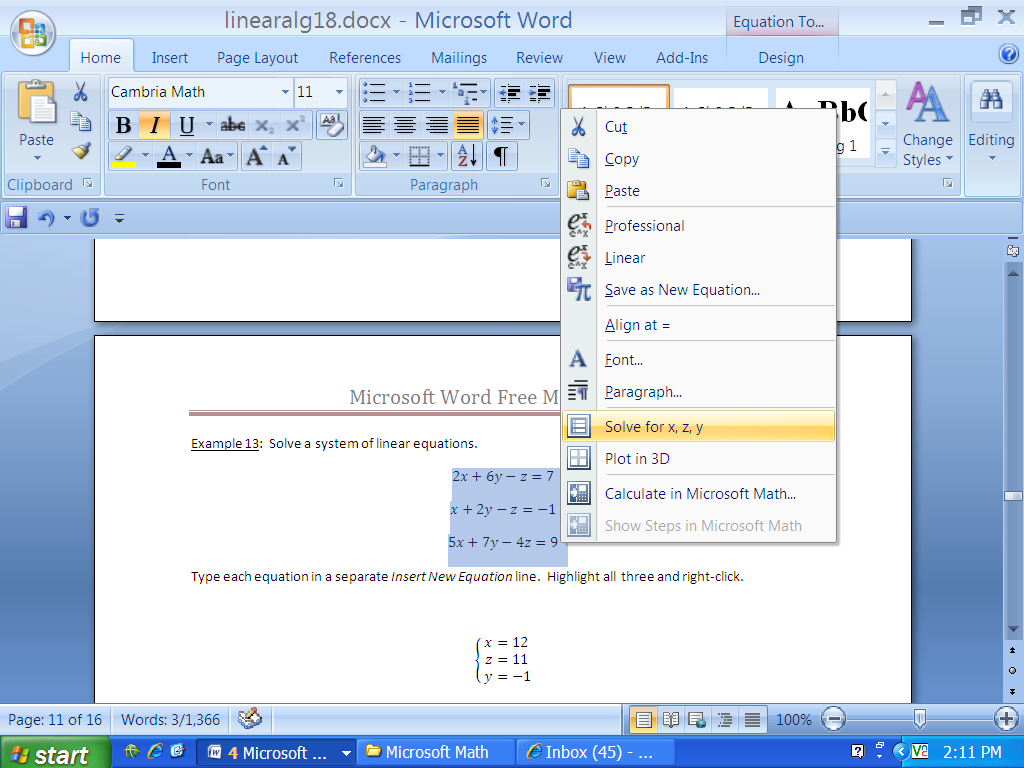
With the insertion of *matrix*, the pop-up box changes and the desired option of *Invert Matrix* appears*.*

**

The answer is:

Example 13: Solve a system of linear equations.

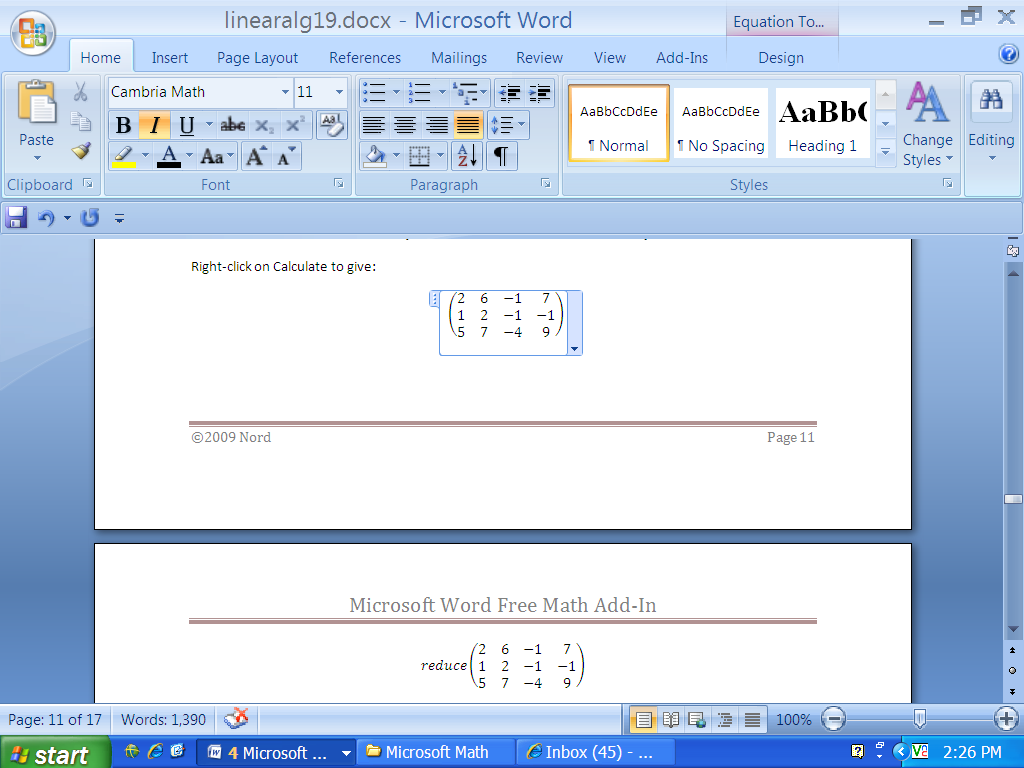
Type each equation in a separate *Insert New Equation* line. If the last equation had no term of *7y,* then a place-holder of *0y* would have been needed. Now, highlight all three and right-click. The menu is:



Select *Solve for x, z, y*. The answer is:

An alternate way is to set-up an augmented matrix. Insert:

Right-click on *Calculate* to give:



Place cursor in blue box at the front.

Type *reduce*.

Right-click to bring up the menu and the option, *Calculate*. The output is:

Interpret the answer to be:

**References**

Lipschutz, Seymour. , *Schaum’s Outline Series Theory and Problems of Linear Algebra*, McGraw-Hill, New York, 1968.

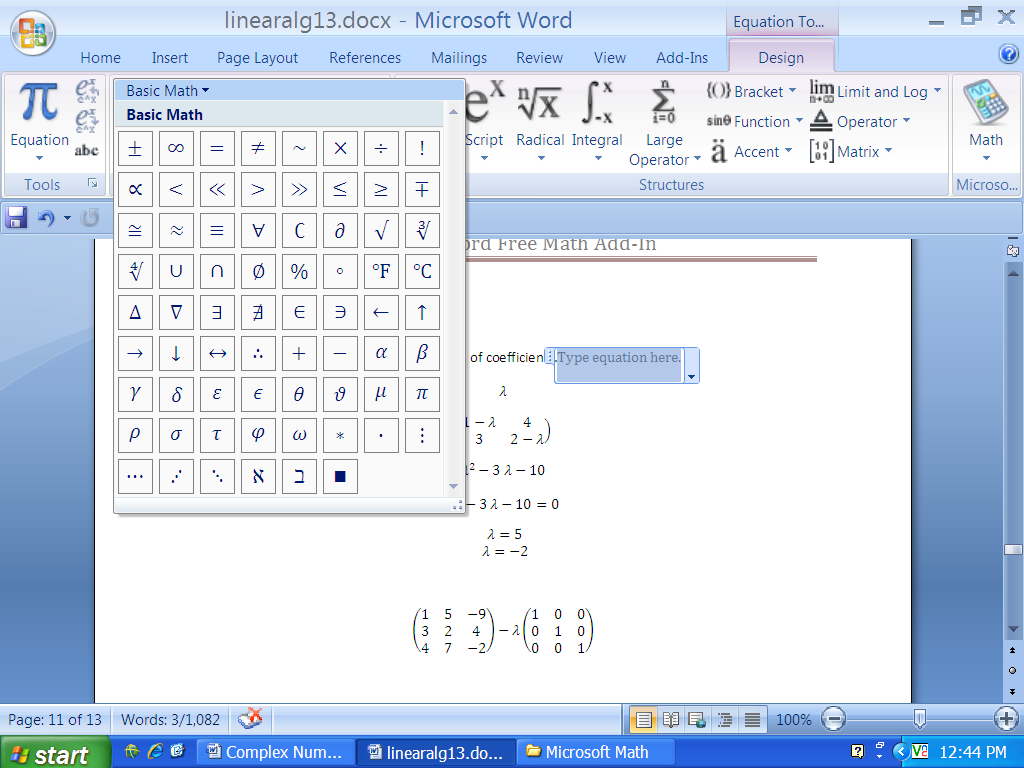
Zill, D. and Cullen, M. Advanced Engineering Mathematics, third edition, Jones and Bartlett, Sudbury, Massachusetts, 2006).

**Linear Algebra**

Eigenvalues

Example 1: Find the eigenvalues of the matrix of coefficients.

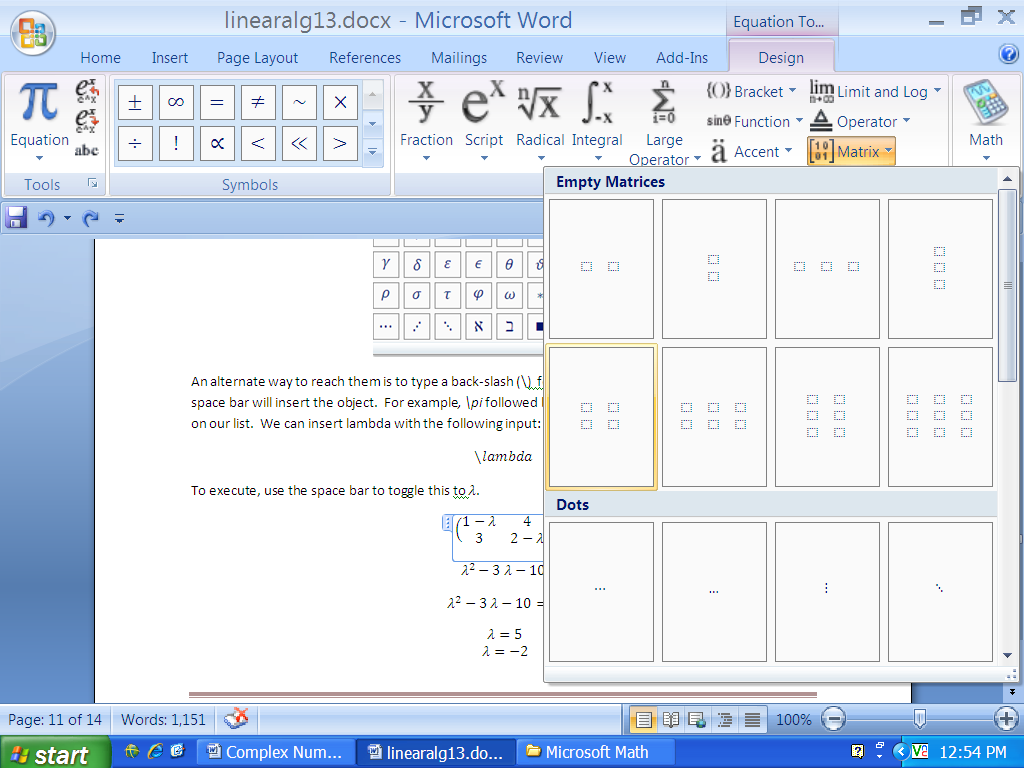
There are some common symbols in *Basic Math*.



An alternate way to reach them is to type a back-slash (\) followed by what you would like. Pressing the space bar will insert the object. For example*, \pi* followed by the space bar will insert . Lambda is not on our list. We can insert lambda with the following input:

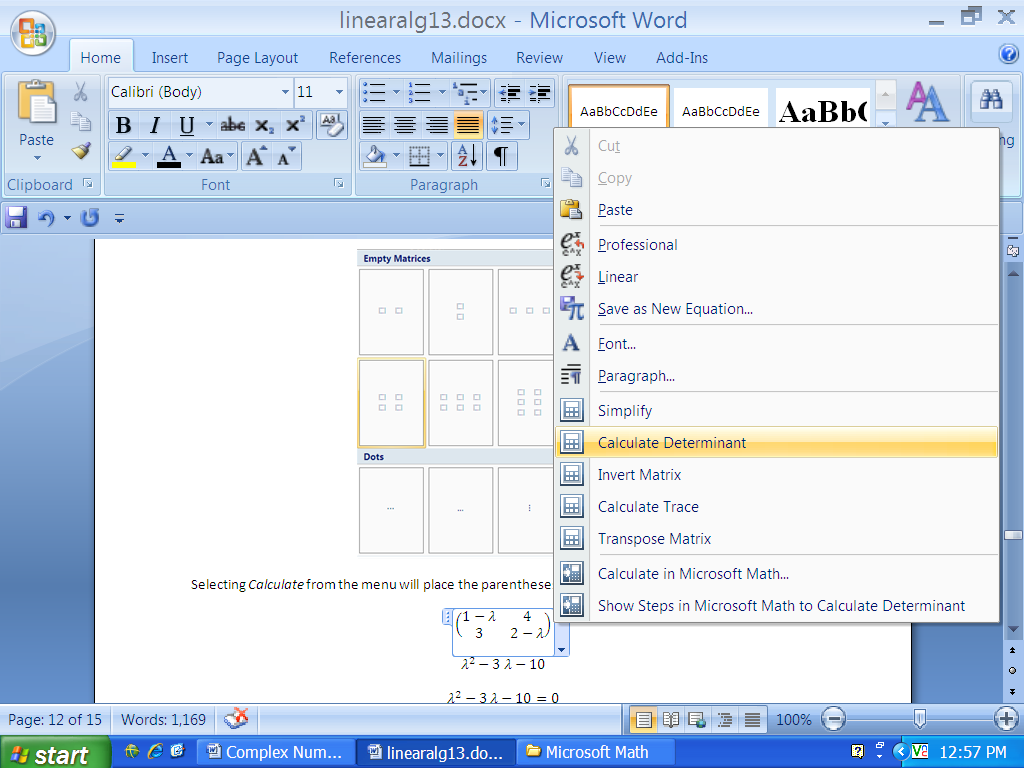
To execute, use the space bar to toggle this to .

Insert the desired matrix using the ribbon icon *Matrix*.



Selecting *Calculate* from the menu will place the parentheses.

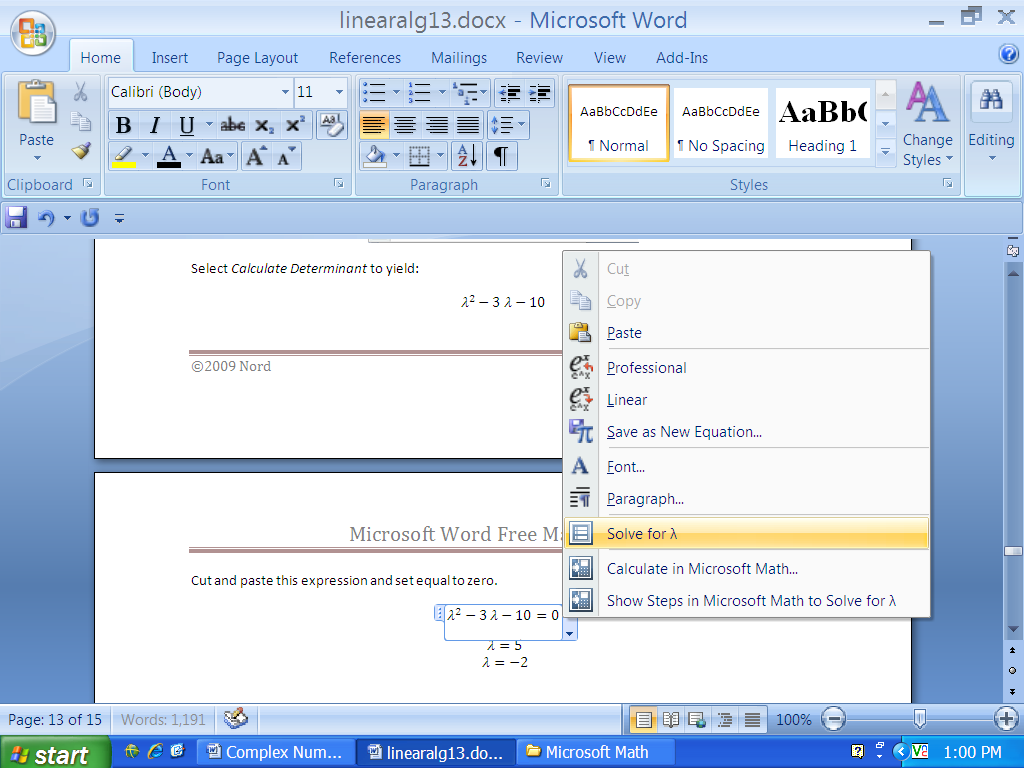
Right-click to bring up the following menu:



Select *Calculate Determinant* to yield:

Cut and paste this expression and set equal to zero.

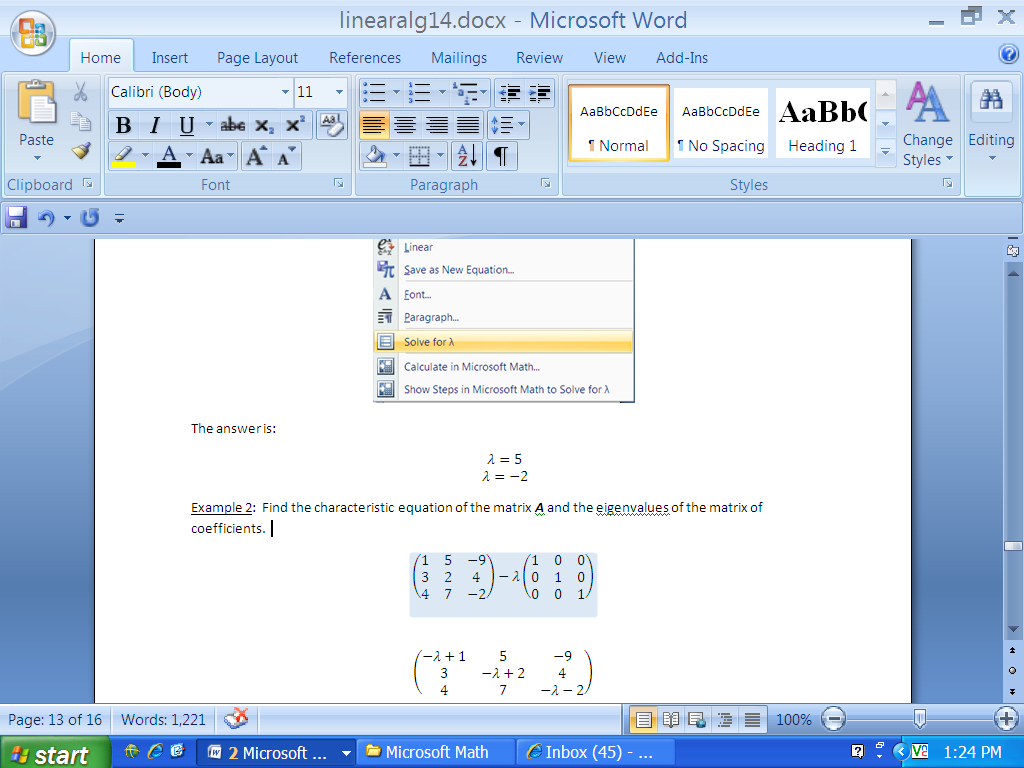
The menu will allow you to solve for lambda.



The answer is:

Example 2: Find the characteristic equation of the matrix ***A*** and the eigenvalues of the matrix of coefficients.

The input must be within one blue frame as shown below:



No operation is needed between lambda and the identity matrix. A short-cut to insert the identity matrix is the command *IdentityMatrix (n)* where *n* is the number of rows of the square matrix. The option, *Calculate,* will insert the parentheses and the *3 x 3* identity matrix. *Simplify* from the pull-down menu will give:

Right-click and press *Calculate Determinant*. Cut and paste the result into a new equation line.

Set equal to zero to form an equation, and select *Solve for .*

The answer is:

**References**

Lipschutz, Seymour. *Schaum’s Outline Series Theory and Problems of Linear Algebra*, McGraw-Hill, New York, 1968.

Zill, D. and Cullen, M. *Advanced Engineering Mathematics*, third edition, Jones and Bartlett, Sudbury, Massachusetts, 2006).