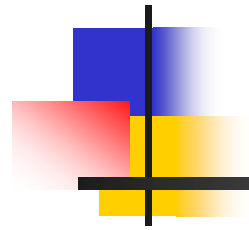


# MATLAB applications

---





# 1. Write matrices in MATLAB

---

- Matrix A (3 by 4)

$$A = \begin{bmatrix} 2 & -1 & 1 & -1 \\ 1 & 0 & -1 & 0 \\ 0 & 1 & 1 & 1 \end{bmatrix}$$

- Matrix of zeros

$$0 = \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

- Matrix I

$$I = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \end{bmatrix}$$

- Extract groups of entries of A

- the entry in the second row,  
third column

-1

- all the entries in the third  
column of A

1

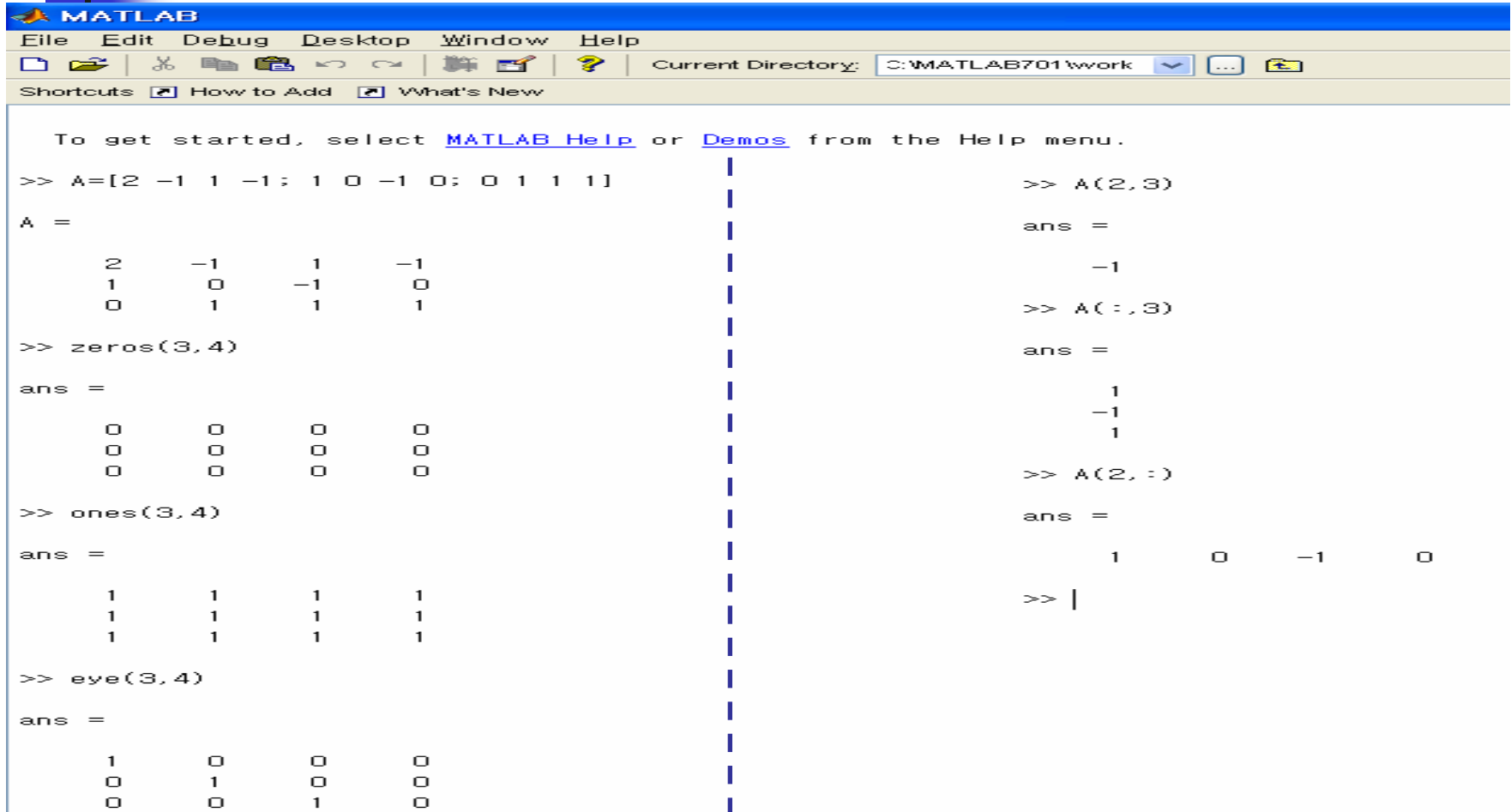
-1

1

- all the entries in the second  
row of A

1 0 -1 0

# MATLAB widows



The image shows a MATLAB window with a blue title bar and a menu bar (File, Edit, Debug, Desktop, Window, Help). Below the menu bar is a toolbar with icons for file operations and a 'Current Directory' field showing 'C:\MATLAB701\work'. The main area is split into two panes by a vertical dashed line. The left pane contains MATLAB code, and the right pane shows the corresponding output.

```

To get started, select MATLAB Help or Demos from the Help menu.

>> A=[2 -1 1 -1; 1 0 -1 0; 0 1 1 1]
A =
     2     -1     1     -1
     1     0     -1     0
     0     1     1     1

>> zeros(3,4)
ans =
     0     0     0     0
     0     0     0     0
     0     0     0     0

>> ones(3,4)
ans =
     1     1     1     1
     1     1     1     1
     1     1     1     1

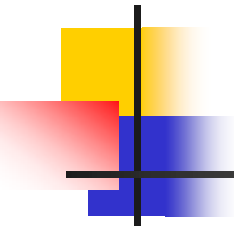
>> eye(3,4)
ans =
     1     0     0     0
     0     1     0     0
     0     0     1     0

>> A(2,3)
ans =
    -1

>> A(:,3)
ans =
     1
    -1
     1

>> A(2,:)
ans =
     1     0    -1     0

>> |
```



## 2. Solve algebraic equations using the command *rref*

---

- Solve the system

$$\begin{array}{rcl} -x & + z & = -1 & x = \\ x + y & & = 0 & y = \\ & z & = 0 & z = \end{array}$$

- MATLAB's command *rref*

# Command “*rref*”

```
MATLAB
File Edit Debug Desktop Window Help
Current Directory: C:\MATLAB701\work
Shortcuts How to Add What's New

>> A=[-1 0 1 -1; 1 1 0 0; 0 0 1 0]
A =
    -1     0     1    -1
     1     1     0     0
     0     0     1     0

>> B=rref(A)
B =
     1     0     0     1
     0     1     0    -1
     0     0     1     0

>> A=[1 1 1 1 1; 1 -1 -1 1 0; 2 1 1 -1 2]
A =
     1     1     1     1     1
     1    -1    -1     1     0
     2     1     1    -1     2

>> B=rref(A)
B =
    1.0000     0     0     0     0.6667
     0    1.0000    1.0000     0     0.5000
     0     0     0     1.0000    -0.1667
```



# 3. The matrix operations in MATLAB

---

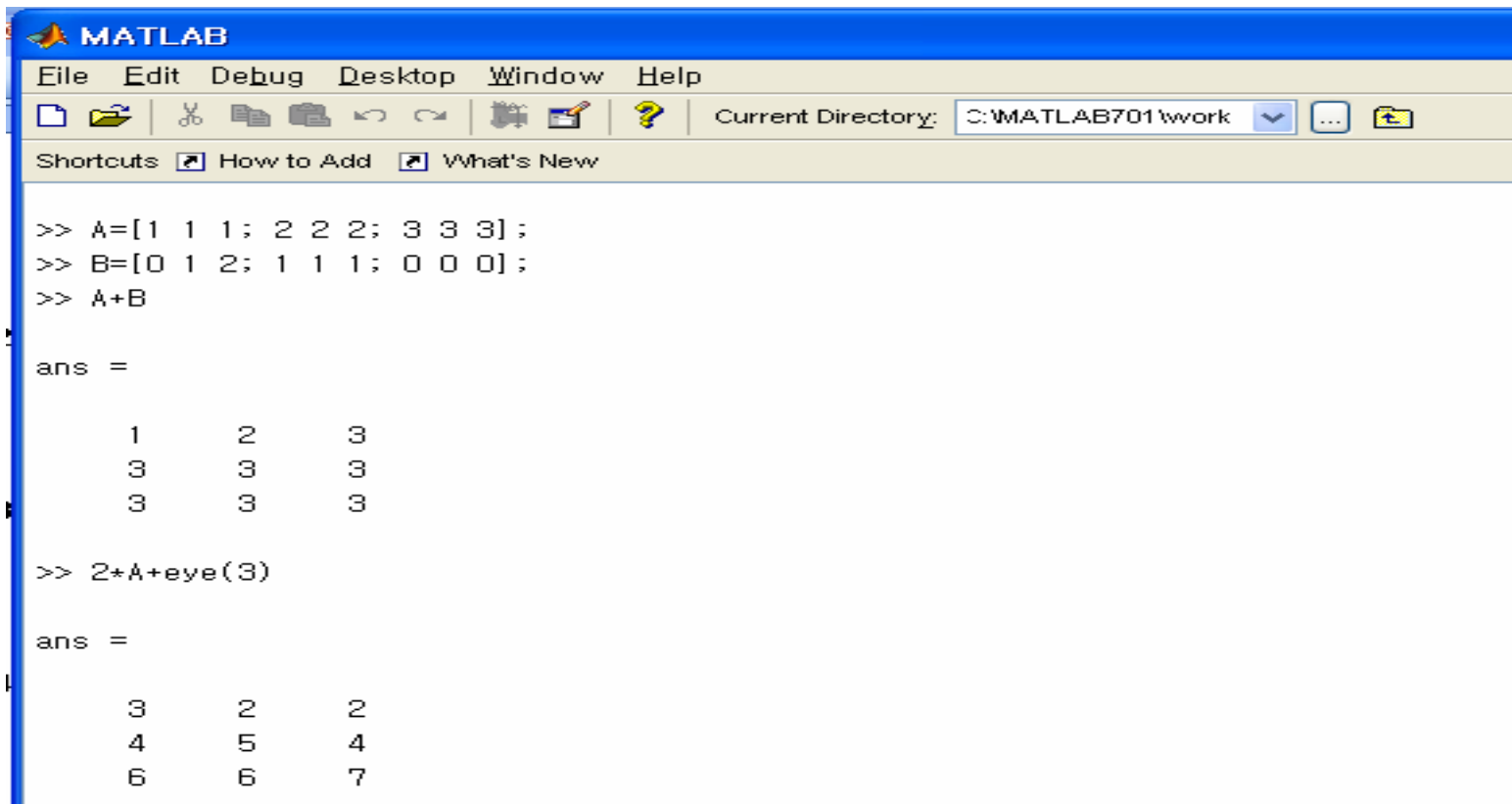
- Matrix addition

$$A + B$$

- Scalar multiplication

$$2 * A + I$$

# Command “A+B” and “2\*A+I”

A screenshot of the MATLAB Command Window. The window title is "MATLAB". The menu bar includes "File", "Edit", "Debug", "Desktop", "Window", and "Help". The toolbar contains icons for file operations and a "Current Directory" dropdown set to "C:\MATLAB701\work". Below the toolbar, there are shortcuts for "How to Add" and "What's New". The command prompt shows the following sequence of commands and their outputs:

```
>> A=[1 1 1; 2 2 2; 3 3 3];
>> B=[0 1 2; 1 1 1; 0 0 0];
>> A+B

ans =

     1     2     3
     3     3     3
     3     3     3

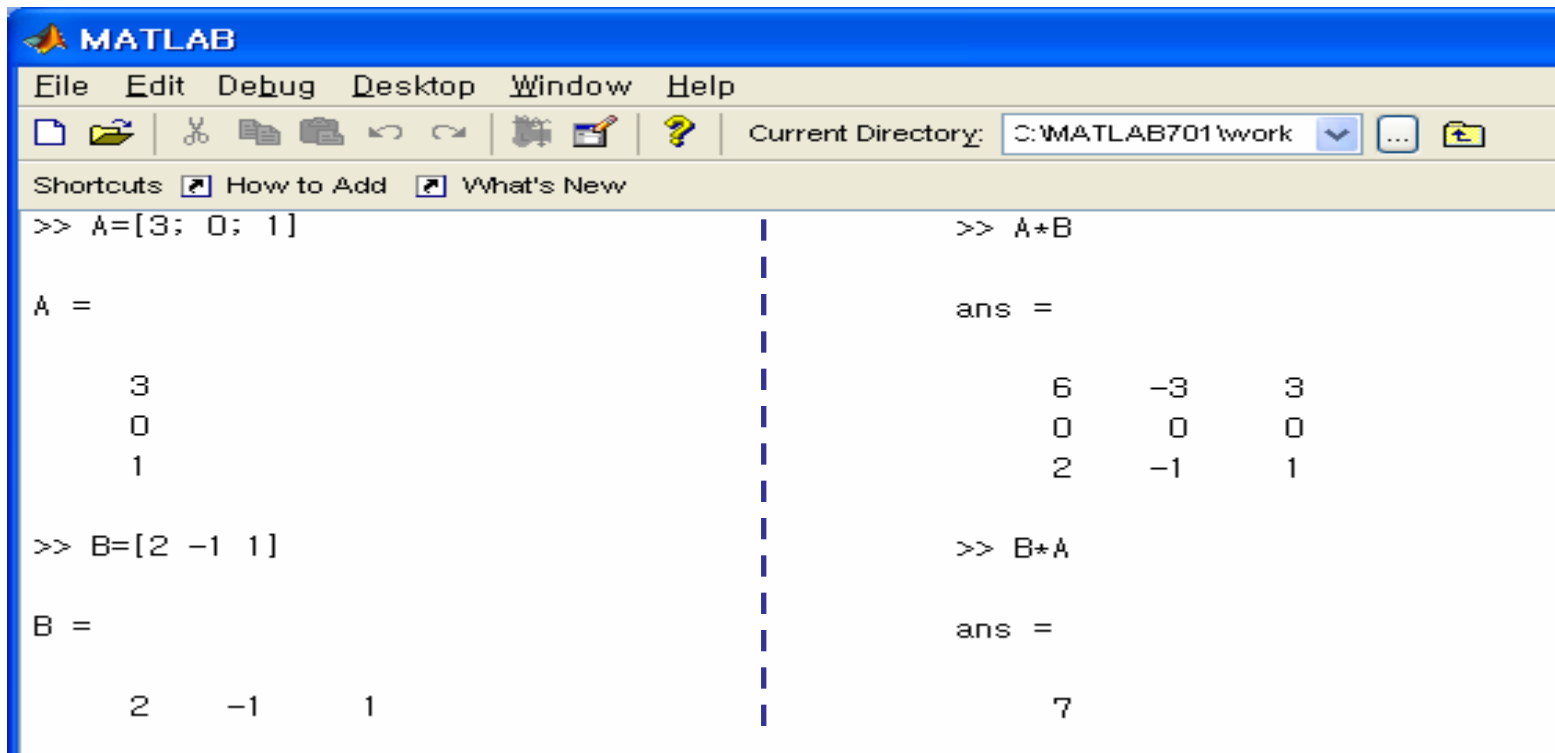
>> 2*A+eye(3)

ans =

     3     2     2
     4     5     4
     6     6     7
```

## 4. Matrix multiplication

- Command “A\*B” and “B\*A”



The screenshot shows the MATLAB Command Window interface. The title bar reads "MATLAB". The menu bar includes "File", "Edit", "Debug", "Desktop", "Window", and "Help". The toolbar contains icons for file operations and a "Current Directory" field showing "C:\MATLAB701\work". Below the toolbar are "Shortcuts" and "How to Add" and "What's New" links. The Command Window is split into two panes by a vertical dashed line. The left pane shows the definition of matrix A and B, and the right pane shows the results of the operations A\*B and B\*A.

```
>> A=[3; 0; 1]

A =

     3
     0
     1

>> B=[2 -1 1]

B =

     2     -1     1

>> A*B

ans =

     6     -3     3
     0     0     0
     2     -1     1

>> B*A

ans =

     7
```





## 5. The computation of $A^{-1}$

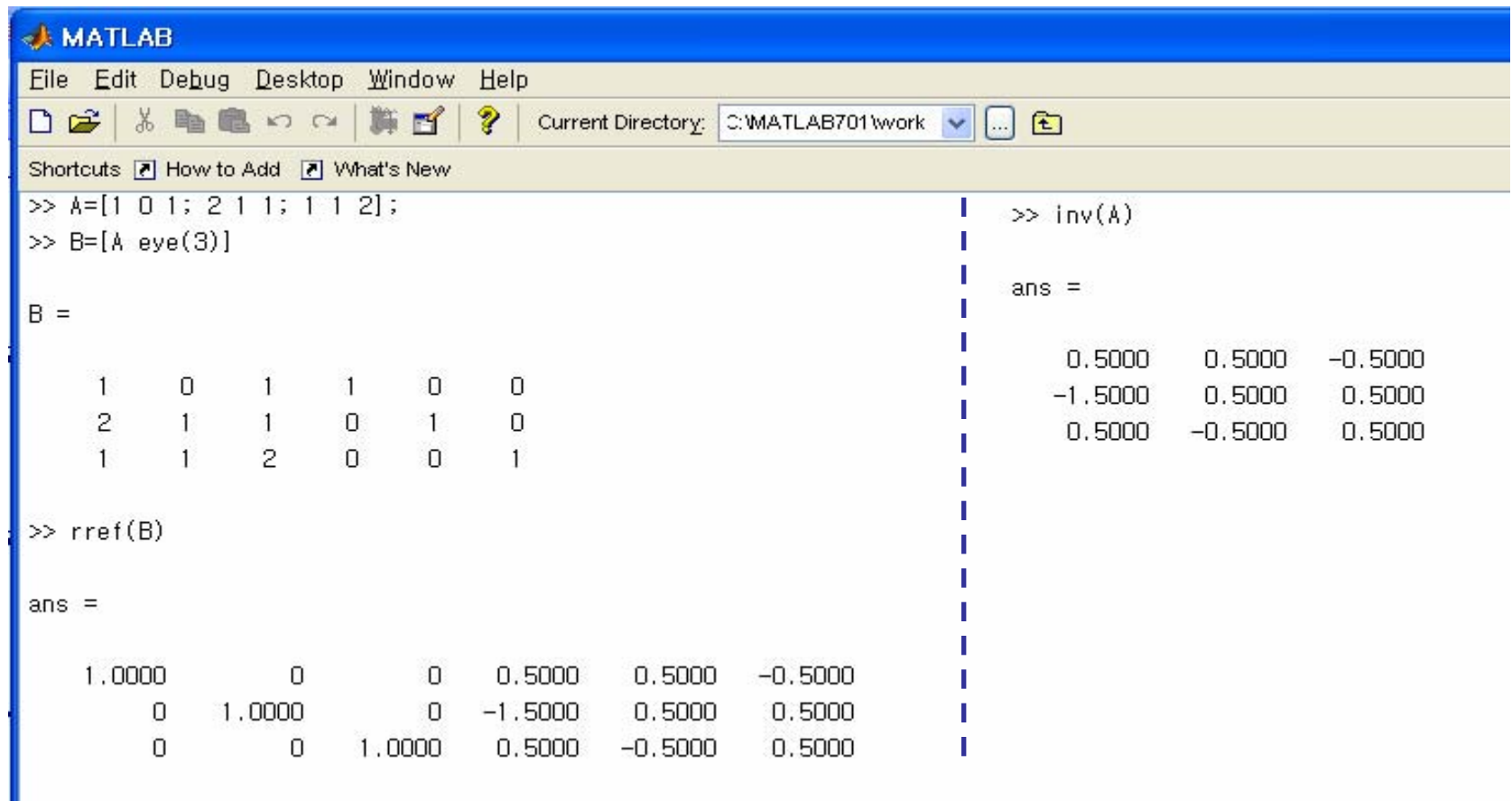
---

- $A^{-1}$  is the inverse of  $A$

$$AA^{-1} = I$$

- If  $A$  is a square matrix, the MATLAB command “*rref*” seen in the earlier section can be used to compute the inverse of  $A$  if this inverse exists.

# Command “*inv*”



The screenshot shows the MATLAB Command Window interface. The title bar reads "MATLAB". The menu bar includes "File", "Edit", "Debug", "Desktop", "Window", and "Help". The current directory is "C:\MATLAB701\work". The command history shows the following sequence of commands and outputs:

```
>> A=[1 0 1; 2 1 1; 1 1 2];  
>> B=[A eye(3)]  
  
B =  
  
     1     0     1     1     0     0  
     2     1     1     0     1     0  
     1     1     2     0     0     1  
  
>> rref(B)  
  
ans =  
  
  1.0000         0         0    0.5000    0.5000   -0.5000  
         0    1.0000         0   -1.5000    0.5000    0.5000  
         0         0    1.0000    0.5000   -0.5000    0.5000
```

A vertical dashed line separates the left column of commands from the right column of commands and outputs. The right column shows the command `>> inv(A)` and its output:

```
>> inv(A)  
  
ans =  
  
     0.5000     0.5000   -0.5000  
   -1.5000     0.5000     0.5000  
     0.5000    -0.5000     0.5000
```



## 6. Compute the determinant of the matrix

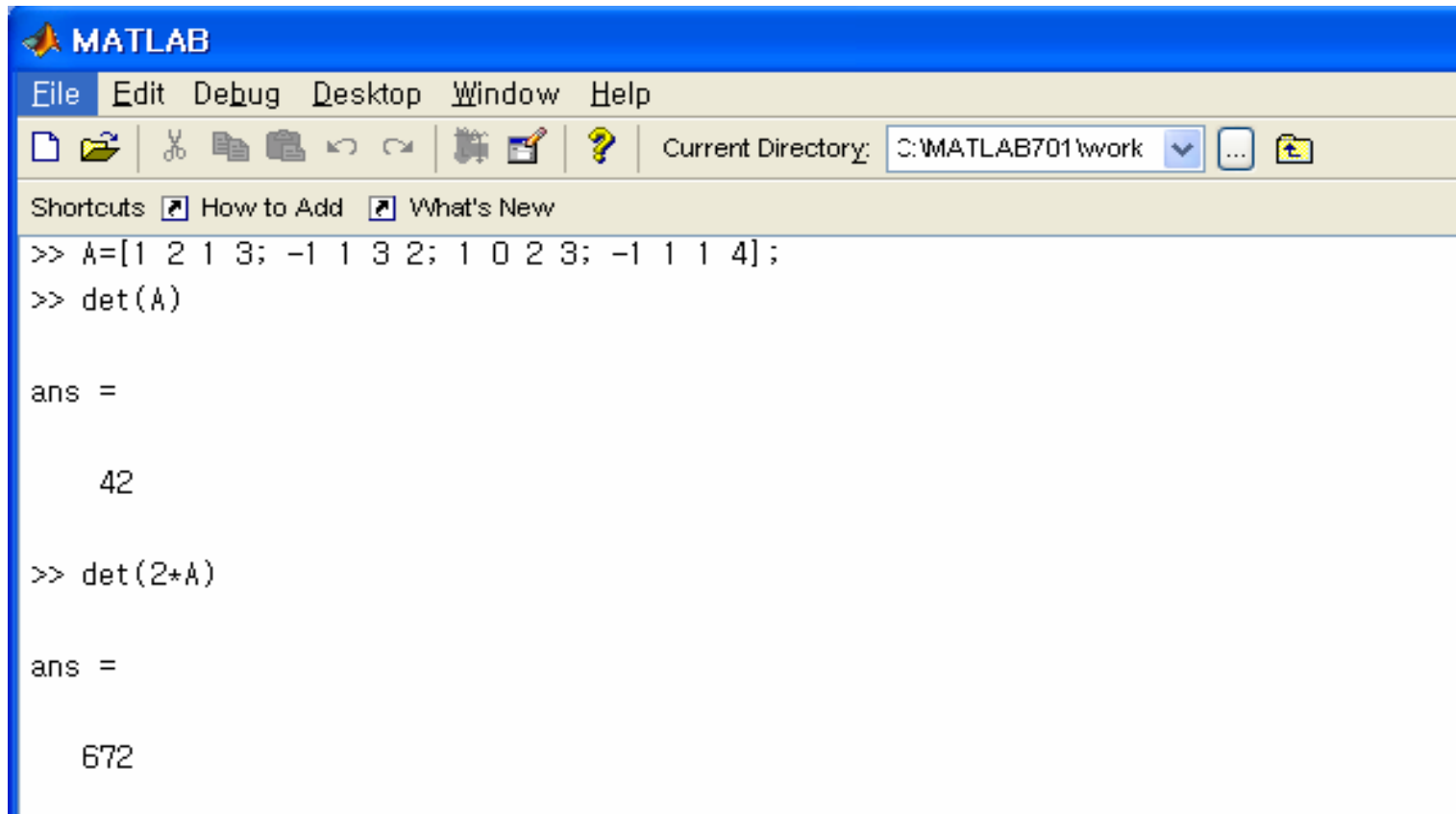
- Determinant

$$\begin{aligned} |a_{11}| &= a_{11}, & \begin{vmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{vmatrix} &= a_{11}a_{22} - a_{12}a_{21} \\ \begin{vmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{vmatrix} &= & a_{11} a_{22} a_{33} + a_{12} a_{23} a_{31} \\ & & + a_{13} a_{21} a_{32} - a_{11} a_{23} a_{32} \\ & & - a_{12} a_{21} a_{33} - a_{13} a_{22} a_{31} \end{aligned}$$

- In general, the determinant of the matrix A

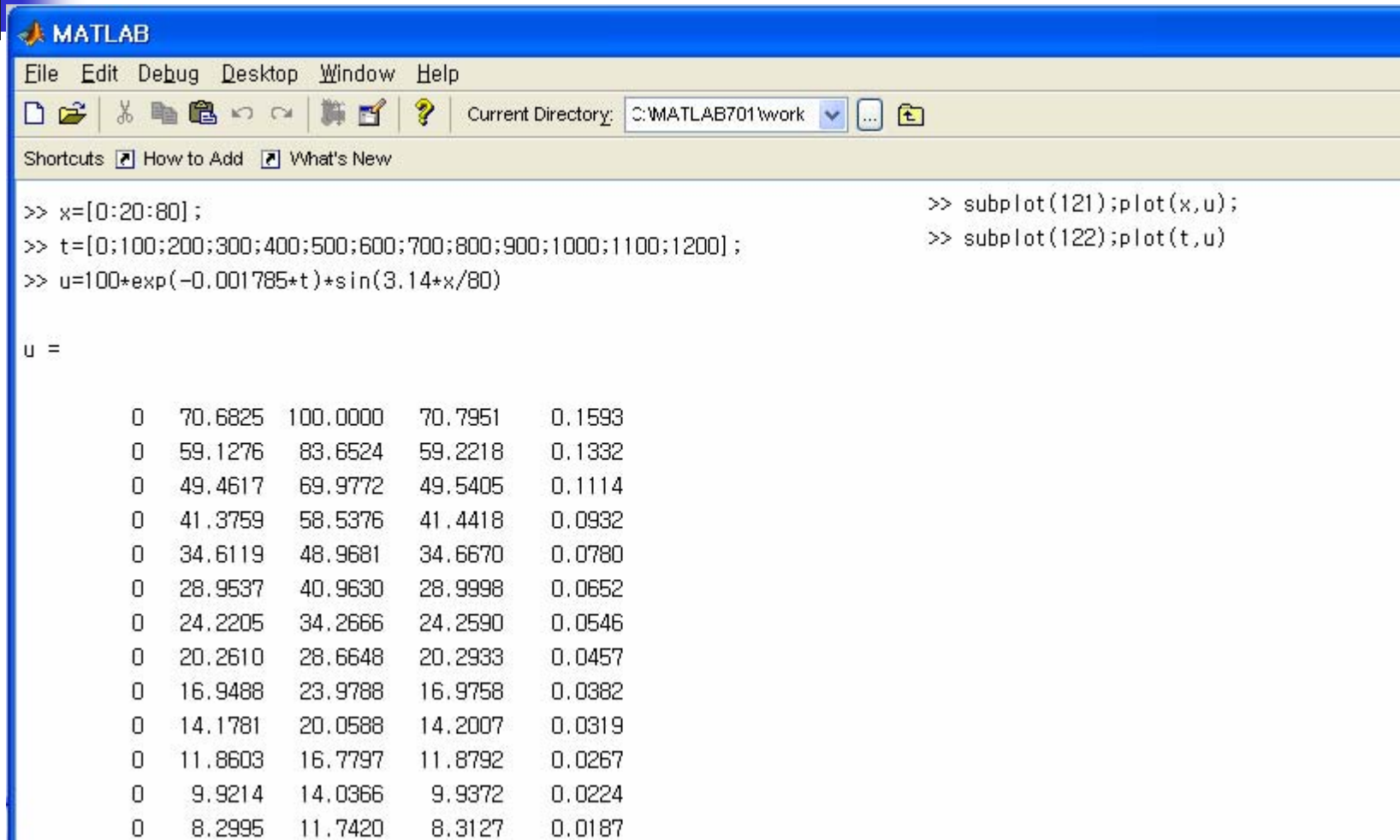
$$|A| = \sum (-1)^k a_{1i} a_{2j} \Lambda a_{ns}$$

# Command “*det*”

A screenshot of the MATLAB Command Window. The window title is "MATLAB". The menu bar includes "File", "Edit", "Debug", "Desktop", "Window", and "Help". The toolbar contains icons for file operations (New, Open, Save, Copy, Paste, Undo, Redo, Print, Run, Help) and a "Current Directory" dropdown menu showing "C:\MATLAB701\work". Below the toolbar, there are links for "Shortcuts", "How to Add", and "What's New". The command prompt shows the following sequence of commands and outputs:

```
>> A=[1 2 1 3; -1 1 3 2; 1 0 2 3; -1 1 1 4];  
>> det(A)  
  
ans =  
  
    42  
  
>> det(2+A)  
  
ans =  
  
    672
```

# 7. Creating graphs in MATLAB



The image shows a screenshot of the MATLAB software interface. The title bar reads "MATLAB". The menu bar includes "File", "Edit", "Debug", "Desktop", "Window", and "Help". The toolbar contains icons for file operations and a "Current Directory" dropdown set to "C:\MATLAB701\work". Below the toolbar, there are "Shortcuts" for "How to Add" and "What's New". The command window displays the following code and its output:

```
>> x=[0:20:80];
>> t=[0;100;200;300;400;500;600;700;800;900;1000;1100;1200];
>> u=100*exp(-0.001785*t)*sin(3.14*x/80)

u =

    0    70.6825    100.0000    70.7951    0.1593
    0    59.1276    83.6524    59.2218    0.1332
    0    49.4617    69.9772    49.5405    0.1114
    0    41.3759    58.5376    41.4418    0.0932
    0    34.6119    48.9681    34.6670    0.0780
    0    28.9537    40.9630    28.9998    0.0652
    0    24.2205    34.2666    24.2590    0.0546
    0    20.2610    28.6648    20.2933    0.0457
    0    16.9488    23.9788    16.9758    0.0382
    0    14.1781    20.0588    14.2007    0.0319
    0    11.8603    16.7797    11.8792    0.0267
    0     9.9214    14.0366     9.9372    0.0224
    0     8.2995    11.7420     8.3127    0.0187
```

# Graphs

