

Mathematics

Lecture 10

MAT 122

Linear Algebra by Spreadsheet

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Learn how to use Excel for the addition and subtraction of matrices.

Learn how to use Excel for the multiplication of matrices.

Learn how to use Excel for calculating the determinants.

Learn how to use Excel for obtaining the inverse of the matrix.

Learn how to use Excel for adjoint of a matrix

Learn how to use Excel for obtaining the transpose of the matrix.

Learn how to use Excel for solving system of equations.

1- Addition and Subtraction of Matrices by spreadsheet

I. Addition and Subtraction of Matrices

Rule: Matrices can be added or subtracted if and only if they have the same sizes, and both matrices must have only real numbers as entries.

Always remember that there is no direct command in MS-Excel to add/subtract two matrices.

Example:

Given $A = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix}$ $B = \begin{bmatrix} 7 & 8 & 9 \\ 10 & 11 & 12 \end{bmatrix}$ Compute the sum of A and B.

To do this operation in MS-Excel, the following procedures are to be followed:

1. Input the entries to Excel. Matrix A will be in cells (A1:C2) and Matrix B cells (A5:C6) as shown below.
2. In cell A9 type $=A1+A5$ then press Enter.
3. Value 8 will appear as result of sum of $1+7$.

To do this operation in MS-Excel, the following procedures are to be followed:

4. Click on Cell A9 then Press Ctrl c to copy the cell
5. Highlight cells that range A9:C10.
6. Press Ctrl v to paste the result of adding two matrices as shown below.

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1- Addition and Subtraction by Spreadsheet

You can do the same procedures for subtracting two matrices. You only need to change the command in number 2 by typing =A1-B5.

	A	B	C
1	1	2	3
2	4	5	6
3			
4			
5	7	8	9
6	10	11	12
7			
8			
9	8	10	12
10	14	16	18

2- Multiplication of Matrices by Spreadsheet

II. Multiplication of Matrices.

A. Scalar Multiplication

Scalar multiplication is defined by multiplying each entry of the matrix by a certain constant k .

Example:

Given $A = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix}$ and the constant $k=5$. Compute kA

To do this operation in MS-Excel, the following procedures are to be followed:

1. Input the entries to Excel. Matrix A will be in cells (A1:C2).
2. Click on cell A5, then type $=5*A1$, press Enter.
3. The value of 5 will appear in Cell A5 as result of product 1 times 5.

To do this operation in MS-Excel, the following procedures are to be followed:

4. Copy cell A5 by clicking on cell A5 then press Ctrl c.
5. Highlight the cells that range A5:C6.

6. Press Ctrl v to paste the result of multiplying a constant (k) to matrix A as shown below.

	A	B	C
1	1	2	3
2	4	5	6
3			
4			
5	5	10	15
6	20	25	30

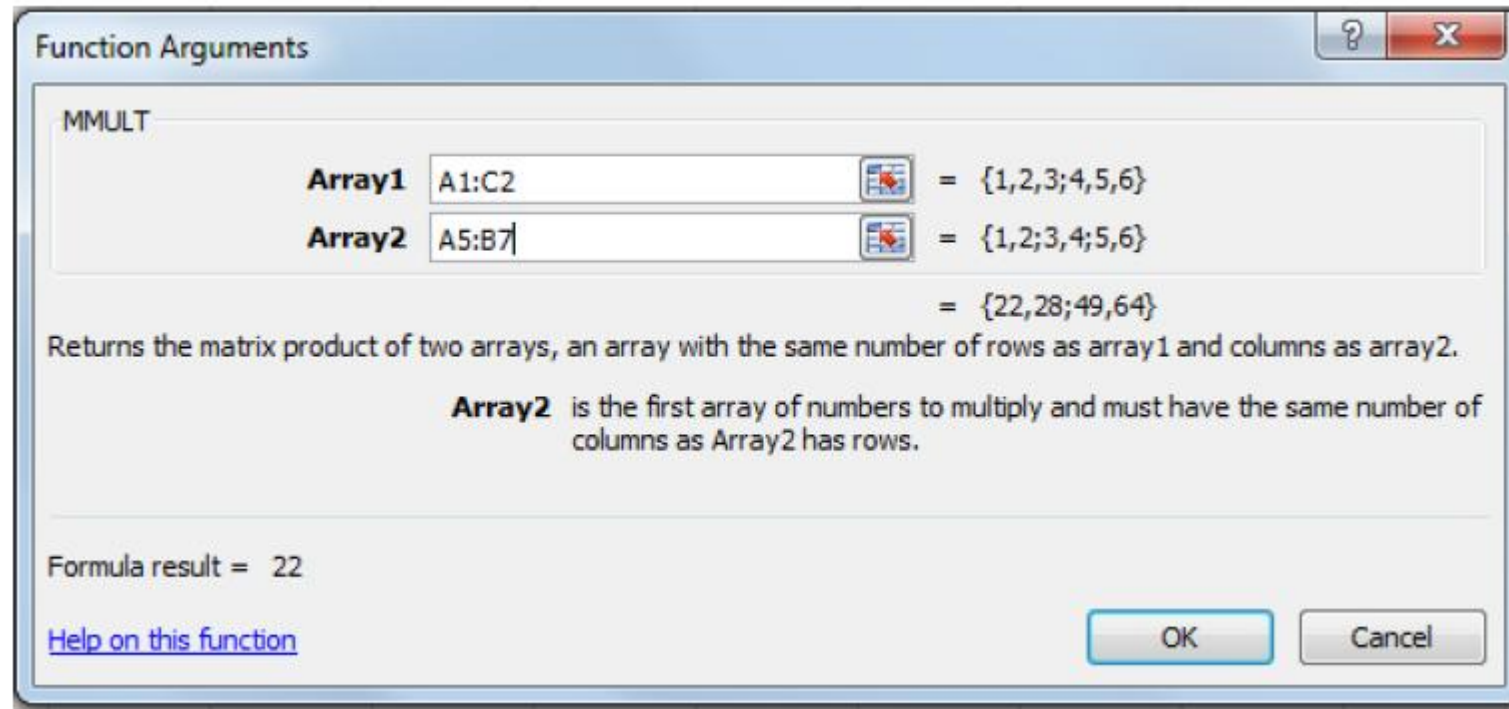
B. Multiplication of two Matrices

Rule: Matrix multiplication is possible only when the number of columns in the first matrix are equal to the number of rows in the second matrix, and both matrices must have only real numbers as entries.

Example: Given $A = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & 2 \\ 3 & 4 \\ 5 & 6 \end{bmatrix}$ Compute AB .

To do this operation in MS-Excel, the following procedures are to be followed:

1. Input the entries to Excel. Matrix A will be in cells (A1:C2) and Matrix B cells (A5:B7)
2. Select cell A9
3. Click on “Formulas” in the menu bar, then select “MMULT” from “Math & Trig” Menu, or simply click on f_x . and select the two matrices as shown below. Then press OK.



4. Copy cell A9 by clicking on cell A5 then press Ctrl c.
5. Highlight the cells that range A9:B10.
6. Press F2.
7. Press Ctrl + Shift + Enter, the result of multiplying two matrices will appear as shown below.

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2- Multiplication for two Matrices

	A	B	C
1	1	2	3
2	4	5	6
3			
4			
5	1	2	
6	3	4	
7	5	6	
8			
9	22	28	
10	49	64	

3- Determinants by Spreadsheet

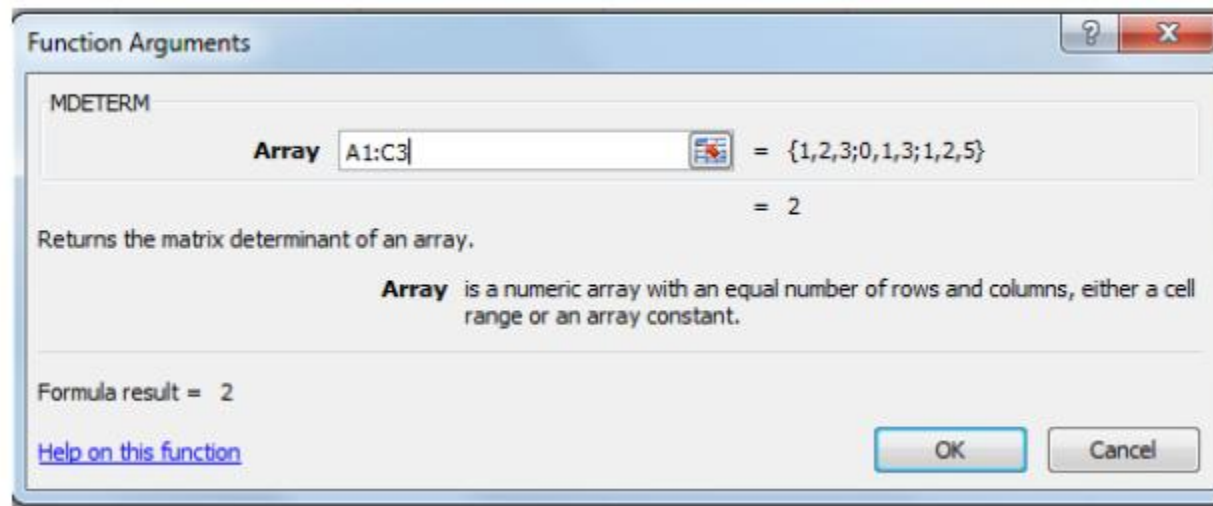
III. Determinants and Singular Matrices

Example:

Given $A = \begin{bmatrix} 1 & 2 & 3 \\ 0 & 1 & 3 \\ 1 & 2 & 5 \end{bmatrix}$ Compute the determinant of matrix A which is usually denoted by $\det(A)$ or $|A|$.

To do this operation in MS-Excel, the following procedures are to be followed:

1. Input the entries to Excel. Matrix A will be in cells (A1:C3).
2. Click on cell A5
3. Click on “Formulas” in the menu bar, then select “MDETERM” from “”Math & Trig” Menu, or simply click on f_x . and select the Matrix A (Range From A1 to C3) as shown below. Then press OK.



4. The value 2 will appear as a result as shown below.

	A	B	C
1	1	2	3
2	0	1	3
3	1	2	5
4			
5	2		

4- The inverse of a matrix by Spreadsheet

IV. The Inverse of a Matrix

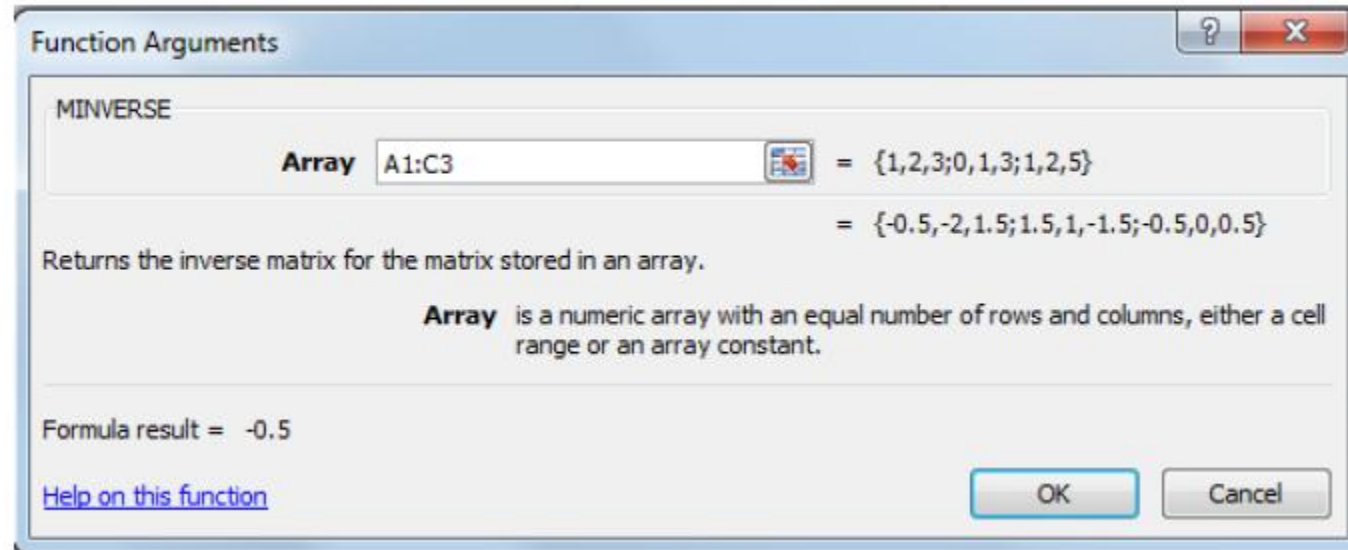
Rule: The matrix should be square a matrix and the $\det(A)$ should be non-zero. If $\det(A)=0$, the inverse matrix does not exist and A is said to be singular or noninvertible.

Example:

$$\text{Given } A = \begin{bmatrix} 1 & 2 & 3 \\ 0 & 1 & 3 \\ 1 & 2 & 5 \end{bmatrix} \text{ Compute inverse matrix } (A^{-1})$$

To do this operation in MS-Excel, the following procedures are to be followed:

1. Input the entries to Excel. Matrix A will be in cells (A1:C3).
2. Click on cell A5
3. Click on “Formulas” in the menu bar, then select “MINVERSE” from “Math & Trig” Menu, or simply click on f_x . and select the Matrix A (Range From A1 to C3) as shown below. Then press OK.



4. Copy cell A5 by clicking on cell A5 then press Ctrl c.
5. Highlight the cells that range A5:C7.
6. Press F2.
7. Press Ctrl + Shift + Enter, the result of multiplying two matrices will appear as shown below.

	A	B	C
1	1	2	3
2	0	1	3
3	1	2	5
4			
5	-0.5	-2	1.5
6	1.5	1	-1.5
7	-0.5	0	0.5

5- Adjoint of Matrix -- $\text{Adj}(A)$ by Spreadsheet

V. Adjoint of Matrix $Adj(A)$.

Rule: If A a square matrix and $\det(A) \neq 0$, then $A^{-1} = \frac{1}{\det(A)} Adj(A)$

Example:

Given $A = \begin{bmatrix} 1 & 2 & 3 \\ 0 & 1 & 3 \\ 1 & 2 & 5 \end{bmatrix}$ Compute $Adj(A)$.

To do this operation in MS-Excel, the following procedures are to be followed:

1. Input the entries to Excel. Matrix A will be in cells (A1:C3).
2. As described above, do the following:
 - a. Compute $\det(A)$.
 - b. Compute A^{-1} .
 - c. Multiply A^{-1} by the $\det(A)$. _____

	A	B	C
1	1	2	3
2	0	1	3
3	1	2	5
4			
5	-1	-4	3
6	3	2	-3
7	-1	0	1

6- Transpose of matrix by Spreadsheet

VI. Transpose of Matrix A^T

Rule: Transpose means to change column of the matrix to rows and vice versa.

Example:

Given $A = \begin{bmatrix} 1 & 2 & 3 \\ 0 & 1 & 3 \\ 1 & 2 & 5 \end{bmatrix}$ Find the transpose of A which is usually denoted by matrix (A^T) .

To do this operation in MS-Excel, the following procedures are to be followed:

1. Input the entries to Excel. Matrix A will be in cells (A1:C3).
2. Select cells that range from A1 to C3. Then press Ctrl c to copy them.
3. Click on Cell A5

4. Click on the small arrow at Paste icon and select Transpose.

	A	B	C
1	1	2	3
2	0	1	3
3	1	2	5
4			
5	1	0	1
6	2	1	2
7	3	3	5

7- Solving system of equations by Spreadsheet

VII. Solve Systems Using Matrix Equations

Rule: The determinant of A should be non-zero.

Example:

Given the system bellow:

$$X + 2Y + 3Z = 6 \quad \text{-----1}$$

$$2X - Y + Z = 2 \quad \text{-----2}$$

$$5X + 2Y = 7 \quad \text{-----3}$$

Find the value of X, Y and Z.

To solve this problem:

1. Form the matrices $AB=C$

$$\begin{bmatrix} 1 & 2 & 3 \\ 2 & -1 & 1 \\ 5 & 2 & 0 \end{bmatrix} \begin{bmatrix} X \\ Y \\ Z \end{bmatrix} = \begin{bmatrix} 6 \\ 2 \\ 7 \end{bmatrix}$$

2. Find the $\det(A)$. since the $\det(A) = 35$, proceed to step 3

To solve this problem:

3. Find A^{-1} .
4. Multiply A^{-1} by C. the result is the answer for X,Y and Z.

$$\begin{bmatrix} X \\ Y \\ Z \end{bmatrix} = \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}$$

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7- Solving system of equations by Spreadsheet

	A	B	C	D	E
1	1	2	3		6
2	2	-1	1		2
3	5	2	0		7
4					
5	35				
6					
7	- 2/35	6/35	1/7		
8	1/7	- 3/7	1/7		
9	9/35	8/35	- 1/7		
10					
11	1				
12	1				
13	1				

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1 Math is not about memorizing ... Math is about understanding

Every rule in differentiation or integration has a geometric and practical meaning. Understand **why** we differentiate and **why** we integrate. Plot the function before solving — you will understand **50% of the problem** before you even start.

2 Solve problems every day, even just one

Consistency matters more than quantity.
One problem a day is better than 30 problems the night before the exam.
Remember:
Math = Practice × Practice

3 Use Excel to Explore and Understand Matrices

Excel is not just for data — it's a powerful tool to understand matrices.

Use it to perform basic operations like:

Matrix addition and subtraction

Multiplication

Determinants

Inverse matrices

Solving systems of linear equations

4 Create a One-Page Summary After Each Lecture

Keep it short and useful.

Include:

Key formulas

Important examples

Common mistakes

Two practice questions

Your summary sheet will save you **half the study time** at the end of the semester.

5 Never Hesitate to Ask Questions

Most students get stuck in Chapter 2 or 3 simply because they don't ask.

There is **no such thing as a silly question** — the real mistake is continuing without understanding.

قال الله تعالى :

وَيَسْأَلُونَكَ عَنِ الرُّوحِ قُلِ
الرُّوحُ مِنْ أَمْرِ رَبِّي وَمَا أُوتِيتُمْ
مِّنَ الْعِلْمِ إِلَّا قَلِيلًا



سورة الإسراء