

	NAME:	Rungiah Tirouvalen
	STUDENT ID:	2410805
	COURSE:	Cyber Security (Group A)
	LEVEL:	1
	LECTURER:	Dr. Narainsamy Pavaday
	MODULE:	ICT 1217Y Cyber Security Mathematics and Statistics

## Addition Of Matrix

### 2\*2 Matrix

$$\begin{bmatrix} 1 & 8 \\ 2 & 4 \end{bmatrix} + \begin{bmatrix} 5 & 7 \\ 6 & 8 \end{bmatrix} = \begin{bmatrix} 6 & 15 \\ 8 & 12 \end{bmatrix}$$

ANSWER

### 3\*3 Matrix

$$\begin{bmatrix} 1 & 2 & 3 \\ 9 & 5 & 6 \\ 7 & 8 & -2 \end{bmatrix} + \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix} = \begin{bmatrix} 2 & 4 & 6 \\ 13 & 10 & 12 \\ 14 & 16 & 7 \end{bmatrix}$$

ANSWER

### 4\*4 Matrix

$$\begin{bmatrix} 1 & 2 & 3 & 4 \\ 5 & 6 & 7 & 8 \\ 9 & 0 & 11 & 12 \\ 13 & 14 & 15 & 16 \end{bmatrix} + \begin{bmatrix} 1 & 2 & 8 & 4 \\ 5 & 4 & 7 & 8 \\ 9 & 5 & -7 & 12 \\ 12 & 14 & 24 & 16 \end{bmatrix} = \begin{bmatrix} 2 & 4 & 11 \\ 10 & 10 & 14 \\ 18 & 5 & 4 \\ 25 & 28 & 39 \end{bmatrix}$$

ANSWER

[illegible]

## Subtraction Of Matrix

2\*2 Matrix

5	6
7	8

-

1	2
3	4

=

4	4
4	4

ANSWER

3\*3 Matrix

18	8	7
6	5	4
3	2	1

-

1	2	3
4	5	6
7	8	9

=

17	6	4
2	0	-2
-4	-6	-8

ANSWER

4\*4 Matrix

17	8	5	8
12	14	19	11
17	9	22	26
23	25	31	36

-

1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16

=

16	6	2
7	8	12
8	-1	11
10	11	16

ANSWER

[illegible]

## Multiplication Of Matrix

### 2\*2 Matrix

1	2
3	4

\*

1	2
3	4

=

7	10
15	22

ANSWER

### 3\*3 Matrix

1	2	3
4	5	6
7	8	9

\*

1	2	3
4	5	6
7	8	9

=

30	36	42
66	81	96
102	126	150

ANSWER

### 4\*4 Matrix

1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16

\*

1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16

=

90	100	110
202	228	254
314	356	398
426	484	542

ANSWER

[illegible]

## Transpose Of Matrix

2\*2 Matrix

1	2
4	5

=

1	4
2	5

ANSWER

3\*3 Matrix

1	2	3
4	5	6
7	8	9

=

1	4	7
2	5	8
3	6	9

ANSWER

4\*4 Matrix

1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16

=

1	5	9	13
2	6	10	14
3	7	11	15
4	8	12	16

ANSWER



## Determinant Of Matrix

### 2\*2 Matrix

1	2
0	4

Determinant = 4

### 3\*3 Matrix

1	2	3
0	4	0
5	6	7

Determinant = -32

### 4\*4 Matrix

1	4	2	3
0	1	4	4
-1	0	1	0
2	0	4	1

DETERMINANT : 65

1	1	4	4
	0	1	0
	0	4	1

-4	0	4	4
	-1	1	0
	2	4	1

2	0
	-1
	2

1	1	4	4
	0	1	0

=	1	1	0
		4	1

-4	0
	0

[illegible]

	0	4	1			DET(ad-bc):		DET(ad-bc):
	1st Co-factor Mult.			1		1		0
-4	0	4	4	=	0	1	0	-1
	-1	1	0			4	1	2
	2	4	1					
	2nd Co-factor Mult.			80		1		-1
2	0	1	4	=	0	0	0	-1
	-1	0	0			0	1	2
	2	0	1					
	3rd Co-factor Mult.			2		0		-1
-3	0	1	4	=	0	0	1	-1
	-1	0	1			0	4	2
	2	0	4					
	4th Co-factor Mult.			-18		0		-6

DET(ad-bc): 0

0	4	-1	1
1		2	4

DET(ad-bc): -6

0	4	-1	0
1		2	0

DET(ad-bc): 0

1	4	-1	0
4		2	0

DET(ad-bc): 0

## Inverse Co-Factor Method

2\*2 Matrix

1	2
3	4

Co-Factor Matrix =	4	-3
	-2	1

Determinant =	-2
---------------	----

Inverse Det. =	-0.5
----------------	------

Transpose Co-Factor =	4	-2
	-3	1

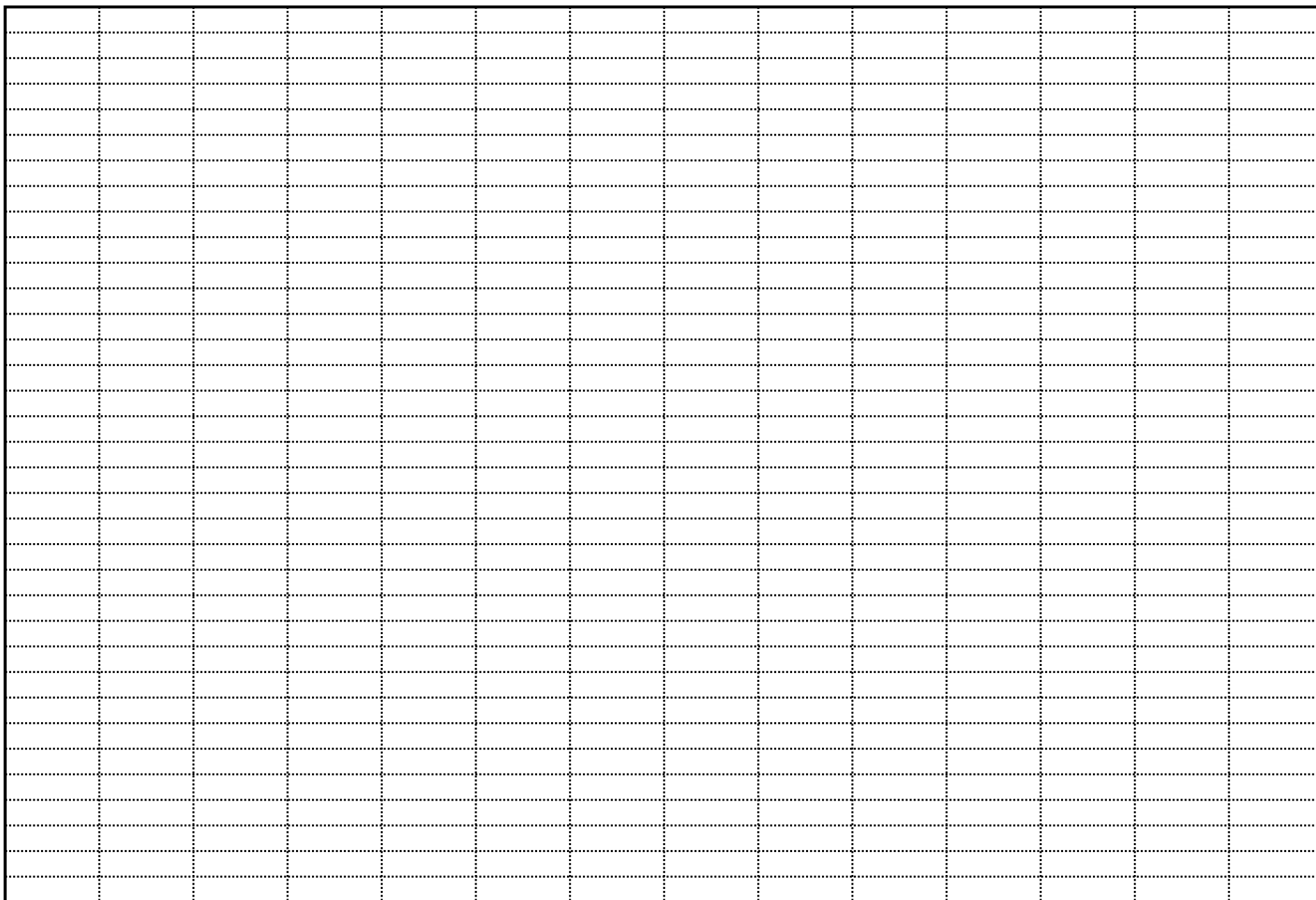
Inverse Matrix =	-2	1
	1.5	-0.5

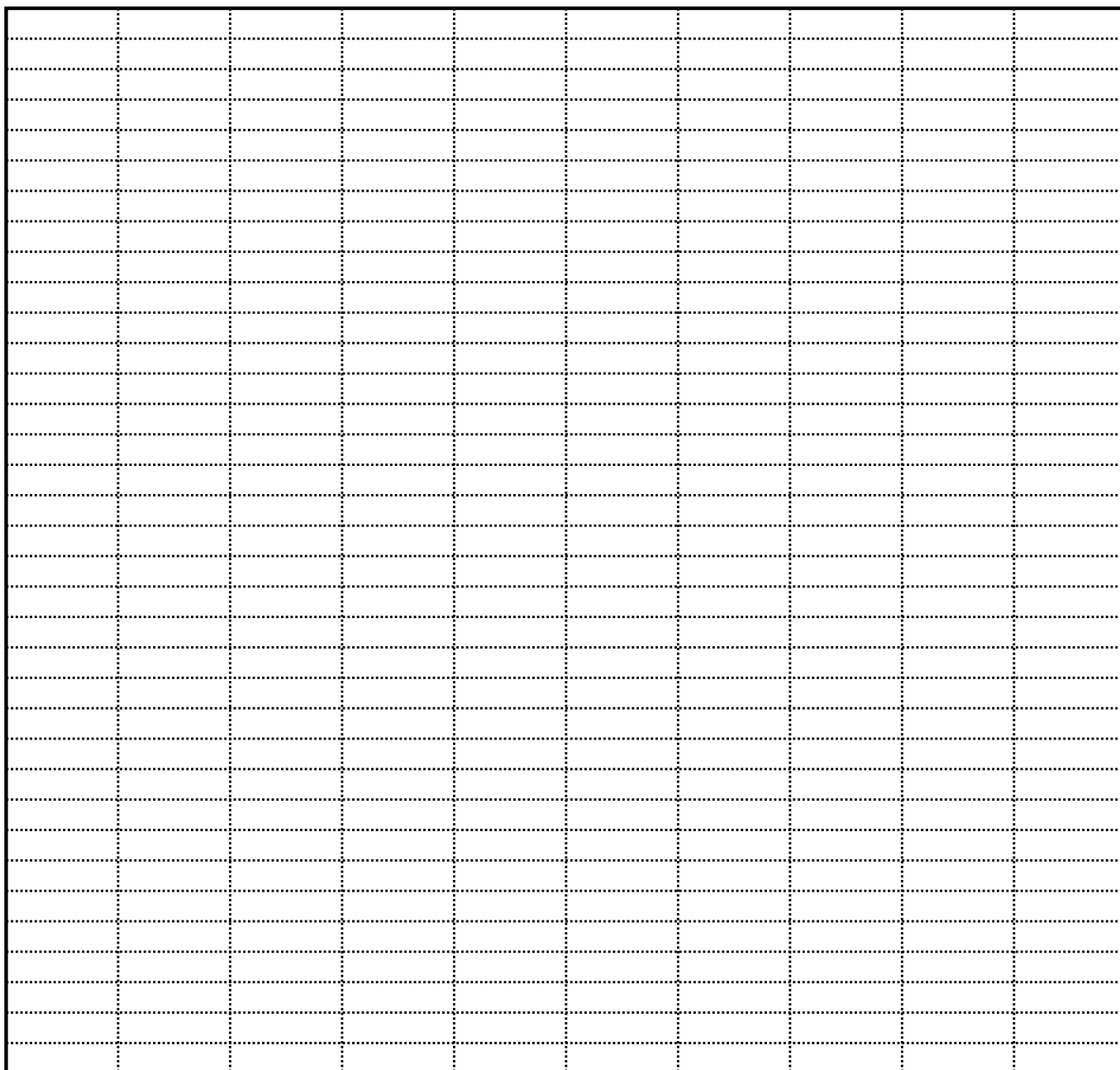
-2	1
1.5	-0.5
ANSWER	

3\*3 Matrix

1	2	3
0	4	0
5	6	7

Co-Factor Matrix =	28	0	-20
	4	-8	4





[illegible]



-0.07576	-0.22727	0.712121
0.348485	0.045455	-0.07576
0.030303	0.090909	-0.48485
-0.57576	0.272727	0.212121

0	-1	1	3	1
3		1	5	2
1		2	2	1

0	5	2
	2	1

DET(ad-bc) 1

6	1	3	0
	1	5	3
	2	2	1

= 1

DET(ad-bc)

5	3	-3	1	3	0	1	5
2	1		2	1		2	2
-1		DET(ad-bc)	-5		DET(ad-bc)	-8	



3rd Co-factor Mult. 84

0	1	2
	2	1

-1	1	3	1
	1	5	2
	2	2	1

= 1

DET(ad-bc) -3

DET(ad-bc)

4th Co-factor Mult. -2

3	1
5	2
2	1

nt 1:	1
nt 2:	1
nt 3:	2

Co-Factor Matrix

-2	-6	14	-2
-5	23	2	-38
-15	3	6	18
47	-5	-32	14

2	6
5	2
2	1

nt 1:	4
nt 2:	-10
nt 3:	-52

Transpose OF Matrix

-2	-5	-15	47
-6	23	3	-5
14	2	6	-32
-2	-38	18	14

2	6
3	1
2	1

nt 1:	4
nt 2:	-10
nt 3:	-32

Inverse Of Matrix

-0.0303	-0.07576	-0.22727	0.712121
-0.09091	0.348485	0.045455	-0.07576
0.212121	0.030303	0.090909	-0.48485

5	2	-3	1	2	1	5
2	1		2	1		2
1		DET(ad-bc)	-3		DET(ad-bc)	-8

4TH ROW	2	6	1		4	6	1		4	2	1		4
	3	1	0		1	1	0		1	3	0		1
	5	2	3		1	2	3		1	5	3		1
	Determinant 1:	6			Determinant 1:	12			Determinant 1:	36			Determina
	Determinant 2:	48			Determinant 2:	16			Determinant 2:	1			Determina
	Determinant 3:	-5			Determinant 3:	-1			Determinant 3:	-3			Determina

		-0.0303	-0.57576	0.272727	0.212121
2	6				
3	1				
5	2				
ht 1:	4				
ht 2:	-26				
ht 3:	-16				

## Inverse Row Operation

3\*3 Matrix

4	-1	2	\	1	0	0	1
-1	2	3	\	0	1	0	0
5	-7	9	\	0	0	1	0

WORKINGS

R1/PIVOT ELEMENT		1	-0.25	0.5	\	0.25	0	0
R2/\$B\$4	=	1	-2	-3	\	0	-1	0
R3/\$B\$5		1	-1.4	1.8	\	0	0	0.2

R1		1	-0.25	0.5	\	0.25	0	0
R2-R1	=	0	-1.75	-3.5	\	-0.25	-1	0
R3-R1		0	-1.15	1.3	\	-0.25	0	0.2

R1		1	-0.25	0.5	\	0.25	0	0
R2/\$E\$13	=	0	1	2	\	0.142857	0.571428571	0
R3/\$E\$14		0	1	-1.130434783	\	0.217391	0	-0.173913044

R1		1	-0.25	0.5	\	0.25	0	0
R2	=	0	1	2	\	0.142857	0.571428571	0
R3-R2		0	0	-3.130434783	\	0.074534	-0.571428571	-0.173913044

R1		1	-0.25	0.5	\	0.25	0	0
R2	=	0	1	2	\	0.142857	0.571428571	0
R3/\$F\$22		0	0	1	\	-0.02381	0.182539683	0.0555555556

R1-(R2*\$E\$24)		1	0	1	\	0.285714	0.142857143	0
R2	=	0	1	2	\	0.142857	0.571428571	0
R3		0	0	1	\	-0.02381	0.182539683	0.0555555556

R1-(R3*\$F\$28)		1	0	0	\	0.309524	-0.03968254	-0.0555555556
R2-(R3*\$F\$29)	=	0	1	0	\	0.190476	0.206349206	-0.1111111111



0	0	\	0.309524	-0.03968	-0.055555556
1	0	\	0.190476	0.206349	-0.111111111
0	1	\	-0.02381	0.18254	0.055555556
ANSWER					

R3			0	0	1	\	-0.02381	0.182539683	0.055555556	
4*4 Matrix										
	4	2	6	1	\	1	0	0	0	
	1	3	1	0	\	0	1	0	0	
	1	5	2	3	\	0	0	1	0	
	2	2	1	1	\	0	0	0	1	
							WORKING			
R1/PIVOT ELEMENT	=	1	0.5	1.5	0.25	/	0.25	0	0	
R2/\$B\$43		1	3	1	0	/	0	1	0	
R3/\$B\$44		1	5	2	3	/	0	0	1	
R4/\$B\$45		1	1	0.5	0.5	/	0	0	0	
R1		1	0.5	1.5	0.25	/	0.25	0	0	
R2-R1	=	0	2.5	-0.5	-0.25	/	-0.25	1	0	
R3-R1		0	4.5	0.5	2.75	/	-0.25	0	1	
R4-R1		0	0.5	-1	0.25	/	-0.25	0	0	
R1		1	0.5	1.5	0.25	/	0.25	0	0	
R2/\$E\$54	=	0	1	-0.2	-0.1	/	-0.1	0.4	0	
R3/\$E\$55		0	1	0.111111111	0.611111111	/	-0.055555556	0	0.222222222	
R4/\$E\$56		0	1	-2	0.5	/	-0.5	0	0	
R1		1	0.5	1.5	0.25	/	0.25	0	0	
R2	=	0	1	-0.2	-0.1	/	-0.1	0.4	0	
R3-R2		0	0	0.311111111	0.711111111	/	0.044444444	-0.4	0.222222222	
R4-R2		0	0	-1.8	0.6	/	-0.4	-0.4	0	
R1		1	0.5	1.5	0.25	/	0.25	0	0	
R2	=	0	1	-0.2	-0.1	/	-0.1	0.4	0	
R3		0	0	0.311111111	0.711111111	/	0.044444444	-0.4	0.222222222	

[illegible]

R4/\$F\$66			0	0	1	-0.333333333	/	0.222222222	0.222222222	0
R1		=	1	0.5	1.5	0.25	/	0.25	0	0
R2			0	1	-0.2	-0.1	/	-0.1	0.4	0
R3			0	0	0.311111111	0.711111111	/	0.044444444	-0.4	0.222222222
R4-(R3/\$F\$70\$)			0	0	0	-2.619047619	/	0.079365079	1.507936508	-0.714285714
R1		=	1	0.5	1.5	0.25	/	0.25	0	0
R2			0	1	-0.2	-0.1	/	-0.1	0.4	0
R3/\$F\$65			0	0	1	2.285714286	/	0.142857143	-1.285714286	0.714285714
R4/\$G\$76			0	0	0	1	/	-0.03030303	-0.575757576	0.272727273
R1-(R2*\$E\$78)		=	1	0	1.6	0.3	/	0.3	-0.2	0
R2			0	1	-0.2	-0.1	/	-0.1	0.4	0
R3			0	0	1	2.285714286	/	0.142857143	-1.285714286	0.714285714
R4			0	0	0	1	/	-0.03030303	-0.575757576	0.272727273
R1-(R4*\$F\$83)		=	1	0	0	-3.357142857	/	0.071428571	1.857142857	-1.142857143
R2			0	1	-0.2	-0.1	/	-0.1	0.4	0
R3			0	0	1	2.285714286	/	0.142857143	-1.285714286	0.714285714
R4			0	0	0	1	/	-0.03030303	-0.575757576	0.272727273
R1-(R4*\$G\$88)		=	1	0	0	0	/	-0.03030303	-0.075757576	-0.227272727
R2-(R3*\$F\$89)			0	1	0	0.357142857	/	-0.071428571	0.142857143	0.142857143
R3-(R4*\$G\$90)			0	0	1	0	/	0.212121212	0.03030303	0.090909091
R4			0	0	0	1	/	-0.03030303	-0.575757576	0.272727273
R1		=	1	0	0	0	/	-0.03030303	-0.075757576	-0.227272727
R2-(R4*\$G\$94)			0	1	0	0	/	-0.060606061	0.348484849	0.045454545
R3			0	0	1	0	/	0.212121212	0.03030303	0.090909091
R4			0	0	0	1	/	-0.03030303	-0.575757576	0.272727273

-0.55555556
0
0
0
-0.55555556
0
0
0
0.212121212
0
0
0
0.212121212
0
0
0
0.212121212
0.712121212
0
-0.484848485
0.212121212
0.712121212
-0.075757576
-0.484848485
0.212121212

## Cramer's Rule

### 3\*3 Matrix

4	-1	2	\	15
-1	2	3	\	5
5	-7	9	\	8
A				X

X1=	4
X2=	3
X3=	1
Answer	

Determinant of A = 126

X1

15	-1	2
5	2	3
8	-7	9

Determinant = 504

X1 = 4

X2

4	15	2
-1	5	3
5	8	9

Determinant = 378

X2 = 3

### 4\*4 Matrix

1	2	3	2	\	1
4	4	9	6	\	2
3	6	10	1	\	3
4	5	0	2	\	4
A					X

X1	0.239437
X2	0.619718
X3	-0.14085
X4	-0.02817
Answer	

A

1	2	3	2
4	4	9	6
3	6	10	1
4	5	0	2

Determinant of A: 213

X3

4	-1	15
-1	2	5
5	-7	8

Determinant =

126

X3=

1







	4	10	1		-9	6	1		6	6	10		2
		0	2			5	2			5	0		
	DET(ad-bc)	20			DET(ad-bc)	7			DET(ad-bc)	-50			DET(ad-bc)
	1st Co-factor Mult.	-283											2nd Co-fac
	3	2	4	6									-2
		3	6	1									
		4	5	2									
	2	6	1		-4	3	1		6	3	6		2
		5	2			4	2			4	5		
	DET(ad-bc)	7			DET(ad-bc)	2			DET(ad-bc)	-9			DET(ad-bc)
	3rd Co-factor Mult.	-144											4th Co-fac
X2	1	1	3	2									
	4	2	9	6					Determinant of X2:	132			
	3	3	10	1									
	4	4	0	2					X2 =	0.619718			
	1	2	9	6									-1
		3	10	1									
		4	0	2									
	2	10	1		-9	3	1		6	3	10		4
		0	2			4	2			4	0		

10	1		-9	3	1	6	3	10	
0	2			4	2		4	0	
20			DET(ad-bc)	2		DET(ad-bc)	-40		
or Mult.	436								
2	4	9							
3	6	10							
4	5	0							
6	10		-4	3	10	9	3	6	
5	0			4	0		4	5	
-50			DET(ad-bc)	-40		DET(ad-bc)	-9		
or Mult.	42								
4	9	6							
3	10	1							
4	0	2							
10	1		-9	3	1	6	3	10	
0	2			4	2		4	0	

	DET(ad-bc)	20		DET(ad-bc)	2		DET(ad-bc)	-40		DET(ad-bc)
	1st Co-factor Mult.	-218								2nd Co-fac
	3	4 2 6 3 3 1 4 4 2								-2
	4	3 1 4 2		-2	3 1 4 2		6	3 3 4 4		4
	DET(ad-bc)	2		DET(ad-bc)	2		DET(ad-bc)	0		DET(ad-bc)
	3rd Co-factor Mult.	12								4th Co-fac
X3	1 2 1 2 4 4 2 6 3 6 3 1 4 5 4 2			Determinant of X3:	-30					
				X3 =	-0.14085					
	1	4 2 6 6 3 1 5 4 2								-2
	4	3 1 4 2		-2	6 1 5 2		6	6 3 5 4		4
	DET(ad-bc)	2		DET(ad-bc)	7		DET(ad-bc)	9		DET(ad-bc)

20			DET(ad-bc)	2		DET(ad-bc)	-40
or Mult.	178						
4	2	9					
3	3	10					
4	4	0					
3	10		-2	3	10	9	3
4	0			4	0		4
-40			DET(ad-bc)	-40		DET(ad-bc)	0
or Mult.	160						
4	2	6					
3	3	1					
4	4	2					
3	1		-2	3	1	6	3
4	2			4	2		4
2			DET(ad-bc)	2		DET(ad-bc)	0

1st Co-factor Mult. 48

2nd Co-fac

1	4	4	6
	3	6	1
	4	5	2

-2

4	6	1
	5	2

-4	3	1
	4	2

6	3	6
	4	5

4

DET(ad-bc) 7

DET(ad-bc) 2

DET(ad-bc) -9

DET(ad-bc)

3rd Co-factor Mult. -34

4th Co-fac

X4	1	2	3	1
	4	4	9	2
	3	6	10	3
	4	5	0	4

Determinant of X4: -6

X4 = -0.02817

1	4	9	2
	6	10	3
	5	0	4

-2

4	10	3
	0	4

-9	6	3
	5	4

2	6	10
	5	0

4

DET(ad-bc) 40

DET(ad-bc) 9

DET(ad-bc) -50

DET(ad-bc)

1st Co-factor Mult. -21

2nd Co-fac

for Mult.	-8
-----------	----

4	4	2
3	6	3
4	5	4

6	3
5	4

-4

3	3
4	4

2

3	6
4	5

9
$$\text{DET}(ad-bc) \quad 0$$
$$\text{DET}(ad-bc) = -9$$

or Mult.	-36
----------	-----

4	9	2
3	10	3
4	0	4

10	3
0	4

-9

3	3
4	4

2

3	10
4	0

40
$$\text{DET}(ad-bc) \quad 0$$

DET(ad-bc)	-40
------------	-----

for Mult.	-160
-----------	------

[illegible]



4	4	9							
3	6	10							
4	5	0							
6	10		-4	3	10		9	3	6
5	0			4	0			4	5
-50			DET(ad-bc)	-40			DET(ad-bc)	-9	
or Mult.	121								

## Rank Of Matrix

4\*4 Matrix Homogenous

Augmented Matrix

4	1	1	1	/	1
1	3	-2	1	/	2
2	2	-3	2	/	3
3	3	2	2	/	2
A					B

1	0.25	0.25
0	1	-0.81818
0	0	-1.51515
0	0	0
A		

WORKING

R1/PIVOT ELEMENT

R2/\$C\$7

R3/\$C\$8

R4/\$C\$9

=

1	0.25	0.25	0.25	/	0.25
1	3	-2	1	/	2
1	1	-1.5	1	/	1.5
1	1	0.666667	0.666667	/	0.666667

R1

R2-R1

R3-R1

R4-R1

=

1	0.25	0.25	0.25	/	0.25
0	2.75	-2.25	0.75	/	1.75
0	0.75	-1.75	0.75	/	1.25
0	0.75	0.416667	0.416667	/	0.416667

R1

R2/\$G\$21

R3/\$G\$22

IF(\$G\$23<>0, R4/\$G\$23, R4)

=

1	0.25	0.25	0.25	/	0.25
0	1	-0.81818	0.272727	/	0.636364
0	1	-2.33333	1	/	1.666667
0	1	0.555556	0.555556	/	0.555556

R1

R2

R3-R2

=

1	0.25	0.25	0.25	/	0.25
0	1	-0.81818	0.272727	/	0.636364
0	0	-1.51515	0.727273	/	1.030303



	IF(\$G\$23<>0, (R4-F\$26), R4)		0	0	1.373737	0.282828	/	-0.08081			
R1			1	0.25	0.25	0.25	/	0.25			
R2		=	0	1	-0.81818	0.272727	/	0.636364			
	IF(\$G\$23<>0,G\$32,G\$32/\$H\$32)		0	0	-1.51515	0.727273	/	1.030303			
	R4/\$H\$33		0	0	1	0.205882	/	-0.05882			
R1			1	0.25	0.25	0.25	/	0.25			
R2		=	0	1	-0.81818	0.272727	/	0.636364			
R3			0	0	-1.51515	0.727273	/	1.030303			
	R4-(R3/H\$37\$)		0	0	0	0.685882	/	0.621176			

## GAUSS JACOBI

4\*4 Matrix

LEADING DIAGONAL DOMINANCE

ARRANGE ROW LEADING DIAGONAL DOMINANCE

6	1	3	2	\	1
5	6	-4	1	\	-2
2	-1	5	-3	\	3
2	3	-3	4	\	3

EQ1:  $6W + 1X + 3Y + 2Z = 1$

EQ2:  $5W + 6X - 4Y + 1Z = -2$

EQ3:  $2W - 1X + 5Y - 3Z = 3$

EQ4:  $2W + 3X - 3Y + 4Z = 3$



# NON LEADING DIAGONAL DOMINANCE

5	6	-4	1	\	-2
6	1	3	2	\	1
2	-1	5	-3	\	3
2	3	-3	4	\	3

	Sum
Row 1	3
Row 2	6
Row 3	1
Row 4	4

Using The IF statement AND MAX, the cells are swapped where the first column is maximum

6	1	3	2	\	1
5	6	-4	1	\	-2
2	-1	5	-3	\	3
2	3	-3	4	\	3

	Sum
Row 1	6
Row 2	3
Row 3	1
Row 4	4

EQ1: 6 W 1 X 3 Y 2 Z = 1

EQ2: 5 W 6 X -4 Y 1 Z = -2

EQ3: 2 W -1 X 5 Y -3 Z = 3

EQ4: 2 W 3 X -3 Y 4 Z = 3





# GAUSS SEIGEL

4\*4 Matrix

LEADING DIAGONAL DOMINANCE

ARRANGE ROW LEADING DIAGONAL DOMINANCE

6	1	3	2	\	1
5	6	-4	1		-2
2	-1	5	-3		3
2	3	-3	4		3

EQ1: 6 W 1 X 3 Y 2 Z =

EQ2: 5 W 6 X -4 Y 1 Z =

EQ3: 2 W -1 X 5 Y -3 Z =

EQ4: 2 W 3 X -3 Y 4 Z =

[illegible]

# NON LEADING DIAGONAL DOMINANCE

5	6	-4	1	\	-2
6	1	3	2		1
2	-1	5	-3		3
2	3	-3	4		3

	Sum
Row 1	3
Row 2	6
Row 3	1
Row 4	4

Using The IF statement AND MAX, the cells are swapped where the first column is maximum

6	1	3	2	\	1
5	6	-4	1		-2
2	-1	5	-3		3
2	3	-3	4		3

	Sum
Row 1	6
Row 2	3
Row 3	1
Row 4	4

EQ1: 6 W 1 X 3 Y 2 Z =

EQ2: 5 W 6 X -4 Y 1 Z =

EQ3: 2 W -1 X 5 Y -3 Z =

EQ4: 2 W 3 X -3 Y 4 Z =

[illegible]