6. MATRICES and A SET OF LINEAR EQUATIONS

This feature of the program allows the user to solve a set of linear equations with up to 70 unknown, to invert a square matrix and to multiply two matrices. Each matrix can be up to the size of 70x70.

NOTE:

To invert a matrix or to solve a set or linear equations, this program uses the Lotus INVERT command. Therefore any matrix that can't be inverted by LOTUS 1-2-3, can't be inverted by this program.

```
Integration  Differentiation  Curve_fit  Root_find  Matrices  Help
Integration of functions and data                [ESC] - Previous menu
```

Press <M> to get the next menu:

```
Invert_square_matrix  Multiply_matrices  Linear_equations_solver
```

6.1 <I>nvert_square_matrix

Press <I> to get the next menu:

```
Retrieve  Edit  Clear  Invert  Data_save  Help
```

6.1A <R>etrieve

Retrieve a spreadsheet matrix file (*.WK1), the matrix file includes the matrix as a square range starting at the A1 cell:

Press <R> to get the next prompt:

Input the file name - MATRIX

Type the file name and press ENTER to get the next screen:

_____

```
Retrieve  Edit  Clear  Invert  Data_save  Help
Retrieve a spreadsheet which include a matrix (see help)
```

	A	B	C	D	E
1	===				
2	Units	|	Output/Input	|	Memory	|
3	===				
4	None	|	0.00 |		0.00|
5	===				

	GA	GB	GC	GD	GE
1	1	8	9	1	
2	2	7	10	2	
3	3	6	3	7	
4	4	5	4	5	
5					

```
6
7
8
9
10
11
12
13
14
```

_____

The program combines the matrix file and puts it at the upper corner
at the cell GA1.

6.1B <E>dit

Press <E> to get into the EDIT mode.

The program is now in the Lotus EDIT mode. Type the numbers in the
cells. Use the cursor keys to move through the cells, press the ENTER
key only after you have finished inserting the numbers or if you don't
want to change anything. The ENTER key is used ONLY to finish the EDIT
mode and to get back to the menu.

                        **** WARNING ****

Since the program is now in the EDIT mode the Lotus keys are operative,
however the user is strongly advised to use ONLY the UP, PGUP, DOWN
and PGDN keys to scroll between the lines, the program doesn't allow
scrolling to the sides by hiding all the columns except the current
column. Trying to unhide the columns MAY destroy the program code.
For example: if by mistake you have pressed the "/" key press ESC to
get back to the READY mode and then press F2 to enter EDIT mode or
just continue to type or press ENTER key to exit.

6.1C <I>nvert

Press <I> to get the next screen:

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```
Retrieve   Edit   Clear   Invert   Data_save   Help
Retrieve a spreadsheet which include a matrix (see help)
              A              B             C             D             E
 1 =====================================================================
 2        Units          |        Output/Input      |        Memory         |
 3 =====================================================================
 4    None              |                   0.00  |                   0.00|
 5 =====================================================================
         GA             GB            GC            GD            GE
160   0.1064814815 −0.2314814815  −0.412037037  0.6481481481
161   0.4814814815 −0.4814814815  −0.037037037  0.1481481481
162 −0.2916666667  0.4166666667   0.0416666667 −0.1666666667
```

```
163 -0.3333333333  0.3333333333  0.3333333333 -0.3333333333
164
165
166
167
168
169
170
171
171
173
```

_____

The square matrix (4x4) is the inversion of the matrix at GA1. The
program stores the inverted matrix starting in the cell GA160.

6.2 <M>ultiply_matrices

Press <M> to get the next menu:

Retrieve 1st_matrix_edit 2nd_matrix_edit Clear Multiply Data_save Help

6.2A <R>etrieve

Retrieve a spreadsheet matrix file (*.WK1), the matrix file includes
the two matrices the first matrix starts at the A1 cell and the second
matrix starts at the A80 cell.

Press <R> to get the next prompt:

Input the file name - MATRIX

Type the file name and press ENTER to get the next screen:

_____

```
Retrieve 1st_matrix_edit 2nd_matrix_edit Clear Multiply Data_save Help
Retrieve a spreadsheet which includes the two matrices (see help)
           A             B             C             D             E
1 =====================================================================
2        Units          |       Output/Input       |      Memory      |
3 =====================================================================
4   None                |                  0.00 |                 0.00|
5 =====================================================================
          GA            GB            GC            GD            GE
1            1             8             9             1
2            2             7            10             2
3            3             6             3             7
4            4             5             4             5
5
6
7
8
```

```
9
10
11
12
13
14
```

_____

The program combines the matrix file and puts it at the upper corner
at the cell GA1 so that the second matrix is in the GA1 cell. To see
or to edit the two matrices use the following options:

<1>st_matrix_edit

Press <1> to get the next screen and to enter the EDIT mode for the
first matrix.

_____

```
GA1: 1                                                      EDIT
1

             A            B            C            D            E
1 ================================================================
2        Units          |       Output/Input      |      Memory      |
3 ================================================================
4   None                |                  0.00 |                 0.00|
5 ================================================================
        GA           GB           GC           GD           GE
1            1            8            9            1
2            2            7           10            2
3            3            6            3            7
4            4            5            4            5
5
6
7
8
9
10
11
12
13
14
```

_____

The program is now in the Lotus EDIT mode. Type the numbers in the
cells. Use the cursor keys to move through the cells, press the ENTER
key only after you have finished inserting the numbers or if you don't
want to change anything. The ENTER key is used ONLY to finish the EDIT
mode and to get back to the menu.

                        **** WARNING ****

Since the program is now in the EDIT mode the Lotus keys are operative,
however the user is strongly advised to use ONLY the UP, PGUP, DOWN
and PGDN keys to scroll between the lines, the program doesn't allow
scrolling to the sides by hiding all the columns except the current
column. Trying to unhide the columns MAY destroy the program code.
For example: if by mistake you have pressed the "/" key press ESC to
get back to the READY mode and then press F2 to enter EDIT mode or
just continue to type or press ENTER key to exit.

<2>nd_matrix_edit

Press <2> to get the next screen and to enter the EDIT mode for the
second matrix.

_____

```
GA80: 1                                                        EDIT
1

            A              B              C              D              E
1 ================================================================
2         Units        |        Output/Input        |        Memory        |
3 ================================================================
4   None                |                   0.00 |                   0.00|
5 ================================================================
            GA              GB              GC              GD              GE
80                   1              5
81                   2              5
82                   3              4
83                   4              0
84
85
86
87
88
89
90
91
92
93
```

_____

In this case the second matrix is a 4x2 matrix therefore the
multiplication of a 4x4 matrix by 4x2 matrix is a 4x2 matrix. The
program stores the second matrix at the GA80 cell.

<M>ultiply

Press <M> to get the resulted matrix and the next screen:

_____

Retrieve 1st_matrix_edit 2nd_matrix_edit Clear Multiply Data_save Help

Retrieve a spreadsheet which includes the two matrices (see help)

```
            A              B              C              D              E
1 ================================================================
2          Units         |        Output/Input       |       Memory        |
3 ================================================================
4   None                 |                    0.00 |                    0.00|
5 ================================================================
           GA             GB             GC             GD             GE
240              48             81
241              54             85
242              52             57
243              46             61
244
245
246
247
248
249
250
251
252
253
```

The program prints the result of the multiplication at the GA240 cell.

6.3 <L>inear_equations_solver

A set of linear equations can be written in matrix notation, for
example let's look on a set of four linear equations with the 4
unknown W, X, Y and Z.


```
 W+8X+ 9Y+ Z=47
2W+7X+10Y+2Z=57
3W+6X+ 3Y+7Z=43
4W+5X+ 4Y+5Z=44
```


can be rewritten in matrix language as:


```
| 1  8   9  Z |   | W |     | 47 |
| 2  7  10  2 | . | X |  =  | 57 |
| 3  6   3  7 |   | Y |     | 43 |
| 4  5   4  5 |   | Z |     | 44 |
```


The 4X4 matrix is called the 1st_matrix and the 4x1 matrix (vector)
is called the 2nd_matrix.

Press <L> to get the next menu:

Retrieve 1st_matrix_edit 2nd_matrix_edit Clear Solve Data_save Help

6.3A <R>etrieve

Retrieve a spreadsheet matrix file (*.WK1), the matrix file includes
the two matrices the first matrix starts at the A1 cell and the second
matrix starts at the A80 cell.

Press <R> to get the next prompt:

Input the file name - LINEAR

Type the file name and press ENTER to get the next screen:

Retrieve 1st_matrix_edit 2nd_matrix_edit Clear Solve Data_save Help
Retrieve a spreadsheet which includes the two matrices (see help)

	A	B	C	D	E
1	===
2	Units		Output/Input		Memory	
3	===
4	None		0.00		0.00
5	===

	GA	GB	GC	GD	GE
1	1	8	9	1	
2	2	7	10	2	
3	3	6	3	7	
4	4	5	4	5	
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					

The program combines the matrix file and puts it at the upper corner
at the cell GA1 so that the second matrix is in the GA1 cell. To see
or to edit the two matrices use the following options:

<1>st_matrix_edit

Press <1> to get the next screen and to enter the EDIT mode for the
first matrix.

GA1: 1   EDIT
1

	A	B	C	D	E
1	===
2	Units		Output/Input		Memory	

```
3 =============================================================================
4    None                    |                       0.00 |                    0.00|
5 =============================================================================
              GA              GB            GC            GD            GE
1               1             8             9             1
2               2             7            10             2
3               3             6             3             7
4               4             5             4             5
5
6
7
8
9
10
11
12
13
14
```

The program is now in the Lotus EDIT mode. Type the numbers in the
cells. Use the cursor keys to move through the cells, press the ENTER
key only after you have finished inserting the numbers or if you dont
want to change anything. The ENTER key is used ONLY to finish the EDIT
mode and to get back to the menu.

                          **** WARNING ****

Since the program is now in the EDIT mode the Lotus keys are operative,
however the user is strongly advised to use ONLY the UP, PGUP, DOWN
and PGDN keys to scroll between the lines, the program doesn't allow
scrolling to the sides by hiding all the columns except the current
column. Trying to unhide the columns MAY destroy the program code.
For example: if by mistake you have pressed the "/" key press ESC to
get back to the READY mode and then press F2 to enter EDIT mode or
just continue to type or press ENTER key to exit.

<2>nd_matrix_edit

Press <2> to get the next screen and to enter the EDIT mode for the
second matrix.

_____

```
GA80: 1                                                          EDIT
1

              A              B            C            D            E
1 =============================================================================
2          Units              |       Output/Input       |       Memory        |
3 =============================================================================
4    None                    |                       0.00 |                    0.00|
5 =============================================================================
```

	GA	GB	GC	GD	GE
80	47				
81	57				
82	43				
83	44				
84					
85					
86					
87					
88					
89					
90					
91					
92					
93					

_____

<S>olve

Press <s> to get the resulted matrix (solution) and the next screen:

_____

Retrieve 1st_matrix_edit 2nd_matrix_edit Clear Solve Data_save Help
Retrieve a spreadsheet which includes the two matrices (see help)

	A	B	C	D	E
1	===
2	Units	|	Output/Input	|	Memory	|
3	===
4	None	|	0.00 |		0.00|
5	===

	GA	GB	GC	GD	GE
240	4				
241	3				
242	2				
243	1				
244					
245					
246					
247					
248					
249					
250					
251					
252					
253					

_____

The program prints the result of the multiplication at the GA240 cell.