

#### 4. SOLVER

Using the solver in this program the user can do:

- o Integration of analytic functions and data tables
- o Differentiation of analytic functions and data tables
- o Regression curve fitting
  - 1st to 8th order Polynomial
  - 1 to 8 products of powers
  - Exponential
  - Multi-linear (8 variables max)
- o Root finding of non linear equations
  - Plot and search
  - Under relaxation
  - Newton's
- o Matrix operations and linear equations solving
  - Invert a matrix (up to 70x70)
  - Multiply two matrices (up to 70x70)
  - Solve a set of linear equations (up to 70 unknown)

Press <S> to get the next menu:

Integration    Differentiation    Curve\_fit    Root\_find    Help

#### 4.1 INTEGRATION

Press <I> to get the next menu:

Function    Data    Help

<F>unction

Using this option the user can integrate analytic functions. The function should be written using Lotus rules (built-in Lotus functions begin with the "@" character like @SIN(X) or use the "+" or "-" signs).

Press <F> to get the next screen:

---

	A	B	C	D	E
1	=====				
2	Units		Output/Input		Memory
3	=====				
4	None		5.00		0.00
5	=====				
	EV	EW	EX	EY	EZ
1	@cos(var)-var				
2					
3					
4					
5					
6					

7  
 8 Input or edit the function as a FORMULA and press ENTER ....  
 9  
 10  
 11  
 12  
 13  
 14

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The program is now in the Lotus EDIT mode, edit or type a function and than press the ENTER key or just press the ENTER key for no changes. When you are finished editing the function press ENTER to return to the previous 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 mget back to the READY mode and then press F2 to enter EDIT mode or just continue to type or press ENTER to exit.

Type the formula [ @cos(var)-var ] and press ENTER to get the next menu:

Rectangle Trapezoid Romberg 1/3 Simpsons 3/8 Simpsons Graph Help

Choosing one of the integration methods brings the next the three prompts

Input the lower limit - 0

Input the upper limit - 14

Input the number of steps - 200

For each prompt type the appropriate number and press ENTER. The results for Rectangle method and these inputs are:

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	Rectangle	Trapezoid	A_Romberg	Graph	Help
	Rectangle rule integration				[ESC] - Previous menu
	A	B	C	D	E
1	=====				
2	Units		Output/Input		Memory
3	=====				
4	None		-96.49		0.00
5	=====				
	EV	EW	EX	EY	EZ
1	1	0	0.07	0.07	
2	0.9275510003	0.07	0.06492857	0.13492857	
3	0.8502159962	0.14	0.0595151197	0.1944436898	
4	0.7680309147	0.21	0.053762164	0.2482058538	

5	0.6810554383	0.28	0.0476738807	0.2958797345
6	0.5893727128	0.35	0.0412560899	0.3371358244
7	0.4930889403	0.42	0.0345162258	0.3716520502
8	0.3923328586	0.49	0.0274633001	0.3991153503
9	0.287255111	0.56	0.0201078578	0.4192232081
10	0.1780275083	0.63	0.0124619256	0.4316851336
11	0.0648421873	0.7	0.0045389531	0.4362240868
12	-0.0520893304	0.77	-0.0036462531	0.4325778336
13	-0.1725371742	0.84	-0.0120776022	0.4205002314
14	-0.2962542505	0.91	-0.0207377975	0.3997624339

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To see the graphs press <G> the next screen appears:

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Before  After  Data_save  Graph_save  Help
The function before integration          [ESC] - Previous menu
      A          B          C          D          E
1 =====
2          Units          |          Output/Input          |          Memory          |
3 =====
4  None          |          -96.49          |          0.00          |
5 =====
      EV          EW          EX          EY          EZ
1          1          0          0.07          0.07
2  0.9275510003          0.07          0.06492857          0.13492857
3  0.8502159962          0.14          0.0595151197          0.1944436898
4  0.7680309147          0.21          0.053762164          0.2482058538
5  0.6810554383          0.28          0.0476738807          0.2958797345
6  0.5893727128          0.35          0.0412560899          0.3371358244
7  0.4930889403          0.42          0.0345162258          0.3716520502
8  0.3923328586          0.49          0.0274633001          0.3991153503
9  0.287255111          0.56          0.0201078578          0.4192232081
10 0.1780275083          0.63          0.0124619256          0.4316851336
11 0.0648421873          0.7          0.0045389531          0.4362240868
12 -0.0520893304          0.77          -0.0036462531          0.4325778336
13 -0.1725371742          0.84          -0.0120776022          0.4205002314
14 -0.2962542505          0.91          -0.0207377975          0.3997624339

```

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<B>efore - View the original graph

<A>fter - View the graph after integration

<D>ata\_save - Save the data table to a disk as a text (ASCII) file for later use

<G>raph\_save - Creates a .PIC file of the last displayed graph

The column EV includes the function values  $Y = @cos(var) - var$   
The column EW includes the independent variable (var) values  
The column EY includes the integral values.

To see the function before integration print the file INTBEF.PIC.  
using Lotus PRINTGRAPH. To see the function after integration print  
the file INTAFT.PIC.

<D>ata

Using this option the user can integrate a function given as a data table. The table should be arranged in two columns of numbers as a text (ASCII) file. The first column is F(X) and the second column is X.

Press <D> to get the next prompt:

Input file name - ISRA7.PRN

The next screen appears:

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Rectangle	Trapezoid	A_Romberg	Graph	Help	
Rectangle rule integration					[ESC] - Previous menu
	A	B	C	D	E
1	=====				
2	Units		Output/Input		Memory
3	=====				
4	None		0.00		0.00
5	=====				
	EV	EW	EX	EY	EZ
1	1200	1195			
2	1201	1195.14			
3	1201	1195.28			
4	1201.5	1195.42			
5	1200	1195.56			
6	1201	1195.7			
7	1201	1195.84			
8	1201.5	1195.98			
9	1199	1196.12			
10	1198	1196.26			
11	1197	1196.4			
12	1197.5	1196.54			
13	1200	1196.68			
14	1201	1196.82			

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The user can choose 3 integration methods:

- Rectangle
- Trapezoid
- Romberg

IMPORTANT: The first two methods can use unevenly spaced data, the third methods MUST HAVE the data points to be evenly spaced to get accurate results.

Press <R> to get the next screen:

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Rectangle	Trapezoid	Romberg	Graph	Help	
Rectangle rule integration					[ESC] - Previous menu
	A	B	C	D	E
1	=====				

2	Units	Output/Input	Memory		
3					
4	None	0.00	0.00		
5					
	EV	EW	EX	EY	EZ
1	1200	1195	168	168	
2	1201	1195.14	168.14	336.14	
3	1201	1195.28	168.14	504.28	
4	1201.5	1195.42	168.21	672.49	
5	1200	1195.56	168	840.49	
6	1201	1195.7	168.14	1008.63	
7	1201	1195.84	168.14	1176.77	
8	1201.5	1195.98	168.21	1344.98	
9	1199	1196.12	167.86	1512.84	
10	1198	1196.26	167.72	1680.56	
11	1197	1196.4	167.58	1848.14	
12	1197.5	1196.54	167.65	2015.79	
13	1200	1196.68	168	2183.79	
14	1201	1196.82	168.14	2351.93	

The number 16298.52 in output display is the integration result.

Press <G>raph to get the next menu:

Before After Data\_save Graph\_save Help

<B>efore - View the original graph

<A>fter - View the graph after integration

<D>ata\_save - Save the data table to a disk as a text (ASCII) file for later use

<G>raph\_save - Creates a .PIC file of the last displayed graph

The column EV includes the function values  $Y = @\cos(\text{var}) - \text{var}$

The column EW includes the independent variable (var)

The column EY includes the integral values.

To see the function before integration print the file DINTBEF.PIC  
Using Lotus PRINTGRAPH. To see the function after integration print  
the file DINTAFT.PIC.