

# INTRODUCTION (Spreadsheet, i.e. MS Excel)



• A. J. Clark School of Engineering • Department of Civil and Environmental Engineering



by

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**ENCE 203 - Computation Methods in Civil Engineering II**

Department of Civil and Environmental Engineering

University of Maryland, College Park

## High-level Languages vs. Spreadsheets, MATLAB & MathCad



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- FORTRAN (introduced by IBM in 1957)
  - FORTRAN = *FOR*mula *TRAN*slation
  - *Developed for the IBM 704 Computer*
  - *Developed by John Backus and a team of 13 other programmers*
- BASIC
- Pascal
- Others such as C and C++



# High-level Languages vs. Spreadsheets, MATLAB & MathCad

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## ■ Software Packages

- MATLAB
- MathCad
- Spreadsheet
  - MS Excel
  - Quattro Pro
  - Lotus 123



# High-level Languages vs. Spreadsheets, MATLAB & MathCad

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## ■ FORTRAN

- FORTRAN is a high-level language such as BASIC, C, and C++
- A compiler translates each statement in the program into a sequence of basic machine language instruction

$$X = A * B + C$$



# High-level Languages vs. Spreadsheets, MATLAB & MathCad

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## ■ FORTRAN

Source Program  
(high level language)



Compiler



Object Program  
(machine language)



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## ■ FORTRAN

- A FORTRAN program consists of
  - Input
  - An execution logic (computation)
  - Output
- A flow chart is used to develop the structure



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## ■ FORTRAN

### – EXAMPLE 1: Volume of a Cylinder

- Input
  - Diameter,  $D$
  - Height,  $h$
- Computation

$$V = \left( \frac{\pi D^2}{4} \right) \times h$$

- Output
  - Volume,  $V$

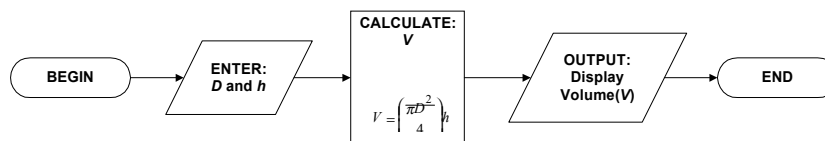


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## ■ FORTRAN

### – Flow Chart for the Example 1



A flow chart is a block diagram that summarizes the program structure and logic flow



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## ■ FORTRAN

### – EXAMPLE 2: Height of a Cylinder

- Input:
  - Diameter,  $D$
  - Volume,  $V$
- Computation

$$h = \frac{4V}{\pi D^2}$$

- Output:
  - Height,  $h$

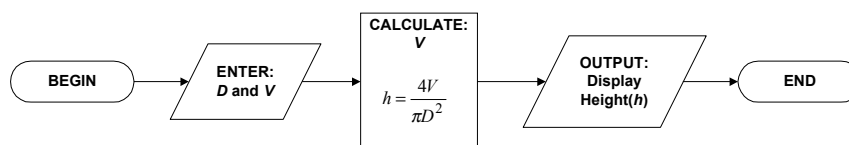


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## ■ FORTRAN

### – Flow Chart for Example 2





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## ■ FORTRAN

– The following is a format of a simple program:

- PROGRAM NAME
- Opening documentation use
- Variables declaration
- Program statements
- END



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## ■ FORTRAN Statements

- Positions 7 to 72 of a line can be used. To continue on the next line, use any character on position 6 of the next line

## ■ Constants

– Examples

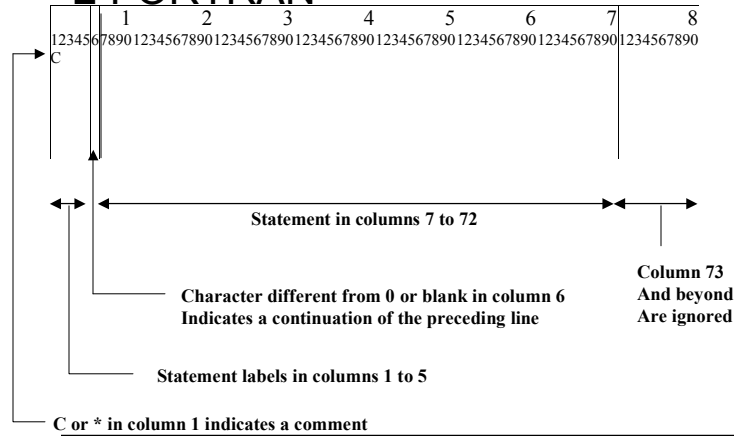
- -12
- 1.2345
- 12.45-e10



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## ■ FORTRAN



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## ■ FORTRAN

### – Data Types

- Integer
- Real
- Double Precision
- Complex
- Character
- Logical

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## ■ FORTRAN

- This program calculates the velocity and height of a projectile given its initial height, velocity, and constant acceleration

$$\text{Height: } h = \frac{1}{2}at^2 + v_0t + h_0$$

$$\text{Velocity: } v = at + v_0$$



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## ■ FORTRAN

```
PROGRAM PROJECT
C
C 1
C 1234567890
C This program calculates the velocity and height of a projectile given its
C initial height, initial velocity, and constant acceleration. Variables used are:
C HGHT0 : initial height
C HGHT : height at any time
C VELOC0 : initial vertical velocity
C VELOC : vertical velocity at any time
C ACCEL : vertical acceleration (Gravity)
C TIME : time elapsed since projectile was launched

REAL HGHT0, HGHT, VELOC0, VELOC, ACCEL, TIME

ACCEL = -9.807
PRINT *, 'Enter initial height, initial velocity, and time?'
READ *, HGHT0, VELOC0, TIME

HGHT = 0.5 * ACCEL * TIME ** 2 + VELOC0 * TIME + HGHT0
VELOC = ACCEL * TIME + VELOC0

PRINT *, 'AT TIME ', TIME, ' THE VERTICAL VELOCITY IS ', VELOC
PRINT *, ' AND THE HEIGHT IS ', HGHT
END
```





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## ■ Spreadsheets

- Spreadsheet is special type software that allow the user to enter and perform calculations on rows and columns of data displayed on computer monitor.
- Advantages of Spreadsheet
  - Easy to use and understand
  - Provide organized record of user computation
  - Entire calculation can be updated easily
  - Suitable for “what if?” scenarios



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## ■ Spreadsheet Calculations

$B5 = B3 + B4$

	A	B	C	D	E	F	I
1							
2							
3	X =	10					
4	Y =	13.5					
5	Sum =	23.5					
6							
7							
8	u =	45					
9	v =	25					
10	$\sqrt{uv} =$	33.54102					
11							
12							

$B10 = \text{sqrt}(B8*B9)$



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## ■ Spreadsheet

### – EXAMPLE 1: Volume of a Cylinder

- Input
  - Diameter,  $D$
  - Height,  $h$
- Computation

$$V = \left( \frac{\pi D^2}{4} \right) \times h$$

- Output
  - Volume,  $V$



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## ■ Spreadsheet (Example 1)

	A	B	C	D	E	F	I
1							
2				Volume of Cylinder:			
3	X =	10		D =	20	in	
4	Y =	13.5		h =	76	in	
5	Sum =	23.5		Volume =	23876.1	in <sup>2</sup>	
6							
7							
8	u =	45					
9	v =	25					
10	$\sqrt{\quad}$	33.54102					
11	uv =						
12							
			B10 = sqrt(B8*B9)		(PI()*E3^2/4)*E4		



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## ■ Spreadsheet

### – EXAMPLE 2: Height of a Cylinder

- Input:
  - Diameter,  $D$
  - Volume,  $V$
- Computation

$$h = \frac{4V}{\pi D^2}$$

- Output:
  - Height,  $h$



# High-level Languages vs. Spreadsheets, MATLAB & MathCad

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## ■ Spreadsheet (Example 2)

	A	B	C	D	E	F	I
			B5 = B3 + B4				
1							
2				Volume of Cylinder:			
3	X =	10		D =	20	in	
4	Y =	13.5		V =	23876.10417	in <sup>3</sup>	
5	Sum =	23.5		h =	76	in	
6							
7							
8	u =	45					
9	v =	25					
10	$\sqrt{uv}$ =	33.54102					
11							
12							
			B10 = sqrt(B8*B9)		E5 = (4*E4/(PI()*E3^2)))		

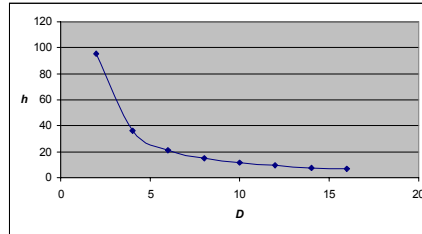


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## ■ Spreadsheet Calculations

	A	B	C	D	E
1					
2		Diameter, $D$	Volume, $V$	Calculated Height, $h$	
3		2	300	95.49296586	
4		4	450	35.8098622	
5		6	600	21.22065908	
6		8	750	14.92077591	
7		10	900	11.4591559	
8		12	1050	9.284038347	
9		14	1200	7.795344151	
10		16	1350	6.714349162	
11					
12					

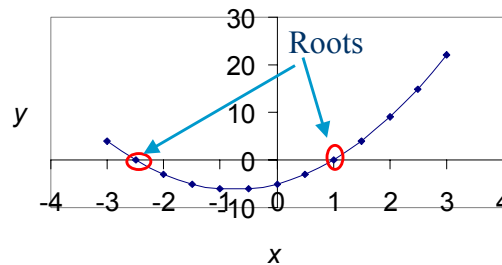


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## ■ Spreadsheet & Numerical Solutions

$x$	$y$
-3	4
-2.5	0
-2	-3
-1.5	-5
-1	-6
-0.5	-6
0	-5
0.5	-3
1	0
1.5	4
2	9
2.5	15
3	22

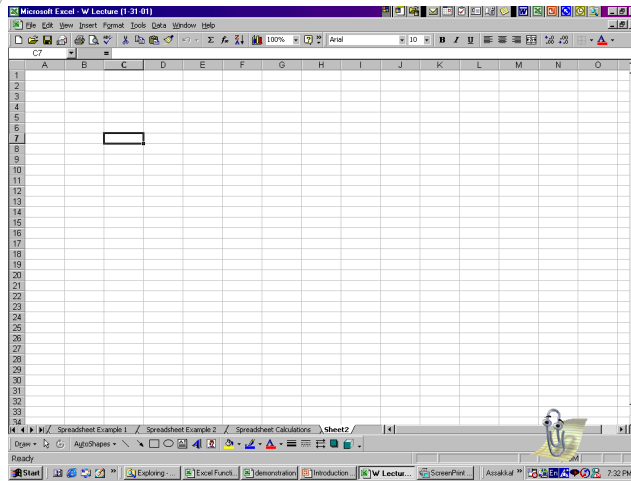


$$y = 2x^2 + 3x - 5 = 0$$

# Introduction to MS Excel



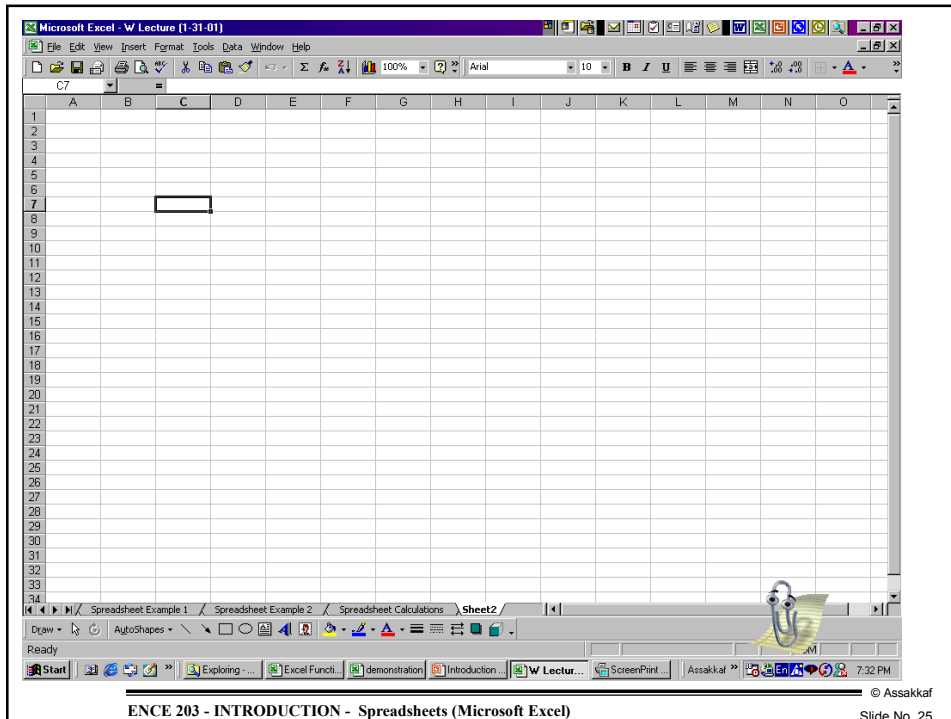
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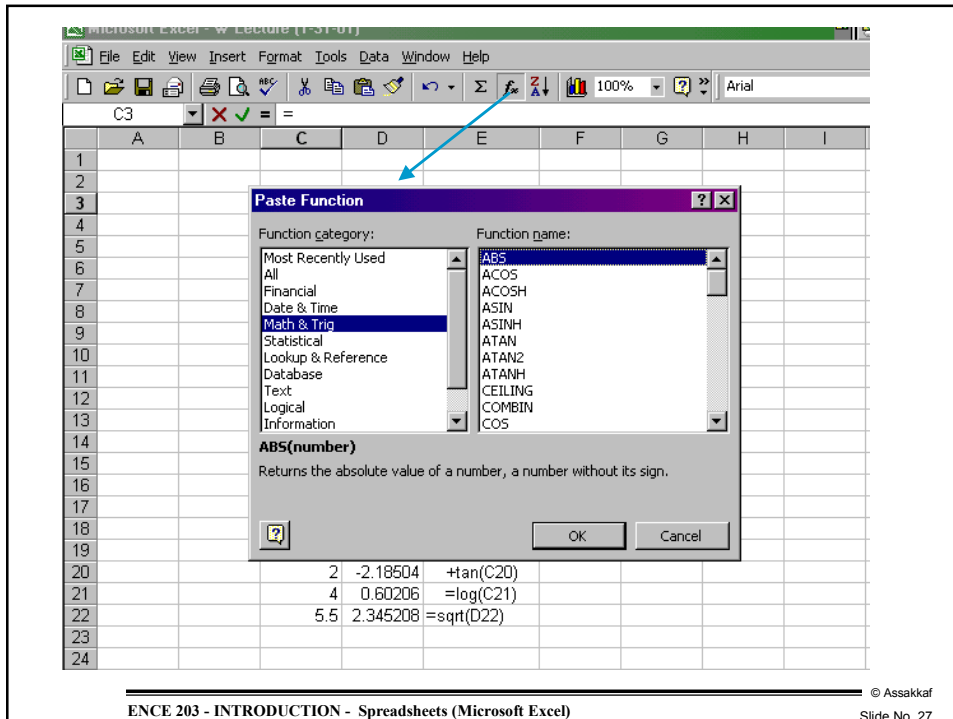
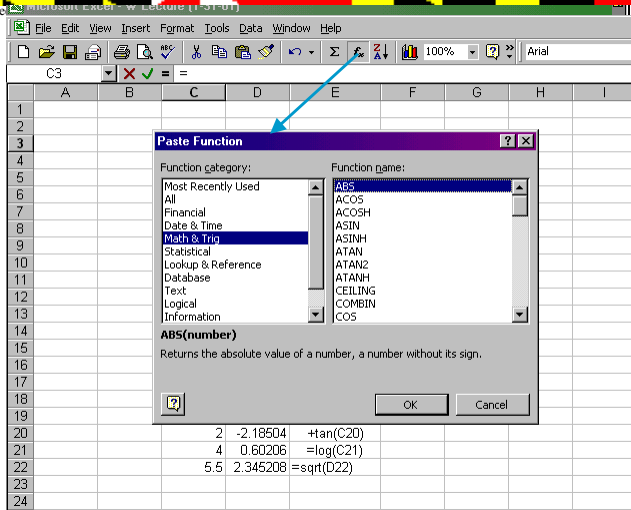
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# Introduction to MS Excel



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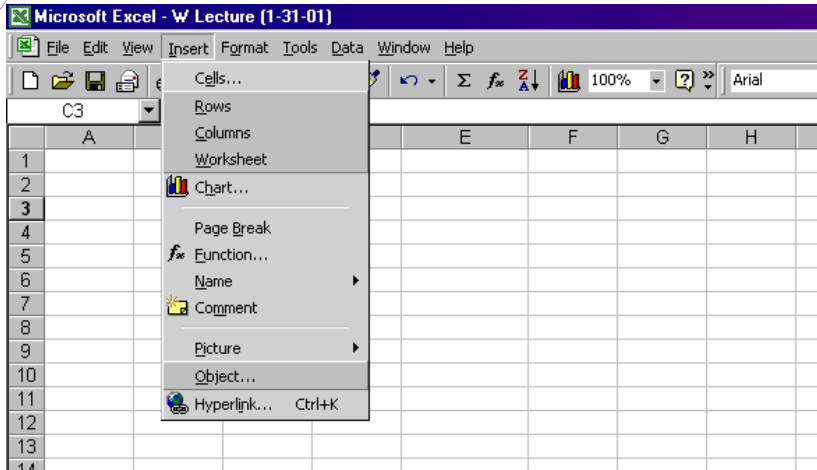
## MS Excel Math and Trig. functions



# Introduction to MS Excel



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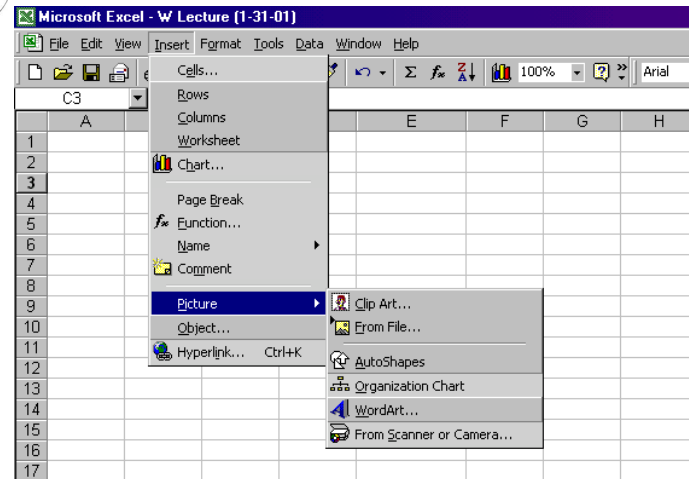
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# Introduction to MS Excel



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# Introduction to MS Excel

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The screenshot shows the Microsoft Excel interface with a menu open over a table of data. The table has columns A and B, and rows 6 through 19. The data is as follows:

	A	B
6	x	y
7	0	30
8	1.2	34
9	2.4	45
10	3.6	56
11	4.8	100
12	6	102
13	7.2	97
14	8.4	83
15	9.6	48
16	10.8	36
17	12	30
18	13.2	29
19	14.4	25
20	15.6	15

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# Introduction to MS Excel

The screenshot shows the Microsoft Excel interface with the 'Format Cells' dialog box open. The dialog box has tabs for Number, Alignment, Font, Border, Patterns, and Protection. The 'Number' tab is selected, and the 'Cell shading' section is visible. The 'Color' dropdown is set to 'No Color'. The 'Pattern' dropdown is also visible. The background shows the same table of data as in the previous slide.

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# Introduction to MS Excel

Chart Wizard - Step 1 of 4 - Chart Type

Standard Types Custom Types

Chart type: XY (Scatter)

Chart sub-type: Scatter with data points connected by smoothed Lines.

Press and Hold to View Sample

Cancel < Back Next > Finish

x	y
0	30
1.2	34
2.4	45
3.6	56
4.8	100
6	102
7.2	97
8.4	83
9.6	48
10.8	36
12	30
13.2	29
14.4	25
15.6	15

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# Introduction to MS Excel

Chart Wizard - Step 2 of 4 - Chart Source Data

Data Range Series

Data range: =Sheet2!\$B\$5:\$C\$19

Series in:  Rows  Columns

Cancel < Back Next > Finish

x	y
0	30
1.2	34
2.4	45
3.6	56
4.8	100
6	102
7.2	97
8.4	83
9.6	48
10.8	36
12	30
13.2	29
14.4	25
15.6	15

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# Introduction to MS Excel



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Microsoft Excel - W Lecture [1-31-01]

File Edit View Insert Format Tools Data Window Help

	A	B	C	D	E	F	G	H	I	J	K
1											
2											
3											
4											
5											
6		x	y								
7		0	30								
8		1.2	34								
9		2.4	45								
10		3.6	56								
11		4.8	100								
12		6	102								
13		7.2	97								
14		8.4	83								
15		9.6	48								
16		10.8	36								
17		12	30								
18		13.2	29								
19		14.4	25								
20		15.6	15								
21											

**Chart Wizard - Step 3 of 4 - Chart Options**

Titles | Axes | Gridlines | Legend | Data Labels

Chart title: Plot of Y vs. X

Value (X) axis: x

Value (Y) axis: y

Second category (X) axis:

Second value (Y) axis:

Cancel < Back Next > Finish

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# Introduction to MS Excel



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Microsoft Excel - W Lecture [1-31-01]

File Edit View Insert Format Tools Data Window Help

	A	B	C	D	E	F	G	H	I	J	K
1											
2											
3											
4											
5											
6		x	y								
7		0	30								
8		1.2	34								
9		2.4	45								
10		3.6	56								
11		4.8	100								
12		6	102								
13		7.2	97								
14		8.4	83								
15		9.6	48								
16		10.8	36								
17		12	30								
18		13.2	29								
19		14.4	25								
20		15.6	15								
21											

**Chart Wizard - Step 4 of 4 - Chart Location**

Place chart:

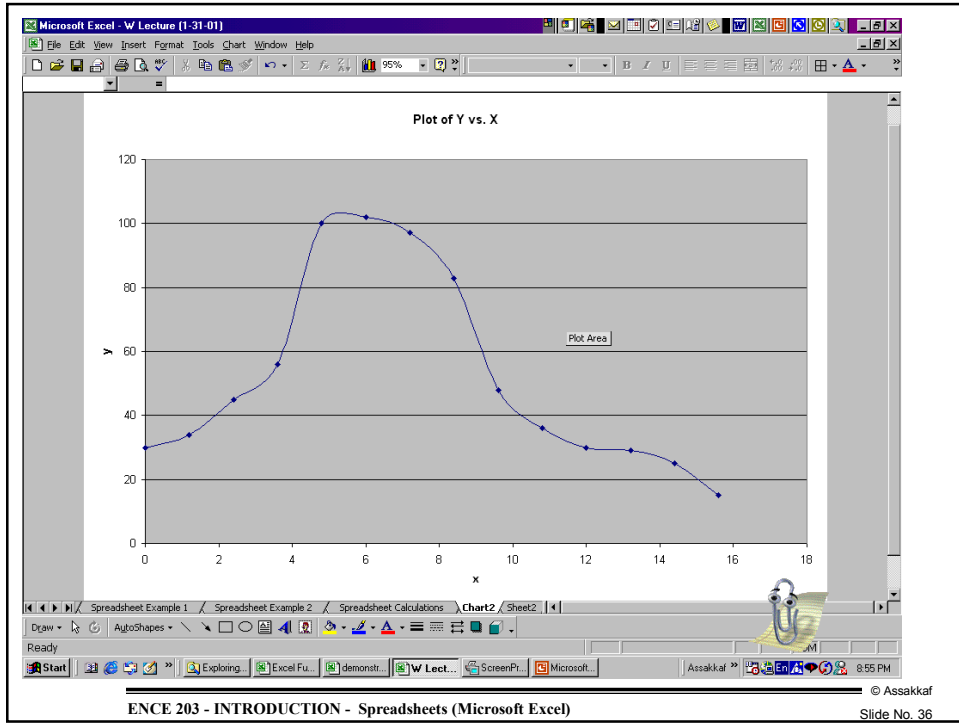
As new sheet: Chart2

As object in: Sheet2

Cancel < Back Next > Finish

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# Introduction to MS Excel

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$y = x^2 - 2x - 20$

x	y	Formula
0	-20	=+B6^2-2*B6-20
1.2	-20.96	=+B7^2-2*B7-20
2.4	-19.04	=+B8^2-2*B8-20
3.6	-14.24	=+B9^2-2*B9-20
4.8	-6.56	=+B10^2-2*B10-20
6	4	=+B11^2-2*B11-20
7.2	17.44	=+B12^2-2*B12-20
8.4	33.76	=+B13^2-2*B13-20
9.6	52.96	=+B14^2-2*B14-20
10.8	75.04	=+B15^2-2*B15-20
12	100	=+B16^2-2*B16-20
13.2	127.84	=+B17^2-2*B17-20
14.4	158.56	=+B18^2-2*B18-20
15.6	192.16	=+B19^2-2*B19-20

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# Introduction to MS Excel



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The screenshot shows an Excel spreadsheet with the following data:

x	y
0	-20
1.2	-20.96
2.4	-19.04
3.6	-14.24
4.8	6.56
6	4
7.2	17.44
8.4	33.76
9.6	52.96
10.8	75.04
12	100
13.2	127.84
14.4	158.56
15.6	192.16

The 'Object' dialog box is open, showing the 'Microsoft Equation 3.0' object type selected. The 'Result' field contains the text: 'Inserts a new Microsoft Equation 3.0 object into your document.'

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# Introduction to MS Excel



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The screenshot shows the same Excel spreadsheet as slide 38. The 'Tools' menu is open, showing the following options:

- Spelling...
- AutoCorrect...
- Share Workbook...
- Track Changes
- Merge Workbooks...
- Protection
- Online Collaboration
- Goal Seek...
- Scenarios...
- Auditing
- Macro
- Add-Ins...
- Customize...
- Options...
- Data Analysis...

A blue arrow points to the 'Goal Seek...' option in the menu.

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# Introduction to MS Excel

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Microsoft Excel - W Lecture (1-31-01)

Microsoft Excel - W Lecture (1-31-01)

File Edit View Insert Format Tools Data Window Help

100% Arial 10

B16

1

2

3  $y = x^2 - 2x - 20$

4

5

x	y
0	-20
1.2	-20.96
2.4	-19.04
3.6	-14.24
4.8	-6.56
6	4
7.2	17.44
8.4	33.76
9.6	52.96
10.8	75.04
12	100
13.2	127.84
14.4	158.56
15.6	192.16

Goal Seek

Set cell:  $\$C\$16$

To value: 0

By changing cell:  $\$B\$16$

OK Cancel

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# Introduction to MS Excel

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Microsoft Excel - W Lecture (1-31-01)

Microsoft Excel - W Lecture (1-31-01)

File Edit View Insert Format Tools Data Window Help

100% Arial 10

G14

1

2

3  $y = x^2 - 2x - 20$

4

x	y
0	-20
1.2	-20.96
2.4	-19.04
3.6	-14.24
4.8	-6.56
6	4
7.2	17.44
8.4	33.76
9.6	52.96
10.8	75.04
5.582576	3.5E-06
6.782576	-12.43819
7.982576	27.75637
9.182576	45.95455

Goal Seek Status

Goal Seeking with Cell C16

Found a solution.

Target value: 0

Current value: 3.50111E-06

OK

Cancel

Step

Pause

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