

INTRODUCTION (Spreadsheet, i.e. MS Excel)



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



by

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Spring 2001

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++



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■ Software Packages

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



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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

$$X = A * B + C$$



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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

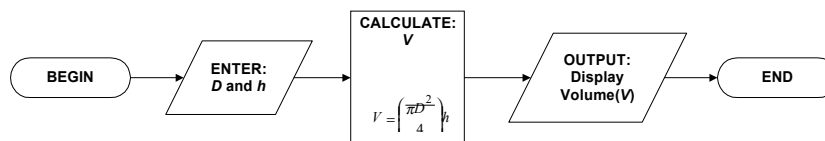


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■ FORTRAN

– 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

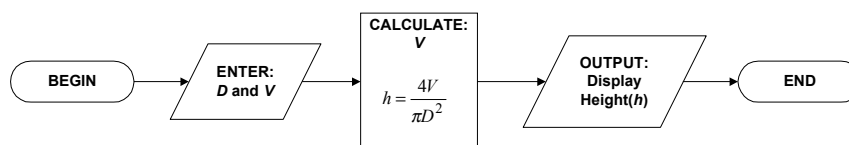


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■ FORTRAN

– 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

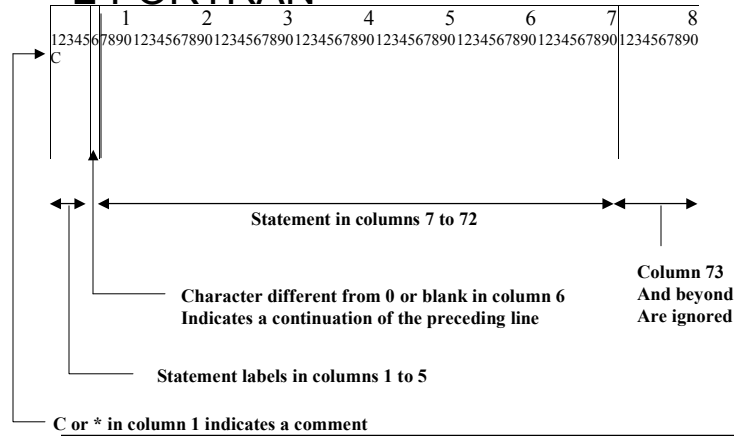
- -12
- 1.2345
- 12.45-e10



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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
1
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 ² | |
| 6 | | | | | | | |
| 7 | | | | | | | |
| 8 | u = | 45 | | | | | |
| 9 | v = | 25 | | | | | |
| 10 | $\sqrt{\quad}$ | 33.54102 | | | | | |
| 11 | $uv =$ | | | | | | |
| 12 | | | | | | | |

B5 = B3 + B4

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



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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 ³ | |
| 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))) | | |

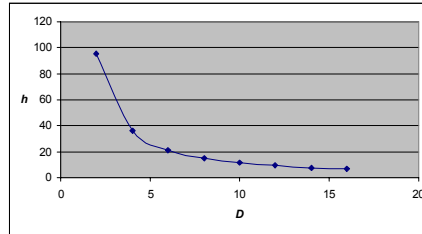


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■ Spreadsheet Calculations

| 1 | A | B | C | D | E |
|----|---|---------------|-------------|------------------------|---|
| 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 | | | | | |

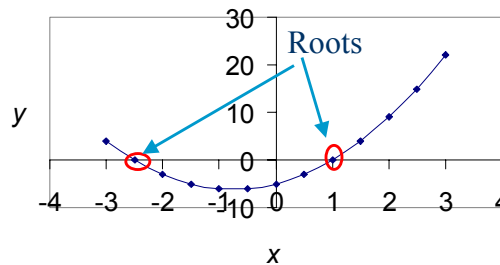


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■ Spreadsheet & Numerical Solutions

| 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 |

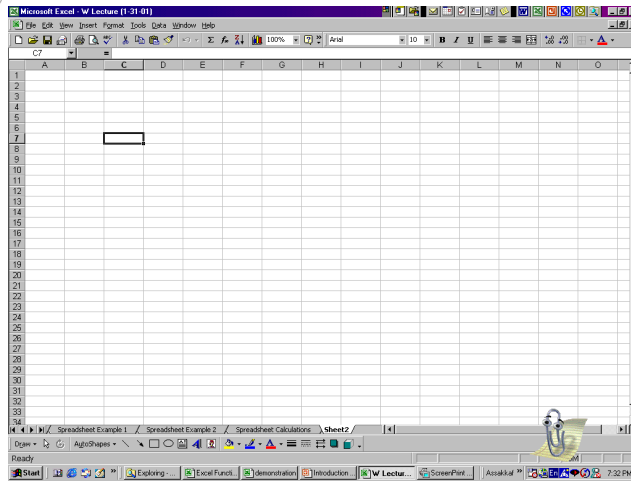


$$y = 2x^2 + 3x - 5 = 0$$

Introduction to MS Excel



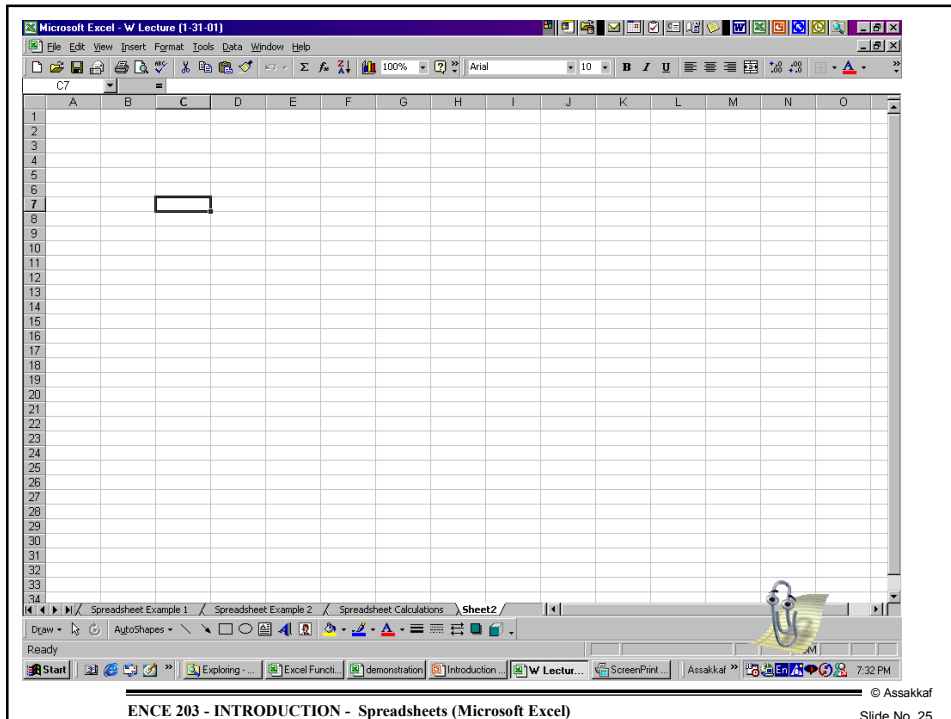
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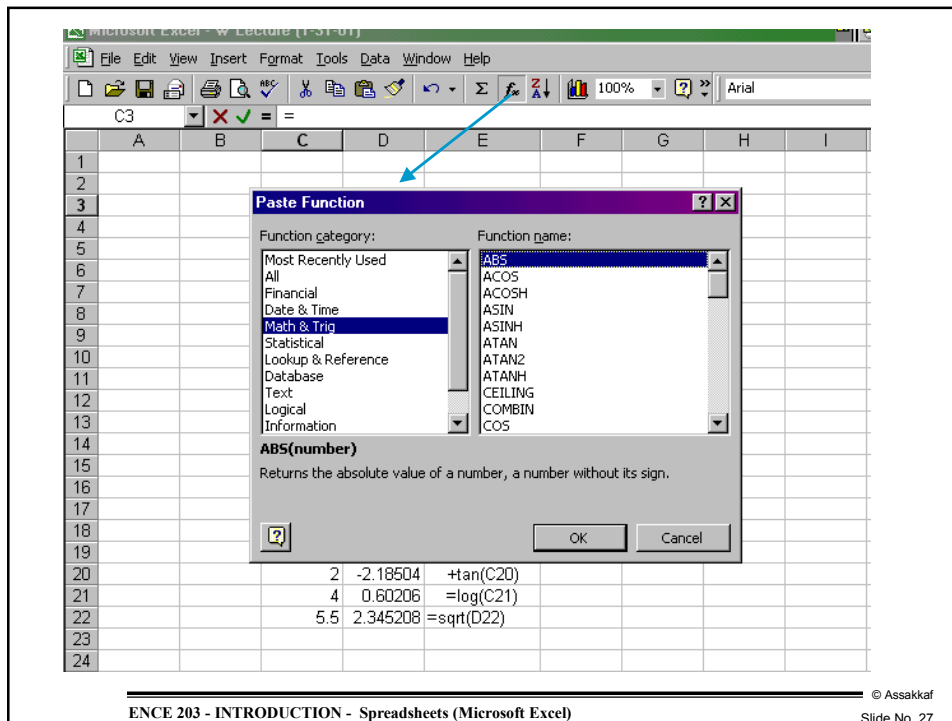
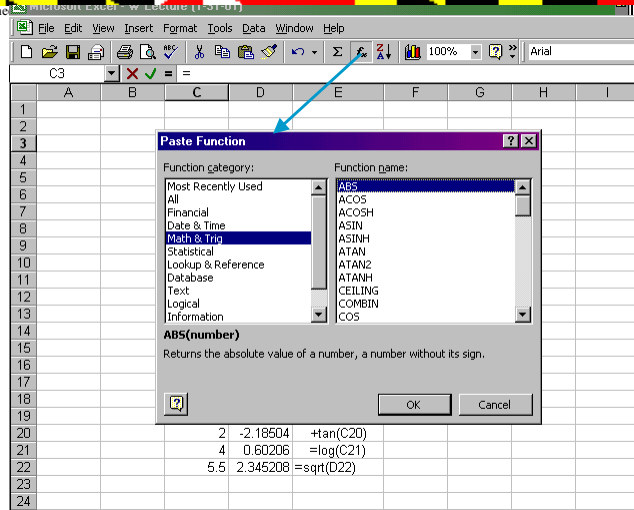
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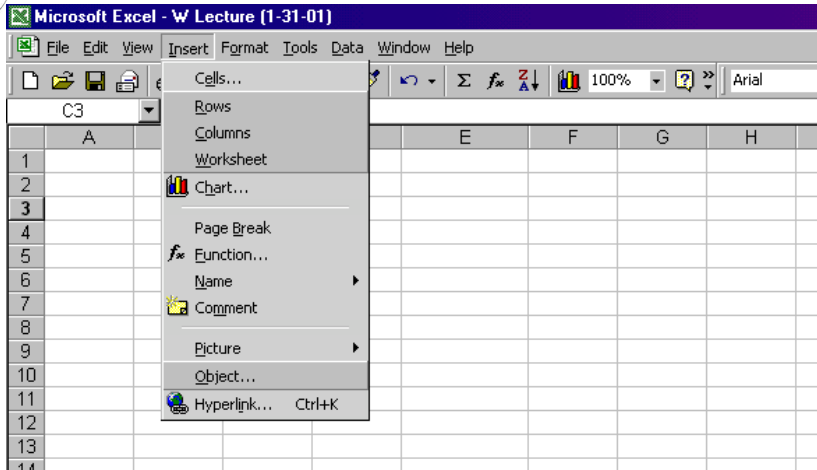
MS Excel Math and Trig. functions



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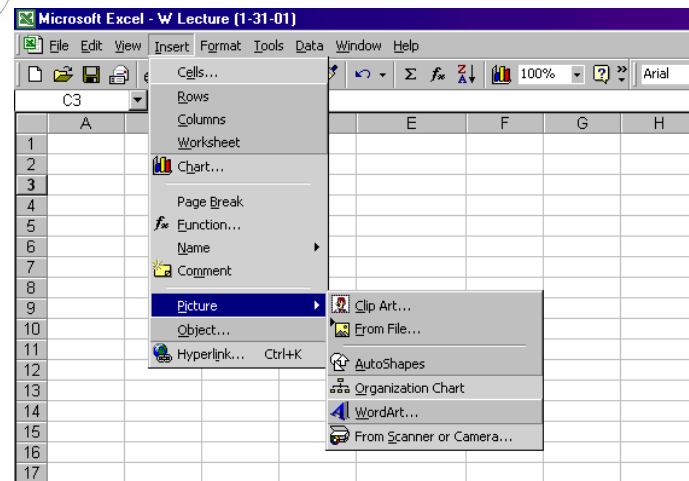
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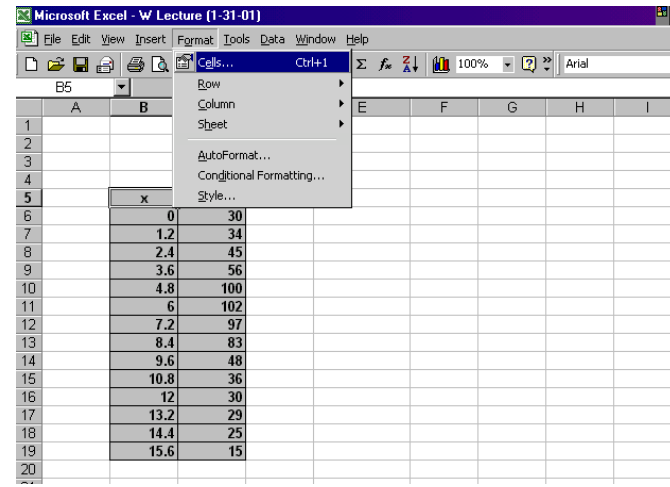
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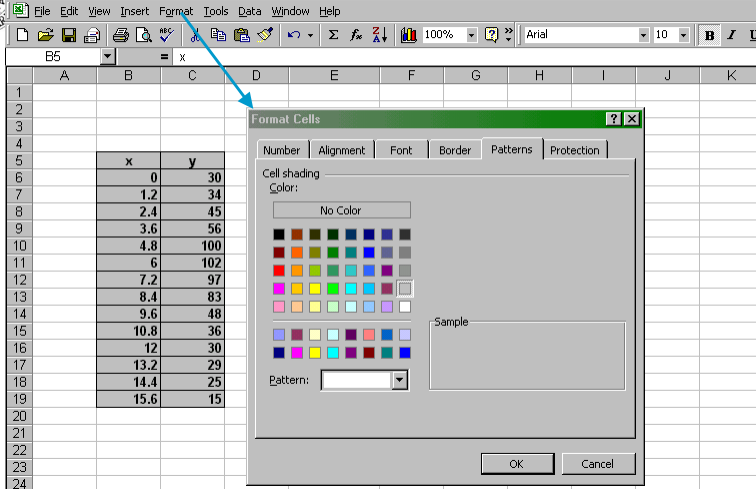
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Chart Wizard - Step 1 of 4 - Chart Type

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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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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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:

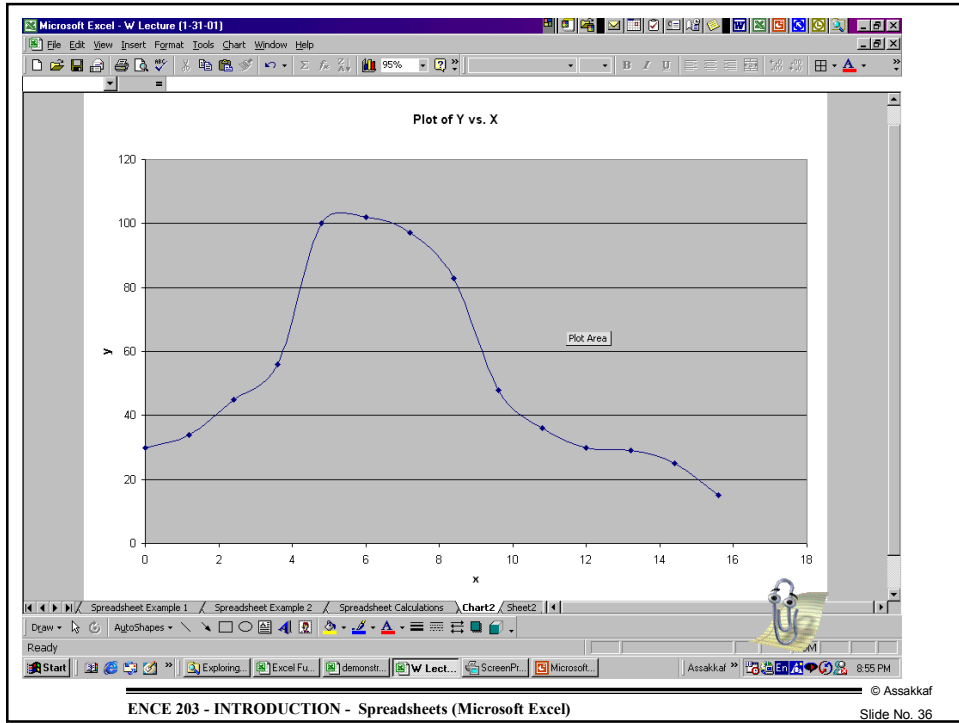
As new sheet: Chart2

As object in: Sheet2


Cancel < Back Next > Finish

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

Formula Bar: C12 = +B12^2-2*B12-20

| 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 |

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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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The screenshot shows the same Excel spreadsheet as slide 38. The 'Tools' menu is open, and 'Goal Seek...' is highlighted. The 'Goal Seek' dialog box is not yet open.

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

File Edit View Insert Format Tools Data Window Help

B16

| | | | | | | | | | |
|----|--|------|---------------------|------------------|--|--|--|--|--|
| 1 | | | | | | | | | |
| 2 | | | | | | | | | |
| 3 | | | $y = x^2 - 2x - 20$ | | | | | | |
| 4 | | | | | | | | | |
| 5 | | x | y | | | | | | |
| 6 | | 0 | -20 | =+B6*2-2*B6-20 | | | | | |
| 7 | | 1.2 | -20.96 | =+B7*2-2*B7-20 | | | | | |
| 8 | | 2.4 | -19.04 | =+B8*2-2*B8-20 | | | | | |
| 9 | | 3.6 | -14.24 | =+B9*2-2*B9-20 | | | | | |
| 10 | | 4.8 | -6.56 | =+B10*2-2*B10-20 | | | | | |
| 11 | | 6 | 4 | =+B11*2-2*B11-20 | | | | | |
| 12 | | 7.2 | 17.44 | =+B12*2-2*B12-20 | | | | | |
| 13 | | 8.4 | 33.76 | =+B13*2-2*B13-20 | | | | | |
| 14 | | 9.6 | 52.96 | =+B14*2-2*B14-20 | | | | | |
| 15 | | 10.8 | 75.04 | =+B15*2-2*B15-20 | | | | | |
| 16 | | 12 | 100 | =+B16*2-2*B16-20 | | | | | |
| 17 | | 13.2 | 127.84 | =+B17*2-2*B17-20 | | | | | |
| 18 | | 14.4 | 158.56 | =+B18*2-2*B18-20 | | | | | |
| 19 | | 15.6 | 192.16 | =+B19*2-2*B19-20 | | | | | |
| 20 | | | | | | | | | |

Goal Seek

Set cell: \$C\$16
To value: 0
By changing cell: \$B\$16

OK Cancel

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

File Edit View Insert Format Tools Data Window Help

G14

| | | | | | | | | | |
|----|--|----------|---------------------|------------------|--|--|--|--|--|
| 1 | | | | | | | | | |
| 2 | | | | | | | | | |
| 3 | | | $y = x^2 - 2x - 20$ | | | | | | |
| 4 | | | | | | | | | |
| 5 | | x | y | | | | | | |
| 6 | | 0 | -20 | =+B6*2-2*B6- | | | | | |
| 7 | | 1.2 | -20.96 | =+B7*2-2*B7- | | | | | |
| 8 | | 2.4 | -19.04 | =+B8*2-2*B8- | | | | | |
| 9 | | 3.6 | -14.24 | =+B9*2-2*B9- | | | | | |
| 10 | | 4.8 | -6.56 | =+B10*2-2*B1 | | | | | |
| 11 | | 6 | 4 | =+B11*2-2*B1 | | | | | |
| 12 | | 7.2 | 17.44 | =+B12*2-2*B1 | | | | | |
| 13 | | 8.4 | 33.76 | =+B13*2-2*B13-20 | | | | | |
| 14 | | 9.6 | 52.96 | =+B14*2-2*B14-20 | | | | | |
| 15 | | 10.8 | 75.04 | =+B15*2-2*B15-20 | | | | | |
| 16 | | 5.582576 | 3.5E-06 | =+B16*2-2*B16-20 | | | | | |
| 17 | | 6.782576 | -12.43819 | =+B17*2-2*B17-20 | | | | | |
| 18 | | 7.982576 | 27.75637 | =+B18*2-2*B18-20 | | | | | |
| 19 | | 9.182576 | 45.95455 | =+B19*2-2*B19-20 | | | | | |
| 20 | | | | | | | | | |

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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