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Solving Polynomial Equations

Subject: Math

Grade Level: High School

Required Software: Microsoft® Excel 97

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Teaching Guide

Summary

In this modeling activity, students will learn how to use spreadsheets as a sophisticated tool for analyzing, visualizing, and solving mathematical problems.

Objectives

To aid students in graphically visualizing polynomial equations, beginning with cubic equations, to model for students how Excel spreadsheets can be used as problem-solving tools, and to introduce students to advanced Excel spreadsheet functions.

Prerequisite Skills

Basic familiarity with spreadsheeting and fundamental grasp of cubic equations and other polynomial equations.

Time Alloted

Two class periods

How to Begin

1. Start this lesson by talking about spreadsheets and how students may have used them. Explain that they will be learning about several functions of the Excel spreadsheet that will help them solve polynomial equations.
2. On a large monitor or an LCD projector, open Excel and choose a new worksheet.
3. Show students how to define a series of cells as variables in an equation. In the A column, type x into A1, then enter a sequence of numbers from -3 to 3 starting in cell A2. Select the entire column of cells, press CTRL + SHIFT +F3, and specify in the dialog box that you want the name this series x; create the name in the top row. Next, go to cell B1 and type y. In cell B2 create an equation using x, such as x^2 (x to the power of 2). Copy this formula and paste it in cells B3:B8. Point out to students how the value of the B cells change. Select B1:B8 and name the series y.
4. Next, walk through Excel's advanced graphing features. Select cells A1 through B8, and choose ChartWizard from the Insert menu. Choose the XY scatter chart function. Explore the results.
5. Finally, introduce students to the Goal Seek function, which allows the user to indicate a desired ending value and ask the spreadsheet to return a variable that meets it. Choose cell B3, then

go to Tools and click on Goal Seek. In the dialog box, specify B3 as the cell you want to set; give it a different value, and specify A3 as the cell that should change to meet it. Close the dialog box and note the result.



6. Hand out the Student Activity pages. Show students that they will be using all three of the functions you just introduced to help solve their cubic equations.



Student Activity

Description

Here's your chance to use Excel to help you solve those tricky cubic equations.

STEP 1 *Define Your Coordinates*

SOFTWARE: Microsoft Excel

WHAT TO DO: Set up your Excel spreadsheet to reflect a cubic equation. The equation we'll be modeling in this lesson is $2x^3 + 6x^2 - 18x + 6 = 0$.

Microsoft Excel - Poly1.xls						
File Edit View Insert Format Tools Data Window Help						
	A	B	C	D	E	F
1	Graph of $y = 2x^3 + 6x^2 - 18x + 6$					
2	x	y				
3	-5	-4				
4	-4	46				
5	-3	60				
6	-2	50				
7	-1	28				
8	0	6				
9	1	-4				
10	2	10				
11	3	60				
12						

Create Names ? X

Create names in:

Top row

Left column

Bottom row

Right column

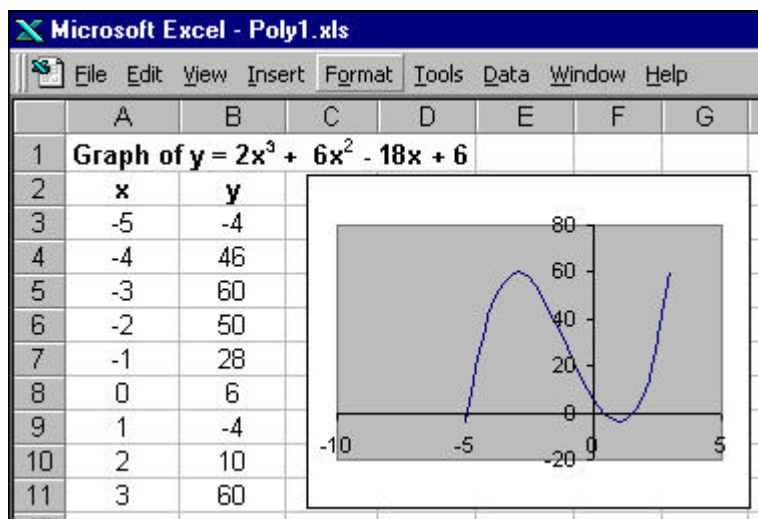
OK Cancel

1. Open a new worksheet. In A1, type this text: Graph of $y = 2x^3 + 6x^2 - 18x + 6$. To position the exponents (such as 3) correctly in the text, highlight each one, go to the Format menu, choose Cells, click on the Font tab, and click Superscript. Decrease the font size slightly. Note: In spreadsheet formulas, as opposed to text, designate exponents by preceding them with the ^ sign.
2. In cell A2, type x. In cell B2, type y.
3. In cells A3:A11, enter a sequential series of values from -5 through 3 (see above).
4. Select A2:A11, press CTRL + SHIFT + F3, and name this column x (see above).
5. In cell B3, enter the formula for y, which is $=2*x^3+6*x^2-18*x+6$. Copy this formula and paste it in cells B4:B11.
6. Look at the values now showing up in column B. Do you see any patterns? Save your work.

STEP 2 Graph the Equation

SOFTWARE: Microsoft Excel

WHAT TO DO: Now you'll want to visualize the equation by making a graph.

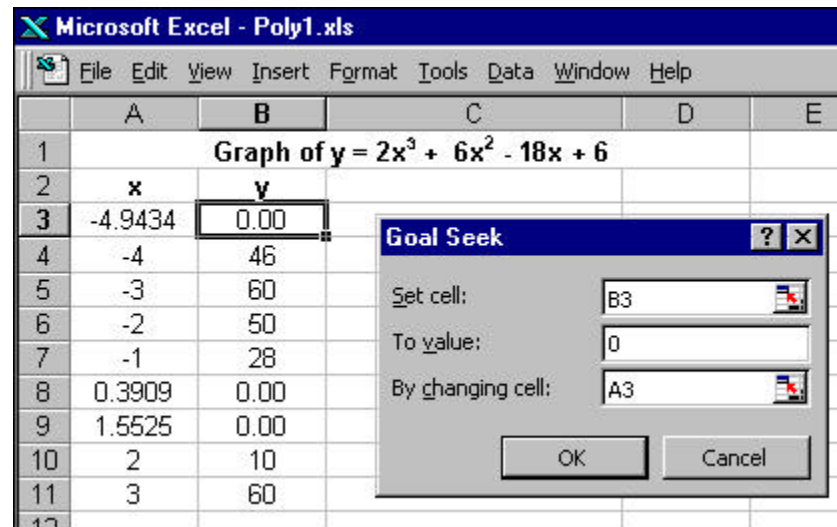


1. Highlight A2:B11.
2. Create an XY scatter function graph by using the ChartWizard on the Insert menu. Save your work.
3. Note from the value of coordinates (above) and from this graph that the value of y changes sign between $x=-5$ and $x=-4.5$ (represented by cell B3), between $x=0$ and $x=1$ (cell B8), and between $x=1$ and $x=2$ (cell B9). That means that the solutions to the cubic equation must lie between those values.

STEP 3 Seek Your Goal

SOFTWARE: Microsoft Excel

WHAT TO DO: Now comes the part where the spreadsheet really shines.



1. Select cells A3, A8, and A9, click on Format menu, choose Cells, and format as Numbers to four decimal places; format B3, B8, and B9 as Numbers to two decimal places.
2. Click on B3. This is your first Goal cell.
3. On the Tools menu, choose Goal Seek. You should see B3 in the Set Cell box.
4. Remember that the equation you are solving is $2x^3 + 6x^2 - 18x + 6 = 0$, so you'll want to enter 0 in the To Value box.
5. The cell you want to change to reach that value is the variable you're solving for, x . In the By Changing Cell box, type A3.
6. Click OK on the Goal Seek Status box, which should return a value of 0.
7. The value in cell B3 should also now read 0.00, while cell A3 reads -4.9434. This is one of your solutions for x .
8. Repeat this process for cells B8 and B9 to reach the other two valid values for x .
9. Save your work.

STEP 4 Now Try These!

SOFTWARE: Microsoft Excel

WHAT TO DO: Now that you know how to set up your spreadsheet to solve cubic equations, try it out on the equations below using the specified domains (ranges of numbers). Make up equations with a friend and test them out. Then see if you can find a way to use spreadsheets to solve



other kinds of equations, such as quadratic.



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