Once again, we focus on the details of polynomial graphs and do some regression.

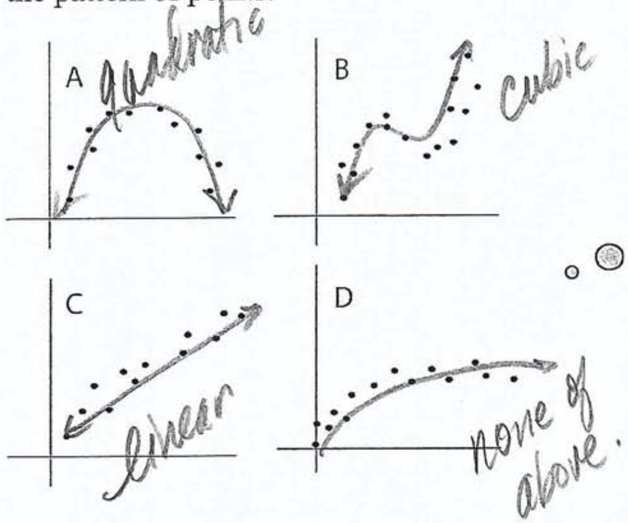
College algebra
Class notes
Polynomial Graphs and Cubic Regression (section 5.2)

The few problems assigned that will ask for end behavior, intercepts, domain, range, zeroes and their multiplicities, turning points, and intervals of increasing or decreasing are the same as we have covered previously. We will *not* give examples of that here. We turn our attention to the new topic of cubic regression.

We have seen linear and quadratic regression.

Cubic Regression Equations:

We studied regression before. We saw how the pattern of a scatter plot of points could be represented by a single equation. Look at the plots below. Draw in a curve (or line) that mimics the pattern of points.



Which looks like a cubic pattern (sort of like $y = x^3$)?

Which looks linear? Which looks quadratic?

STAT > Edit to enter data
STAT > CALC > CubicReg to get eqn

expl 1: The data to the right details the percentage of families with children in the United States whose income is below the poverty level.

Year, x	Percent of Families with Children Below Poverty Level, y
2005, 1	14.5
2006, 2	14.6
2007, 3	15.0
2008, 4	15.7
2009, 5	17.1
2010, 6	18.5
2011, 7	18.5
2012, 8	18.4
2013, 9	18.1
2014, 10	17.6
2015, 11	16.3
2016, 12	15.0

a.) Use your calculator to draw a scatter plot and then fit a cubic function to this data. Let x represent the number of years since 2004. Round your equations' coefficients to four decimal places.

$y \approx -0.0166x^3 + 0.2052x^2 - 0.0246x + 14.0495$

Take note of how they define x.

Enter 1, 2, 3, ... in for x's.
(x = # of years since 2004)

b.) Use the function from part a to estimate the percent of US families with children who are under the poverty level in 2017.

$2017 \rightarrow x = 13$

This value will be considerably different depending on how you round coefficients.

$y \approx -0.0166(13)^3 + 0.2052(13)^2 - 0.0246(13) + 14.0495$

$y \approx 11.9$ → In 2017, we estimate the percent of US families with children in poverty is 11.9%.

c.) Use the function from part a to estimate the percent of US families with children who are under the poverty level in 2020. Look for this point on the regression equation's graph. Use this to discuss the limitations of regression.

$2020 \rightarrow x = 16$

$y \approx -0.0166(16)^2 + 0.2052(16)^2 - 0.0246(16) + 14.0495 \rightarrow y \approx -1.8$

The y-value does not make sense (negative percent) because x-value of 16 is too far from original data.

Definition: Coefficient of Determination, R^2:

The **coefficient of determination** is used similarly to the correlation coefficient seen with linear regression. When we try to fit various types of regression (quadratic, cubic, or quartic) to a set of data, the coefficient of determination will tell us which one gives us the *best* fit. The regression equation that gives us an R^2 value closest to 1 will be the one we choose to use.

This is *not* covered in our book but you might see it elsewhere.

Worksheet: Quadratic (and higher order) Regression on Your Calculator (TI-82, 83, or 84):

This worksheet provides an example and step-by-step instructions for finding a quadratic, cubic, and quartic regression equations on your calculator. These higher degree regression equations are done similarly. On these problems, you will want to compare higher orders of regression to find which fits the data best. This is mentioned on the worksheet.

You will see quadratic, cubic, and quartic regression. This book warns against using quartic regression.