Classroom Activity

Corn & Tractor Price Comparisons

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Introduction

Graphing relationships such as the price of new tractors and field corn per bushel can be an extension of applications of farm-related math problems in the classroom (Lifer, 2009). With an emphasis on problem solving, *Principles and Standards for School Mathematics* (NCTM, 2000) states that the "goal of high school mathematics is to equip students with knowledge and tools to enable them to formulate, approach, and solve problems beyond those that they have studied" (p. 335). This lesson allows a student to apply mathematical knowledge to a real setting by using a TI-83 or TI-84 graphing calculator.

This activity uses the data from Duncan & Litwiller (2009) that compared the price of field corn, yield per acre, and the price of a new tractor. These data are displayed in Table 1. Teachers can use this information to teach new concepts or review previous graphing concepts. Worksheets at the end of this article are provided for teacher use in the classroom.

Exploring the Data

Begin by considering the corn and tractor data provided in Table 1.

Tsble 1: Corn and Tractor Prices (Duncan & Litwiller, 2009)

Year	Price of Full Size New John Deere Tractor	Average Corn Yield (Bushels per Acre)	Price of Newly Harvested Corn (Dollars per Bushel)
1919	$1,150	26.8	$1.34
1928	$1,115	26.3	$0.76
1933	$1,452	22.8	$0.50
1948	$1,253	43.0	$1.31
1953	$2,900	40.7	$1.50
1958	$4,000	52.8	$1.08
1963	$6,500	67.9	$1.05
1970	$9,000	72.4	$1.25
1977	$23,000	90.8	$1.99
1984	$67,000	106.7	$2.51
1992	$95,000	131.5	$2.30
2007	$121,000	164.0	$3.40

These data can be typed into a TI-83 or TI-84 graphing calculator using List 1 for year (0 for 1900) and List 2 for the cost of a new tractor. Figure 1 displays the data and window settings. Step-by-step instructions for calculator use are provided at the end of this article.

Students can see that the coefficient of determination (R^2) for the quartic equation is

Fig 1 (Left) Year and Tractor cost entered into lists; (Right) Window settings

In order to see the graphed data values, enter stat plot settings as shown in Figure 2, left. The graphed data values are shown in Figure 2, right.

Fig 2 (Left) STAT PLOT settings (press 2nd, Y=, ENTER); (Right) Data represented as scatterplot (press GRAPH button)

Teacher and students can investigate how these data fit different types of best-fit-equations. Figure 3 shows the graphs of linear, quadratic, cubic, and quartic equations. Figure 4 shows logarithmic, exponential, power, and logistic graphs.
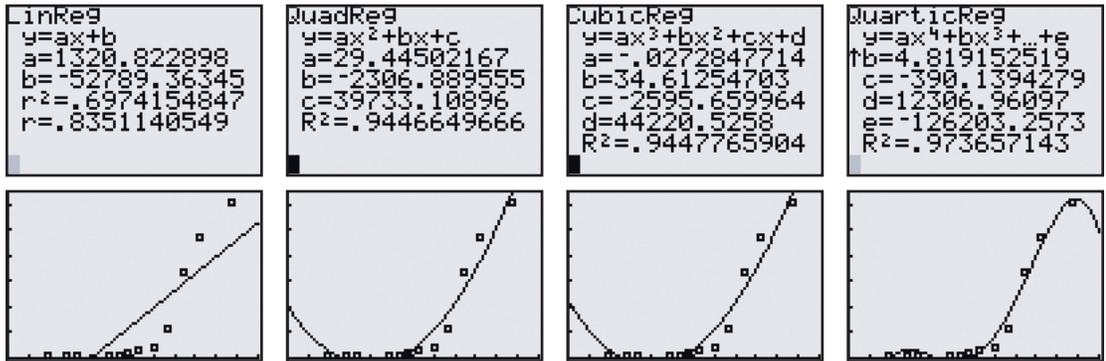
Fig 3 (From left to right) Linear, quadratic, cubic, and quartic regression calculations (top) and graphs (bottom)
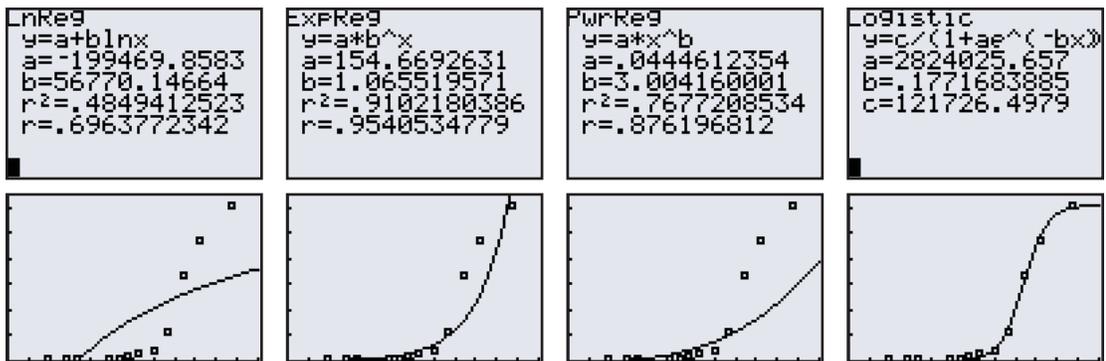

Fig 4 (From left to right) Logarithmic, exponential, power, and logistic regression calculations (top) and graphs (bottom)

the highest, although no comparison can be made for the logistic equation since none is displayed on the calculator screen. A visual inspection reveals that the logistic graph does not decrease at the right hand part of the screen as the quartic graph does. Since the price of a tractor is unlikely to decrease, the logistic regression equation seems the most reasonable one to use.

Questions for Discussion

The following questions are ones that generate fruitful discussion with our students.
- Why does quadratic regression provide a better regression equation than that generated by linear regression?
- If the R^2 value is not displayed, how would we pick one graph over another?
- Why are the data points relatively level on the left side of the graph, but then take such a dramatic increase toward the right side?

Further Explorations

Similar work can be done comparing year with corn yield (Figure 5) and year with corn price (Figure 6). This exercise is good not only to practice using a graphing calculator, but it allows students to use real world data in the examination of different types of graphs.
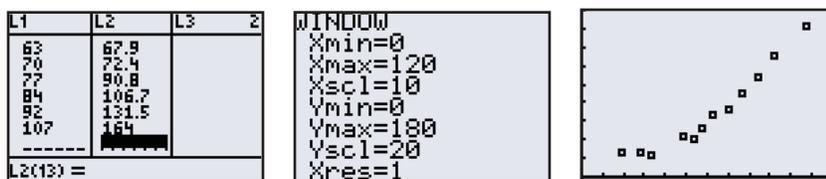
Questions for Further Discussion

Fig 5 Comparing year with corn yield

Fig 6 Comparing year with corn price

The following questions are ones that generate fruitful discussion with our students.
- Why does the plot of corn yield with respect to year seem to follow a more upward linear trend than the plot of tractor price with respect to year? Provide a possible real-world explanation.
- Why does the plot of corn price with respect to year appear to be more scattered than the plot of corn yield with respect to year? Provide a possible real-world explanation.

On the following pages, we provide three classroom-ready worksheets that you can use with your students to investigate the topics we've discussed in this article.
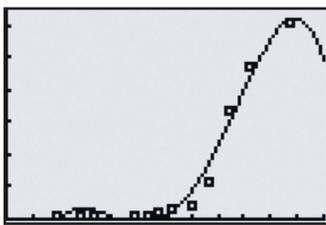
Student Worksheet 1   Name: _____
Corn and Tractor Price Comparisons
Graphing Real-World Data

Directions: Let 0 = year 1900. then complete the items that follow.

| 1. Consider the following data.		2. Enter the data into your calculator.	3. Use these Window settings.	4. Plot the scatterplot.
Year	**Price of Full Size New John Deere Tractor**	L1 L2 L3 2 63 6500 70 9000 77 23000 84 67000 92 95000 107 121000 ------ L2(13) =	WINDOW Xmin=0 Xmax=120 Xscl=10 Ymin=0 Ymax=130000 Yscl=20000 Xres=1	
1919	$1,150			
1928	$1,115			
1933	$1,452			
1948	$1,253			
1953	$2,900			
1958	$4,000			
1963	$6,500			
1970	$9,000			
1977	$23,000			
1984	$67,000			
1992	$95,000			
2007	$121,000			

Perform the following regressions on your calculator, with L1 the independent variable and L2 the dependent variable. Then write the correct letter underneath each scatterplot in items 5-11.

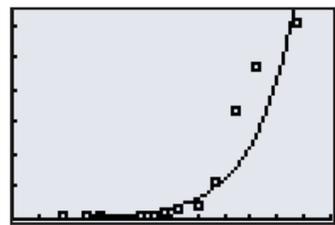A. Linear   B. Quadratic   C. Quartic   D. Logarithmic   E. Exponential   F. Power   G. Logistic
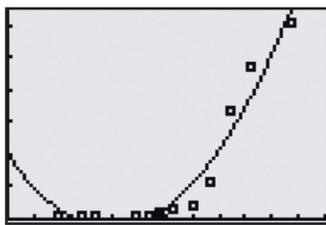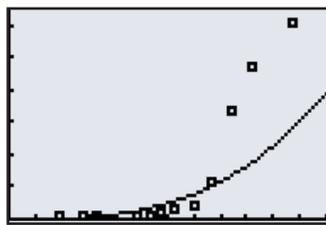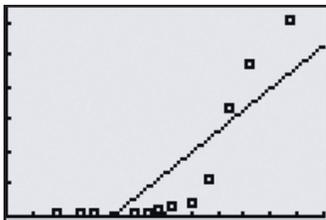

5. _____   6. _____   7. _____   8. _____
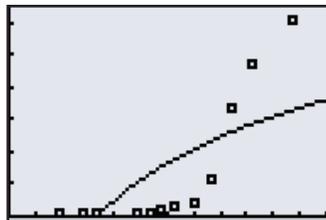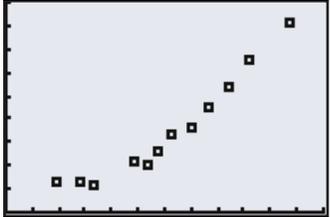

9. _____   10. _____   11. _____

Student Worksheet 2   Name: _____
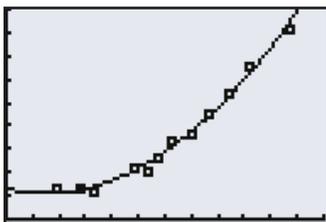**Corn and Tractor Price Comparisons**
Graphing Real-World Data

Directions: Let 0 = year 1900. then complete the items that follow.

| 1. Consider the following data.		2. Enter the data into your calculator.	3. Use these Window settings.	4. Plot the scatterplot.
Year	**Average Corn Yield (Bushels per Acre)**	L1 L2 _____ 2 63 67.9 70 72.4 77 90.8 84 106.7 92 131.5 107 164 ------ ------ L2(13) =	WINDOW Xmin=0 Xmax=120 Xscl=10 Ymin=0 Ymax=180 Yscl=20 Xres=1	
1919	26.8			
1928	26.3			
1933	22.8			
1948	43.0			
1953	40.7			
1958	52.8			
1963	67.9			
1970	72.4			
1977	90.8			
1984	106.7			
1992	131.5			
2007	164.0			

Perform the following regressions on your calculator, with L1 the independent variable and L2 the dependent variable. Then write the correct letter underneath each scatterplot in items 5-12.
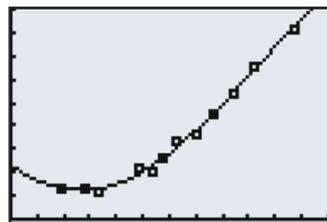
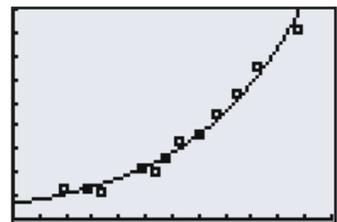A. Linear   B. Quadratic   C. Cubic   D. Quartic   E. Logarithmic   F. Exponential   G. Power   H. Logistic
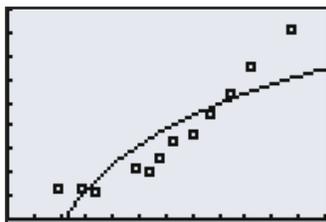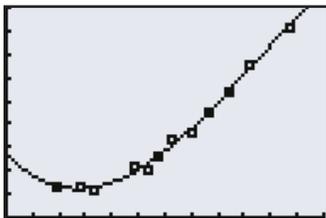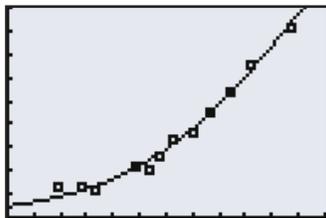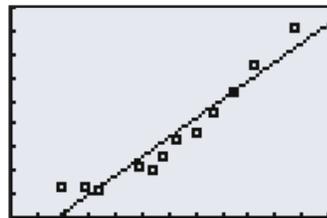
5. _____   6. _____   7. _____   8. _____
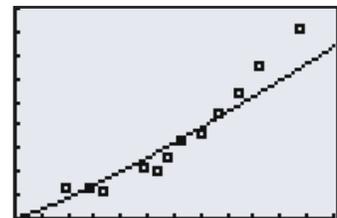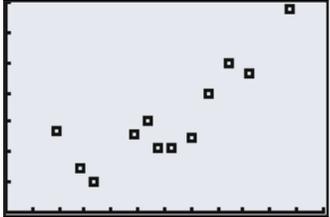
9. _____   10. _____   11. _____   12. _____

Student Worksheet 3   Name: _____
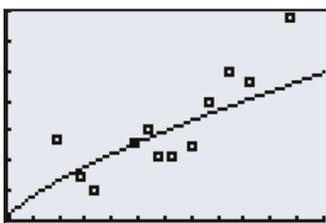**Corn and Tractor Price Comparisons**
Graphing Real-World Data

Directions: Let 0 = year 1900. then complete the items that follow.

| 1. Consider the following data.		2. Enter the data into your calculator.	3. Use these Window settings.	4. Plot the scatterplot.
Year	**Price of Newly Harvested Corn (Dollars per Bushel)**	L1 L2 ----- 2 63 1.05 70 1.25 77 1.99 84 2.51 92 2.3 107 3.4 ------ L2(13) =	WINDOW Xmin=0 Xmax=120 Xscl=10 Ymin=0 Ymax=3.5 Yscl=.5 Xres=1	
1919	$1.34			
1928	$0.76			
1933	$0.50			
1948	$1.31			
1953	$1.50			
1958	$1.08			
1963	$1.05			
1970	$1.25			
1977	$1.99			
1984	$2.51			
1992	$2.30			
2007	$3.40			

Perform the following regressions on your calculator, with L1 the independent variable and L2 the dependent variable. Then write the correct letter underneath each scatterplot in items 5-11.
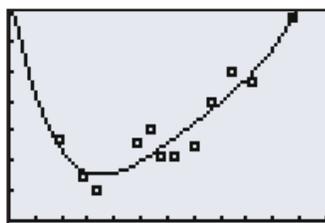
A. Linear   B. Quadratic   C. Cubic   D. Quartic   E. Logarithmic   F. Exponential   G. Power
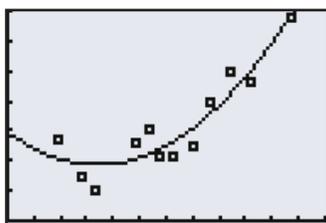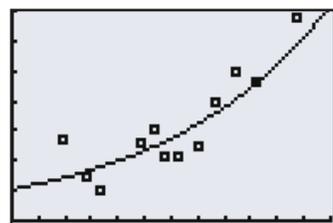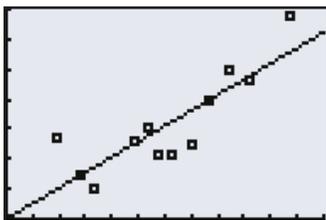
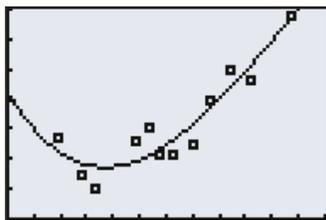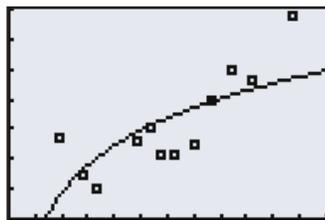5. _____   6. _____   7. _____   8. _____

9. _____   10. _____   11. _____

Worksheet Solutions

Worksheet #1:
5. Quartic; 6. Quadratic; 7. Power; 8. Exponential; 9. Linear; 10. Logistic; 11. Logarithmic

Worksheet #2:
5. Quadratic; 6. Logarith; 7. Quartic; 8. Exponential; 9. Cubic; 10. Logistic; 11. Linear; 12. Power

Worksheet #3:
5. Power; 6. Quadratic; 7. Quartic; 8. Exponential; 9. Linear; 10. Cubic; 11. Logarithmic

Calculator Step-by-step Instructions

Enter Data into the calculator STAT ENTER

Calculate regression equation
STAT ► select # corresponding to desired regression equation ENTER

Put **regression equation into calculator** after calculating the regression equation
Y= VARS 5 ► ► ENTER

Works Cited

Duncan, D. R., Litwiller, B. H. (2009). Corn and Tractor Price Comparisons, *Ohio Journal of School Mathematics, 60*, 48-49.

Lifer, S. (2009). Farm-(Info) week: How Mathematics is Used in Agriculture, Ohio *Journal of School Mathematics, 59*, 21-24.

National Council of Teachers of Mathematics. (2000). *Principles and Standards for School Mathematics.* Reston, VA: NCTM.

STEVE LIFER, lifer.steve@lexington.k12.oh.us, has taught at Lexington High School for 25 years. He challenges himself to make mathematics lessons interesting, memorable, and applicable to everyday life.

"Finish every day and be done with it. You have done what you could; some blunders and absurdities no doubt crept in; forget them as soon as you can. Tomorrow is a new day."

- Ralph Waldo Emerson

"A simple pairing of concepts can be enough to induce an unconscious association and, eventually, the sense that there is something familiar and true about the pairing. This is the basis of every ad we've ever seen that pairs a product with attractive, cheery, and sexually charged people."
Eagleman, D. M. (2011). *Incognito: The secret lives of the brain, 65.* Pantheon Books, NY.