

Algebra 2

Price of Apples – Linear Data

Goals:

- Describe graphically, algebraically and verbally real-world phenomena as functions; identify the independent and the dependent variable (3.01)
- Translate among graphic, algebraic, and verbal representations of relations (3.02)
- Graph relations and functions and find the zeros of functions (3.03)
- Write and interpret an equation of a curve (linear) which models a set of data (4.01)
- Find the equation of best fit (linear) for a set of data. Interpret the constants, coefficients, and based in the context of the data. Check the equation for goodness of fit and use equation for prediction (4.02)

Materials and Equipment Needed:

- “By hand” graph of the Apple data – *it is best if students have this complete before the lesson begins*
- Copy of handout for each student
- Graphing calculator
- Graph paper for each student
- Paper for note taking during class

Activity One: Fit linear data with linear regression model, interpret meaning of slope and y-intercept, use linear function to predict outside given data. (Data is taken from Algebra 2 Indicators on NCLearn web site.)

Price of Apples Data

- Using the data given by indicator 3.01 C, students **enter data into the lists** of the calculator. Determine which variable is independent and which is dependent.
- Look at a scatter plot of the data. Discuss **window** settings. Talk about domain and range.
- **Subtract 1980 from each year** to create a list of years since 1980. This makes the y-intercept meaningful to the data. Graph scatter plot.
- Use **LinReg** to determine the least squares line that fits this data. Use best-fit line. Result: $y = 0.01955x + 0.558$, where x = years since 1980 and y = price per pound of apples. **Write the equation in the function list.**
- **Superimpose the line over the data.** Discuss whether the model fits the data.
- Discuss the **meaning of the y – intercept and the slope of the line.**
- Define residual and find the value of the residual for several of the points. Begin by using the scatter plot of data on graph paper. Once several have been done by hand, then move to the calculator and determine the value using the y-value from data minus the y-value from the prediction equation. Finally, use the **Y()** on the calculator.
- **Forecast** the price per pound of apples in 2010 (when students are 25,26,27) using the prediction equation. Result: \$1.14 per pound. This year (2001) the average price per pound is \$0.969 according to our model. Remind students of the independent variable.

Follow-Up Activity: Fit linear data with linear regression model, interpret meaning of slope and y-intercept, use linear function to predict outside given data. (Data is adapted from *Contemporary Precalculus Through Applications*, page 53.)

Wave Data.

- Students enter the data representing the length of time it takes 550 students to do the wave into their calculators. In List 1 put the number of students and in List 2 put the time. Reinforce the definitions of independent and dependent variables.

- Students will work independently to fit this data set with a linear regression model. This should be a familiar concept from last week. Reinforce the idea that Linear Regression, Least Squares, and Line of Best-Fit are all the same equation. Also, that prediction equation and model refer to the same thing.
- Students write down their findings by answering questions on the handout.
- Steps should include finding a scatter plot of the data on the calculator, finding the linear regression model for the data and putting it into the function list. The model is $y = 0.1963x + 0.9120$. Superimpose the line over the scatter plot.
- What is the meaning of the slope? Each additional student added to the group that is doing the wave causes the process to take approximately 0.1963 seconds longer. It might be useful to point out that another way to describe what the slope tells us is that each additional 10 students added to the group that is doing the wave causes the process to take approximately 2 seconds longer. The y-intercept in this case is not meaningful. Literally, it says that if no students are doing the wave it will take approximately 0.9120 seconds. It does, however, give us a sense that we have a good model since this amount of time is so small.
- The residual associated with 20 students is approximately -0.2278 . In our data set, the length of time it took 20 students to do the wave is approximately 0.2278 seconds less than our model would predict.
- Determine the goodness of fit based on a discussion of the residuals.
- If the trend continues, it will take approximately 109 seconds for all 550 students to do the wave. Is this reasonable? On the calculator, this result can be found several ways: table, Y1(550) from the home screen, TRACE then x=550 from the graphing screen.

Student Handout
Mean Price of Apples
Algebra 2

Activity One - Mean Price of Apples per pound for 1980 to 2000

| | | | |
|------|---------|------|---------|
| 1980 | \$0.593 | 1991 | \$0.843 |
| 1981 | 0.525 | 1992 | 0.899 |
| 1982 | 0.648 | 1993 | 0.802 |
| 1983 | 0.532 | 1994 | 0.804 |
| 1984 | 0.64 | 1995 | 0.793 |
| 1985 | 0.677 | 1996 | 0.894 |
| 1986 | 0.72 | 1997 | 0.914 |
| 1987 | 0.741 | 1998 | 0.962 |
| 1988 | 0.635 | 1999 | 0.852 |
| 1989 | 0.741 | 2000 | 0.96 |
| 1990 | 0.652 | | |

1. Determine which variable is independent and which is dependent. Enter the data into the lists of your calculator. (This data is taken from Algebra 2 Indicators)
2. Look at a scatter plot of the data. Describe the scatter plot.
3. Subtract 1980 from each year to create a list of years since 1980. What is the y-intercept?
4. Use **LinReg** to determine the least squares line that fits this data. Write the equation in the function list.
5. Superimpose the line over the data. Do you think this model is a good fit for the data?
6. What is the meaning of the y -intercept and the slope of the line.
7. Determine the residuals for the data set.
8. Using your line of best-fit, predict the price per pound of apples in 2010.

Follow-Up Activity
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Wave Data

| | | | | | | | | | | |
|--------------------|------|------|------|------|------|------|------|------|------|------|
| Number of Students | 6 | 7 | 11 | 12 | 14 | 16 | 17 | 20 | 22 | 26 |
| Time (seconds) | 2.07 | 3.03 | 2.09 | 3.40 | 3.51 | 4.53 | 3.94 | 4.56 | 5.38 | 6.25 |

1. Determine which variable is independent and which is dependent. Enter data into the lists of your calculator.
2. Look at a scatter plot of the data.
3. Use **LinReg** to determine the least squares line that fits this data. Write the equation in the function list.
4. Superimpose the line over the data. Do you think this model fits the data?
5. Discuss the meaning of the y -intercept and the slope of the line.
6. Determine the residuals for the data set. What is the residual associated with 20 students? What does this number mean?
7. Is your model a good fit? Discuss why or why not.
8. Predict the time it will take all 550 students to do the wave.