Square It Up!

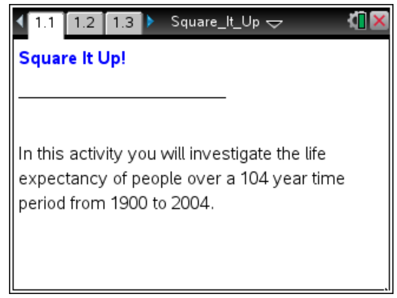
Student Activity

Name ______________

Class ______________

Open the TI-Nspire™ document *Square_It_Up.tns*

In this activity you will investigate the life expectancy of people over a 104 year time period from 1900 to 2004. You will do this by exploring the least squares line.



Move to page 1.2

The spreadsheet on page 1.2 displays the life expectancy for men, women, and people in the United States for every ten years from 1900 to 2000 and each year from 2001 to 2004. Let's investigate the relationship between the year and the life expectancy for a person.

Move to page 1.3

On this Data & Statistics page, create a scatter plot to illustrate the relationship between the year and the life expectancy for a **person** by selecting **year** on the horizontal axis and **person** on the vertical axis.

1. Describe the relationship between the two variables.

Add a movable line to the graph and move it to estimate the line of best fit.

Tech Tip: Press menu **> Analyze > Add Movable Line**. Adjust the line until you feel that it best fits your data by using the following steps:
Move the cursor to the middle of the line until cross arrows (✢) appear.
Press ctrl to grab the line and a closed hand will be displayed.
Move the hand vertically to shift the line up and down.
When the line is in the correct position, press esc to release the hand.
Move the cursor to either the end of the line to change the slope of the line.
When the curved arrows appear, grab the line with ctrl.
Note that the equation updates as you move the line.

Tech Tip: Tap and choose **Analyze** > **Add Movable Line**. Grab and move the line near the middle of the line to change the *y*-intercept. Grab and move the line near the end of the line to rotate it.

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Analyze the residuals.

From the menu options choose **Analyze > Residuals > Show Residual Squares**. A square will appear at each data point. The side of the square is equal to the value of the residual.

Residual = Actual value – Predicted value

2. If a data point is above the regression line, is the value of the residual positive or negative?

3. If a data point is below the regression line, is the value of the residual positive or negative?

Find a least squares regression line

A **least squares regression line** is found by minimizing the sum of the area of the squares

Move the line to minimize the size of the squares.

4. What is the smallest value you can find for the **sum of squares**?

5. How many of the points are above your line? How many are below your line?

6. Check with a partner. How does his/her value compare to yours? If it is different, explain how.

7. Which data points increase the sum of squares the most? Where do these occur in the data?

8. How does the size of these squares compare to the others?

9. What do you notice about the distribution of the data points around the line (i.e., above vs. below the line, or equal spacing vs. clusters)?

10. To have the smallest sum, how do the points need to be distributed?

Use technology to calculate a least squares line.

Now, you will compare your line with the regression line created by the TI-Nspire. From the menu options choose **Analyze > Regression > Show Linear (mx+b)**. Also choose **Show Residual Squares** again.

11. What is the value of the sum of squares?

12. How does the regression line differ from your line? How much did the slope differ?

13. How well did you do? Compare your sum of squares with the one generated from the regression line.

14. What advice would you give to a friend who was trying to find the least squares regression line? What techniques would work best for him/her? (Do not answer with "trial and error.")

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Extension

Analyze the two additional sets of data in the spreadsheet by adding a line of best fit and then minimizing the sum of the squares. Check your answer each time by finding the linear regression model and the sum of the squares.

	Women	***Men***
your equation		
sum of squares		
regression equation		
sum of squares		

15. Use the linear regression model to predict the life expectancy in 2010? What would be the life expectancy in 2020?

16. Predict what year the life expectancy will be 92? When will the life expectancy be 105? (Round to the nearest year.)

17. Does the residual plot (**Menu** > **Analyze** > **Residual** > **Show Residual Plot**) indicate that the linear regression is an accurate means of predicting life span? Explore other regressions to see if another model (such as an exponential or logistic model) more accurately fits the data. Which is best? Explain.