Lesson 11: Relationships Between Two Numerical Variables

Exploratory Activity – Scatterplots

(adapted from the UCLA Curtis Center)

In 1736, Benjamin Franklin created the first "firehouse" where men would stand in a line between the fire and a water source passing buckets of water between them to pour onto the fire.

How efficient is this method? Using our imaginations for the water and fire, we'll create our own "bucket brigade" to find out.

Fire Bucket Brigade by Monroe Historical Society

1. Predict the time it will take one person in your class to fill a bucket, run to the fire, dump the water and return to the water source.

2. What do you think will happen to the time it takes to move the bucket from water source to the fire and back again when we add more people to the line? If add one person, how much time will it take? What about 2 people, 4 people or 10 people?

3. Reenact the bucket brigade and record the time is takes the bucket to make the whole trip from the water source, to the fire and back to the water source.

| Number of people in the line	1	2	3	4	5	6	7	8	9	10
Time in seconds for the bucket to make one trip	30	28	25	22	19	15	12	12	12	12

4. Were your predictions in Exercises 1 and 2 correct? Explain why?

Scatterplots

A scatterplot is an informative way to display numerical data with two variables. In your previous work in Grades 7 and 8, you saw how to construct and interpret scatterplots. Recall that if the two numerical variables are denoted by x and y, the scatterplot of the data is a plot of the (x, y) data pairs.

5. Use your data from Exercise 3 to create a scatterplot. Label your axes appropriately.

6. About how long do you think it would take 20 people to complete the bucket passing activity? Explain how you arrived at your answer.

7. If it takes 55 seconds for a group to complete the bucket passing activity, how many people are in the line? Explain how you found your answer.

8. A. Using a ruler or straightedge, draw a line of best fit for the data in your graph.

   B. To determine the equation of your line you'll need the slope. Choose two point on your line and highlight them on your graph. These do not have to be data points from the activity, but they MUST be on your drawn line. Then find the slope between these two points.

   Points on my line: (_____ , _____) and (_____ , _____)

   Slope of my line: _____

9. What does your slope mean in the context of the Bucket Brigade activity?

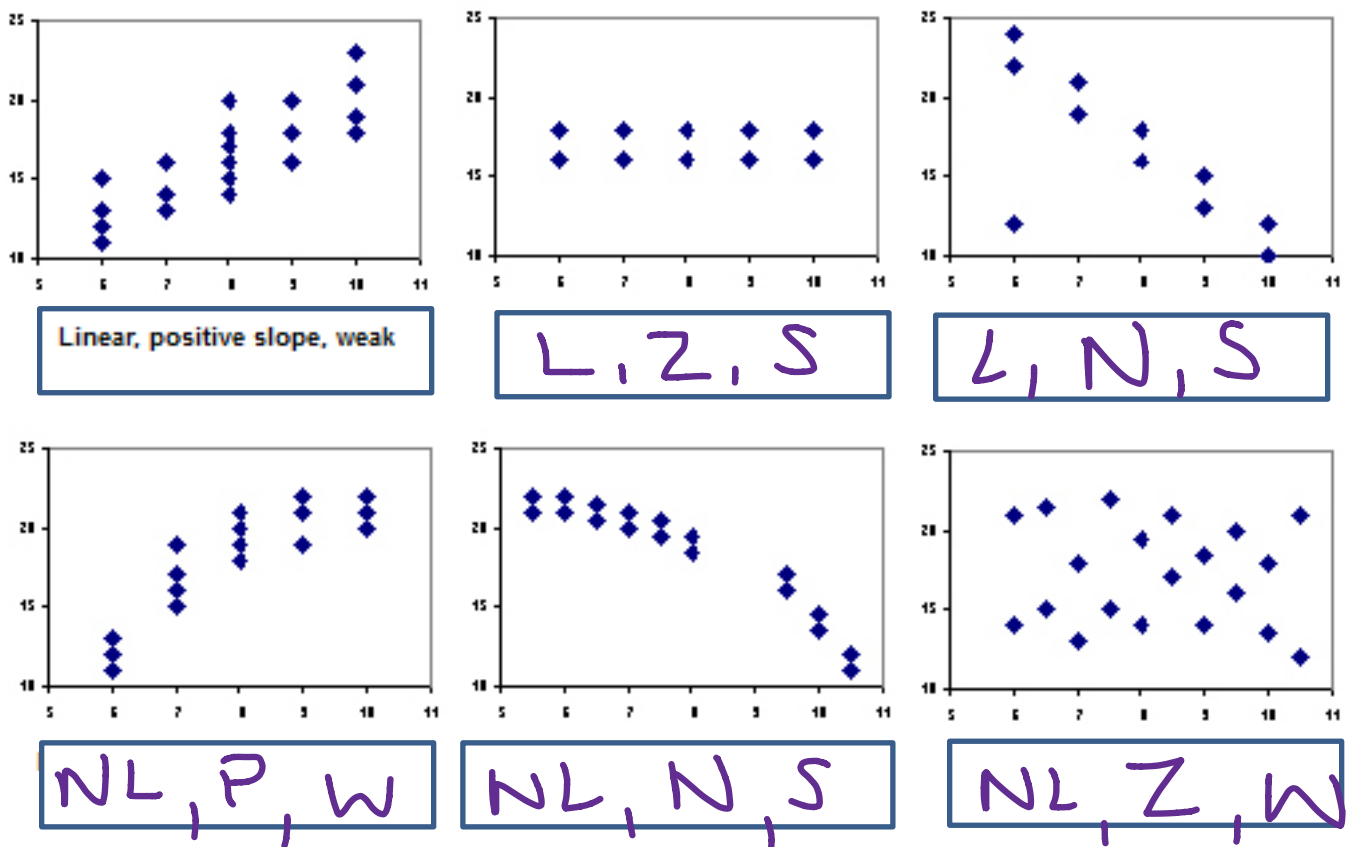**Bucket Brigade**

0   1   2   3   4   5   6   7   8   9   10
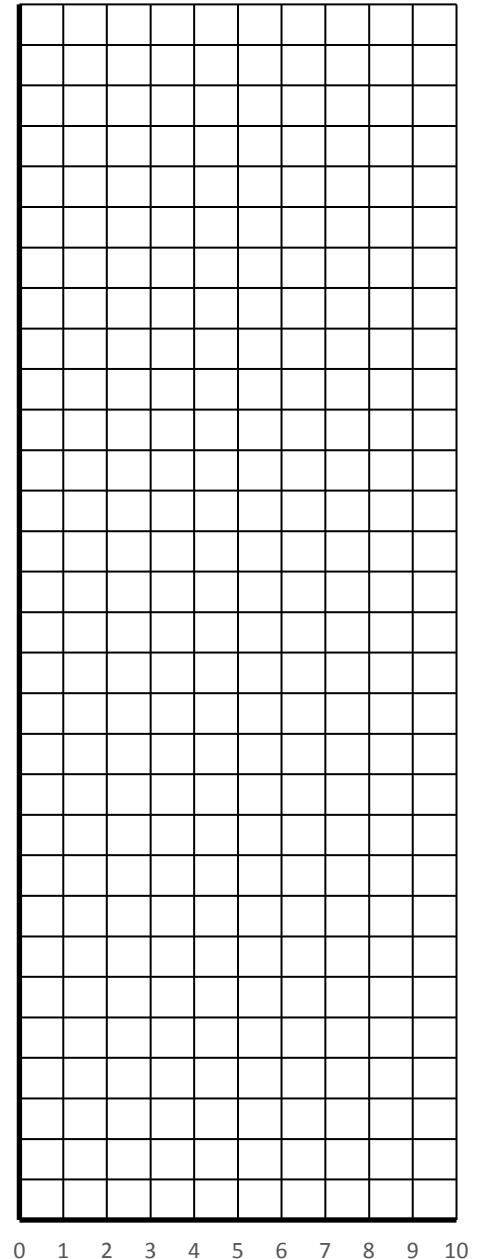
Scatterplots are used to analyze patterns in *bivariate* data. We use the words: linearity, slope and strength to describe the patterns in the data.

- *Linearity* refers to whether a data pattern is linear or nonlinear.

- *Slope* refers to the direction of change in the y-variable when the x-variable gets bigger. If y gets bigger then the slope is positive and if the y gets smaller the slope is negative.

- *Strength* refers to the degree of scatter in the plot. If the dots are widely spread, the relationship between variables is weak. If the dots are concentrated around a line or curve the relationship is strong.

[adapted from http://stattrek.com/statistics/charts/scatterplot.aspx?Tutorial=AP]

10. For each scatterplot below describe each with the words: linearity, slope and strength. One has been done for you.

Linear, positive slope, weak

L, Z, S

L, N, S

NL, P, W

NL, N, S

NL, Z, W

11. Describe your scatterplot from the Bucket Brigade (Exercise 5).

Lesson Summary

Scatterplots

- A scatterplot can be used to investigate whether or not there is a relationship between two numerical variables (bivariate data).

- A line can be used to represent the trend in a scatterplot.

- Evaluating the equation of the line for a value of the independent variable determines a value predicted by the line.

- A good line for prediction is one that goes through the middle of the points in a scatterplot and for which the points tend to fall close to the line.

- There are three ways we describe bivariate data on a scatterplot.

Strong or Weak   Linear or Nonlinear   Positive, Negative or 0 Slope
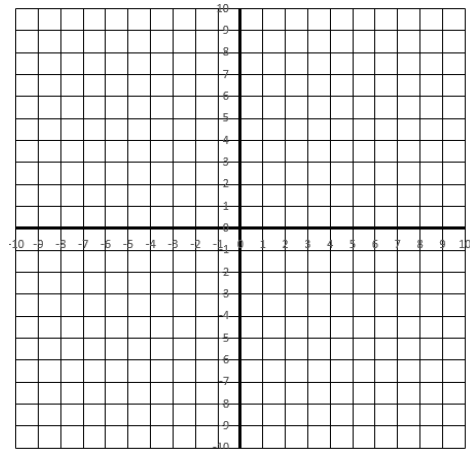

Strong Linear Relationship

Weak Linear Relationship

No Linear Relationship

Nonlinear Relationship

[source: http://mat117.wisconsin.edu/2-a-scatterplot/]

12. Describe the slope each of the graphs above.

Homework Problem Set

1. A. Graph the data in the table.

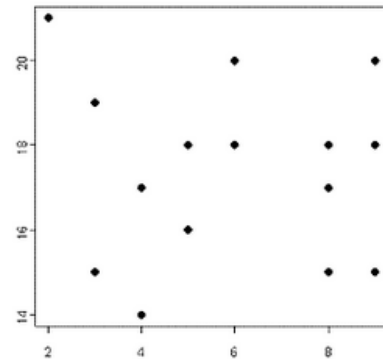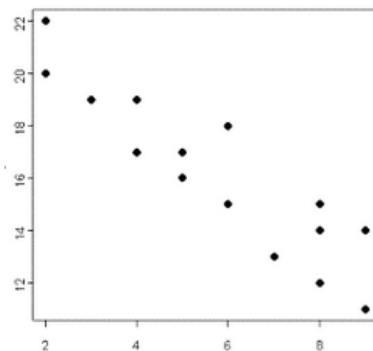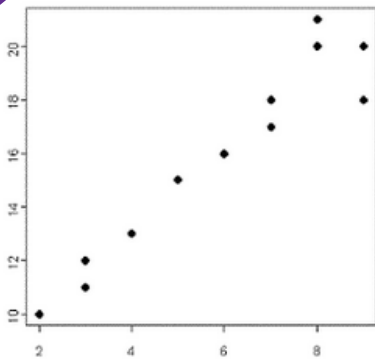| x	-2	-1	0	1	2	3
y	9	7	5	3	1	-1

B. Draw a line of best fit.

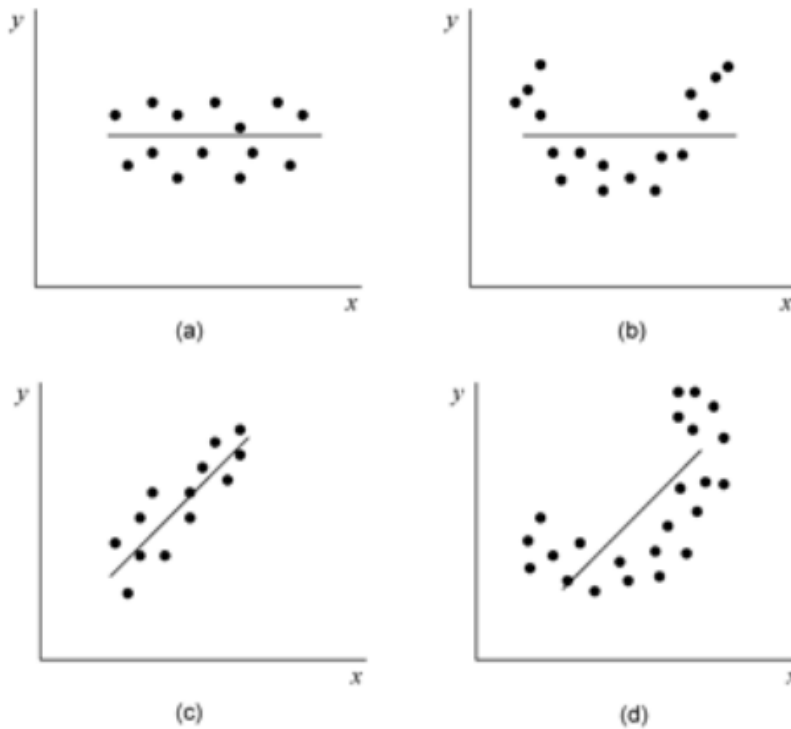C. Choose two points on your line. _____ and _____

D. What is the slope of your line?

2. Describe each graph below. Be sure to discuss linearity, slope and strength. Then draw a line of best fit.

[source: http://www.stat.yale.edu/Courses/1997-98/101/scatter.htm]

3. A. Which graphs are showing a line of best that would make a good model for the data?

(a)   (b)

(c)   (d)

[source: http://reliawiki.org/index.php/Simple_Linear_Regression_Analysis]

B. Draw a better line or curve of best for the other graphs.

4. TECHNOLOGY The data set relates the number of chirps per second for striped ground crickets and the temperature in degrees Fahrenheit. Use Desmos or Excel to graph the following set of data. Then describe the graph and draw a line of best fit.

Chirps per second	Temperature (°F)	Chirps per second	Temperature (°F)	Chirps per second	Temperature (°F)
20.0	88.6	16.0	71.6	19.8	93.3
18.4	84.3	17.1	80.6	15.5	75.2
14.7	69.7	17.1	82.0	15.4	69.4
16.2	83.3	15.0	79.6	17.2	82.6
16.0	80.6	17.0	83.5	14.4	76.3

[source: George W. Pierce, The Song of Insects, Harvard University Press, 1948]