NUMB3RS **Activity: How tall is the criminal?**
Episode: "Judgment Day"

Topic: Scatterplots   **Grade Level**: 8–12
Objective: Students will create and use a scatterplot to make predictions.
**Time**: about 15 minutes

Materials:
- graphing calculator
- meter stick(s) with centimeters marked

Introduction

Two-dimensional scatterplots are often used to compare two sets of data and to see whether there is any relationship, or correlation, between the data. These relationships may show a *positive correlation*, a *negative correlation*, or *no correlation*. Give examples of these situations.

Example
- An example of two sets with positive correlation—temperature and the number of air conditioners sold. As the temperature increases, you would expect more air conditioners to be sold.
- An example of two sets with negative correlation—temperature and the number of heaters sold. As the temperature increases, you would expect fewer heaters to be sold.
- An example of two sets with no correlation—temperature and the number of dishwashers sold. There is no relationship between temperature and number of dishwashers sold.
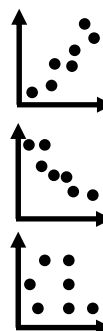
Discuss with Students

In **"Judgment Day***"*, Charlie shows FBI agents a scatterplot of data from their case files in order to quickly see which cases are relevant to their current investigation and which are not. By looking at where and how the data is spread on the graph, Charlie may find a rule or pattern that describes this cluster of data.

The scatterplot allows Charlie and the agents to easily see which cases fit the criteria without having to go through each one individually. They can see more than one characteristic of the case based on where it lies.

Student Page Answers: 1: Answers will vary; *positive* **2**: *Answers will vary; should be around 190 cm* **3**: *188.13 cm; this may be more or less than the height they found.* **4**: *Using the scatterplot, the student must estimate where to put the point. There are many places that make sense on the graph. The formula only gives one answer. Also, the class may not be a good representation of the population.*

Name: _____   Date: _____

NUMB3RS Activity: How tall is the criminal?

Agent Eppes is tracking an unknown criminal. As the criminal was escaping the crime scene, witnesses saw him jump out of a window and land on his side in wet grass. Much of the impression of the criminal is obscured by footprints, but the criminal's leg from knee to hip was measured to be 47 cm.

Agent Eppes has taken this information and thinks that there is a relationship between the height of a person compared to the length of his or her femur (the bone in your leg from your hip to your knee). Here is your chance to help.

Step 1: Measure your leg from the center of your kneecap to the bone on the outside of your hip. Record this length and your own height in the table below. Fill in the table with similar measurements from your classmates. Use the chart below to record your data.

Femur Length (cm)								
Height (cm)								
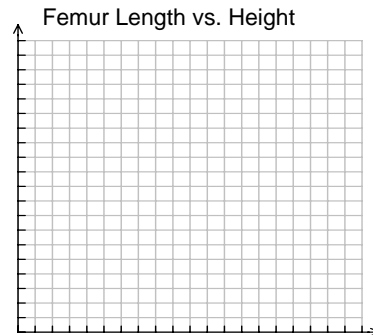
Step 2: Plot the data on a scatterplot, using a graphing calculator or by hand. Label your axes.

Femur Length vs. Height

1. Describe the pattern you see in the scatterplot. Explain the relationship.
_____

2. Based on the data, what is your estimate for the height of the criminal?
_____

3. Anthropologists have developed a formula to determine the height from femur length. In cm, a man's height is given as **2.59•(femur length) + 66.4**. Use this formula to determine the height of the escaping criminal and compare it to the height that you found in #2. _____
_____

4. What might explain the differences in the height that you found using the scatterplot and the height you found using the formula? _____
_____

Extensions

Activity: Explore Lines of Best Fit

Introduction
Explain to students that the anthropology formula used in the activity is the same as the equation for the line of best fit. The line of best fit is useful because it allows you to make predictions based on a set of data.

Additional Resources
Investigating Linear Relationships:
http://illuminations.nctm.org/index_o.aspx?id=135
This site provides lessons that allow students to investigate linear relationships, including the regression line and correlation.

Generating and Analyzing Data: **http://illuminations.nctm.org/index_d.aspx?id=300**
This site provides lessons that challenge students to look for functions within a given set of data, analyze the data, and determine a type of function that represents the data.

NCTM Standards: **http://my.nctm.org/eresources/members/login.asp**
Members of NCTM can read what the *Principles and Standards for School Mathematics* says about data analysis and scatterplots. For nonmembers, you may want to visit your state department of education's website to read about data analysis and scatterplots.

For the Student
Have students use a ruler to draw a line through the data on the student page. Encourage students to describe the method they used to draw their line, anticipating answers such as "a line that fits most of the data" or "is closest to the data."

Have students derive an equation for the line they drew, and explain the process they used. Encourage students to use their formula to predict the height given the known femur measurements. Students should compare their formula with the anthropologists' formula.

For more advanced students, explore the concept of least-squares regression, coefficient of correlation (r) and coefficient of determination (r^2), which measure how well the two data sets correlate to each other.

Demonstrate how the calculator can find the line of best fit and calculate the correlation coefficient by using the LinReg function on the TI-84 Plus under the STAT menus.