

**Arrested Development: Investigations and Math**  
**CRJ 421 Criminal Investigations**  
**Blood Spatter Model**

Team Members:

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Materials

- Fake Blood
- Dropper
- Measuring tape/Yardstick
- Ruler/caliper
- Paper

**Instructions**

Data Collection

- 1) Drop a drop of fake blood from a height of six inches onto a sheet of paper.
- 2) Measure the diameter of the blood spatter and record it on the data table.
- 3) Repeat this process for 12 inches and then every six inches after that until the data table is filled. Be consistent with the amount of fake blood in each drop.

Enter the data in the calculator

- 1) Press the **[STAT]** key. From the **EDIT** menu choose option **1:Edit...** (If there is already data in the lists, clear it out.)
- 2) Enter the height (in inches) in **L1**.
- 3) Enter the diameter (in mm) of the blood spatter in **L2**.

Graph the data.

- 1) Press **[2<sup>nd</sup>] [Y=]** to get into the **STAT PLOTS** menu.
- 2) Select **1:Plot 1**
- 3) Move cursor over **ON** and press **[ENTER]** to turn on **Plot 1**.
- 4) For **TYPE**, select the first option, the scatter plot.
- 5) Choose **L1** for the **Xlist:**. (This is the height data.)
- 6) Choose **L2** for the **Ylist:**. (This is the diameter data.)
- 7) Press **[ZOOM]**
- 8) Scroll down and choose **9:ZoomStat** to see a scatter plot of your data.

**Reading your scatter diagram.**

The horizontal axis represents the height from which the blood was dropped, the further to the right a point in the graph is, the higher the height. The vertical axis represents the diameter of the resulting spatter so the higher the mark on the scatter diagram, the larger the spatter's diameter. Press [TRACE] on your calculator. Notice the cursor is flashing on one of the points. At the bottom of the screen the calculator will tell you what x equals and what y equals. The x-value is the height from which the blood was dropped and the y-value is the diameter of the spatter of blood dropped from that height. Use the right and left arrow keys to move the cursor from one point to another in your scatter diagram.

**Question**

From your scatter diagram, is there a general trend to the data? Do the data points appear to fall along a straight line or curve?

Now it's time to find a linear equation that will model the relationship between height and blood spatter.

Find a linear model.

- 1) Press [STAT] then move cursor to right to see the **CALC** menu.
- 2) Select **4:LinReg(ax+b)**, press [2<sup>nd</sup>][1] to choose **L1**, then press [,], then press [2<sup>nd</sup>][2] to choose **L2**, then press [,], then press [VARS], move the cursor to **Y-VARS**, choose **1:Function...**, then choose **Y1**.

Your screen should now look like this: **LinReg(ax+b) L1, L2, Y1**

- 3) Press [ENTER].
- 4) Copy the information from your screen:

LinReg

y=ax+b

a = \_\_\_\_\_ (round to two decimal places)

b = \_\_\_\_\_ (round to two decimal places)

r<sup>2</sup> = \_\_\_\_\_

r = \_\_\_\_\_

- 5) Write the linear equation that will model the relationship between blood spatter diameter and height.
  
- 6) The value of r is an indication of how well the line fits your data. The closer the value is to 1, the better the model fits the data.
- 7) Now, press [GRAPH] to see the line.
- 8) Press [TRACE] again. We want to trace along the graph of the line and not the data points in the scatter diagram. (Use the up and down arrows until the cursor is on the line. In the upper left hand corner of the screen, it should show you the curve that you are tracing.) Move the cursor along the curve and watch the values of x and y change as you trace along the line. The y-values represent the model's estimate of the diameter of blood dropped from that particular height.

Questions

Do the data points from the scatter diagram fall close to the line?

Are there any points that are not close to the line? If there are, which ones?

Do you think the line is a good model for the data? Explain your answer.

### Using the Model to Estimate the Suspect's Height

Use the model to find estimate the height that the drop fell from.

- 1) Find the diameter of the suspect's blood drop that was found at the scene.  
Diameter of suspect's blood spatter: \_\_\_\_\_
- 2) Press [TRACE] and use the right and left arrows to move the cursor along the graph of the line until you find the value of Y that is *closest* to the diameter of the suspect's spatter.
- 3) With the cursor at that point, record the X value to get an estimate of the suspect's height.

X = \_\_\_\_\_

Estimate of suspect's height = \_\_\_\_\_

### Case Analysis

- 1) Which of the suspect's could have created the blood spatters at the crime scene? Explain.
- 2) How accurate do you think your estimate of the suspect's height is? What factors can contribute to inaccuracy in your estimate? What can you do to minimize these factors?
- 3) Forensic scientists often do tests to determine the relationship between height and spatter diameter for the different crime scenes they are investigating. What factors can cause the relationship between height and spatter diameter to differ from crime scene to crime scene?