

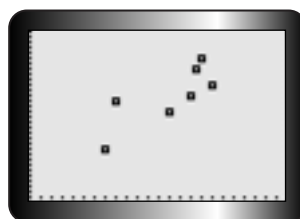
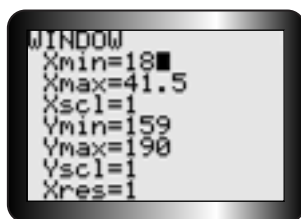
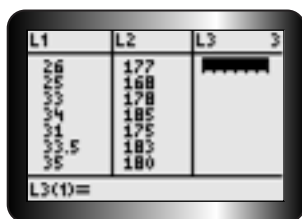


3.1

Investigating a Special Kind of Relationship

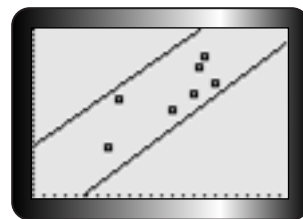
EXPLORATION

In earlier grades, you may have studied the relationship between footprint length and height. The data in L1 and L2 in the first screen were collected from seven students in a grade 11 math class. How can you predict the height of someone whose footprint is 28 cm long?

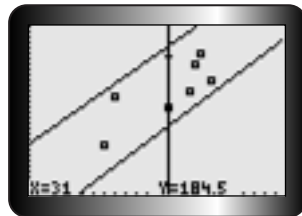
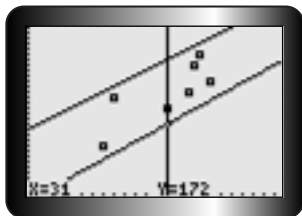


Think, Do, Discuss

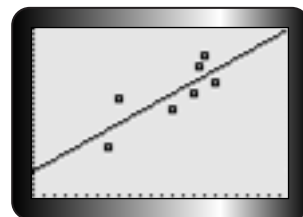
- This data illustrates a relationship between footprint length and height. Which variable is independent in this case?
 - Using a TI-83 Plus calculator, enter the data into lists and create a scatter plot. Zoom in, if needed, so that your screen looks like the third screen above.
 - Someone in the group has a footprint that is 31 cm long. What can you say about that person's height?
 - Now you know one value of the independent variable. Does this value determine a unique value for the dependent variable?
- It appears that there might be a relationship between footprint length and height for all the students in the class. For this relationship, footprint is the input and height is the output. It appears that a student's height can be found using the length of his or her footprint.
 - Think of a line that runs just above all the data points. Think of another line that lies just below all the data points. Enter the equations for these lines into the equation editor and graph. It might be reasonable to expect that data about other students in the class may lie between these two lines. Write your two equations.
 - Estimate a reasonable range for Asif's height if his footprint is 31 cm long.
 - Draw a vertical line through $x = 31$ by doing the following:
 - Press **2nd** **PRGM** to open the DRAW menu.
 - Select **4:Vertical**. Scroll left or right until $x = 31$.



- ii. Use your graph to estimate a reasonable range for Asif's height by doing the following:
- Scroll up or down to move the cursor to each line.
 - Record the y -coordinate for the top line as Asif's greatest possible height. Record the y -coordinate for the bottom line as Asif's least possible height.



- (c) What can you say about Asif's height? How could you make your prediction more accurate?
- (d) The two lines you have drawn and all of the points between these lines define a model for the relationship between footprint length and height for the whole class. Suppose that you are given a value of the independent variable. Does this model *uniquely* determine a value for the dependent variable?
- (e) A 31-cm long footprint is found in the snow. How can you use this model to predict the person's height? How might you change the model to make a more accurate prediction?
3. Another model for the relationship between footprint length and height is the line of best fit and its equation.
- (a) Let ℓ be the length of the footprint for any student in the class. Then let h be the corresponding height. Think of an equation for the line of best fit and graph it on the scatter plot. Record your equation for the line of best fit.
- (b) Use your equation to estimate the height of a student in the class whose footprint is 31 cm long.
- (c) Imagine that you know a value of the independent variable. Does this model uniquely determine a value for the dependent variable?
- (d) Determine the correlation coefficient, r , for the line of best fit. What does the correlation coefficient tell you about this model for the relationship?



The relationship between footprint length and height for the seven students:

Consider the data for the seven students. You could identify each student by his or her footprint since the length of each footprint is different. This relationship is called a **function** because there is only one height for each footprint.

The relationship between footprint length and height for all students in the grade 11 class:

You have the data about a few students, but you cannot predict the relationship between footprint length and height for all the students in the class with complete accuracy. There may be several students in the class whose footprint is 28 cm long, but with different heights. In this situation, there are several different heights for one footprint length, so this relationship is not a function.

The linear model for the relationship using the equation of the line of best fit:

You could describe the linear model as a rule, for example, “Multiply the length of the footprint by 1.1 and then add 143.6 cm to determine the height.” Using this model, you can estimate that the person whose footprint is 28 cm long will be 174 cm tall.



In this model, height is a **function** of the length of the footprint, because height depends on the length of the footprint. The equation can be used to estimate a person's height, given the length of his or her footprint.

4. For set of data,
 - i. create a scatter plot
 - ii. determine a linear model and a quadratic model. Which model is more appropriate?
 - iii. decide a reasonable range for the y -coordinate if the x -coordinate is 4
 - iv. estimate the y -coordinate if the x -coordinate is 4

(a)

x	y
-1	5
2	-3
5	-4
8	0
9	3
12	15

(b)

x	y
-1	6
2	3
5	1
8	-2
9	-3
12	-5

(c)

x	y
-1	-4
2	2
5	7
8	11
9	12
12	15

(d)

x	y
-1	0
2	1
5	3
8	4
9	5
12	6