

Chapter 6 – Describing Associations of Two Variables Graphically
Section 1 – Scatterplots

Objectives

1. Identify explanatory and response variables.
2. Construct a scatterplot.
3. Determine the direction of an association.

Vocabulary

1. explanatory/independent variable
2. response/dependent variable
3. ordered pair
4. scatterplot
5. association
6. correlation
7. positively/negatively associated

Lesson/Activity

OBJECTIVE 1 – Identify explanatory and response variables.

Here we review the meanings of explanatory variable and response variable (Section 2.3):

Definition: Explanatory and response variables

In a study about whether a variable x explains (affects) a variable y ,

We call x the **explanatory variable** (or **independent variable**).

We call y the **response variable** (or **dependent variable**).

Recall that calling a variable the explanatory variable does not mean for sure that the variable affects (explains) the response variable. After all, we'd have to carry out the study to find out.

1. For each situation, identify the explanatory variable and the response variable.
 - a. Let d be the number of miles a person runs per day, and let T (in seconds) be the person's best mile run time.
 - b. Let n be the number of adults who want to buy an iPhone that costs d dollars.
 - c. Let s be an employee's salary (in thousands of dollars) at a company, and let n be the number of years the employee has worked for the company.

For an ordered pair (a, b) , we write the value of the explanatory variable in the first (left) position and the value of the response variable in the second (right) position.

2. Let s be the sales (in thousands) of a video game, and let b be the game's advertising budget (in thousands of dollars). A video game with a \$50-thousand-dollar advertising budget has sales of 742 thousand games. Express this as an ordered pair.
3. Let n be the mean number of hours that a student studies prestatistics per week, and let p be percentage of points the student earns on the first test. A student who studies 15 hours per week earns 93% of the points on the first test. Express this as an ordered pair.

4. Let s be the mean number of grams of sugar that an adult consumes daily, and let n be the mean number of cavities the person gets per decade. What does the ordered pair (76, 1.5) mean in this situation?
5. Let p be the percentage of Americans at age A years who listen to talk radio. What does the ordered pair (59, 23) mean in this situation?

Columns of Tables and Axes of Coordinate Systems

Assume that an authentic situation can be described by using two numerical variables. Then

- For tables, the values of the explanatory variable are listed in the first column and the values of the response variable are listed in the second column. [Give an example.]
- For coordinate systems, the values of the explanatory variable are described by the horizontal axis and the values of the response variable are described by the vertical axis. [Draw a figure.]

OBJECTIVE 2 – Construct a scatterplot.

A coordinate system with plotted ordered pairs is called a **scatterplot**.

6. The fatality rates from automobile crashes are shown in the following table for various speeds. Let r be the fatality rate (deaths per 1000 crashes) for a speed of s mph.

Speed Group (mph)	Speed Used to Represent Speed Group (mph)	Fatality Rate (deaths per 1000 crashes)
0 – 30	15	2.5
30 – 40	35	3.5
40 – 50	45	6.1
50 – 60	55	15.3
over 60	70	16.9

Source: National Highway Transportation Safety Administration

- a. Construct a scatterplot.
 - b. Which of the points in your scatterplot is lowest? What does that mean in this situation?
 - c. Which of the points in your scatterplot is highest? What does that mean in this situation?
- Recall that there is an **association** between the explanatory and response variables if the response variable changes as the explanatory variable changes.
 - An association of *numerical* explanatory and response variables is often called a **correlation**.
 - If there is an association between two variables that does not necessarily mean there is causation.

OBJECTIVE 3 – Determine the direction of an association.

Definition: Positive and negative association

Assume two numerical variables are the explanatory and response variables of a study.

- If the response variable tends to increase as the explanatory variable increases, we say the variables are **positively associated** (or **positively correlated**) and that there is a **positive association** (or **positive correlation**). [Draw a figure.]
- If the response variable tends to decrease as the explanatory variable increases, we say the variables are **negatively associated** (or **negative correlated**) and that there is a **negative association** (or **negative correlation**). [Draw a figure.]

We describe the **direction** of an association by determining whether the association is positive, negative, or neither.

7. Percentages of adults surveyed who plan to attend a Halloween party this year are shown in the following table for various ages groups.

Age Group (years)	Age Used to Represent Age Group (years)	Percent
18 – 24	21.0	44
25 – 34	29.5	34
35 – 44	39.5	25
45 – 54	49.5	14
55 – 64	59.5	10
65 or over	70.0	6

Source: International Mass Retail Association

Let p be the percentage of adults at age a years who plan to attend a Halloween party this year.

- Construct a scatterplot.
 - Determine whether the association is positive, negative, or neither.
8. Let t be the number of years since 2000. Find the values of t that represent the years 2000, 2005, 2010, and 2015.
9. Let n be the number (in thousands) of new apps submitted to Apple’s App Store per month at t years since 2010. In 2015, 40 thousand new apps were submitted to Apple’s App Store (Source: pocketgamer.biz). Express this as an ordered pair.
10. Let p be the percentage of adults ages 18–24 who live with their parents at t years since 2005. What does the ordered pair (7, 56) mean in this situation?

11. The numbers of Internet searches using Google are shown in the following table for various years.

<u>Year</u>	<u>Number of Searches (in billions)</u>
2008	83
2009	107
2010	122
2011	133
<u>2012</u>	<u>139</u>

Source: Google

Let r be the annual number (in billions) of searches at t years since 2005.

- Construct a scatterplot.
- Determine whether the association is positive, negative, or neither.

Homework/Assessment

1, 3, 9, 17, 23, 31, 35, 39, 41, 43, 47, 51, 55, 59, 69