2.2 Explanatory or response? For each of the following scenarios, classify each of the pair of variables as explanatory or response or neither. Give reasons for your answers.

(a) The quality rating of a laundry detergent and the price per load of the detergent.

(b) The day of the week and the amount of time spent studying for a statistics class.

(c) Children classified by age group and whether they met the requirement for the amount of calcium needed in their diet.

(d) The number of alcoholic drinks consumed and the blood alcohol content.

2.11 Fuel consumption. Natural Resources Canada tests new vehicles each year and reports several variables related to fuel consumption for vehicles in different classes.[10] For 2018 the group provides data for 502 vehicles that use regular fuel. Two variables reported are carbon dioxide (CO_2) emissions and highway fuel consumption (FuelConsHwy). CO_2 is measured in grams per kilometer (g/km), and highway fuel consumption is measured in liters per 100 kilometers (L/100 km). CANFREG

(a) Make a scatterplot of the data with highway fuel consumption on the x axis and CO_2 emissions on the y axis.

(b) Describe the form, direction, and strength of the relationship.

(c) Are there any outliers or unusual observations?

2.12 Fuel consumption with a line. Refer to the previous exercise. CANFREG

(a) Add a line to the plot. To what extent to you think that the line does a good job of summarizing the relationship?

(b) If your have the appropriate software, use smooth curves to examine the relationship. Does your analysis support the idea of using a straight line to summarize the relationship? Summarize what you find using this method.

2.13 Fuel consumption for different types of vehicles. Refer to the previous two exercises. Those exercises examined data for vehicles that used regular fuel. Data are also available for vehicles that use several other types of fuel. There are 1045 vehicles in total. The variable Fuel has four different possible values: X, for regular fuel; Z, for premium fuel; D, for diesel; and E, for ethanol. CANFUEL

(a) Make a scatterplot of all of the data using different symbols or colors for the different fuel types.

(b) Does the relationship between CO_2 and highway fuel consumption depend upon the type of fuel that the vehicle uses? Explain your answer.

• Correlation ignores the distinction between explanatory and response variables. The value of r is not affected by changes in the unit of measurement of either variable.

• While scatterplots give a full graphical summary of the relationship between two variables, it can be hard to see the form of the relationship. The correlation can give a better description of the relationship, but it is only meaningful for linear relationships, and is not resistant to outliers (which can greatly change the value of r).

escribe the direction and strength of a linear
wo quantitative variables. *Review Example 2.19*
rcise 2.31.

vhich the correlation is not a good measure of
wo quantitative variables. *Review Example 2.20*
rcise 2.47.

e correlation, a numerical summary, and the scatterplot,
for describing the relationship between two quantitative
nple 2.19 (page 93) and try Exercise 2.33.

2.30 Blueberries and anthocyanins. In Exercise 2.8 (page 88), you examined the relationship between Antho4 and Antho3, two anthocyanins found in blueberries. BERRIES

(a) Find the correlation between these two anthocyanins.

(b) Look at the scatterplot for these data that you made in part (a) of Exercise 2.8 (or make one if you did not do that exercise). Is the correlation a good numerical summary of the graphical display in the scatterplot? Explain your answer.

(c) Does the size of the correlation suggest that the amounts of these two anthocyanins is approximately equal in these blueberries? Explain why or why not.

2.31 Blueberries and anthocyanins with logs. In Exercise 2.9 (page 88), you examined the relationship between Antho4 and Antho3, two anthocyanins found in blueberries, using logs for both variables. Answer the questions in the previous exercise for the variables transformed in this way. BERRIES

2.32 Fuel consumption. In Exercise 2.11 (page 88), you used a scatterplot to examine the relationship between CO_2 emissions and highway fuel consumption for 502 vehicles that use regular fuel. Find the correlation between these two variables. Use the scatterplot and the correlation to describe the relationship. CANFREG

2.33 Fuel consumption for different types of vehicles. In Exercise 2.13 (page 89), you examined the relationship between CO_2 emissions and highway fuel consumption for 1045 vehicles that use four different types of fuel. Find the correlations between CO_2 and highway fuel consumption for each of these four categories of vehicle. Summarize your results and explain the similarities and differences in the relationships among the four types of fuel. CANFUEL

2.34 Strong association but no correlation. Here is a data set that illustrates an important point about correlation: CORR

X	45	55	65	75	85
Y	30	50	70	50	30

(a) Make a scatterplot of Y versus X.

(b) Describe the relationship between Y and X. Is it weak or strong? Is it linear?

(c) Find the correlation between Y and X.

(d) What important point about correlation does this exercise illustrate?

2.35 Bone strength. Exercise 2.14 (page 89) gives the bone strengths of the dominant and the nondominant arms of 15 men who were controls in a study. ARMSTR

(a) Find the correlation between the bone strength of the dominant arm and the bone strength of the nondominant arm.

(b) Look at the scatterplot for these data that you made in part (a) of Exercise 2.14 (or make one if you did not do that exercise). Is the correlation a good numerical summary of the graphical display in the scatterplot? Explain your answer.

2.36 Bone strength for baseball players. Refer to the previous exercise. Similar data for baseball players are given in Exercise 2.15 (page 89). Answer parts (a) and (b) of the previous exercise for these data. ARMSTR

2.37 Student ratings of teachers. A college newspaper interviews a psychologist about student ratings of the teaching of faculty members. The psychologist says, "The evidence indicates that the correlation between the research productivity and teaching rating of faculty members is close to zero." The paper reports this as "Professor McDaniel said that good researchers tend to be poor teachers, and vice versa." Explain why the paper's report is wrong. Write a statement in plain language (without using the word "correlation") to explain the psychologist's meaning.

2.38 Decay of a radioactive element. Data for an experiment on the decay of barium-137m is given in Exercise 2.22 (page 90). DECAY

(a) Find the correlation between the radioactive counts and the time after the start of the first counting period.

2.50 Fuel consumption. In Exercise 2.11 (page 88), you examined the relationship between CO_2 emissions and highway fuel consumption for 502 vehicles that use regular fuel. In Exercise 2.32 (page 96), you found the correlation between these two variables. CANFREG

(a) Find the equation of the least-squares regression line for predicting CO_2 emissions from highway fuel consumption.

(b) Make a scatterplot of the data with the fitted line.

(c) How well does the line fit the data? Explain your answer.

(d) Use the line to predict the value of CO_2 for vehicles that consume 8.0 liters per 100 kilometers (L/100 km).

2.51 Fuel consumption for different types of vehicles. In Exercise 2.13 (page 89), you examined the relationship between CO_2 emissions and highway fuel consumption for 1045 vehicles. You used different plotting symbols for the four different types of fuel used by these vehicles: regular, premium, diesel, and ethanol. CANFUEL

(a) Find the least-squares regression equation for predicting CO_2 emissions from highway fuel consumption for all 1045 vehicles.

(b) Make a scatterplot of the data with the fitted line.

(c) Based on what you learned from Exercise 2.13, do you think that a single least-squares regression line provides a good fit for all four types of vehicles? Explain your answer.