

Text Exercise Set 11

NAME:

11-1 In Exercise 10-5, the Biotin and Weight Data, displayed in Table 10-5, is used in a study of the relationship between the amount of biotin added per kilogram of feed and the weight in grams of newly hatched turkeys after three weeks.

Suppose there is interest in the prediction of weight from amount of biotin.

- (a) Identify the response variable Y and the explanatory variable X .

- (b) In Exercise 10-5, it was found that $\bar{x} = 112.5$, $\bar{y} = 326.0$, $s_x^2 = 5729.17$, $s_y^2 = 8722.67$, and $r = +0.9725$. Find the equation of the least squares line, and write a one sentence interpretation of the slope of the least squares line

- (c) Use the least squares line to predict the weight after three weeks with a biotin level of 200 per kilogram of feed.

- (d) Use the least squares line to estimate the average weight after three weeks with a biotin level of 150 per kilogram of feed.

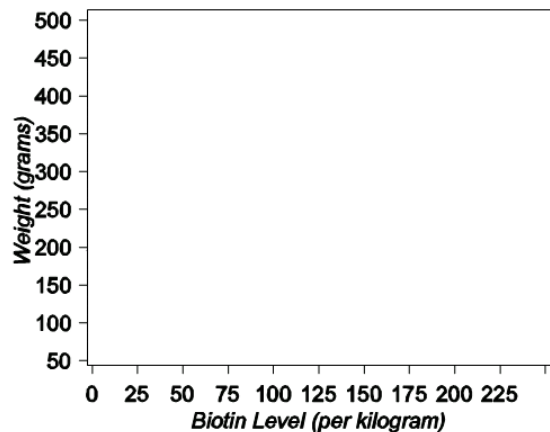
- (e) Give an example of a biotin level for which using the least squares line to predict weight would not be appropriate.

- (f) On average, what is the change in weight with an increase in biotin level of 3 per kilogram of feed?

- (g) Use the least squares line to estimate the biotin level resulting in a weight of 305 grams.

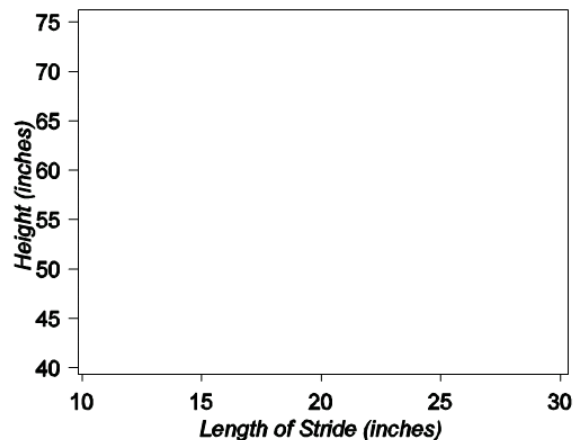
- (h) Complete the construction of the scatter plot of the data, and graph the least squares line on the scatter plot.

- (i) Do the values for the explanatory variable in the data look random, or do they look like they were controlled by the experimenter?



11-2 In Exercise 10-6, the Stride and Height Data, displayed in Table 10-6, is used in a study of the relationship between a person's height and a person's length of stride (distance between footprints). Suppose there is interest in the prediction of height from length of stride.

- (a) Identify the response variable Y and the explanatory variable X .
- (b) In Exercise 10-6, it was found that $\bar{x} = 18$, $\bar{y} = 61.8$, $s_x^2 = 25$, $s_y^2 = 43.7$, and $r = +0.9076$. Find the equation of the least squares line, and write a one sentence interpretation of the slope of the least squares line
- (c) Use the least squares line to predict the height of a person with a length of stride equal to 23 inches.
- (d) Use the least squares line to estimate the average height of people with a length of stride equal to 15 inches.
- (e) Why would it not be appropriate to use the least squares line to estimate the mean height of individuals with a length of stride equal to 10 inches?
- (f) On average, what is the change in height with an increase of 2 inches in length of stride?
- (g) Use the least squares line to estimate the length of stride resulting in a height of 60 inches.
- (h) Complete the construction of the scatter plot of the data, and graph the least squares line on the scatter plot.
- (i) Do the values for the explanatory variable in the data look random, or do they look like they were controlled by the experimenter?



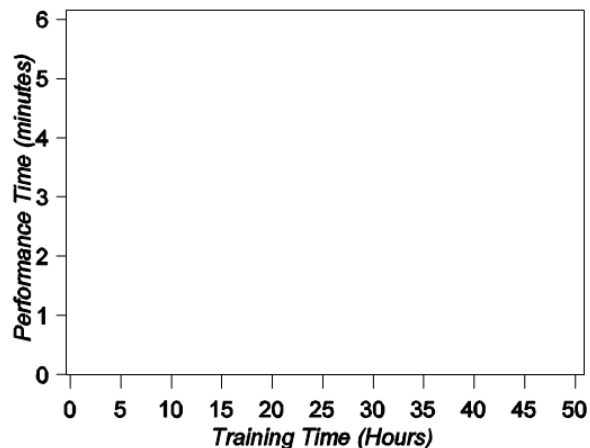
11-3 The relationship between the number of hours of training to perform a certain job and the number of minutes necessary to perform the job is being investigated, with regard to the prediction of time to perform the job from training hours. The Task Training Data, displayed as Table 11-1, is recorded for several subjects.

- (a) Identify the response variable Y and the explanatory variable X .
- (b) Find the mean for each variable and the variance for each variable.

Training Time (hrs.)	Performance Time (min.)
15	5.2
15	5.9
30	3.7
30	4.7
45	3.8
45	3.1

- (c) Find the correlation between the two variables.
- (d) Based on the value of the correlation, which of Figures 9-1a to 9-1j (reproduced in Exercise Set 10) would you expect a scatter plot of this data to resemble? Why?
- (e) Find the equation of the least squares line, and write a one sentence interpretation of the slope of the least squares line.

- (f) Complete the construction of the scatter plot of the data, graph the least squares line on the scatter plot, and decide whether you think the relationship should be considered linear or non-linear.



11-3 - continued

- (g) Use the least squares line to predict the number of minutes to perform the job after 40 hours of training.
- (h) Use the least squares line to estimate the average number of minutes to perform the job after 25 hours of training.
- (i) Give an example of a number of training hours for which using the least squares line to predict the number of minutes to perform the job would not be appropriate.
- (j) On average, what is the change in number of minutes to perform the job with an increase of 1.5 training hours?
- (k) Use the least squares line to estimate the training time resulting in a performance time of 4 minutes.
- (l) Do the values for the explanatory variable in the data look random, or do they look like they were controlled by the experimenter?

11-4 The relationship between temperature and the breaking strength of a particular alloy is being studied, with regard to the prediction of breaking strength from temperature. The Temperature and Strength Data, displayed as Table 11-2, is recorded for several pieces of the alloy.

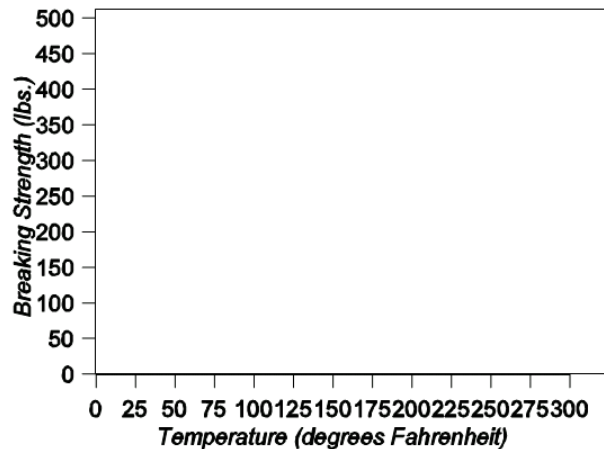
- (a) Identify the response variable Y and the explanatory variable X .
- (b) Find the mean for each variable and the variance for each variable.
- (c) Find the correlation between the two variables.

Temperature (°F)	Breaking Strength (lbs.)
9	396
50	351
60	320
97	281
123	263
140	227
152	155
178	116
225	61
262	36
277	16

11-4 - continued

- (d) Based on the value of the correlation, which of Figures 9-1a to 9-1j (reproduced in Exercise Set 10) would you expect a scatter plot of this data to resemble? Why?
- (e) Find the equation of the least squares line, and write a one sentence interpretation of the slope of the least squares line.

- (f) Complete the construction of the scatter plot of the data, graph the least squares line on the scatter plot, and decide whether you think the relationship should be considered linear or non-linear.



- (g) Use the least squares line to predict the breaking strength of the alloy at a temperature of 32 degrees Fahrenheit.
- (h) Use the least squares line to estimate the average breaking strength of the alloy at a temperature of 212 degrees Fahrenheit.
- (i) Why would it not be appropriate to use the least squares line to estimate the breaking strength of the alloy at a temperature of 300 degrees Fahrenheit?
- (j) On average, what is the change in breaking strength with an increase of 10 degrees Fahrenheit in temperature?
- (k) Use the least squares line to estimate the temperature resulting in a breaking strength of 290 lbs.
- (l) Do the values for the explanatory variable in the data look random, or do they look like they were controlled by the experimenter?

11-5 Each day, the owner of a hot dog stand at a beach records the temperature at noon and the volume of sales. The owner reports a very high correlation of $r = +0.9327$ was found between the temperature at noon and the volume of sales. What information is missing which is important in making a decision as to how significant this correlation is?

11-6 Identify which of the correlations listed would be considered most significant and which would be considered least significant.

- (a) $r = + 0.8555$ with $n = 10$ observations
- (b) $r = - 0.0078$ with $n = 10$ observations
- (c) $r = + 0.4355$ with $n = 100$ observations
- (d) $r = - 0.8327$ with $n = 100$ observations

11-7 Why would using a least squares line to make predictions for the future with the data of Exercise 9-7 most likely produce poor predictions.

11-8 Why would using a least squares line to make predictions for the future with the data of Exercise 9-8 most likely produce poor predictions.

11-9 Each of the following describes a situation where a large collection of observations of a quantitative variable could be made. Describe the shape of the distribution you might expect to observe if the observations were actually made and a histogram was constructed to display the data; also, give a reason to justify your answer (but please note that you are not required to actually collect any data; you are only being asked to make educated guesses about what is likely to occur if data were collected).

- (a) Several hundred 20-year-old males are arbitrarily selected. Each male's height is recorded.

- (b) Several hundred 20-year-old individuals, about half male and half female, are arbitrarily selected. Each person's height is recorded.

11-9 - *continued*

- (c) Several hundred one-dollar bills are arbitrarily selected from those passed by patrons of a restaurant.

- (d) Several hundred names are arbitrarily selected from a phone book. The last digit of each person's phone number is recorded.

11-10 Each of the following describes a situation where a large collection of observations of a quantitative variable could be made. Describe the shape of the distribution you might expect to observe if the observations were actually made and a histogram was constructed to display the data; also, give a reason to justify your answer (but please note that you are not required to actually collect any data; you are only being asked to make educated guesses about what is likely to occur if data were collected).

- (a) Ten pennies are flipped simultaneously, and the number of pennies displaying heads is recorded. This is repeated several hundred times.

- (b) A fair, six-sided die has one dot painted on one side, two dots painted on a second side, three dots painted on a third side, four dots painted on a fourth side, five dots painted on a fifth side, and six dots painted on a sixth side. The die is rolled, and the number of dots displayed upward is recorded. This is repeated several hundred times.

- (c) A fair, twelve-sided die has one dot painted on three of its sides, two dots painted on two of its sides, three dots painted on one of its sides, four dots painted on one of its sides, five dots painted on two of its sides, and six dots painted on three of its sides. The die is rolled, and the number of dots displayed upward is recorded. This is repeated several hundred.

- (d) Several hundred automobiles are arbitrarily selected on a busy city street. The age of each automobile in years is recorded.

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