ALEKS® Objective 3 Worksheet

Introduction to Statistics / Math 117 Statistics (Mr. Banimahd)

1. An urn contains 7 black and 5 pink balls. Five balls are randomly drawn from the urn in succession, with replacement. That is, after each draw, the selected ball is returned to the urn. What is the probability that all 5 balls drawn from the urn are black? Round your answer to three decimal places.

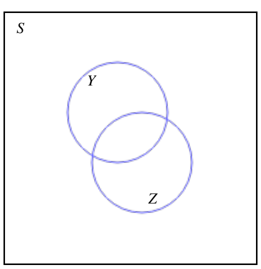
2. An urn contains 7 pink and 9 green balls. Six balls are randomly drawn from the urn in succession, with replacement. That is, after each draw, the selected ball is returned to the urn. What is the probability that all 6 balls drawn from the urn are green? Round your answer to three decimal places.

3. An urn contains 7 green and 8 red balls. Four balls are randomly drawn from the urn in succession, with replacement. That is, after each draw, the selected ball is returned to the urn. What is the probability that all 4 balls drawn from the urn are green? Round your answer to three decimal places.

4. An urn contains 9 pink and 6 black balls. Five balls are randomly drawn from the urn in succession, with replacement. That is, after each draw, the selected ball is returned to the urn. What is the probability that all 5 balls drawn from the urn are black? Round your answer to three decimal places.

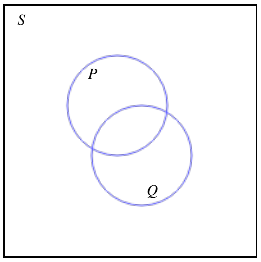
5. As shown in the Venn diagram below, Y and Z are events in the sample space S.

Indicate the event $Y \cup Z$ by shading the appropriate region(s).



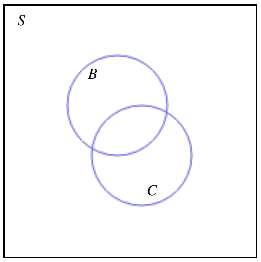
6. As shown in the Venn diagram below, P and Q are events in the sample space S.

Indicate the event $\overline{P}$ by shading the appropriate region(s).



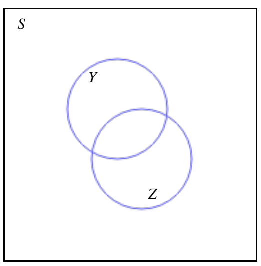
7. As shown in the Venn diagram below, B and C are events in the sample space S.

Indicate the event $\overline{C}$ by shading the appropriate region(s).



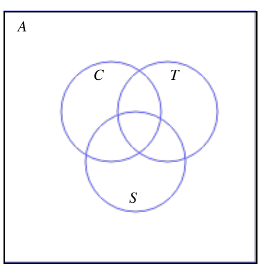
8. As shown in the Venn diagram below, Y and Z are events in the sample space S.

Indicate the event $Y \cup Z$ by shading the appropriate region(s).



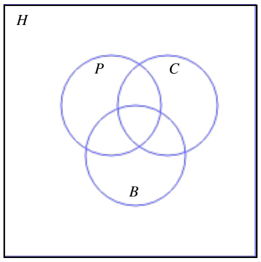
9. Among adults (denoted by A), there are those who drink coffee (denoted by C), those who drink tea (denoted by T), and those who drink soda (denoted by S).

Represent, by shading the appropriate region(s), those adults who drink coffee or tea (or both) but don't drink soda.



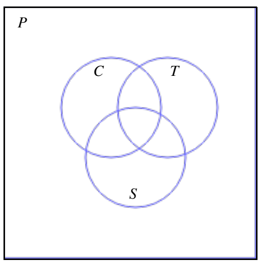
10. Among high-school graduates (denoted by H), there are those who studied physics (denoted by P), those who studied chemistry (denoted by C), and those who took biology (denoted by B).

Represent, by shading the appropriate region(s), those high-school graduates who studied either physics or chemistry but not both, and in addition took no biology.



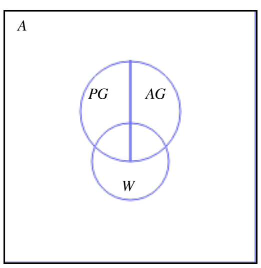
11. Among people (denoted by P), there are those who drink coffee (denoted by C), those who drink tea (denoted by T), and those who add sugar to their beverages (denoted by S).

Represent, by shading the appropriate region(s), those people who drink coffee or tea (or both) but don't add sugar to their beverages.



12. Among all athletes (denoted by A), there are those who play golf. There are also those athletes (denoted by W) who have won a tournament competition. Golfers are made up of professionals (denoted by PG) and amateurs (denoted by AG).

Represent, by shading the appropriate region(s), all athletes who are either professional golfers who have won a tournament or amateur golfers who have not.



13. A coin is tossed three times. An outcome is represented by a string of the sort HTT (meaning a head on the first toss, followed by two tails). The 8 outcomes are listed in the table below. Note that each outcome has the same probability.

For each of the three events below, check the outcome(s) that are contained in the event. Then, in the last column, enter the probability of the event.

		Outcomes								Probability
		TTT	TTH	THT	HHH	HTT	THH	HTH	HHT	
Events	More tails than heads	☐	☐	☐	☐	☐	☐	☐	☐	▯
	A head on the last toss	☐	☐	☐	☐	☐	☐	☐	☐	▯
	Exactly one tail	☐	☐	☐	☐	☐	☐	☐	☐	▯

14. A coin is tossed three times. An outcome is represented by a string of the sort HTT (meaning a head on the first toss, followed by two tails). The 8 outcomes are listed in the table below. Note that each outcome has the same probability.

For each of the three events below, check the outcome(s) that are contained in the event. Then, in the last column, enter the probability of the event.

		Outcomes								Probability
		TTT	THT	TTH	HTT	HHT	HHH	THH	HTH	
Events	A tail on the first toss or the third toss (or both)	☐	☐	☐	☐	☐	☐	☐	☐	▯
	A tail on both the first and the last tosses	☐	☐	☐	☐	☐	☐	☐	☐	▯
	Alternating heads and tails (with either coming first)	☐	☐	☐	☐	☐	☐	☐	☐	▯

15. A coin is tossed three times. An outcome is represented by a string of the sort HTT (meaning a head on the first toss, followed by two tails). The 8 outcomes are listed in the table below. Note that each outcome has the same probability.

For each of the three events below, check the outcome(s) that are contained in the event. Then, in the last column, enter the probability of the event.

		Outcomes								Probability
		HTT	TTT	HHT	THT	HTH	HHH	THH	TTH	
Events	A tail on both the first and the last tosses	☐	☐	☐	☐	☐	☐	☐	☐	▯
	No heads on the first two tosses	☐	☐	☐	☐	☐	☐	☐	☐	▯
	Two or more heads	☐	☐	☐	☐	☐	☐	☐	☐	▯

16. A coin is tossed three times. An outcome is represented by a string of the sort HTT (meaning a head on the first toss, followed by two tails). The 8 outcomes are listed in the table below. Note that each outcome has the same probability.

For each of the three events below, check the outcome(s) that are contained in the event. Then, in the last column, enter the probability of the event.

		Outcomes								Probability
		HTH	TTT	THT	HHT	HTT	TTH	HHH	THH	
Events	A head on the first toss	☐	☐	☐	☐	☐	☐	☐	☐	▯
	No tails on the first two tosses	☐	☐	☐	☐	☐	☐	☐	☐	▯
	A tail on each of the first two tosses	☐	☐	☐	☐	☐	☐	☐	☐	▯

17. An ordinary (fair) die is a cube with the numbers 1 through 6 on the sides (represented by painted spots). Imagine that such a die is rolled twice in succession and that the face values of the two rolls are added together. This sum is recorded as the outcome of a single trial of a random experiment.

Compute the probability of each of the following events:

Event A: The sum is greater than 5.
Event B: The sum is an odd number.

Round your answers to at least two decimal places.

$P(A) =$
$P(B) =$

18. An ordinary (fair) die is a cube with the numbers 1 through 6 on the sides (represented by painted spots). Imagine that such a die is rolled twice in succession and that the face values of the two rolls are added together. This sum is recorded as the outcome of a single trial of a random experiment.

Compute the probability of each of the following events:

Event A: The sum is greater than 6.
Event B: The sum is not divisible by 4 and not divisible by 6.

Round your answers to at least two decimal places.

$P(A) =$
$P(B) =$

19. An ordinary (fair) die is a cube with the numbers 1 through 6 on the sides (represented by painted spots). Imagine that such a die is rolled twice in succession and that the face values of the two rolls are added together. This sum is recorded as the outcome of a single trial of a random experiment.

Compute the probability of each of the following events:

Event A: The sum is greater than 8.
Event B: The sum is an even number.

Round your answers to at least two decimal places.

$P(A) =$
$P(B) =$

20. An ordinary (fair) die is a cube with the numbers 1 through 6 on the sides (represented by painted spots). Imagine that such a die is rolled twice in succession and that the face values of the two rolls are added together. This sum is recorded as the outcome of a single trial of a random experiment.

Compute the probability of each of the following events:

Event A: The sum is greater than 9.
Event B: The sum is not divisible by 3.

Round your answers to at least two decimal places.

$P(A) =$
$P(B) =$

21. Survey data indicate that 56% of customers at MegaHit video rental stores subscribe to premium movie channels through their cable television provider. The data also indicate that 38% of MegaHit customers own a DVD player, while 70% of MegaHit customers subscribe to premium movie channels or own a DVD player (or both). What is the probability that a randomly selected MegaHit customer both owns a DVD player and subscribes to premium movie channels?

Write your answer as a decimal (not as a percentage).

22. At a particular restaurant, 52% of all customers order an appetizer and 50% of all customers order dessert. If 77% of all customers order an appetizer or dessert (or both), what is the probability a randomly selected customer orders both an appetizer and dessert?

Write your answer as a decimal (not as a percentage).

23. WLD Incorporated, a national data-collection agency, estimates that 49% of all customers at home warehouse stores (in the United States) own their own home. WLD also estimates that 34% of all home warehouse customers have lived at their current address for less than five years, and that 57% of all home warehouse customers own their own home or have lived at their current address for less than five years (or both). Using these estimates, what is the probability that a randomly selected home warehouse customer both owns her own home and has lived at her current address for less than five years?

Write your answer as a decimal (not as a percentage).

24. At a certain pizza parlor, 44% of the customers order a pizza containing onions, 36% of the customers order a pizza containing sausage, and 70% order a pizza containing onions or sausage (or both). Find the probability that a customer chosen at random will order a pizza containing both onions and sausage.

Write your answer as a decimal (not as a percentage).

25. Suppose that A and B are independent events such that $P(A)=0.50$ and $P(\overline{B})=0.40$.

Find $P(A\cap B)$ and $P(A\cup B)$.

$P(A\cap B)=$
$P(A\cup B)=$

26. Suppose that A and B are independent events such that $P(A)=0.40$ and $P(\overline{B})=0.50$.

Find $P(A\cap B)$ and $P(A\cup B)$.

$P(A\cap B)=$
$P(A\cup B)=$

27. Suppose that A and B are independent events such that $P(A)=0.50$ and $P(\overline{B})=0.30$.

Find $P(A\cap B)$ and $P(A\cup B)$.

$P(A\cap B)=$
$P(A\cup B)=$

28. Suppose that A and B are independent events such that $P(A)=0.50$ and $P(\overline{B})=0.70$.

Find $P(A\cap B)$ and $P(A\cup B)$.

$P(A\cap B)=$
$P(A\cup B)=$

29. At a factory that produces pistons for cars, Machine 1 produced 531 satisfactory pistons and 59 unsatisfactory pistons today. Machine 2 produced 300 satisfactory pistons and 200 unsatisfactory pistons today. Suppose that one piston from Machine 1 and one piston from Machine 2 are chosen at random from today's batch. What is the probability that the piston chosen from Machine 1 is satisfactory and the piston chosen from Machine 2 is unsatisfactory ?

Do not round your answer.

30. Of the people who fished at Clearwater Park today, 36 had a fishing license, and 24 did not. Of the people who fished at Mountain View Park today, 40 had a license, and 10 did not. (No one fished at both parks.)

Suppose that one fisher from each park is chosen at random. What is the probability that the fisher chosen from Clearwater did not have a license and the fisher chosen from Mountain View had a license?

Do not round your answer.

31. At a local college, 82 of the male students are smokers and 328 are non-smokers. Of the female students, 120 are smokers and 180 are non-smokers. A male student and a female student from the college are randomly selected for a survey. What is the probability that both are smokers?

Do not round your answer.

32. At a factory that produces pistons for cars, Machine 1 produced 621 satisfactory pistons and 69 unsatisfactory pistons today. Machine 2 produced 720 satisfactory pistons and 80 unsatisfactory pistons today. Suppose that one piston from Machine 1 and one piston from Machine 2 are chosen at random from today's batch. What is the probability that the piston chosen from Machine 1 is unsatisfactory and the piston chosen from Machine 2 is satisfactory ?

Do not round your answer.

33. Which of the following variables are best thought of as continuous, which discrete? Indicate your choice for each by circling the appropriate answer.

(a) In a reaction time study involving 12 participants, the number of participants whose average time is between 400 and 600 milliseconds.

Discrete Continuous

(b) The lifetime, in hours, of a 100-watt light bulb manufactured by Northington Industries.

Discrete Continuous

(c) The time that a student in Calculus 101 takes to complete a midterm exam.

Discrete Continuous

(d) The mass of the solid impurities per milliliter of Los Angeles tap water.

Discrete Continuous

34. Which of the following variables are best thought of as continuous, which discrete? Indicate your choice for each by circling the appropriate answer.

(a) The time it takes to drive from home to work (or school).

Discrete Continuous

(b) The number of your fellow classmates who have used the World Wide Web for information on Seasonal Affective Disorder.

Discrete Continuous

(c) In a reaction time study involving 12 participants, the number of participants whose average time is between 400 and 600 milliseconds.

Discrete Continuous

(d) The time that a student in Calculus 101 takes to complete a midterm exam.

Discrete Continuous

35. Which of the following variables are best thought of as continuous, which discrete? Indicate your choice for each by circling the appropriate answer.

(a) The lifetime, in hours, of a 100-watt light bulb manufactured by Northington Industries.

Discrete Continuous

(b) The number of personal-injury traffic accidents last week on Interstate 65 in Indiana.

Discrete Continuous

(c) The cranial capacity (space inside the skull) of a human skull.

Discrete Continuous

(d) The body temperature measurement of a participant in a lie-detector test.

Discrete Continuous

36. Which of the following variables are best thought of as continuous, which discrete? Indicate your choice for each by circling the appropriate answer.

(a) The total snowfall amount in Minneapolis this year.

Discrete Continuous

(b) The lifetime, in hours, of a 100-watt light bulb manufactured by Northington Industries.

Discrete Continuous

(c) The number of personal-injury traffic accidents last week on Interstate 65 in Indiana.

Discrete Continuous

(d) The temperature of a burrito served to a customer in a local Mexican restaurant.

Discrete Continuous

37. Fill in the $P(X=x)$ values in the table below to give a legitimate probability distribution for the discrete random variable X, whose possible values are $-6, 0, 2,$ 5, and 6.

Value x of X	P(X =x)
-6	
0	0.23
2	
5	0.19
6	0.17

38. Fill in the $P(X=x)$ values in the table below to give a legitimate probability distribution for the discrete random variable X, whose possible values are $-3, 0, 3,$ 5, and 6.

Value x of X	P(X =x)
-3	0.29
0	0.24
3	0.13
5	
6	

39. Fill in the $P(X=x)$ values in the table below to give a legitimate probability distribution for the discrete random variable X, whose possible values are $-5,1,3,$ 4, and 5.

Value x of X	P(X =x)
-5	0.22
1	0.10
3	
4	
5	0.23

40. Fill in the $P(X=x)$ values in the table below to give a legitimate probability distribution for the discrete random variable X, whose possible values are $-6,1,4,$ 5, and 6.

Value x of X	P(X =x)
-6	
1	
4	0.14
5	0.28
6	0.15

41. An ordinary (fair) coin is tossed 3 times. Outcomes are thus triples of "heads" (h) and "tails" (t) which we write hth, ttt, etc. For each outcome, let R be the random variable counting the number of tails in each outcome. For example, if the outcome is thh, then $R(thh)=1$. Suppose that the random variable X is defined in terms of R as follows: $X=2R-3$. The values of X are thus:

Outcome	thh	tth	tht	ttt	hhh	hth	hht	htt
Value of X	-1	1	1	3	-3	-1	-1	1

Calculate the probability distribution function of X, i.e. the function $p_X(x)$. First, fill in the first row with the values of X. Then fill in the appropriate probabilities in the second row.

Value x of X				
$P_X(x)$				

42. Suppose that the genders of the three children of a certain family are soon to be revealed. Outcomes are thus triples of "girls" (g) and "boys" (b), which we write gbg, bbb, etc. For each outcome, let R be the random variable counting the number of boys in each outcome. For example, if the outcome is ggb, then $R(ggb)=1$. Suppose that the random variable X is defined in terms of R as follows: $X=2R^2-6R-1$. The values of X are thus:

Outcome	bbb	bgb	ggb	bgg	bbg	gbb	gbg	ggg
Value of X	-1	-5	-5	-5	-5	-5	-5	-1

Calculate the probability distribution function of X, i.e. the function $p_X(x)$. First, fill in the first row with the values of X. Then fill in the appropriate probabilities in the second row.

Value x of X		
$P_X(x)$		

43. Suppose that the genders of the three children of a certain family are soon to be revealed. Outcomes are thus triples of "girls" (g) and "boys" (b), which we write gbg, bbb, etc. For each outcome, let R be the random variable counting the number of girls in each outcome. For example, if the outcome is ggb, then $R(ggb)=2$. Suppose that the random variable X is defined in terms of R as follows: $X=R^2-2R-4$. The values of X are thus:

Outcome	gbb	ggb	gbg	bgb	ggg	bgg	bbb	bbg
Value of X	-5	-4	-4	-5	-1	-4	-4	-5

Calculate the probability distribution function of X, i.e. the function $p_X(x)$. First, fill in the first row with the values of X. Then fill in the appropriate probabilities in the second row.

Value x of X			
$P_X(x)$			

44. Suppose that the genders of the three children of a certain family are soon to be revealed. Outcomes are thus triples of "girls" (g) and "boys" (b), which we write gbg, bbb, etc. For each outcome, let R be the random variable counting the number of boys in each outcome. For example, if the outcome is ggg, then $R(ggg)=0$. Suppose that the random variable X is defined in terms of R as follows: $X=2R-2R^2-1$. The values of X are thus:

Outcome	ggb	bbg	gbg	ggg	bgg	bbb	bgb	gbb
Value of X	-1	-5	-1	-1	-1	-13	-5	-5

Calculate the probability distribution function of X, i.e. the function $p_X(x)$. First, fill in the first row with the values of X. Then fill in the appropriate probabilities in the second row.

Value x of X			
$P_X(x)$			

45. A soft drink company has recently received customer complaints about its one-liter-sized soft drink products. Customers have been claiming that the one-liter-sized products contain less than one liter of soft drink. The company has decided to investigate the problem. According to the company records, when there is no malfunctioning in the beverage dispensing unit, the bottles contain 1.01 liters of beverage on average, with a standard deviation of 0.15 liters. A sample of 70 bottles has been taken to be measured from the beverage dispensing lot. The mean amount of beverage in these 70 bottles was 0.993 liters. Find the probability of observing a sample mean of 0.993 liters or less in a sample of 70 bottles, if the beverage dispensing unit functions properly.

Carry your intermediate computations to at least four decimal places. Round your answer to at least three decimal places.

46. The mean salary offered to students who are graduating from Coastal State University this year is $\$24,260$, with a standard deviation of $\$3712$. A random sample of 80 Coastal State students graduating this year has been selected. What is the probability that the mean salary offer for these 80 students is $\$24,500$ or less?

Carry your intermediate computations to at least four decimal places. Round your answer to at least three decimal places.

47. Polychlorinated biphenyl (PCB) is among a group of organic pollutants found in a variety of products, such as coolants, insulating materials, and lubricants in electrical equipment. Disposal of items containing less than 50 parts per million (ppm) PCB is generally not regulated. A certain kind of small capacitor contains PCB with a mean of 47.7 ppm and a standard deviation of 5 ppm. The Environmental Protection Agency takes a random sample of 40 of these small capacitors, planning to regulate the disposal of such capacitors if the sample mean amount of PCB is 49 ppm or more. Find the probability that the disposal of such capacitors will be regulated.

Carry your intermediate computations to at least four decimal places. Round your answer to at least three decimal places.

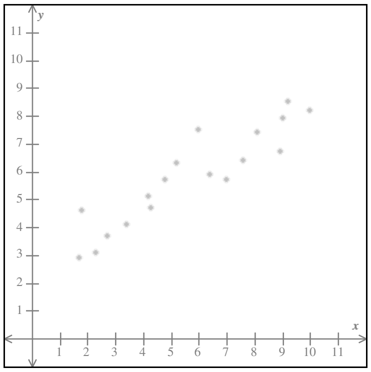
48. Seventy million pounds of trout are grown in the U.S. every year. Farm-raised trout contain an average of 32 grams of fat per pound, with a standard deviation of 7 grams of fat per pound. A random sample of 36 farm-raised trout is selected. The mean fat content for the sample is 31.1 grams per pound. Find the probability of observing a sample mean of 31.1 grams of fat per pound or less in a random sample of 36 farm-raised trout.

Carry your intermediate computations to at least four decimal places. Round your answer to at least three decimal places.

49. Bivariate data for the quantitative variables x and y are given in the table below. These data are plotted in the scatter plot shown next to the table.

In the scatter plot, sketch an approximation of the least-squares regression line for the data.

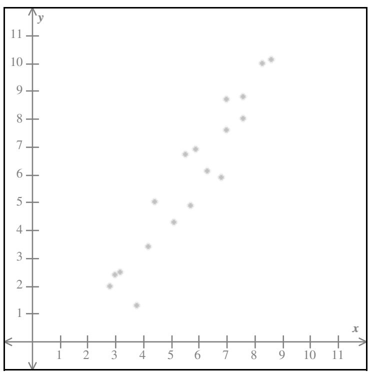
x	y
1.8	4.6
2.7	3.7
6.4	5.9
8.1	7.4
4.8	5.7
7.6	6.4
1.7	2.9
8.9	6.7
5.2	6.3
9.2	8.5
6.0	7.5
4.3	4.7
9.0	7.9
7.0	5.7
3.4	4.1
2.3	3.1
10.0	8.2
4.2	5.1



50. Bivariate data for the quantitative variables x and y are given in the table below. These data are plotted in the scatter plot shown next to the table.

In the scatter plot, sketch an approximation of the least-squares regression line for the data.

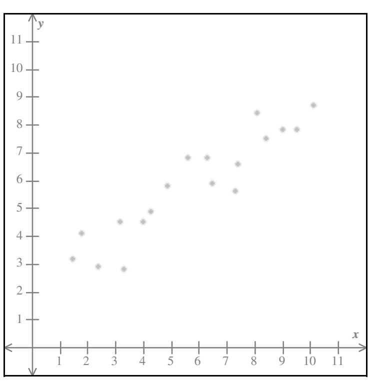
x	y
5.9	6.9
7.0	8.7
5.7	4.9
7.6	8.8
7.0	7.6
8.3	10.0
3.0	2.4
2.8	2.0
4.4	5.0
7.6	8.0
3.2	2.5
4.2	3.4
3.8	1.3
5.1	4.3
6.8	5.9
8.6	10.1
5.5	6.7
6.3	6.1



51. Bivariate data for the quantitative variables x and y are given in the table below. These data are plotted in the scatter plot shown next to the table.

In the scatter plot, sketch an approximation of the least-squares regression line for the data.

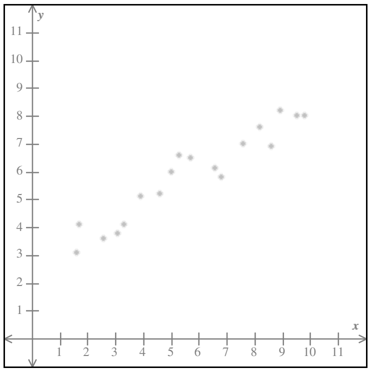
x	y
7.3	5.6
8.1	8.4
3.2	4.5
4.0	4.5
9.5	7.8
9.0	7.8
10.1	8.7
5.6	6.8
2.4	2.9
4.9	5.8
8.4	7.5
6.3	6.8
7.4	6.6
1.8	4.1
3.3	2.8
6.5	5.9
1.5	3.2
4.3	4.9



52. Bivariate data for the quantitative variables x and y are given in the table below. These data are plotted in the scatter plot shown next to the table.

In the scatter plot, sketch an approximation of the least-squares regression line for the data.

x	y
3.1	3.8
4.6	5.2
5.3	6.6
9.8	8.0
5.7	6.5
1.7	4.1
9.5	8.0
8.6	6.9
6.8	5.8
1.6	3.1
6.6	6.1
2.6	3.6
7.6	7.0
3.9	5.1
8.2	7.6
8.9	8.2
3.3	4.1
5.0	6.0



53. Sir Francis Galton, in the late 1800s, was the first to introduce the statistical concepts of regression and correlation. He studied the relationships between pairs of variables such as the size of parents and the size of their offspring.

Data similar to that which he studied are given below, with the variable x denoting the height (in centimeters) of a human father and the variable y denoting the height at maturity (in centimeters) of the father's oldest (adult) son. The data are given in tabular form and also displayed in the Figure 1 scatter plot, which gives the least-squares regression line as well. The equation for this line is $\hat{y} = 91.94 + 0.50x$.

Height of father, ***x*** (in centimeters)	Height of son, ***y*** (in centimeters)
189.2	188.2
155.8	174.9
175.2	174.6
159.9	167.2
203.3	191.3
188.9	177.4
182.5	177.1
184.6	186.9
191.4	195.1
181.0	186.6
173.6	177.0
172.3	181.1
170.8	172.6
160.1	171.7
200.4	189.9
192.9	191.0

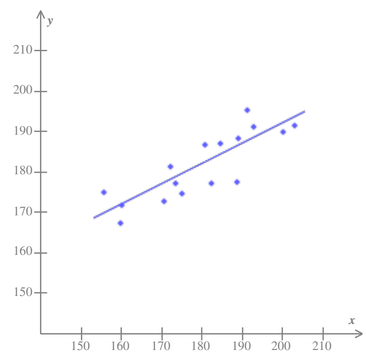


Figure 1

Answer the following:

1. Fill in the blank: For these data, heights of sons that are less than the mean of the heights of sons tend to be paired with heights of fathers that are _____ the mean of the heights of fathers.
   a. greater than b. less than
2. Fill in the blank: According to the regression equation, for an increase of one centimeter in father's height, there is a corresponding _____ of 0.50 centimeters in son's height.
   a. increase b. decrease
3. From the regression equation, what is the predicted son's height (in centimeters) when the height of the father is 159.9 centimeters? (Round your answer to at least one decimal place.)
4. What was the observed son's height (in centimeters) when the height of the father was 159.9 centimeters?

54. An advertising firm wishes to demonstrate to its clients the effectiveness of the advertising campaigns it has conducted. The following bivariate data on fifteen recent campaigns, including the cost of each campaign (in millions of dollars) and the resulting percentage increase in sales following the campaign, were presented by the firm. Based on these data, we would compute the least-squares regression line to be $\hat{y} = 6.11 + 0.20x$, with x representing campaign cost and y representing the resulting percentage increase in sales. (This line is shown in Figure 1, along with a scatter plot of the data.)

Campaign cost, ***x*** (in millions of dollars)	Increase in sales, ***y*** (percent)
2.27	6.67
2.12	6.76
1.27	6.38
4.11	7.00
1.63	6.14
3.65	6.77
2.13	6.44
3.21	6.50
1.69	6.60
2.97	6.66
2.94	6.87
3.59	6.89

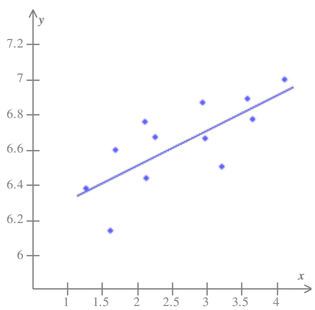


Figure 1

Answer the following:

1. Fill in the blank: For these data, values for campaign cost that are less than the mean of the values for campaign cost tend to be paired with values for percentage increase in sales that are _____ the mean of the values for percentage increase in sales.
   a. greater than   b. less than
2. Fill in the blank: According to the regression equation, for an increase of one million dollars in advertising campaign cost, there is a corresponding _____ of 0.20 percent in sales.
   a. increase   b. decrease
3. What was the observed percentage increase in sales when the advertising campaign cost was 2.94 million dollars?
4. From the regression equation, what is the predicted percentage increase in sales when the advertising campaign cost is 2.94 million dollars? (Round your answer to at least two decimal places.)

55. A popular, nationwide standardized test taken by high-school juniors and seniors may or may not measure academic potential, but we can nonetheless attempt to predict performance in college from performance on this test.

We have chosen a random sample of fifteen students just finishing their first year of college, and for each student we've recorded her score on this standardized test (from 400 to 1600) and her grade point average (from 0 to 4) for her first year in college. The data are shown below, with x denoting the score on the standardized test and y denoting the first-year college grade point average. The least-squares regression line for these data is $\hat{y} = 0.8746 + 0.0017x$. This line is shown in the scatter plot in Figure 1.

Standardized test score, ***x***	Grade point average, ***y***
1500	3.02
1310	2.96
1020	3.05
1210	2.89
1350	3.74
1000	2.45
1490	3.41
950	2.13
810	2.17
1090	2.29
890	2.68
1400	3.07
1230	3.34
850	2.10
1050	2.81

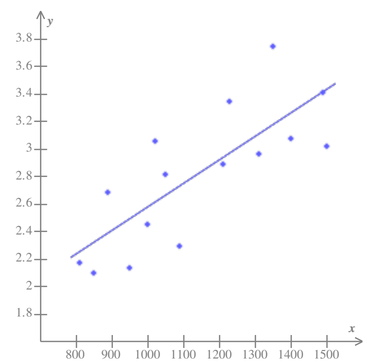


Figure 1

Answer the following:

1. Fill in the blank: For these data, standardized test scores that are greater than the mean of the standardized test scores tend to be paired with grade point averages that are _____ the mean of the grade point averages.
   a. greater than   b. less than

2. Fill in the blank: According to the regression equation, for an increase of one point in standardized test score, there is a corresponding _____ of 0.0017 points in grade point average.
   a. increase   b. decrease

3. What was the observed grade point average when the standardized test score was 810 ?

4. From the regression equation, what is the predicted grade point average when the standardized test score is 810 ? (Round your answer to at least two decimal places.)

56. Weber's law, a concept taught in most Introduction to Psychology courses, states that the ratio of the intensity of a stimulus to the "just noticeable" increment in intensity is constant, that is, the ratio doesn't depend on the intensity of the stimulus. The ratio is called the "Weber fraction," so a concise statement of Weber's law is that "the Weber fraction is constant, regardless of the stimulus intensity." It turns out that Weber's law is not so much a law as it is a rule of thumb, since it is violated in many situations. For instance, for some auditory stimuli, the Weber fraction does depend systematically on the stimulus intensity.

The following bivariate data are the experimental data obtained for one listener in an auditory intensity discrimination task. For each of the ten stimulus intensities x (in decibels), the experimental Weber fraction y (in decibels) is shown. For these data, the least-squares regression line is $\hat{y} = 2.7741 - 0.0870x$. This line is shown in the scatter plot in Figure 1.

Stimulus intensity, ***x*** (in decibels)	Weber fraction, ***y*** (in decibels)
35	-0.76
40	-0.55
45	-0.96
50	-1.29
55	-1.71
60	-2.77
65	-3.02
70	-2.88
75	-4.15
80	-4.17

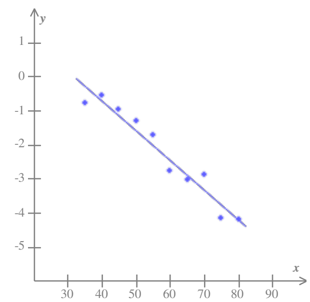


Figure 1

Answer the following:

1. Fill in the blank: For these data, Weber fractions that are greater than the mean of the Weber fractions tend to be paired with stimulus intensities that are _____ the mean of the stimulus intensities.
   a. greater than b. less than
2. According to the regression equation, for an increase of one decibel in stimulus intensity, there is a corresponding decrease of how many decibels in the Weber fraction?
3. What was the observed Weber fraction (in decibels) when the stimulus intensity was 60 decibels?
4. From the regression equation, what is the predicted Weber fraction (in decibels) when the stimulus intensity is 60 decibels? (Round your answer to at least two decimal places.)

57. Sir Francis Galton, in the late 1800s, was the first to introduce the statistical concepts of regression and correlation. He studied the relationships between pairs of variables such as the size of parents and the size of their offspring.

Data similar to that which he studied are given below, with the variable x denoting the height (in centimeters) of a human father and the variable y denoting the height at maturity (in centimeters) of the father's oldest son. The data are given in tabular form and also displayed in the Figure 1 scatter plot.

Height of father, ***x*** (in centimeters)	Height of son, ***y*** (in centimeters)
159.5	171.5
190.4	195.7
159.8	167.1
156.0	174.4
170.4	182.7
181.6	178.8
200.3	189.9
184.4	186.4
175.4	173.7
181.1	189.9
175.5	178.8
190.7	187.0
173.1	170.5
191.4	189.7
187.7	175.9

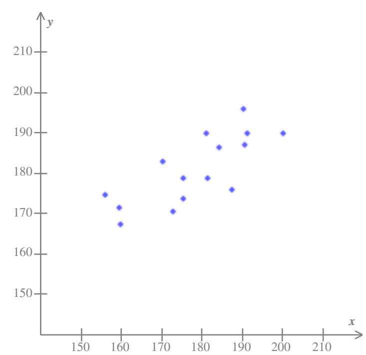


Figure 1

The least-squares regression line for these data has a slope of approximately 0.51.

Answer the following. Carry your intermediate computations to at least four decimal places, and round your answers as specified below.

What is the value of the *y*-intercept of the least-squares regression line for these data? Round your answer to at least two decimal places.

What is the value of the sample correlation coefficient for these data? Round your answer to at least three decimal places.

58. An advertising firm wishes to demonstrate to its clients the effectiveness of the advertising campaigns it has conducted. The following bivariate data on twelve recent campaigns, including the cost of each campaign (denoted by x, in millions of dollars) and the resulting percentage increase in sales (denoted by y) following the campaign, were presented by the firm. A scatter plot of the data is shown in Figure 1. Also given are the products of the values for campaign cost and values for percentage increase in sales for each of the twelve campaigns. (These products, written in the column labelled "xy," may aid in calculations.)

Campaign cost, ***x*** (in millions of dollars)	Increase in sales, ***y*** (percent)	***xy***
2.85	6.94	19.779
2.23	6.57	14.6511
1.63	6.26	10.2038
1.66	6.62	10.9892
3.99	7.04	28.0896
2.81	6.57	18.4617
3.45	6.87	23.7015
1.98	6.48	12.8304
1.23	6.44	7.9212
2.13	6.75	14.3775
3.15	6.60	20.79
3.60	6.84	24.624

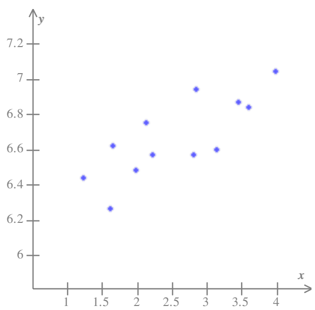


Figure 1

Answer the following. Carry your intermediate computations to at least four decimal places, and round your answer as specified below.

What is the value of the sample correlation coefficient for these data? Round your answer to at least three decimal places.

59. A popular, nationwide standardized test taken by high-school juniors and seniors may or may not measure academic potential, but we can nonetheless examine the relationship between scores on this test and performance in college.

We have chosen a random sample of fifteen students just finishing their first year of college, and for each student we've recorded her score on this standardized test (from 400 to 1600) and her grade point average (from 0 to 4) for her first year in college. The data are shown below, with x denoting the score on the standardized test and y denoting the first-year college grade point average. A scatter plot of the data is shown in Figure 1.

Standardized test score, x	Grade point average, y
1490	3.36
910	2.61
1020	3.03
1480	3.18
870	2.16
1260	3.37
1000	2.44
1360	3.61
1390	3.01
1190	2.86
940	2.05
1070	2.72
1100	2.30
790	2.38
1280	3.07

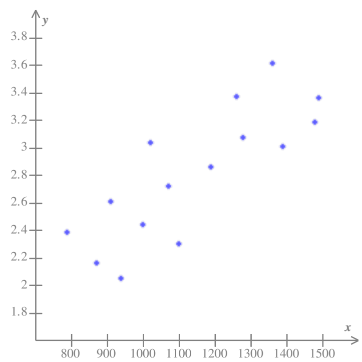


Figure 1

The value of the sample correlation coefficient r for these data is approximately 0.814.

Answer the following. Carry your intermediate computations to at least four decimal places, and round your answers as specified below.

What is the value of the slope of the least-squares regression line for these data? Round your answer to at least four decimal places.

What is the value of the y-intercept of the least-squares regression line for these data? Round your answer to at least four decimal places.

60. Weber's law, a concept taught in most Introduction to Psychology courses, states that the ratio of the intensity of a stimulus to the "just noticeable" increment in intensity is constant, that is, the ratio doesn't depend on the intensity of the stimulus. The ratio is called the "Weber fraction," so a concise statement of Weber's law is that "the Weber fraction is constant, regardless of the stimulus intensity." It turns out that Weber's law is not so much a law as it is a rule of thumb, since it is violated in many situations. For instance, for some auditory stimuli, the Weber fraction does depend systematically on the stimulus intensity.

The following bivariate data are the experimental data obtained for one listener in an auditory intensity discrimination task. For each of the ten stimulus intensities x (in decibels), the Weber fraction y (in decibels) is shown. Figure 1 is a scatter plot of the data. Also given are the products of the stimulus intensities and Weber fractions for each of the ten stimuli. (These products, written in the column labelled "xy," may aid in calculations.)

Stimulus intensity, ***x*** (in decibels)	Weber fraction, ***y*** (in decibels)	***xy***
35	-0.53	-18.55
40	-0.16	-6.4
45	-1.12	-50.4
50	-1.03	-51.5
55	-2.18	-119.9
60	-2.59	-155.4
65	-3.16	-205.4
70	-2.94	-205.8
75	-4.27	-320.25
80	-4.33	-346.4

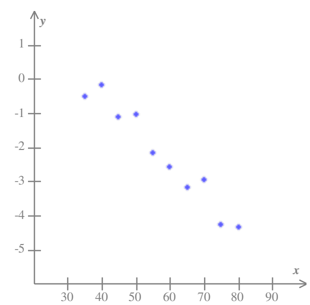


Figure 1

Answer the following. Carry your intermediate computations to at least four decimal places, and round your answer as specified below.

What is the value of the slope of the least-squares regression line for these data? Round your answer to at least four decimal places.

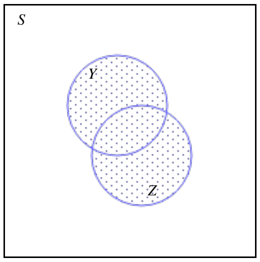
1. 0.068

2. 0.032

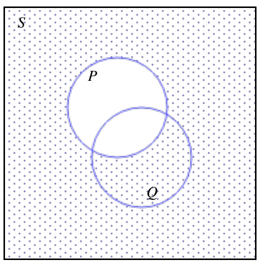
3. 0.047

4. 0.010

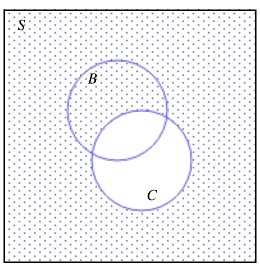
5.



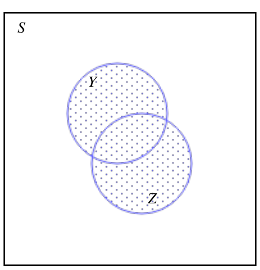
6.



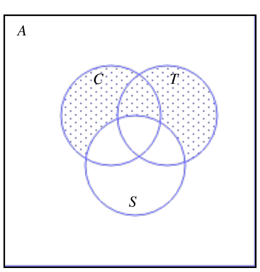
7.



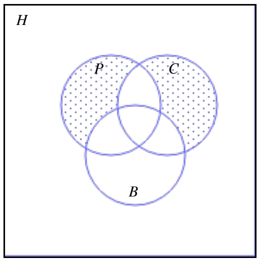
8.



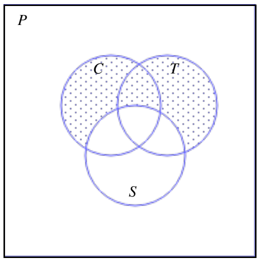
9.



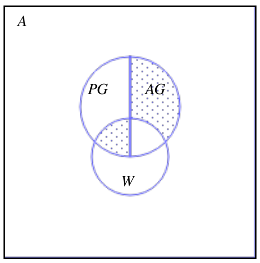
10.



11.



12.



13.

		Outcomes								Probability
		TTT	TTH	THT	HHH	HTT	THH	HTH	HHT	
Events	More tails than heads	☑	☑	☑	☐	☑	☐	☐	☐	$\frac{1}{2}$
	A head on the last toss	☐	☑	☐	☑	☐	☑	☑	☐	$\frac{1}{2}$
	Exactly one tail	☐	☐	☐	☐	☐	☑	☑	☑	$\frac{3}{8}$

14.

		Outcomes								Probability
		TTT	THT	TTH	HTT	HHT	HHH	THH	HTH	
Events	A tail on the first toss or the third toss (or both)	☑	☑	☑	☑	☑	☐	☑	☐	$\frac{3}{4}$
	A tail on both the first and the last tosses	☑	☑	☐	☐	☐	☐	☐	☐	$\frac{1}{4}$
	Alternating heads and tails (with either coming first)	☐	☑	☐	☐	☐	☐	☐	☑	$\frac{1}{4}$

15.

		Outcomes								Probability
		HTT	TTT	HHT	THT	HTH	HHH	THH	TTH	
Events	A tail on both the first and the last tosses	☐	☑	☐	☑	☐	☐	☐	☐	$\frac{1}{4}$
	No heads on the first two tosses	☐	☑	☐	☐	☐	☐	☐	☑	$\frac{1}{4}$
	Two or more heads	☐	☐	☑	☐	☑	☑	☑	☐	$\frac{1}{2}$

16.

		Outcomes								Probability
		HTH	TTT	THT	HHT	HTT	TTH	HHH	THH	
Events	A head on the first toss	☑	☐	☐	☑	☑	☐	☑	☐	$\frac{1}{2}$
	No tails on the first two tosses	☐	☐	☐	☑	☐	☐	☑	☐	$\frac{1}{4}$
	A tail on each of the first two tosses	☐	☑	☐	☐	☐	☑	☐	☐	$\frac{1}{4}$

17. $P(A) = 0.72$
$P(B) = 0.50$

18. $P(A) = 0.58$
$P(B) = 0.61$

19. $P(A) = 0.28$
$P(B) = 0.50$

20. $P(A) = 0.17$
$P(B) = 0.67$

21. 0.24.

22. 0.25.

23. 0.26.

24. 0.1.

25. $P(A \cap B) = 0.30$
$P(A \cup B) = 0.80$

26. $P(A \cap B) = 0.20$
$P(A \cup B) = 0.70$

27. $P(A \cap B) = 0.35$
$P(A \cup B) = 0.85$

28. $P(A \cap B) = 0.15$
$P(A \cup B) = 0.65$

29. 0.36

30. 0.32

31. 0.08

32. 0.09

33.
(a) Discrete

(b) Continuous

(c) Continuous

(d) Continuous

34.

(a) Continuous

(b) Discrete

(c) Discrete

(d) Continuous

35.

(a) Continuous

(b) Discrete

(c) Continuous

(d) Continuous

36.

(a) Continuous

(b) Continuous

(c) Discrete

(d) Continuous

37

Value x of X	$P(X = x)$
-6	0.21
0	0.23
2	0.20
5	0.19
6	0.17

38

Value x of X	$P(X = x)$
-3	0.29
0	0.24
3	0.13
5	0.30
6	0.04

39.

Value x of X	$P(X=x)$
-5	0.22
1	0.10
3	0.04
4	0.41
5	0.23

40.

Value x of X	$P(X=x)$
-6	0.41
1	0.02
4	0.14
5	0.28
6	0.15

41.

Value x of X	-3	-1	1	3
$P_X(x)$	$\frac{1}{8}$	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{1}{8}$

42.

Value x of X	-5	-1
$P_X(x)$	$\frac{6}{8}$	$\frac{2}{8}$

43.

Value x of X	-5	-4	-1
$P_X(x)$	$\frac{3}{8}$	$\frac{4}{8}$	$\frac{1}{8}$

44.

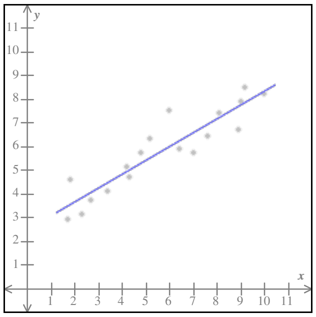
Value x of X	-13	-5	-1
$P_X(x)$	$\frac{1}{8}$	$\frac{3}{8}$	$\frac{4}{8}$

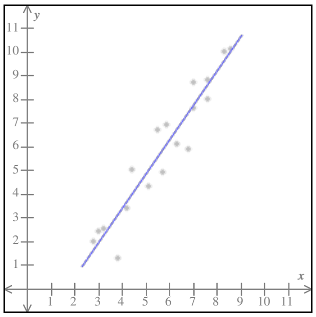
45. 0.172

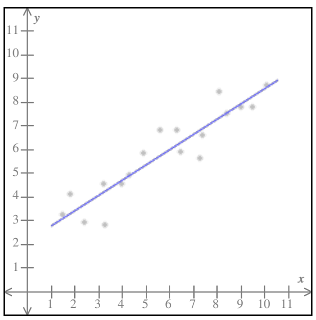
46. 0.718

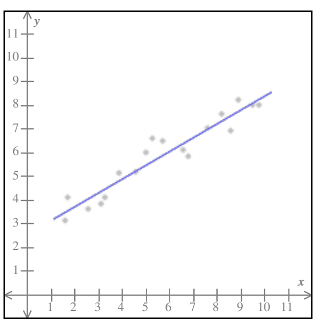
47. 0.050

48. 0.220

49.


50.


51.


52.


53.
1. Fill in the blank: For these data, heights of sons that are less than the mean of the heights of sons tend to be paired with heights of fathers that are _____ the mean of the heights of fathers.
   b. less than

2. Fill in the blank: According to the regression equation, for an increase of one centimeter in father's height, there is a corresponding _____ of 0.50 centimeters in son's height.
   a. increase

3. From the regression equation, what is the predicted son's height (in centimeters) when the height of the father is 159.9 centimeters? (Round your answer to at least one decimal place.)
   171.9

4. What was the observed son's height (in centimeters) when the height of the father was 159.9 centimeters?
   167.2

54. 1. Fill in the blank: For these data, values for campaign cost that are less than the mean of the values for campaign cost tend to be paired with values for percentage increase in sales that are _____ the mean of the values for percentage increase in sales.
b. less than

2. Fill in the blank: According to the regression equation, for an increase of one million dollars in advertising campaign cost, there is a corresponding _____ of 0.20 percent in sales.
a. increase

3. What was the observed percentage increase in sales when the advertising campaign cost was 2.94 million dollars?
6.87

4. From the regression equation, what is the predicted percentage increase in sales when the advertising campaign cost is 2.94 million dollars? (Round your answer to at least two decimal places.)
6.7

55. 1. Fill in the blank: For these data, standardized test scores that are greater than the mean of the standardized test scores tend to be paired with grade point averages that are _____ the mean of the grade point averages.
a. greater than

2. Fill in the blank: According to the regression equation, for an increase of one point in standardized test score, there is a corresponding _____ of 0.0017 points in grade point average.
a. increase

3. What was the observed grade point average when the standardized test score was 810 ?
2.17

4. From the regression equation, what is the predicted grade point average when the standardized test score is 810 ? (Round your answer to at least two decimal places.)
2.25

56. 1. Fill in the blank: For these data, Weber fractions that are greater than the mean of the Weber fractions tend to be paired with stimulus intensities that are _____ the mean of the stimulus intensities.
b. less than

2. According to the regression equation, for an increase of one decibel in stimulus intensity, there is a corresponding decrease of how many decibels in the Weber fraction?
0.087

3. What was the observed Weber fraction (in decibels) when the stimulus intensity was 60 decibels?
-2.77

4. From the regression equation, what is the predicted Weber fraction (in decibels) when the stimulus intensity is 60 decibels? (Round your answer to at least two decimal places.)
-2.45

57.

What is the value of the y-intercept of the least-squares regression line for these data? Round your answer to at least two decimal places.	89.77
What is the value of the sample correlation coefficient for these data? Round your answer to at least three decimal places.	0.773

58.

What is the value of the sample correlation coefficient for these data? Round your answer to at least three decimal places.	0.790

59.

What is the value of the slope of the least-squares regression line for these data? Round your answer to at least four decimal places.	0.0017
What is the value of the y-intercept of the least-squares regression line for these data? Round your answer to at least four decimal places.	0.8663

60. What is the value of the slope of the least-squares regression line for these data? Round your answer to at least four decimal places.	-0.0956