1. Give the slope and y-intercept for the line that passes through the pairs of points listed below.

a. $(8,8)$ and $(10,10)$ **b.** $(0,13)$ and $(13,0)$

c. $(-11,7)$ and $(5,11)$ **d.** $(-9,-3)$ and $(4,6)$

a. Find the slope and the y-intercept for the line that passes through $(8,8)$ and $(10,10)$.

The slope is $\square$.

The y-intercept is $\square$.

(Type integers or simplified fractions.)

b. Find the slope and the y-intercept for the line that passes through $(0,13)$ and $(13,0)$.

The slope is $\square$.

The y-intercept is $\square$.

(Type integers or simplified fractions.)

c. Find the slope and the y-intercept for the line that passes through $(-11,7)$ and $(5,11)$.

The slope is $\square$.

The y-intercept is $\square$.

(Type integers or simplified fractions.)

d. Find the slope and the y-intercept for the line that passes through $(-9,-3)$ and $(4,6)$.

The slope is $\square$.

The y-intercept is $\square$.

(Type integers or simplified fractions.)

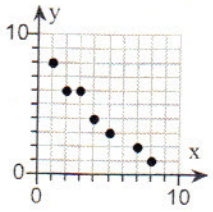
2. Consider the pairs of measurements shown to the right.

x	7	4	8	1	5	2	3
y	8	6	9	2	7	4	4

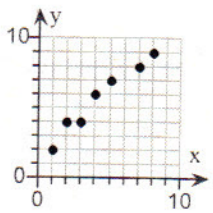
a. Construct a scattergram of these data.
b. What does the scattergram suggest about the relationship between x and y?
c. Find the least squares estimates of β_0 and β_1.
d. Plot the least squares line on your scattergram. Does the line appear to fit the data well?

a. Choose the correct graph below.

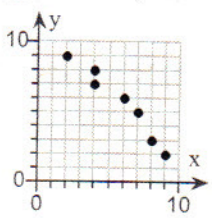
○A.



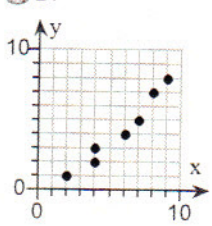
○B.



○C.



○D.



b. Complete the statement below to describe the relationship.

As x increases, y [decreases / increases], indicating that the least squares line has a [positive / negative] slope.

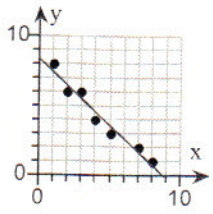
c. Determine the least squares estimates.

$\hat{\beta}_1 =$ ☐ (Round to three decimal places as needed.)

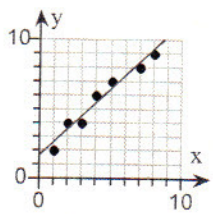
$\hat{\beta}_0 =$ ☐ (Round to three decimal places as needed.)

d. Choose the correct graph below.

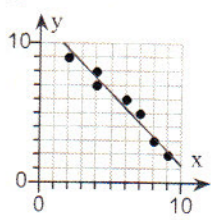
○A.



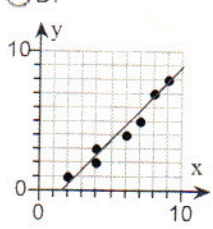
○B.



○C.



○D.



Does the line appear to fit the data well?

2. (cont.)

○A. No, several of the data are very far from the line.

○B. Yes, the line passes through all of the points.

○C. No, the line does not pass through all of the points.

○D. Yes, all of the data are fairly close to and follow along the line.

3. A MINITAB printout relating the size of the diamond (number of carats) to the asking price (dollars) for 308 diamonds is shown below. Complete parts **a** through **e**.

The regression equation is PRICE = − 2290 + 11594 CARAT

Predictor	Coef	SE Coef	T	P
Constant	− 2290	158.1	− 14.48	0.000
CARAT	11594	230.1	50.39	0.000

S = 1117.56 R-Sq = 94.5% R-Sq(adj) = 94.5%

a. Write the equation of a straight-line model relating asking price (y) to number of carats (x). Choose the correct equation below.

○A. $y = \beta_0 + \beta_1 x$

○B. $y = \beta_1 + \beta_0 x + \varepsilon$

○C. $y = \beta_1 + \beta_0 x$

○D. $y = \beta_0 + \beta_1 x + \varepsilon$

b. Find the equation of the least squares line.

$\hat{y} = \square + \square x.$

c. Give a practical interpretation of the y-intercept of the least squares line. Choose the correct interpretation below.

○A. The y-intercept is the asking price of a 0-carat diamond.

○B. The y-intercept is the number of carats of a $0 diamond.

○C. The y-intercept is the asking price of no diamond.

○D. The y-intercept has no meaning.

d. Give a practical interpretation of the slope of the least squares line. Over what range of x is the interpretation meaningful? Choose the correct answer below.

○A. The slope is the increase in the asking price for each additional carat and is meaningful for values of x within the observed range.

○B. The slope is the asking price of a 1-carat diamond and is meaningful for x = 1.

○C. The slope has no meaning and therefore is not meaningful for any values of x.

e. Use the least squares line to predict the asking price of a 0.4-carat diamond.

3. $ (Round to the nearest cent as needed.)

(cont.)

4. Researchers investigated the effect of tablet surface area to volume on the rate at which a drug is released in a controlled-release dosage. For six similarly shaped tablets with different weights and thicknesses, the diffusional drug release rate (percentage of drug released divided by the square root of time) was determined. The experimental data are listed in the table. Complete parts **a** through **d**.

Drug Release Rate ($\%$ released / $\sqrt{\text{time}}$)	Sur. Area to Vol. (mm^2 / mm^3)
60	1.5
49	1.07
41	0.94
34	0.72
33	0.62
29	0.63

a. Fit the simple linear model, $E(y) = \beta_0 + \beta_1 x$, where y = drug release rate and x = surface area to volume ratio.

$\hat{y} =$ ☐ + ☐ x (Round to two decimal places as needed.)

b. Interpret the estimates of β_0 and β_1.

Choose the correct interpretation of the estimate of $\hat{\beta}_0$ below.

- ○A. $\hat{\beta}_0$ is the average drug release rate.
- ○B. $\hat{\beta}_0$ is the drug release rate when the surface area to volume ratio is zero.
- ○C. $\hat{\beta}_0$ is the surface area to volume ratio when the drug release rate is zero.
- ○D. $\hat{\beta}_0$ has no practical meaning.

Choose the correct interpretation of the estimate of $\hat{\beta}_1$.

- ○A. $\hat{\beta}_1$ is the amount that the drug release rate changes for each unit increase in the surface area to volume ratio.
- ○B. $\hat{\beta}_1$ is the amount that the surface area to volume ratio changes for each unit increase in the drug release rate.
- ○C. $\hat{\beta}_1$ has no practical meaning.

c. Predict the drug release rate for a tablet that has a surface area/volume ratio of 0.68.

☐ (Round to two decimal places as needed.)

d. Comment on the reliability of the prediction in part **c**.

4.

(cont.) The reliability of the estimate in part **c** is [not in / in] question, because the value of x, 0.68, is [outside / inside] the observed range of x.

5. Explain what each of the following sample correlation coefficients tells you about the relationship between the x and y values in the sample.

a. $r = 1$ **b.** $r = -1$ **c.** $r = 0$

d. $r = 0.9$ **e.** $r = 0.1$ **f.** $r = -0.93$

a. What relationship exists between the x and y values in the sample?

- ○ A. x and y have a perfect, negative linear relationship.
- ○ B. x and y have a strong, positive linear relationship.
- ○ C. x and y have a weak, negative linear relationship.
- ○ D. x and y have a strong, negative linear relationship.
- ○ E. x and y have a perfect, positive linear relationship.
- ○ F. x and y have a weak, positive linear relationship.
- ○ G. x and y are not linearly related.

b. What relationship exists between the x and y values in the sample?

- ○ A. x and y have a perfect, negative linear relationship.
- ○ B. x and y have a weak, positive linear relationship.
- ○ C. x and y have a weak, negative linear relationship.
- ○ D. x and y have a perfect, positive linear relationship.
- ○ E. x and y have a strong, positive linear relationship.
- ○ F. x and y have a strong, negative linear relationship.
- ○ G. x and y are not linearly related.

c. What relationship exists between the x and y values in the sample?

5. (cont.)

○A. x and y have a weak, positive linear relationship.

○B. x and y have a perfect, positive linear relationship.

○C. x and y have a weak, negative linear relationship.

○D. x and y have a perfect, negative linear relationship.

○E. x and y have a strong, positive linear relationship.

○F. x and y have a strong, negative linear relationship.

○G. x and y are not linearly related.

d. What relationship exists between the x and y values in the sample?

○A. x and y have a weak, positive linear relationship.

○B. x and y have a strong, positive linear relationship.

○C. x and y have a perfect, positive linear relationship.

○D. x and y have a strong, negative linear relationship.

○E. x and y have a weak, negative linear relationship.

○F. x and y have a perfect, negative linear relationship.

○G. x and y are not linearly related.

e. What relationship exists between the x and y values in the sample?

○A. x and y have a strong, positive linear relationship.

○B. x and y have a perfect, positive linear relationship.

○C. x and y have a strong, negative linear relationship.

○D. x and y have a weak, positive linear relationship.

○E. x and y have a weak, negative linear relationship.

○F. x and y have a perfect, negative linear relationship.

○G. x and y are not linearly related.

f. What relationship exists between the x and y values in the sample?

5. (cont.)

- ◯ A. x and y have a perfect, negative linear relationship.
- ◯ B. x and y have a weak, negative linear relationship.
- ◯ C. x and y have a strong, negative linear relationship.
- ◯ D. x and y have a strong, positive linear relationship.
- ◯ E. x and y have a perfect, positive linear relationship.
- ◯ F. x and y have a weak, positive linear relationship.
- ◯ G. x and y are not linearly related.

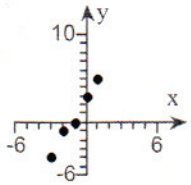
6. Construct a scattergram for each data set. Then calculate r and r^2 for each data set. Interpret their values. Complete parts **a** through **d**.

a.

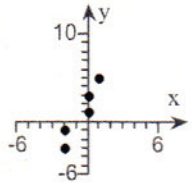
x	−3	−2	−1	0	1
y	−4	−1	0	3	5

Choose the correct graph below.

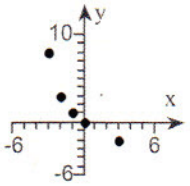
○A.



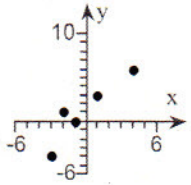
○B.



○C.



○D.



Calculate r.

r = ☐ (Round to four decimal places as needed.)

Calculate r^2.

r^2 = ☐ (Round to four decimal places as needed.)

Interpret r. Choose the correct answer below.

○A. There is a very strong positive linear relationship between x and y.

○B. x and y are not related.

○C. There is not enough information to answer this question.

○D. There is a very strong negative linear relationship between x and y.

Interpret r^2.

☐% of the total sample variability around $\bar{y}$ [is explained / is not explained] by the linear relationship between x and y.

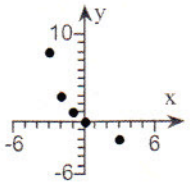
(Round to two decimal places as needed.)

b.

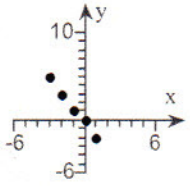
x	−3	−2	−1	0	1
y	5	3	1	0	−2

6.
(cont.) Choose the correct graph below.

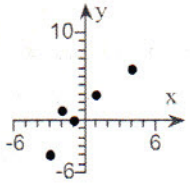
○A.



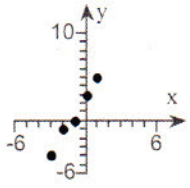
○B.



○C.



○D.



Calculate r.

$r =$ ☐ (Round to four decimal places as needed.)

Calculate r^2.

$r^2 =$ ☐ (Round to four decimal places as needed.)

Interpret r. Choose the correct answer below.

○A. x and y are not related.

○B. There is a very strong negative linear relationship between x and y.

○C. There is not enough information to answer this question.

○D. There is a very strong positive linear relationship between x and y.

Interpret r^2.

☐% of the total sample variability around $\bar{y}$ [is explained / is not explained] by the linear relationship between x and y.
(Round to two decimal places as needed.)

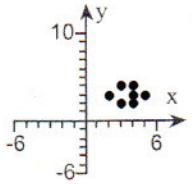
c.

x	2	3	3	4	4	4	5
y	3	2	4	2	3	4	3

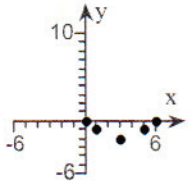
Choose the correct graph below.

6. (cont.)

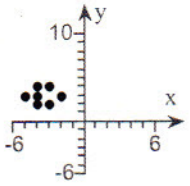
○A.



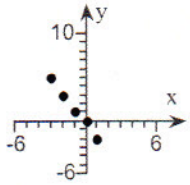
○B.



○C.



○D.



Calculate r.

$r =$ ☐ (Round to four decimal places as needed.)

Calculate r^2.

$r^2 =$ ☐ (Round to four decimal places as needed.)

Interpret r. Choose the correct answer below.

○A. There is not enough information to answer this question.

○B. There is a very strong negative linear relationship between x and y.

○C. There is a very strong positive linear relationship between x and y.

○D. x and y are not related.

Interpret r^2.

☐% of the total sample variability around $\bar{y}$ [is explained / is not explained] by the linear relationship between x and y.
(Round to two decimal places as needed.)

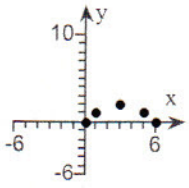
d.

x	0	1	3	5	6
y	0	1	2	1	0

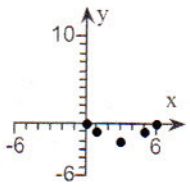
Choose the correct graph below.

6. (cont.)

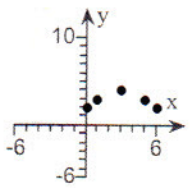
○A.



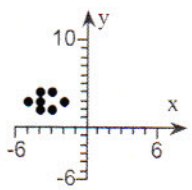
○B.



○C.



○D.



Calculate r.

$r =$ ☐ (Round to four decimal places as needed.)

Calculate r^2.

$r^2 =$ ☐ (Round to four decimal places as needed.)

Interpret r. Choose the correct answer below.

○A. There is a very strong negative linear relationship between x and y.

○B. There is a very strong positive linear relationship between x and y.

○C. There is not enough information to answer this question.

○D. x and y are not related.

Interpret r^2.

☐% of the total sample variability around $\bar{y}$ [is explained / is not explained] by the linear relationship between x and y.

(Round to two decimal places as needed.)

7. Suppose you fit the first-order model $y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \varepsilon$ to $n = 28$ data points and obtain SSE = 0.33 and $R^2 = 0.91$.

a. Do the values of SSE and R^2 suggest that the model provides a good fit to the data? Explain.

- A. Yes. Since $R^2 = 0.91$ is close to 1, this indicates the model provides a good fit. Also, SSE = 0.33 is fairly small which indicates the model provides a good fit.
- B. No. Since $R^2 = 0.91$ is close to 1, this indicates the model does not provide a good fit. Also, SSE = 0.33 is fairly small which indicates the model does not provide a good fit.
- C. There is not enough information to decide.

b. Is the model of any use in predicting y? Test the null hypothesis H_0: $\beta_1 = \beta_2 = \ldots = \beta_5 = 0$ against the alternative hypothesis: At least one of the parameters $\beta_1, \beta_2, \ldots, \beta_5$ is nonzero. Use $\alpha = 0.10$.

- A. There is insufficient evidence to indicate the model is useful in predicting y at $\alpha = 0.10$.
- B. There is not enough evidence to indicate whether the model is useful or not in predicting y at $\alpha = 0.10$.
- C. There is sufficient evidence to indicate the model is useful in predicting y at $\alpha = 0.10$.

8. A study of traits in people was conducted. A rating score was determined for each in a sample of people of a large university. For one portion of the study, the researcher modeled a person's score (y) as a function of age, gender, education, and income. Data on n = 191 people yielded the results in the table to the right. Complete parts **a** through **c**.

Independent variable	t value for $H_0: \beta_i = 0$	p-value
Age (x_1)	− 0.55	> 0.10
Gender (x_2)	0.52	> 0.10
Education (x_3)	2.14	< 0.10
Income (x_4)	0.10	> 0.10
Overall model: $R^2 = 0.86$, $F = 285.64$ (p-value < 0.01)		

a. Conduct a test of overall model utility. Use $\alpha = 0.05$. What are the null and alternative hypotheses?

○A. H_0: At least one $\beta_i \neq 0$
H_a: $\beta_0 = \beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$

○B. H_0: $\beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$
H_a: At least one $\beta_i \neq 0$

○C. H_0: At least one $\beta_i \neq 0$
H_a: $\beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$

○D. H_0: $\beta_0 = \beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$
H_a: At least one $\beta_i \neq 0$

What is the test statistic?

F = ☐ (Round to two decimal places as needed.)

What is the p-value?

p = ☐ (Round to four decimal places as needed.)

Determine the conclusion. Choose the correct answer below.

○A. Reject H_0. There is sufficient evidence to conclude that the model may be statistically useful.

○B. Fail to reject H_0. There is insufficient evidence to conclude that the model may be statistically useful.

○C. Fail to reject H_0. There is sufficient evidence to conclude that the model may be statistically useful.

○D. Reject H_0. There is insufficient evidence to conclude that the model may be statistically useful.

b. Interpret the coefficient of determination, R^2. Choose the correct answer below.

8. (cont.)

A. 14% of the sample variation in scores can be explained by the model.

B. 50% of the sample variation in scores can be explained by the model.

C. 86% of the sample variation in scores can be explained by the model.

D. An interpretation cannot be made.

c. Is there sufficient evidence (at $\alpha = 0.05$) to say that gender is a statistically useful predictor of score? What are the null and alternative hypotheses?

A. $H_0: \beta_2 = 0$
$H_a: \beta_2 > 0$

B. $H_0: \beta_2 = 0$
$H_a: \beta_2 < 0$

C. $H_0: \beta_2 \neq 0$
$H_a: \beta_2 = 0$

D. $H_0: \beta_2 = 0$
$H_a: \beta_2 \neq 0$

What is the test statistic?

$t =$ ☐ (Round to two decimal places as needed.)

What is the p-value?

$p =$ ☐ (Round to four decimal places as needed.)

Determine the conclusion. Choose the correct answer below.

A. Fail to reject H_0. There is sufficient evidence to conclude that including gender in the model may be statistically useful.

B. Reject H_0. There is insufficient evidence to conclude that including gender in the model may be statistically useful.

C. Fail to reject H_0. There is insufficient evidence to conclude that including gender in the model may be statistically useful.

D. Reject H_0. There is sufficient evidence to conclude that including gender in the model may be statistically useful.

9. A magazine reported on a study of the reliability of a commercial kit to test for arsenic in groundwater. The field kit was used to test a sample of 20 groundwater wells in a country. In addition to the arsenic level (micrograms per liter), the latitude (degrees), longitude (degrees), and depth (feet) of each well was measured. Complete parts **a** through **g**.

Click the icon to view the data table.

a. Write a first-order model for arsenic level (y) as a function of latitude, longitude, and depth. Choose the correct answer below.

A. $E(y) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3$

B. $E(y) = \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3$

C. $E(y) = \beta_3 + \beta_2 x_1 + \beta_1 x_2 + \beta_0 x_3$

D. $E(y) = \beta_3 x_1 + \beta_2 x_2 + \beta_1 x_3$

b. Fit the model to the data using the method of least squares. Let x_1 be the latitudes, x_2 be the longitudes, and x_3 be the depths.

$\hat{y} = (\square) + (\square)x_1 + (\square)x_2 + (\square)x_3$

(Round the constant term and the coefficients for x_1 and x_2 to the nearest integer as needed. Round the coefficient for x_3 to the nearest hundredth as needed.)

c. Give practical interpretation of the β estimates. Interpret the estimate of β_0. Choose the correct answer below.

A. As longitude increases by 1, the level of arsenic is estimated to increase by $\hat{\beta}_0$.

B. As latitude increases by 1, the level of arsenic is estimated to increase by $\hat{\beta}_0$.

C. As depth increases by 1, the level of arsenic is estimated to increase by $\hat{\beta}_0$.

D. An interpretation cannot be determined.

Interpret the estimate of β_1. Choose the correct answer below.

A. As longitude increases by 1, the level of arsenic is estimated to increase by $\hat{\beta}_1$.

B. As latitude increases by 1, the level of arsenic is estimated to increase by $\hat{\beta}_1$.

C. As depth increases by 1, the level of arsenic is estimated to increase by $\hat{\beta}_1$.

D. An interpretation cannot be determined.

9. (cont.) Interpret the estimate of β_2. Choose the correct answer below.

- A. As longitude increases by 1, the level of arsenic wis estimated toill increase by $\hat{\beta}_2$.
- B. As depth increases by 1, the level of arsenic is estimated to increase by $\hat{\beta}_2$.
- C. As latitude increases by 1, the level of arsenic is estimated to increase by $\hat{\beta}_2$.
- D. An interpretation cannot be determined.

Interpret the estimate of β_3. Choose the correct answer below.

- A. As depth increases by 1, the level of arsenic is estimated to increase by $\hat{\beta}_3$.
- B. As latitude increases by 1, the level of arsenic is estimated to increase by $\hat{\beta}_3$.
- C. As longitude increases by 1, the level of arsenic is estimated to increase by $\hat{\beta}_3$.
- D. An interpretation cannot be determined.

d. Find the model standard deviation, s, and interpret its value.

$s =$ ☐ (Round to one decimal places as needed.)

Interpret this result. Choose the correct answer below.

- A. We can expect the model to provide predictions of arsenic to be within about ± 49 micrograms per liter.
- B. We can expect the model to provide predictions of arsenic to be within about ± 2 micrograms per liter.
- C. We can expect the model to provide predictions of arsenic to be within about ± 97 micrograms per liter.
- D. An interpretation cannot be determined.

e. Find and interpret the values of R^2 and R_a^2.

$R^2 =$ ☐ (Round to three decimal places as needed.)

Interpret this result. Choose the correct answer below.

9. (cont.)

○A. 68.8% of the sample variation in scores can be explained by the model.

○B. 31.2% of the sample variation in scores can beexplained by the model.

○C. 50% of the sample variation in scores can be explained by the model.

○D. An interpretation cannot be determined.

Find R_a^2.

$R_a^2 =$ ☐ (Round to three decimal places as needed.)

Interpret this result. Choose the correct answer below.

○A. 62.9% of the sample variation in scores can be explained by the model.

○B. 37.1% of the sample variation in scores can be explained by the model.

○C. 50% of the sample variation in scores can be explained by the model.

○D. An interpretation cannot be determined.

f. Conduct a test of overall model utility at $\alpha = 0.10$. What are the null and alternative hypotheses?

○A. $H_0: \beta_1 = \beta_2 = \beta_3 = 0$
H_a: At least one $\beta_i \neq 0$

○B. H_0: At least one $\beta_i \neq 0$
$H_a: \beta_0 = \beta_1 = \beta_2 = \beta_3 0$

○C. $H_0: \beta_0 = \beta_1 = \beta_2 = \beta_3 = 0$
H_a: At least one $\beta_i \neq 0$

○D. H_0: At least one $\beta_i \neq 0$
$H_a: \beta_1 = \beta_2 = \beta_3 = 0$

What is the test statistic?

$F =$ ☐ (Round to two decimal places as needed.)

What is the p-value?

$p =$ ☐ (Round to three decimal places as needed.)

Determine the conclusion. Choose the correct answer below.

9. (cont.)

○A. Fail to reject H_0. There is insufficient evidence to conclude that the model may be statistically useful.

○B. Reject H_0. There is insufficient evidence to conclude that the model may be statistically useful.

○C. Reject H_0. There is sufficient evidence to conclude that the model may be statistically useful.

○D. Fail to reject H_0. There is sufficient evidence to conclude that the model may be statistically useful.

g. Based on the results of parts **d-f**, would you recommend using the model to predict arsenic level (y)? Explain.

○A. Recommend using the model because it is not useful according to the F-test. Assume that the test is valid.

○B. Do not recommend using the model because it is useful according to the F-test. Assume that the test is valid.

○C. Do not recommend using the model because it is not useful according to the F-test. Assume that the test is valid.

○D. Recommend using the model because it is useful according to the F-test. Assume that the test is valid.

Data Table

Well ID	Latitude	Longitude	Depth	Arsenic
1	23.7714	90.6221	45	78
2	23.7764	90.6492	45	65
3	23.7832	90.6321	100	192
4	23.7944	90.6386	60	21
5	23.7644	90.6224	90	187
6	23.7916	90.6228	125	187
7	23.7674	90.6225	30	123
8	23.7694	90.6176	75	285
9	23.7732	90.6147	60	182
10	23.7894	90.6482	150	292
11	23.7852	90.6215	90	182
12	23.7856	90.6207	30	76
13	23.7745	90.6496	75	55
14	23.7479	90.6387	45	179
15	23.7734	90.6487	100	185
16	23.7681	90.6463	100	285

9. (cont.)

17	23.7754	90.6452	75	185
18	23.7881	90.6489	150	192
19	23.7872	90.6218	45	55
20	23.7818	90.6243	125	192