STA 3024 **Practice Problems Exam 2**

NOTE: These are just Practice Problems. This is NOT meant to look just like the test, and it is NOT the only thing that you should study. Make sure you know all the material from the notes, quizzes, suggested homework and the corresponding chapters in the book.

1. The parameters to be estimated in the simple linear regression model $Y=\alpha+\beta x+\varepsilon$ $\varepsilon \sim N(0,\sigma)$ are:
a) α, β, σ b) $\alpha, \beta, \varepsilon$ c) a, b, s d) $\varepsilon, 0, \sigma$

2. We can measure the proportion of the variation explained by the regression model by:
a) r b) R^2 c) σ^2 d) F

3. The MSE is an estimator of:
a) ε b) 0 c) σ^2 d) Y
Mean Sq. error

4. In multiple regression with p predictor variables, when constructing a confidence interval for any β_i, the degrees of freedom for the tabulated value of t should be:
a) n-1 b) n-2 c) n- p-1 d) p-1
df error
n - p - 1
samples # predictor var.

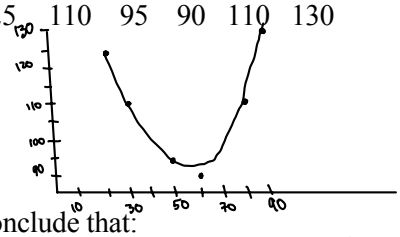
5. In a regression study, a 95% confidence interval for β_1 was given as: (-5.65, 2.61). What would a test for H_0: $\beta_1=0$ vs H_a: $\beta_1\neq 0$ conclude?
a) reject the null hypothesis at $\alpha=0.05$ and all smaller α
b) fail to reject the null hypothesis at $\alpha=0.05$ and all smaller α
c) reject the null hypothesis at $\alpha=0.05$ and all larger α
d) fail to reject the null hypothesis at $\alpha=0.05$ and all larger α
↑ is 0 in CI?
NO Diff from H_0

6. In simple linear regression, when β is **not** significantly different from zero we conclude that:
a) X is a good predictor of Y b) there is no linear relationship between X and Y
c) the relationship between X and Y is quadratic d) there is no relationship between X and Y
β = coeff. of indep. var (X)
SLR → only make conclusions on linear relationships

7. In a study of the relationship between X=mean daily temperature for the month and Y=monthly charges on electrical bill, the following data was gathered:

X	20	30	50	60	80	90
Y	125	110	95	90	110	130

Which of the following seems the most likely model?
a) $Y=\alpha+\beta x+\varepsilon$ $\beta<0$
b) $Y=\alpha+\beta x+\varepsilon$ $\beta>0$
c) $Y=\alpha+\beta_1 x+\beta_2 x^2+\varepsilon$ $\beta_2<0$
d) $Y=\alpha+\beta_1 x+\beta_2 x^2+\varepsilon$ $\beta_2>0$
linear
quad.
· quadratic
· opens up



8. If a predictor variable x is found to be highly significant we would conclude that:
a) a change in y causes a change in x b) a change in x causes a change in y
c) changes in x are not related to changes in y d) changes in x are associated to changes in y
causation ≠ correlation

9. At the same confidence level, a prediction interval for a new response is always;
a) somewhat larger than the corresponding confidence interval for the mean response
b) somewhat smaller than the corresponding confidence interval for the mean response
c) one unit larger than the corresponding confidence interval for the mean response
d) one unit smaller than the corresponding confidence interval for the mean response
PI > CI
↑ wider

10. Both the prediction interval for a new response and the confidence interval for the mean response are narrower when made for values of x that are:
a) closer to the mean of the x's b) further from the mean of the x's
c) closer to the mean of the y's d) further from the mean of the y's

11. In the regression model $Y = \alpha + \beta x + \varepsilon$ the change in Y for a one unit increase in x:

a) will always be the same amount, α
b) will always be the same amount, β
c) will depend on the error term
d) will depend on the level of x

12. In a regression model with a dummy variable **without** interaction there can be:

a) more than one slope and more than one intercept
b) more than one slope, but only one intercept
c) only one slope, but more than one intercept
d) only one slope and one intercept

13. In a multiple regression model, where the x's are predictors and y is the response, multicollinearity occurs when:

a) the x's provide redundant information about y
b) the x's provide complementary information about y
c) the x's are used to construct multiple lines, all of which are good predictors of y
d) the x's are used to construct multiple lines, all of which are bad predictors of y

14. Compute the simple linear regression equation if:

$a = \bar{y} - b\bar{x}$ $\quad \hat{y} = a + bx$

$b = r \cdot \frac{s_y}{s_x}$ $\quad b = -0.774\left(\frac{54.2}{16.2}\right) = -2.59$

$a = 874.1 - 163.5(-2.59) = 1297.49$

$\hat{y} = 1297.49 - 2.59x$

	mean	stdev	correlation
x	163.5	16.2	-0.774
y	874.1	54.2	

15. Match the statements below with the corresponding terms from the list.

a) multicollinearity
b) extrapolation
c) R^2 adjusted
d) quadratic regression
e) interaction
f) residual plots
g) fitted equation
h) dummy variables
i) cause and effect
j) multiple regression model
k) R^2
l) residual
m) influential points
n) outliers

D Used when a numerical predictor has a curvilinear relationship with the response.

M Worst kind of outlier, can totally reverse the direction of association between x and y.

F Used to check the assumptions of the regression model.

C Used when trying to decide between two models with different numbers of predictors.

E Used when the effect of a predictor on the response depends on other predictors.

K Proportion of the variability in y explained by the regression model.

L Is the observed value of y minus the predicted value of y for the observed x..

N A point that lies far away from the rest.

B Can give bad predictions if the conditions do not hold outside the observed range of x's.

I Can be erroneously assumed in an observational study.

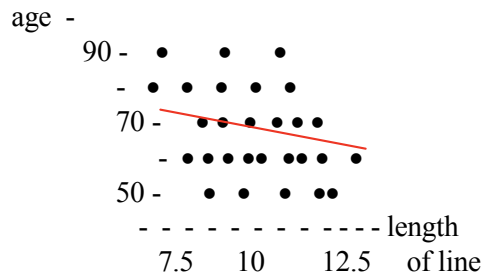
J $y = \alpha + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_p x_p + \varepsilon \quad \varepsilon \sim N(0, \sigma^2)$

G $\hat{y} = a + b_1 x_1 + b_2 x_2 + \ldots + b_p x_p$

A Problem that can occur when the information provided by several predictors overlaps.

H Used in a regression model to represent categorical variables.

Questions 16 - 19 Palm readers claim to be able to tell how long your life will be by looking at a specific line on your hand. The following is a plot of age of person at death (in years) vs length of life line on the right hand (in cm) for a sample of 28 (dead) people.



16. If we fit a simple linear regression model to these data, what would the value of r be?
a) close to -1
b) close to 0
c) close to 1
d) it's impossible to tell

17. Would you say:
a) length of life line is a very good predictor of age of person at death
b) length of life line is a poor predictor of age of person at death
c) length of life line is a reasonably good predictor of age of person at death
d) cannot determine how good a predictor length of life line is of age of person at death

18. The ANOVA p-value will be around
a) 1.00 b) 0.000 c) 0.05 d) 0.01

19. A better way of modeling age of person at death using this data set would be to use:
a) a nonparametric procedure
b) the average age at death
c) a contingency table
d) quadratic regression

20. According to the null hypothesis of the ANOVA F test, which predictor variables are providing significant information about the response?
a) most of them b) none of them c) all of them d) some of them

21. According to the alternative hypothesis of the ANOVA F test, which predictor variables are providing significant information about the response?
a) most of them b) none of them c) all of them d) some of them

22. In general, the Least Squares Regression approach finds the equation:
a) that includes the best set of predictor variables
b) of the best fitting straight line through a set of points
c) with the highest R^2, after comparing all possible models
d) that has the smallest sum of squared errors

23. Studies have shown a high positive correlation between the number of firefighters dispatched to combat a fire and the financial damages resulting from it. A politician commented that the fire chief should stop sending so many firefighters since they are clearly destroying the place. This is an example of:
a) extrapolation
b) dummy variables
c) misuse of causality
d) multicollinearity

24. The following appeared in the magazine *Financial Times*, March 23, 1995: "When Elvis Presley died in 1977, there were 48 professional Elvis impersonators. Today there are an estimated 7328. If that growth is projected, by the year 2012 one person in four on the face of the globe will be an Elvis impersonator." This is an example of:
a) extrapolation
b) dummy variables
c) misuse of causality
d) multicollinearity

Questions 25 – 43 Most supermarkets use scanners at the checkout counters. The data collected this way can be used to evaluate the effect of price and store's promotional activities on the sales of any product. The promotions at a store change weekly, and are mainly of two types: flyers distributed outside the store and through newspapers (which may or may not include that particular product), and in-store displays at the end of an aisle that call the customers' attention to the product. Weekly data was collected on a particular beverage brand, including sales (in number of units), price (in dollars), flyer (1 if product appeared that week, 0 if it didn't) and display (1 if a special display of the product was used that week, 0 if it wasn't).

As a preliminary analysis, a simple linear regression model was done.
The fitted regression equation was: sales = 2259 - 1418 price.
The ANOVA F test p-value was .000, and R^2= 59.7%.

25. The response variable is:
a) quantitative b) y c) sales d) all of the above

26. Which of the following is the best interpretation of the slope of the line?
a) As the price increases by 1 dollar, sales will increase, on average, by 2259 units.
b) As the price increases by 1 dollar, sales will decrease, on average, by 1418 units.
c) As the sales increase by 1 unit, the price will increase, on average, by 2259 dollars.
d) As the sales increase by 1 unit, the price will decrease, on average, by 1418 dollars.

Δy for 1 unit Δx
change in sales for 1 change in price

27. Should the intercept of the line be interpreted in this case?
a) Yes, as the average price when no units are sold.
b) Yes, as the average sales when the price is zero dollars.
c) No, since sales of zero units are probably out of the range observed.
d) No, since a price of zero dollars is probably out of the range observed.

2259
x=0 & price=0

28. The proportion of the variability in sales accounted for by the price of the product is:
a) 14.18% b) 22.59%
c) 59.70% d) 100%

R^2

29. The coefficient of linear correlation, r, for this analysis is:
a) 7.73 b) -7.73
c) .773 d) -.773

$r = \sqrt{R^2} = \sqrt{0.597} = 0.773$ → -0.773 b/c slope is neg.

30. According to this model, how many units will be sold, on average, when the price of the beverage is $1.10?
a) 3818.8
b) 699.2
c) 1066.9
d) 3902.9

sales = 2259 − 1418(1.10)
sales = 699.2 units

31. Is price a good predictor of sales?
a) Yes, the p-value is very small. b) Yes, the intercept is very large.
c) No, R-square is not too good. d) No, the slope is negative.

p-val = 0.000 sig.

32. Below is a sketch of the residual plot for this analysis. What can you conclude from it?
a) All the assumptions seem to be satisfied.
b) There seems to be an outlier in the data.
c) Simple linear regression might not be the best model.
d) The assumption of constant variance might be violated.

Next, a quadratic regression was fitted to the data. Parts of the computer output appear below.

	Predictor	Coef	Stdev	t-ratio	p
	Constant	7990.0	724.7	11.03	0.000
x	price	-10660	1151	-9.26	0.000
x^2	price2	3522.3	436.8	8.06	0.000

↑ pos. open-up

Analysis of Variance

SOURCE	DF	SS	MS	F	p
Regression	2	16060569	8030284	125.11	0.000
Error	60	3851231	64187		
Total	62	19911800			

33. We can write the model fitted here as:

a) $Y = \alpha + \beta x + \varepsilon$
b) $Y = \alpha + \beta_1 x_1 + \beta_2 x_2 + \varepsilon$
c) $Y = \alpha + \beta_1 x + \beta_2 x^2 + \varepsilon$
d) $Y = \alpha + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_1 x_2 + \varepsilon$

34. What is R^2?

$\frac{SS_{reg}}{SS_{tot}} = \frac{16060569}{19911800} = 0.807 \times 100 = 80.7\%$

a) 19.3%
b) 80.7%
c) 23.98%
d) 76.06%

35. What is the test statistic to determine if the quadratic term significantly differs from zero?

test stat = $\frac{\text{coefficient}}{\text{st. dev}}$

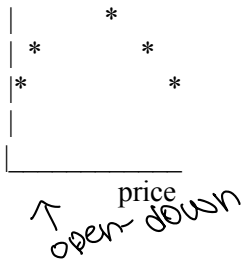
$\frac{3522.3}{436.8} = 8.06$

a) 125.11
b) 11.03
c) -9.26
d) 8.06

36. Based on the results of the two regression analyses presented here, which of the following sketches best describes the relationship between price of the item and sales?

R^2 adj: Quadratic

a)

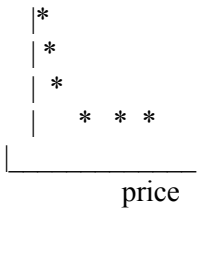


↑ open-down

b)

c)

d)



← open-up

37. According to this model, how many units will be sold, on average, when the price of the beverage is $1.10?

a) 525.98
b) 138.53
c) 10660
d) 3522.3

$\hat{y} = 7990 - 10660x + 3522.3x^2$

$\hat{y} = 7990 - 10660(1.1) + 3522.3(1.1)^2$

525.98 units

Predictor	Coef
Constant	7990.0
price	-10660
price2	3522.3

38. Is the quadratic model preferable to the linear model in this case?

a) No, we always prefer the simpler model.
b) No, the p-value for the quadratic term is zero.
c) Yes, the p-value for the quadratic term is zero.
d) Yes, we had more data for the quadratic model.

dummy variables

Next, the categorical variables flyer and display were added to the model. Parts of the computer output appear below.

Predictor	Coef	Stdev	t-ratio	p
Constant	3829.5	700.4	5.47	0.000
price	-5056	1026	-4.93	0.000
price2	1667.7	369.9	4.51	0.000
flyer	804.12	86.75	9.27	0.000
display	-31.49	53.38	-0.59	0.558

1 for appeared, 0 for not appeared
1 for appeared, 0 for not appeared

not sig.

s = 162.8 R-sq = 92.3% R-sq(adj) = 91.7%

Analysis of Variance

SOURCE	DF	SS	MS	F	p
Regression	4	18373664	4593416	173.21	0.000
Error	58	1538137	26520		
Total	62	19911802			

39. According to this model, what is the average effect of advertising the product on the weekly flyer, after adjusting for price and display?

look @ coef. for flyer

804.12

a) There will be a significant increase in sales of about 804 units.
b) There will be an insignificant increase in sales of about 9 units.
c) Since the effect is significant, we should not interpret the coefficient.
d) Since the effect is not significant, we should not interpret the coefficient.

40. According to this model, what is the average effect of promoting the product with an in-store display, after adjusting for price and flyer?

p-val. is not sig.

a) There will be an insignificant increase in sales of less than one unit.
b) There will be a significant decrease in sales of about 31 units.
c) Since the effect is significant, we should not interpret the coefficient.
d) Since the effect is not significant, we should not interpret the coefficient.

41. What can you say about price and price squared in this model?

a) Both of them are still good predictors of sales.
b) Neither of them seems to be a good predictor of sales now.
c) Price is a good predictor, but price squared is not.
d) Price is not a good predictor, but price squared is.

42. Should anything be done to improve this model?

a) No, it has very good ANOVA p-value, R-sq and R-sq adjusted.
b) No, it has a lot of parameters so it does a good job of predicting sales.
c) Yes, not all the variables included in the model are good predictors of sales. → displays
d) Yes, "price" and "display" should be taken out since they have negative coefficients.

x price

43. Flyers usually advertise products that are on sale that week. This implies that we should add to the model:

a) an interaction between display and flyer.
b) an interaction between price and flyer.
c) a quadratic term for display.
d) a quadratic term for flyer.

Questions 44 – 50 A scientific foundation wanted to evaluate the relation between y= salary of researcher (in thousands of dollars), x_1= number of years of experience, x_2= an index of publication quality, x_3=sex (M=1, F=0) and x_4= an index of success in obtaining grant support. A sample of 35 randomly selected researchers was used to fit the multiple regression model. Parts of the computer output appear below.

Predictor	Coef	SE Coef	T	P
Constant	17.846931	2.001876	8.915	0.0001
Years	1.103130	0.359573	3.068	0.0032
Papers	0.321520	0.037109		0.0002
Sex	1.593400	0.687724	2.317	0.0083
Grants	1.288941	0.298479	4.318	0.0003

s = 1.75276 R-sq = 92.3% adj R-sq = 91.4%

44. The least squares line fitted to the data is:
a) salary = $2.001 + 0.33\ x_1 + 0.04\ x_2 + 0.69\ x_3 + 0.30\ x_4 + \varepsilon$
b) salary = $17.85 + 1.10\ x_1 + 0.32\ x_2 + 1.59\ x_3 + 1.29\ x_4 + \varepsilon$
c) salary = $2.001 + 0.33\ x_1 + 0.04\ x_2 + 0.69\ x_3 + 0.30\ x_4$
d) salary = $17.85 + 1.10\ x_1 + 0.32\ x_2 + 1.59\ x_3 + 1.29\ x_4$

NO error term

45. The p-value of the ANOVA F test will be:
a) very large, since it's clear that all of the variables are good predictors of salary
b) very small, since it's clear that all of the variables are good predictors of salary
c) very large, since it's clear that none of the variables are good predictors of salary
d) very small, since it's clear that none of the variables are good predictors of salary

all p-values are small

46. The (one-sided) p-value for testing whether salary increases with years of experience is:
a) .0001 b) .0032 c) .0064 d) .0016

0.0032
↑ two-sided: $H_0: \beta_1 = 0$ $H_a: \beta_1 \neq 0$

47. The variable that helps the most in predicting salary is:
a) intercept b) years c) papers d) sex e) grants

smallest p-value

48. Which of the following gives a 95% CI for β_1?
a) 17.847± t* (2.002) b) 17.847± t* (8.915) c) 1.1031± t* (.3596) d) 1.1031 ± t* (3.068)

$= 1.103 \pm t(\text{st.dev})$

t: df from error

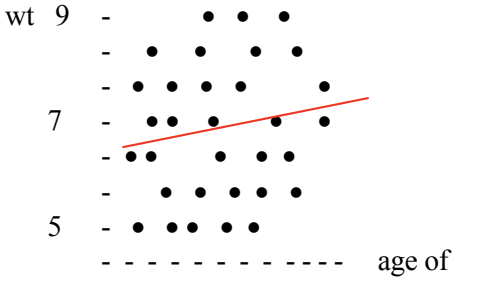
49. How many degrees of freedom does the t* value from the previous question have?
a) 34 b) 33 c) 30 d) 4

$N - p - 1$
$35 - 4 - 1 = 30$
↑ #pp ↑ #variables

50. According to the assumptions, what has to have a Normal distribution and constant variance?
a) the researchers b) the years c) the variables d) the salaries

response variable

Questions 51 – 53 In a study on teenage pregnancies, the researchers attempted to determine the relationship between y=weight of baby at birth (in pounds) and x=age of the mother. The data collected is plotted below.

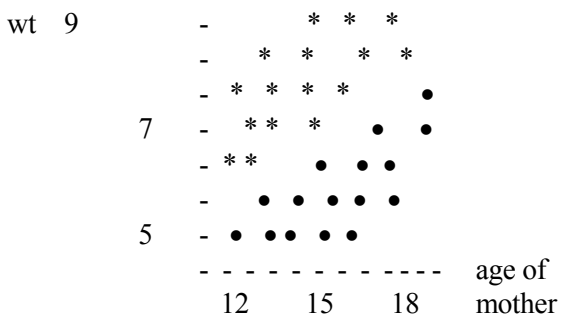


51. If we fit a simple linear regression model to these data, the value of r will be closest to?
a) 0 b) -1 c) 1 d) 100

52. To determine if age of mother is a significantly good predictor of weight of baby we could:
a) construct a confidence interval for the slope
b) test whether the slope is zero or not
c) use an ANOVA F test
d) all of the above

53. The best fitting line through these points will probably have a slope that is:
a) positive and significantly different from zero.
b) positive but not significantly different from zero.
c) negative and significantly different from zero.
d) negative but not significantly different from zero.

Questions 54 – 63 The following is a plot of the same data, but using different symbols to represent mothers who received prenatal care (*) and those who didn't (•). We fit the model:
$Y = \alpha + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_1 x_2 + \varepsilon$, where Y= wt x_1=age x_2= 0 for prenatal care, 1 if not



54. The model we fit to these data is not:
a) Multiple Regression
b) Regression with Dummy Variables
c) Least Squares Regression
d) Quadratic Regression

no parabola

55. The baseline group is:
a) age b) weight c) prenatal care d) random

$x_2 = 0$

Match each parameter with the interpretations at right:

56. β_3 — d) change in slope
57. β_2 — b) intercept for baseline group
58. β_1 — c) slope for baseline group
59. α — a) change in intercept
e) slope for non-baseline group

what's added to α

what's added to β_1 $\beta_1 + \beta_3$

Baseline: $x_2 = 0$
$Y = \alpha + \beta_1 x_1 + \varepsilon$

other: $x_2 = 1$
$Y = \alpha + \beta_1 x_1 + \beta_2 + \beta_3 x_1$
$Y = (\alpha + \beta_2) + x(\beta_1 + \beta_3)$
intercept slope

60. For the model above, and based on the plot, which of the following statements is true?
a) Age of mother does not seem to be a good predictor of weight of baby. X
b) Prenatal care will probably have a significant effect on weight of baby. ✓
c) There appears to be an interaction between prenatal care and age of mother. X all ages equally received care
d) all the statements are false.

61. Which parameter would we test for to determine if the rate at which weight of baby increases with age of mother differs for mothers who receive prenatal care and those who don't?
a) β_3 b) β_2 c) β_1 d) α

slope change change in slope

The computer output reports following equation: $wt = -1.84 + 0.53x_1 + 1.79x_2 - .003\, x_1x_2$.
Use that equation to answer the next two questions:

62. To predict weight of babies born to teenagers who do not receive prenatal care we use the equation:
a) $wt = -0.05 + .527x_1$ b) $wt = -1.84 + 0.53x_1$
c) $wt = 1.79 + .003x_1$ d) $wt = 1.79 + 0.53x_1$

$x_2 = 1$
$wt = -1.84 + 0.53x_1 + 1.79 - 0.003x_1$
$wt = -0.05 + 0.527x_1$

63. To predict weight of babies born to teenagers who receive prenatal care we use the equation:
a) $wt = -0.05 + .527x_1$ b) $wt = -1.84 + 0.53x_1$
c) $wt = 1.79 + .003x_1$ d) $wt = 1.79 + 0.53x_1$

$x_2 = 0$
$wt = -1.84 + 0.53x_1$

Questions 64 -70 Data for 51 U.S. "states" (50 states, plus the District of Columbia) was used to examine the relationship between violent crime rate (violent crimes per 100,000 persons per year) and the predictor variables of urbanization (percentage of the population living in urban areas) and poverty rate. A predictor variable indicating whether or not a state is classified as a Southern state (1 = Southern, 0 = not) was also included. Some Minitab output for the analysis of this data is shown below (with some information intentionally left blank).

```
The regression equation is
Crime = -321.9 +4.69Urban +39.3Poverty -649.3South +12.1Urban*South -5.84Poverty*South

Predictor        Coef    SE Coef       T      P
Constant      -321.90     148.20   -2.17  0.035
Urban           4.689      1.654    2.83  0.007
Poverty         39.34      13.52    2.91  0.006
South(S=1)    -649.30     266.96   -2.43  0.019
Urban*South     12.05      2.871    4.20  0.000
Poverty*South  -5.838     16.671   -0.35  0.728

Analysis of Variance
Source           DF       SS      MS       F      P
Regression        5  2060459  412091     ———  0.000
Residual Error   45   882169   19604
Total            50  2942628
```

large

64. Which of the following represents the fitted relationship between crime, urbanization, and poverty for Southern states?

a) Crime = –321.9 + 4.69Urban + 39.3Poverty
b) Crime = –315.6 + 4.69Urban + 39.3Poverty
c) Crime = –315.6 + 16.8Urban + 33.5Poverty
d) Crime = –971.2 + 16.8Urban + 33.5Poverty
e) Crime = –971.2 + 4.69Urban + 39.3Poverty

S=1

$-321.9 + 4.689\,urban + 39.34\,pov - 649.3(1) + 12.05\,urban(1) - 5.838(pov)(1)$

int. $-321.9 - 649.3 = -971.2$

urban $4.689 + 12.05 = 16.8$

pov $39.34 - 5.838 = 33.5$

65. Predict the violent crime rate for a Southern state with an urbanization of 55.4 and a poverty rate of 13.7.

a) 417.2 b) 510.1 c) 535.8 d) 582.4 e) 633.5

S=1 urban = 55.4 pov. = 13.7

$Crime = -321.9 + 4.689(55.4) + 39.34(13.7) - 649.3 + 12.05(55.4) - 5.838(13.7)$

417.2

66. Predict the violent crime rate for a non-Southern state with an urbanization of 65.6 and a poverty rate of 8.0.

a) 300.4 b) 336.5 c) 349.1 d) 416.9 e) 432.2

S=0 urban = 65.6 pov = 8

$Crime = -321.9 + 4.689(65.6) + 39.34(8)$

300.4

67. Calculate the ANOVA *F* test statistic value.

a) 2.34 b) 4.20 c) 4.58 d) 21.02 e) 47.00

$\frac{MS_{reg}}{MS_{error}} = \frac{412091}{19604} = 21.02$

68. When finding the p-value for the ANOVA *F* test, what degrees of freedom should be used?

a) df = 5 b) df = 45
c) df = 50 d) $df_1 = 5,\ df_2 = 45$ e) $df_1 = 5,\ df_2 = 50$

df_1 = reg : 5
df_2 = error : 45

69. Based on the p-value for the ANOVA *F* test shown in the output, how many of the predictors are useful for predicting crime rate?

p-val = 0.000 H_0: none H_a: some useful

a) none of them b) all of them c) exactly one of them d) at least one of them

70. Which of the following predictors should probably be removed from the model to improve it?

a) Urban b) Poverty c) South d) Urban*South e) Poverty*South

large p-val

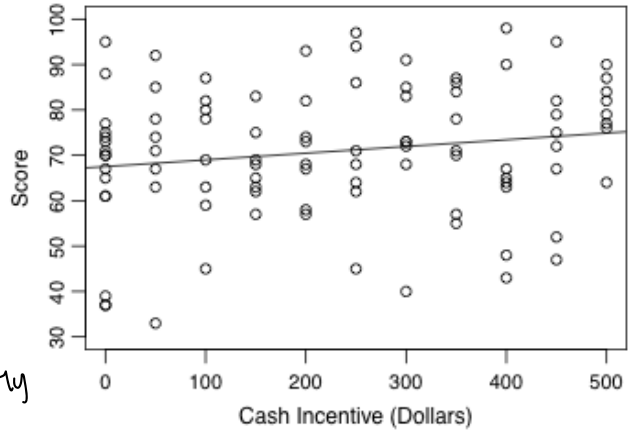
Questions 71 - 79 The National Math and Science Initiative (NMSI) has recently begun a controversial program in which high school students are paid cash incentives for passing an end-of-year standardized test. Suppose we conduct a similar study, in which end-of-year test scores (y) are measured on a scale of 0–100 and the amount of the cash incentive offered to the student (x) is measured in dollars from \$0 to \$500. A scatterplot of the 96 observations in the sample and the regression line is shown below, along with some Minitab output (with some information intentionally left blank).

```
The regression equation is
Score = 67.51 +0.0148Cash

Predictor      Coef  SE Coef      T      P
Constant     67.513    2.509   _____  _____
Cash       0.014762  0.00886   _____  _____

Predicted Values for New Observations
Cash     Fit  SE Fit     95% CI      95% PI
200     _____ _____    ---[A]---    ---[B]---

Cash     Fit  SE Fit     95% CI      95% PI
500     _____ _____    ---[C]---    ---[D]---
```



BUD: PI that new data predict correctly $200 ↑ AND $500 : CI that predict from equation correctly

71. The coefficient 0.01476 in the equation is
a) the parameter α. b) the parameter β.
c) our estimate of the parameter α. d) our estimate of the parameter β.

↑constant ↑slope

72. Which of the following is the best interpretation of the slope? Δy for 1 unit Δx
a) For each additional dollar offered to students, their scores increase by 0.01476 points, on average. change in score for each $1
b) For each additional dollar offered to students, their scores increase by 67.51 points, on average.
c) For each 0.01476 additional dollars offered to students, their scores increase by one point, on average.
d) For each 67.51 additional dollars offered to students, their scores increase by one point, on average.

73. Which of the following is the best interpretation of the intercept? 67.51 x=0 $0 incentive
a) The predicted score of a student who is offered no cash is 0.01476 points.
b) The predicted score of a student who is offered no cash is 67.51 points.
c) The amount of cash offered to a student who scores a zero is, on average, 0.01476 dollars.
d) The amount of cash offered to a student who scores a zero is, on average, 67.51 dollars.
e) None of the above; it is not appropriate to interpret the intercept in this situation.

74. Calculate the predicted test score of a student who is offered a cash incentive of \$200.
a) 64.56 b) 70.46 c) 73.41 d) 76.37 e) 82.27 score = 67.51 + 0.0148(200) = 70.46

75. The p-value for the ANOVA test was 0.0952, so there is _____ evidence that scores on the test depend on the size of the cash incentive.
a) not enough p > 0.1 b) pretty strong p ≤ 0.05 c) very strong p ≤ 0.01 d) some p ≤ 0.1 e) no NEVER

76. Calculate the value of the t test statistic for testing whether score depends on cash incentive.
a) 0.600 b) 1.67 c) 2.79 d) 4.10 e) 9.59 SLOPE $\frac{\text{Coeff}}{\text{st.dev}} = \frac{0.0148}{0.00886} = 1.67$

77. Which of the four intervals labeled as [A]–[D] in the Minitab output would be the *widest*?
a) [A] b) [B] c) [C] d) [D] e) All four would have the same width.

PI $500 narrowest near $\bar{x}$ → widest @ ends

78. Which of the four intervals labeled as [A]–[D] in the Minitab output would be the *narrowest*?
a) [A] b) [B] c) [C] d) [D] e) All four would have the same width.

CI near $\bar{x}$

79. Which of the four intervals labeled as [A]–[D] in the Minitab output would be the confidence interval for β?
a) [A] b) [B] c) [C] d) [D] e) None of these

Questions 80 - 87 The economic structure of Major League Baseball allows some teams to make substantially more money than others, which in turn allows some teams to spend much more on player salaries. These teams might therefore be expected to have better players and win more games on the field as a result. Suppose that after collecting data on team payroll (in millions of dollars) and season win total for 2010, we find a regression equation of Wins = 71.87 + 0.101Payroll - 0.060League where League is an indicator variable that equals 0 if the team plays in the National League or 1 if the team plays in the American League.

80. If Teams A and B both play in the same league, and Team A's payroll is $1 million higher than Team B's, then we would expect Team A to win, on average,

a) 0.101 games more than Team B. b) 71.87 games more than Team B.
c) 0.060 games more than Team B. d) 0.060 games fewer than Team B.

81. If Teams A and B have the same payroll, but Team A plays in the National League while Team B plays in the American League, then we would expect Team A to win, on average,

a) 0.101 games more than Team B. b) 71.87 games more than Team B.
c) 0.060 games more than Team B. d) 0.060 games fewer than Team B.

82. Suppose we plotted the data and drew the regression lines for National League and American League teams. What would be the slope of the line for American League teams?

a) –0.060 b) 0.060 c) 0.941
d) 0.101 e) 71.81

83. Suppose we plotted the data and drew the regression lines for National League and American League teams. What would be the intercept of the line for American League teams?

a) –0.060 b) 0.060 c) 0.941
d) 0.101 e) 71.81

84. Calculate the predicted number of wins for a National League team with a payroll of $98 million.

a) 65.99 b) 77.75 c) 77.85
d) 81.71 e) 81.77

85. One American League team in the data set had a payroll of $108 million and won 88 games. Calculate the residual for this observation.

a) –1.26 b) 5.28 c) 9.65
d) 11.70 e) 22.61

86. The t tests for which variable would have the same p-value as the ANOVA test?

a) constant b) payroll
c) league d) wins
e) none of them

87. Common sense suggests that teams with a higher payroll should have a strong tendency to win more games, but that league affiliation should not matter. Then common sense suggests that the ANOVA *F* test for this data would probably have

a) a small test statistic value and a small p-value.
b) a small test statistic value and a large p-value.
c) a large test statistic value and a small p-value.
d) a large test statistic value and a large p-value.

88. Based on the common sense described in the previous question, in which of the following *t* tests would we probably reject the null hypothesis?

a) the *t* test for Payroll b) the *t* test for League
c) both *t* tests d) neither *t* test

Questions 89 -95 Ecologists have long known that there is a relationship between the amount of precipitation a location receives and the number of trees that grow in the area. Suppose that the yearly rainfall (x, measured in mm) and the amount of the ground covered by trees (y, measured on a scale from 0 to 100) are recorded for 49 geographic locations. In the sample data, x has a sample mean of 1182.4 and a sample standard deviation of 226.0, while y has a sample mean of 49.6 and a sample standard deviation of 7.1. The sample correlation between x and y is 0.673.

89. In a simple linear regression analysis of this data, when we write $y = \alpha + \beta x + \varepsilon$, which of the following do we assume?

a) The x values are independent and normally distributed with mean 0 and constant variance.
b) The x values are independent and normally distributed with variance 0 and constant mean.
c) The errors are independent and normally distributed with mean 0 and constant variance.
d) The errors are independent and normally distributed with variance 0 and constant mean.
e) both a) and c)

90. Use the information provided to calculate the regression equation.

a) TreeCover = 24.70 + 0.0211 Rainfall
b) TreeCover = 0.0211 + 24.70 Rainfall
c) TreeCover = –25371.8 + 21.5 Rainfall
d) TreeCover = 21.5 – 25371.8 Rainfall
e) TreeCover = 25471.0 + 21.5 Rainfall

$a = \bar{y} - b\bar{x}$

$b = r \cdot \frac{s_y}{s_x}$

$b = 0.673\left(\frac{7.1}{226}\right) = 0.02$

$a = 49.6 - (0.02)(1182.4) = 24.6$

$24.6 + 0.02x = y$ (rainfall, treecover)

91. Calculate the predicted amount of tree cover for an area that receives 1230 mm of rainfall per year.

a) 50.6 b) 52.3 c) 55.9 d) 60.9 e) 63.8

$\text{treecover} = 24.7 + 0.0211(1230)$
$= 50.6$

92. What percentage of the variability in tree cover is explained by rainfall?

a) 2.1% b) 21.5% c) 24.7% d) 45.3% e) 67.3%

$R^2 = (\text{correlation})^2 = (0.673)^2$
$= 0.453 \times 100 = 45.3\%$

93. For this data set, find the degrees of freedom for regression.

a) 1 b) 2 c) 47 d) 48 e) 49

$g - 1$ (# statistics α & β)

$2 - 1 = 1$

94. For this data set, find the degrees of freedom for error.

a) 1 b) 2 c) 47 d) 48 e) 49

$N - g$
$49 - 2$

95. In a regression t test for this data, which of the following statements is the *alternative* hypothesis (in words)?

a) The population mean of tree cover is not zero.
b) The population mean of tree cover is zero.
c) Tree cover depends on rainfall.
d) Tree cover does not depend on rainfall.
e) The population means of tree cover and rainfall are not equal.

reg. t-test: determine if rainfall is good predictor of tree cover

H_0: bad predictor
H_0: good predictor