

For **Problems 1-10**, use a subset of the High School and Beyond data involving students who are in the low SES. We are interested in predicting science score from math score.

1. The estimates of the intercept and slope of the regression line are 14.\_58 and 0.\_95, respectively.

- 1) 4
- 2) 5
- 3) 6
- 4) 7

Write your answer as a two-digit number.

2. The SEs of the intercept and slope are 3.\_79 and 0.\_79, respectively.

- 1) 0
- 2) 3
- 3) 5
- 4) 7

Write your answer as a two-digit number.

3. When  $X = 48$ , the mean predicted score is 4.\_833.

- 1) 4
- 2) 5
- 3) 6
- 4) 7

Write your answer as a single-digit number.

4. The predicted score for an individual whose  $X = 48$  is \_\_\_\_ the predicted mean score.

- 1) less than
- 2) equal to
- 3) greater than

Write your answer as a single-digit number.

5. The SE of the mean prediction when  $X = 48$  is 0.\_468.

- 1) 4
- 2) 5
- 3) 6
- 4) 7

Write your answer as a single-digit number.

6. The SE for an individual prediction for the same value of  $X$  is \_\_\_\_ the SE of the mean prediction.

- 1) less than
- 2) equal to
- 3) greater than

Write your answer as a single-digit number.

7. Which is NOT an assumption about the error terms?
- 1) They are independent.
  - 2) They are normally distributed.
  - 3) They can be positive or negative.
  - 4) Their means and variances are identical.

Write your answer as a single-digit number.

8. The lower limits of for the 99% CI estimates of the intercept and slope are 4.\_88 and 0.\_89, respectively. The upper limits are 24.329 and 0.901.
- 1) 3
  - 2) 4
  - 3) 5
  - 4) 6

Write your answer as a two-digit number.

9. When  $X = 48$ , the upper limits for the 90% mean and individual interval predictions are \_8.9041 and \_0.4529, respectively. The corresponding lower limits are 46.7617 and 35.2131.
- 1) 4
  - 2) 5
  - 3) 6
  - 4) 7

Write your answer as a two-digit number.

10. To test whether math and science are related, the null hypothesis is \_\_\_\_, the computed t-statistic is \_.8, which will result in the rejection of the null hypothesis.
- 1)  $\beta_0 = 0$
  - 2)  $\beta_1 = 0$
  - 3) 3
  - 4) 8
  - 5) 77

Write your answer as a two-digit number.

Use the following table for **Problems 11-14**. Nutrition facts labels provide consumers with information about the nutritional value of food products that they buy. A study of these labels collected from 162 consumers who were sent information about a frozen chicken dinner. Each subject was asked to give an overall product nutrition score and also evaluate each of 10 nutrients on a 9-point scale, with higher values indicating that the product has a healthy value for the given nutrient. Composite scores for favorable nutrients (e.g., protein and fiber) and

unfavorable nutrients (e.g., fat and sodium) were used in multiple regression to predict the overall product nutrition score. The following are the regression results:

Explanatory Variable	<i>B</i>	<i>se</i>	<i>t</i>	Model <i>F</i>	<i>R</i> <sup>2</sup>
				44.0**	0.36
Constant	3.96	0.12	32.8**		
Unfavorable Nutrients	0.86	0.12	6.9**		
Favorable Nutrients	0.66	0.10	6.9**		

\*\*  $p < 0.01$

11. The equation of the least-squares line is:

$$\text{Overall} = 3.96 + 0.\_6 \times \text{Favorable} + 0.\_6 \times \text{Unfavorable}.$$

- 1) 5
- 2) 6
- 3) 7
- 4) 8

Write your answer as a two-digit number.

12. The null and alternative hypotheses associated with the entry level “Model *F*” are \_\_\_  $\beta(s)$  is(are) zero and \_\_\_  $\beta(s)$  is(are) not equal to zero, respectively. The p-value associated with the test statistic is \_\_\_ than .001, so we can \_\_\_ the null hypothesis.

- 1) One
- 2) All
- 3) At least one
- 4) less
- 5) greater
- 6) retain
- 7) reject

Write your answer as a four-digit number.

13. From the column labeled “*t*,” both predictors are \_\_\_, indicating that both predictors \_\_\_ contribute to the model when the other predictor is already in the model.

- 1) significant
- 2) not significant
- 3) still
- 4) no longer

Write your answer as a two-digit number.

14. Overall, the model can account for \_\_\_\_ of the variance in the response.

- 1) 36%
- 2) 44%
- 3) 60%

Write your answer as a single-digit number.

Use the HSB data set to solve the **Problems 15-20**. We want to investigate the usefulness of predicting science score from reading, writing, math and civics scores. Use  $\alpha = .01$  for this problem.

15. The multiple regression model with four predictors \_\_\_\_ useful in predicting science score. The computed statistic is 181.\_\_\_\_.

- 1) is
- 2) is not
- 3) 1
- 4) 5
- 5) 8
- 6) 9

Write your answer as a four-digit number.

16. When we run four separate simple linear regression analyses with reading, writing, math and civics scores as predictor, we can conclude that \_\_\_\_ are useful in predicting science score.

- 1) 0
- 2) 1
- 3) 2
- 4) 3
- 5) 4

Write your answer as a single-digit number.

17. Based on the coefficients table associated with the four-predictor regression analysis, we can conclude the \_\_\_\_ predictors are useful in predicting science score even when the three other predictors are already in the model.

- 1) 0
- 2) 1
- 3) 2
- 4) 3
- 5) 4

Write your answer as a single-digit number.

18. Combining 16 and 17, we can conclude that Reading is \_\_\_\_, Writing is \_\_\_\_, Math is \_\_\_\_, and Civics is \_\_\_\_.
- 1) useful by itself ONLY
  - 2) useful even with three predictors already in the model ONLY
  - 3) useful by itself AND with three other predictors in the model.

Write your answer as a four-digit number.

19. The proportion of variance in the science scores that the model with four predictors can account for 0. \_ 49.
- 1) 1
  - 2) 3
  - 3) 5
  - 4) 7

Write your answer as a single-digit number.

20. The  $F$ -statistic for the four-predictor regression model follows the \_\_\_\_ distribution.
- 1)  $t(595)$
  - 2)  $t(599)$
  - 3)  $F(4, 595)$
  - 4)  $F(4, 599)$

Write your answer as a single-digit number.

Problems 21-25: Using the HSB data, we are interested in examining whether students from different races or ethnicities (Hispanic = "1", Asian = "2", Black = "3", and White = "4") performed differently on the science test.

This is the main question for this study:

I. Are the 4 groups different?

In addition, we are also interested in answering the following questions:

IIA. Is the performance of the majority group different from the average performance of the minority groups?

IIB. Is the average score of the two high-performing groups different from the average score of the two low-performing groups?

IIC. Do White and Asian students have different mean science scores?

21. For the test for I:  $H_0: \mu_1 = \mu_2 = \mu_3 = \mu_4$ , and the alternative is  $\mu_s$  are equal. The computed test statistic is  $F = 3\_462$ .

- 1) All
- 2) Not all
- 3) 9
- 4) 0

Write your answer as a two-digit number.

22. The p-value for the above test is close to  $\_\_\_\_\_\_$ , so we  $\_\_\_\_\_\_$  the null hypothesis that the four ethnic groups have the same mean science score.

- 1) 0
- 2) 1
- 3) retain
- 4) reject

Write your answer as a two-digit number.

Now, perform the tests for II (i.e., IIA-IIC) assuming that these questions are formulated prior to the data collection.

23. Find the missing coefficient for each of the three contrasts.

Contrast coefficients for IIA: +1 +1 +1  $\_\_\_\_\_\_$

Contrast coefficients for IIB: +1 -1 +1  $\_\_\_\_\_\_$

Contrast coefficients for IIC: 0  $\_\_\_\_\_\_$  0 -1

- 1) -3
- 2) -1
- 3) 1
- 4) 3

Write your answer as a three-digit number.

24.

For IIA,  $c$ ,  $SE(c)$  and  $t$  are: -9.5177, 2.5347 and -7.700.

For IIB,  $c$ ,  $SE(c)$  and  $t$  are: -19.1296, .2313 and -8.573.

For IIC,  $c$ ,  $SE(c)$  and  $t$  are: -0.1941, 1.5824 and -.123.

- 1) 0
- 2) 1
- 3) 2
- 4) 3

Write your answer as a three-digit number.

25. The  $df$  for testing the contrast is 59. Before correction, the p-values are close to .000 for IIA, close to .000 for IIB, and equal to 0.02 for IIC. (Write your answer as a four-digit number.)

- 1) 6
- 2) 7
- 3) 8
- 4) 9

Write your answer as a two-digit number.

26. To account for the fact that we are testing multiple planned contrasts, we will use the \_\_\_\_ method. This will make the p-values \_\_\_\_ as large as the original p-values. Hence, we reject the  $H_0$  for IIA, \_\_\_\_ the  $H_0$  for IIB, and \_\_\_\_ the  $H_0$  for IIC.

- 1) Scheffé
- 2) Bonferonni
- 3) thrice
- 4) a third
- 5) retain
- 6) reject

Write your answer as a four-digit number.

Note that p-values are probabilities so they are always in the interval  $[0, 1]$ . If the values are smaller than 0 or larger than 1, we set them to 0 or 1, respectively,

Assume that the overall ANOVA result was significant, but we did not have any planned contrast a priori. At this point, we are interested in examining all the possible pairwise comparisons using a) Scheffé's method, as well as b) Tukey's procedure.

27. Based on Scheffé's method and  $\alpha = .05$ , the mean science score of Black students is not different from that of \_\_\_\_ students, and, whereas the mean science score of White students is not different from that of \_\_\_\_ students. The p-value for the former is \_\_\_\_; the p-value of the latter is \_\_\_\_.

- 1) Hispanic
- 2) Asian

- 3) Black
- 4) White
- 5) .820
- 6) 1.00

Write your answer as a four-digit number.

28. Comparing Tukey's procedure to Scheffé's method, we will arrive at \_\_\_\_ conclusions; however, the p-values are \_\_\_\_\_. This tells us that Tukey's procedure is \_\_\_\_\_ conservative than Scheffé's method.

- 1) the same
- 2) different
- 3) smaller
- 4) larger
- 5) less
- 6) more

Write your answer as a three-digit number.

For the remaining problems, use the following data for a  $2 \times 2$  design with 4 subjects per treatment condition.

	<i>b1</i>	<i>b2</i>
<i>a1</i>	15 12 14 16	19 16 18 20
<i>a2</i>	12 9 10 8	11 7 8 7

29. We can first analyze whether or not the four groups differ. This is equivalent to asking whether all the main and interaction effects are equal to 0. For this test, the correct p-value is \_\_\_\_\_, and we can conclude that \_\_\_\_\_.

- 1) .000
- 2) .009
- 3) .180
- 4) all the effects are zero
- 5) all the effects are not zero
- 6) some effects are not zero

Write your answer as a two-digit number.

30. In analyzing the main and interaction effects, we can conclude that there is \_\_\_\_ main effect due to Factor A, there is \_\_\_\_ main effect due to Factor B, and there is \_\_\_\_ interaction effect.

- 1) no



- 2) a
- 3) an

Write your answer as a three-digit number.

31. Taking together the results of the tests for the main and interaction effects into account, our final model is:  $\mu_{ijk} =$

- 1)  $\mu + \alpha_i$
- 2)  $\mu + \beta_j$
- 3)  $\mu + \alpha_i + (\alpha\beta)_{ij}$
- 4)  $\mu + \beta_j + (\alpha\beta)_{ij}$
- 5)  $\mu + \alpha_i + \beta_j + (\alpha\beta)_{ij}$

Write your answer as a single-digit number.

A 2×2 design produces four different groups or combinations (i.e., (1,1), (1,2), (2,1), (2,2)). We can create a new variable  $g = 10 \times a + b$  to denote the four groups (i.e., 11, 12, 21, 22).

In SPSS, we can create a new variable using **Transform → Compute Variable**.

In the **Compute Variable** dialog box, type the new variable name in the **Target Variable** box (e.g., **g**), and formula in the **Numeric Expression** box (i.e., **10\*A+B**).

Finally, click OK.

32. Use a one-way ANOVA to analyze the same data using  $g$  as the grouping variable. The p-value of the test is equal to \_\_\_\_.

- 1) .000
- 2) .009
- 3) .180

Write your answer as a single-digit number.

Consider the following contrast coefficients:

Contrast 1	1	1	-1	-1
Contrast 2	1	-1	1	-1
Contrast 3	1	-1	-1	1

33. The computed  $t$ -statistics for Contrasts 1, 2, and 3 are \_\_\_\_, \_\_\_\_, and \_\_\_\_, respectively.

- 1) -1.424

- 2) -3.132
- 3) 8.258

Write your answer as a three-digit number.

34. The p-values for Contrasts 1, 2, and 3 are \_\_\_\_, \_\_\_\_, and \_\_\_\_, respectively.
- 1) .000
  - 2) .009
  - 3) .180

Write your answer as a three-digit number.

35. This correspondence suggests that Contrasts 1, 2, and 3 are testing the \_\_\_\_, \_\_\_\_, and \_\_\_\_, respectively.
- 1) overall effect
  - 2) main effect of Factor A
  - 3) main effect of Factor B
  - 4) interaction effect

Write your answer as a three-digit number.