STA 580 — Spring 2011 — Dr. Charnigo

Final Examination

Please print your name at the tops of all seven pages. You may use the backs of the pages for scratch work, but all key steps and final answers are to be clearly recorded on the fronts of the pages.

[30] 1. Refer to "Endocrinology" along with Tables 11.26 and 11.27 on page 552. Let X denote the bone density from the lumbar spine and Y the bone density from the femoral neck. We have $L_{yy} = 0.0021375$, $L_{xx} = 0.0074535$, $L_{xy} = 0.0019145$, $\bar{y} = 0.65625$, $\bar{x} = 0.83625$, and $n = 8$. In what follows, we consider the linear regression model $Y_i = \alpha + \beta x_i + \epsilon_i$.

[05] a. Provide the least squares estimates of α and β.

[05] b. Test $H_0 : \beta = 0$ against $H_1 : \beta \neq 0$ at level 0.05 using an f statistic.

[05] c. Test $H_0 : \beta = 0.5$ against $H_1 : \beta \neq 0.5$ at level 0.05 using a t statistic.

[05] d. Use the linear regression model to calculate a 95% confidence interval for the expected bone density from the femoral neck if the bone density from the lumbar spine is 0.850.

[05] e. What fraction of variability in the bone density from the femoral neck is explained by the bone density from the lumbar spine?

[05] f. Calculate the Pearson correlation between X and Y. (You may calculate it directly, or you may deduce it from your answer to part e. If you use the latter approach, note that the sign of the Pearson correlation — positive or negative — must be the same as the sign of the least squares estimate for β.)

[25] 2. Refer to "Ophthalmology" and Table 12.36 on page 625. Let μ_1 through μ_3 be defined in the obvious manner. We have Total SS = 22.51 and Between SS = 17.84. Use the "120" row in Table 5 to approximate critical values based on a t reference distribution on between 121 and 125 degrees of freedom; also, use the "120" row in Table 9 to approximate critical values based on an f reference distribution on between 121 and 125 denominator degrees of freedom.

[05] a. Find Within SS.

[05] b. Find Between MS and Within MS.

[05] c. Test $H_0 : \mu_1 = \mu_2 = \mu_3$ against the complementary alternative at level 0.05.

[05] d. Test $H_0 : \mu_1 = \mu_3$ and $H_0 : \mu_2 = \mu_3$ against their respective complementary alternatives at Bonferroni-adjusted level 0.05.

[05] e. Test $H_0 : \mu_1 - 0.5\mu_2 - 0.5\mu_3 = 0$ against its complementary alternative at Scheffe-adjusted level 0.05.

[25] 3. Refer to "Health Promotion" and Table 10.40 on pages 458 and 459. Let p_1 denote the proportion of obese-BMI individuals with at least a high school education, and let p_2 denote the proportion of normal-BMI individuals with at least a high school education. Note that (with allowances for rounding) 83% of 64 is 53 and 91% of 77 is 70.

[05] a. Report point estimates of p_1 and p_2.

[05] b. Construct a 95% confidence interval for p_1/p_2.

[05] c. Construct a 95% confidence interval for $\frac{p_1/(1-p_1)}{p_2/(1-p_2)}$.

[05] d. Construct a 95% confidence interval for $p_1 - p_2$.

[05] e. Test $H_0 : p_1 = p_2$ against $H_1 : p_1 \neq p_2$ at level 0.05 using either a z statistic or a χ^2 statistic (your choice).

[20] 4. Identify the best answer for each item and record its letter to the left of the item. Multiple letters, illegible letters, and non-responses will be considered incorrect answers. Scoring for this exercise will be 4 points per correct answer.

i. Which of the following is not an option when performing follow-up tests after rejecting the omnibus null hypothesis in one-way analysis of variance?

a. No adjustment for multiple comparisons
b. Bonferroni adjustment for multiple comparisons
c. Scheffe adjustment for multiple comparisons
d. Dunn adjustment for multiple comparisons

ii. Which of the following is an assumption for linear regression?

a. The dependent variable is a linear function of the independent variable.
b. The independent variable is normally distributed.
c. The error terms have zero mean.
d. The error terms have zero variance.

iii. In which scenario might we consider employing the rank sum test?

a. Comparing means, two independent samples
b. Comparing medians, two independent samples
c. Comparing means, two paired samples
d. Comparing medians, two paired samples

iv. Suppose that the survival function equals 0.80 at 2 years. Which of the following is impossible?

a. The survival function equals 0.99 at 1 year.
b. The survival function equals 0.75 at 1 year.
c. The survival function equals 0.75 at 3 years.
d. The survival function equals 0.75 at 5 years.

v. Which of the following is used to test a null hypothesis of equal survival functions based on two independent samples?

a. Kaplan-Meier curve
b. log rank test
c. chi-square test of association
d. Kruskal-Wallis test