

Statistics 514
Review for First Midterm Exam

1. True or False

- (a) Hypothesis testing is conservative in that you declare the null hypothesis false unless there is strong evidence to the contrary.
- (b) Other things being equal, the smaller the p -value, the stronger the evidence against the null hypothesis.
- (c) When the null hypothesis is true, $SS_{T_{rt}}/DF_{T_{rt}}$ is an unbiased estimate of the error variance σ^2 .
- (d) The sum of squared errors for the alternative model is always less than or equal to the sum of squared errors for the null.
- (e) If the alternative hypothesis is true, two kinds of errors are possible.
- (f) If the null hypothesis is true, the numerator and denominator mean squares for the F -ratio will be estimates of the same number, and the F -ratio will tend to be near 0.
- (g) There are two possible meanings for a large F -ratio: either the corresponding null hypothesis is true, or an unlikely event has occurred.
- (h) The sum of squared errors associated with the null model is SS_{Tot} .
- (i) The critical value (when $\alpha = 0.05$) for an F -ratio is chosen so that 95% of all data sets for which the null hypothesis is true will have F -ratios smaller than the critical value.
- (j) If I wanted the false discovery rate to be closer to the familywise error rate, I would add experiments with true null hypotheses.
- (k) If a p -value indicates the results of a study are highly statistically significant, the null hypothesis cannot be true.
- (l) A procedure which controls the familywise error rate at level q^* type has a comparison-wise error rate that is less than q^* .
- (m) The p -value for a randomization test cannot be 0.
- (n) The p -value for a randomization test cannot be 1.
- (o) If the F -ratio is significant, then there is at least one contrast that can be found significant.
- (p) If the F -ratio is significant, then there is at least one contrast that can be found significant using Scheffé's method.

2. Complete the following problems. Each part is unrelated to those previous.

- (a) The printer you are using is low on ink. You print the following ANOVA table but realize several of the cells are missing. Using the information given, fill these cells in as best you can, and state your conclusions. (Use Table IV – page 610 in the book – to decide if the result is significant when $\alpha = 0.05$.)

Dependent Variable: Y

Source	DF	Sum of Squares	F value	p < 0.05?
Model		800		
Error	20			
Corrected Total	29	1200		

- (b) Four (4) independent observations are chosen from a normal distribution with mean μ and variance σ^2 . What is the probability that the sample mean falls in the interval $[\mu - \sigma, \mu + \sigma]$?
- (c) In the case of the balanced two-sample t -test, the critical value is $t_{n-1}(1 - \alpha)$. In the case of the Bonferroni procedure with three comparisons, the critical value of each comparison is $t_?$ (?). (Fill in the ?'s.)
- (d) A fixed effects model has

$$y_{i,j} = \mu + \tau_i + \sigma e_{i,j}$$

where $e_{i,j}$ comes from a standard normal distribution. As a result, what is the mean and variance of the $y_{i,j}$? Under the null hypothesis of no treatment effect, what is the mean and variance of $y_{i,j}$?

3. Answer the following question. Please use complete sentences.

A rocket was designed by an aerospace company to carry an expensive payload of scientific equipment to a satellite to be launched in orbit around the earth. On the launch date, scientists debated whether to launch due to possible adverse weather conditions. In the context of a test of a statistical hypothesis, the relevant hypotheses might be posed as follows:

H_0 : the satellite will not launch successfully.

H_A : the satellite will launch successfully (i.e., without incident),

- (a) Describe the Type I and the Type II errors for these hypotheses.
- (b) Which error appears to be more serious? Why?
- (c) How, in the context of this exercise, would you decide whether to launch to make the Type I error probability acceptably small? (Would you be more likely to launch or less? Would you be more concerned about weather conditions or less?)
- (d) How, in the context of this exercise, would you decide whether to launch to make the Type II error probability acceptably small?