Name _____ Fall 2014

Applied Statistics Comprehensive Examination

Statistical Methods I & II

1. (25 points) The Australian Wildlife Commission (AWC) is in the process of evaluating the accuracy of one of their oldest publications, "Lizards of Australia". The book has long stated that adult thick-tailed geckos have an average length of 120mm with a standard deviation of 7mm, but the AWC feels that 120mm may be too low.

a. (10 points) Suppose the AWC decides that they can afford to obtain a random sample of 36 adult thick-tailed geckos from around the country. Assuming 7mm is the true standard deviation of adult thick-tailed gecko lengths, find the power for the appropriate 0.05-level test if the true mean length is 124mm.

b. (15 points) The AWC goes ahead and collects a random sample of 36 adult thick-tailed geckos, finding a sample mean length of 123.5mm with a sample standard deviation of 9mm. Conduct the desired 0.05-level test and state your conclusion in terms of the problem.

2. (20 points) The administration at Villanova Preparatory School is concerned that the school's acceptance rate has been fluctuating too much over the past several years, but the Enrollment Office feels that the variations are to be expected and that the overall acceptance rate is essentially the same over this time period. Below are the admissions numbers for the last three school years:

	2012-2013	2013-2014	2014-2015
# Accepted	300	240	330
# Applied	460	420	570

Test the hypothesis that the acceptance rate is constant over the past three years at the 0.10 level.

3. (20 points) Suppose Athwear is a new company in the business of making athletic shoes. In their first national advertising campaign, they want to provide an estimate for how much longer their shoes last on average than the top brand, Nike. They commission 14 volunteers to wear one of the brands of shoes for 8 hours a day for as long as the shoes last. The volunteers are randomly assigned so that 7 wear Athwear and 7 wear Nike. Based on their study, they find that Athwear shoes last an average of 134 days with a standard deviation of 11 days and the Nike shoes last an average of 125 days with a standard deviation of 10 days.

a. (15 points) Find a 95% confidence interval for the true difference in means for how long two brands of shoes last. You may assume that the length of time the shoes last are approximately normal for both brands, with equal variances. Interpret your interval in terms of the problem.

b. (5 points) Can Athwear conclude at the 0.05 level that there is a difference in how long each brand of shoes lasts? Explain briefly.

4. (20 points) The U.S. Department of Agriculture has recently developed several genetically modified varieties of corn and would like to identify whether any one of the varieties has a shorter average growth period before reaching maturity. To make this decision, they conduct an experiment where seven seeds of each of the five varieties are planted separately in a controlled greenhouse environment. The length of time in days that it takes each individual corn plant to reach maturity is then recorded.

a. (5 points) State the appropriate mathematical model and all of its assumptions.

b. (10 points) Given that the total sum of squares is 910 and the treatment mean square is 55, complete the appropriate ANOVA table, state the null and alternative hypotheses of interest, and draw a conclusion about the corn varieties at the 0.05 level.

c. (5 points) State how you would assess the assumptions underlying this ANOVA procedure.

5. (15 points) State if each statement is True or False.

a. A complete set of mutually orthogonal contrasts can be used to estimate all pairwise comparisons among a set of four treatment means.

b. Even though an F-test for comparing several means yields a non-significant result at a 5% significance level, it is possible that a t-test comparing two of the means yields a significant result at the 5% significance level.

c. For the model $y_{ij} = \mu + \alpha_i + \varepsilon_{ij}$, the hypotheses of interest will be the same whether the α_i's are fixed effects or random effects.

d. When performing an ANOVA for a randomized block design, the experimenter is usually as interested in estimating differences among the blocks as he/she is in estimating differences among the treatments.

e. If the coefficient of determination (R^2) for a simple linear regression is 0.36, then it follows that the correlation between the two variables is 0.60.