Applied Statistics Comprehensive Examination

Statistical Methods I & II

1. (20 pts) A study is conducted to investigate the association between flower color and fragrance in wild azaleas. Two hundred randomly selected, blooming plants are observed in the wild and each is classified as white, pink or orange and the presence or absence of fragrance is noted. The results of the study are summarized in the following table:

Fragrance	Flower Color		
	White	Pink	Orange
Yes	12	60	58
No	50	10	10

State the appropriate null and alternative hypotheses, analyze the data and draw a conclusion using $\alpha = 0.05$.

2. (40 pts) A study was run to compare some of the physical attributes of female Olympic swimmers with those of female Olympic runners. One variable of interest is the total body fat in kilograms. These data resulted:

Swimmers		Runners	
14.4	12.7	11.2	7.2
14.8	13.7	10.1	7.3
11.4	11.9	9.9	6.9
14.3	10.7	8.7	5.5
9.2	8.7	8.3	5.0
		8.2	3.7

(a) (10 pts) Calculate the mean and variance for each group of female Olympic athletes.

(b) (10 pts) Using $\alpha = 0.10$, determine if these data support a claim of equal population variances for female Olympic swimmers and female Olympic runners.

(c) (10 pts) Construct a 95% confidence interval for the difference in population means between female Olympic swimmers and female Olympic runners. Be sure to base your interval upon the outcome of part (b). Use this interval to decide if these two population means are different and justify your decision.

(d) (10 pts) State the assumptions that are needed to justify the inferences made in parts (b) and (c) and how you might assess them.

3. (20 pts) A pharmaceutical company wishes to claim that the mean amount of antibiotic in their capsules is 250 mg. It is known that the amount of antibiotic in a single capsule is normally distributed with a standard deviation of 5 mg. An FDA inspector will take a sample of 10 capsules and reject the claim ($\mu = 250$ mg) if the average of the 10 capsules is 244 mg or less.

   (a) (10 pts) Suppose that the company wants to keep the probability of rejecting the claim to no more than 1%. Determine the minimum value for the mean amount of antibiotic per capsule that will achieve this objective.

   (b) (10 pts) Suppose that the mean amount of antibiotic is actually 246 mg. Find the power of the FDA's intended hypothesis test.

4. (20 pts) The State Road Commission decides to make a study of the soil erosion on hillsides that have been cut into in order to prepare roadbeds. A random sample of native species of plants that can serve as ground cover is selected for study as well as a random sample of affected hillsides around the state and each species is planted on each hillside. After the plants are established, five observations on erosion are made on each plant and hillside combination and the following partial ANOVA table is constructed.

Source	df	SS	MS
Plant Species	5		410
Hillsides			416
P x H Interaction	20		80
Residual			12
Total			

   (a) (10 pts) Identify all sources of variation as either fixed or random effects and complete the ANOVA table.

   (b) (10 pts) Make all appropriate inferences; that is, perform hypothesis tests for all fixed effects and provide point estimates for all variance components.