

STA 6207 – Fall 2001 – Quiz 2

Print Name: _____ SSN: _____

1) Adhesive force on gummed material was determined under three fixed humidity (factor A) and three fixed temperature (factor B) conditions. Four readings were made under each set of conditions. The experiment was completely randomized and some of the results are given below.

$$\sum_{i=1}^a \sum_{j=1}^b \sum_{k=1}^r (\bar{y}_{ijk} - \bar{y}_{...})^2 = 52.30 \quad \sum_{i=1}^a \sum_{j=1}^b \sum_{k=1}^r (\bar{y}_{ijk} - \bar{y}_{ij.})^2 = 28.50$$

Of the among cell variation, 38.1% is attributable to humidity level effects, 36.4% is attributable to temperature level effects, and 25.5% is attributable to humidity/temperature interaction effects.

a) Give the ANOVA table, clearly stating: sources of variation, degrees of freedom, sums of squares, and mean squares.

b) Does the effect of temperature depend on the level of humidity (and vice versa)? Test at $\alpha = 0.05$ significance level. Clearly state all elements of the test.

2) A study was conducted to study the fixed effects of two ad types (humor and informative) in three product categories (fast food, automobile, and insurance). There are a total of 120 subjects, 20 assigned to each combination of ad type and product category at random. Brand attractiveness scores are obtained after being exposed to the advertisement. The cell means are given in the following table. For this analysis, $MSE = 2000.0$. The researcher believes that effects of ad types will depend on product categories since consumers consider the purchases of these three types of products to be of varying levels of impacts on their lives.

Type	Category		
	Fast Food	Automobile	Insurance
Humor	75.0	55.0	35.0
Informative	45.0	60.0	75.0

a) Write out the statistical model.

b) Estimate the model parameters, clearly stating any assumptions about model parameters.

c) Give a 95% confidence interval for the simple effect that measures the difference in means for fast food and insurance firms under the humorous ad type.

3) A large timber area is made up of a population of parcels of land (each consisting of one acre of land). On each parcel of land, is a large number of trees. A forest researcher is interested in the numbers of termites (per cubic foot) of trees in the area. She samples t parcels, and r trees per parcel, measuring the density of termites per cubic foot per tree. She makes the usual assumptions regarding distributions and independence among model components. She fits the model:

$$y_{ij} = \mu + a_i + e_{ij} \quad i = 1, \dots, t \quad j = 1, \dots, r$$

Across all trees in the timber area, the average density of pine beetles per cubic foot is 100. Across the parcels of land, approximately 95% have mean termite densities between 50 and 150 pine beetles per cubic foot. Among trees with a parcel of land, approximately 95% have a density within 20 of the parcel mean.

a) $\mu =$ _____

b) $\sigma_e^2 =$ _____

c) $\sigma_a^2 =$ _____

d) $\rho_I =$ _____

e) She conducts an analysis of variance, based on a sample of 6 parcels of land and 6 trees per parcel. Give estimates of each parameter. Her total number of pine beetles is 3708.

Source	SS
Parcels	20000
Error	2700
Total	22700

e) $\hat{\mu} =$ _____

f) $\hat{\sigma}_e^2 =$ _____

g) $\hat{\sigma}_a^2 =$ _____

h) $\hat{\rho}_I =$ _____

4) A medical researcher is interested in determining the effects of two types of antibiotics on two strains of a virus. She originally planned on applying each treatment to three units of each virus strain (that is, she designed the experiment with $r = 3$). However, her lab assistant dropped two of the test tubes, thus the design was no longer balanced, as she was unable to replace the missing experimental material. She measures Y , the time for the antibiotic to eradicate the virus, in minutes. She obtains the following data:

Virus Strain	Antibiotic	
	1	2
1	65,55	70,75,80
2	30,40,50	60,70

Use the method of weighted sums of means to set up the ANOVA for the following model, and test for main interaction between antibiotic and virus strain, as well as main effects of virus strain and antibiotic. Conduct all tests at $\alpha = 0.05$ significance levels.