Biology 4605/7220 Name_____
Exam 2b 10 November 2004

For each of the following situations (1 and 2):

(A) Define variables in a tabular format, as follows. name symbol scale
scale = nominal, ordinal, or cardinal
cardinal = interval or ratio scale.

(B) Using the symbols, write a general linear model relating the response variable to explanatory variable(s) and interaction terms (if appropriate).

(C) Complete the first two columns of the ANOVA table source df

(D) Write a Minitab glm statement to carry out the analysis (omit residuals and fits subcommands) Fill in the covariate command line only when appropriate.

(E) State the name of the analysis, from the following list.
t-test, one-way ANOVA, two-way ANOVA, three-way ANOVA
paired comparisons, randomized blocks,
hierarchical (nested) ANOVA
regression, multiple regression,
ANCOVA (= at least 1 nominal and at least 1 cardinal scale explanatory variable)
none of the above.

1. Rao (1988 *Statistical Research Methods in the Life Sciences*, Duxbury Press, p283) reports soil bulk density (g cm^{-3}) at 4 sites with continuous grazing, at 4 sites with 2-week grazing and 1-week rest, and at 4 sites with 2-week grazing and 2-week rest.
Does soil compaction depend on grazing practice ? A = [2] C = [3]

A. name symbol scale

C. source df

B. _____ = _____ + error [2]

D. MTB > glm _____ [2]

SUBC> covariate _____ [1]

E. [1]

2. Augustin and Clark (1991 *Journal of Dairy Research* 58: 219-229) investigated the effects of three variables on calcium ion activity (mM) of milk manufactured from powder: the pH of the milk, percent solids (9%, 19.6%, and 26% total solids), and preheat treatment during manufacture (none, low heat, medium heat, high heat, indirect UHT, and direct UHT). pH was measured on each of 36 batches of milk manufactured from powder. Assume that there are no interactive effects, except that preheat treatment interacts with level of solids in its effect on calcium ion activity.

A = [4] C = [6]

A. name symbol scale

C. source df

B. _____ = _____ + error [5]

D. MTB > glm _____ [5]

SUBC> covariate _____ [1]

E. [1]

3a. Define a symbol for litter size of cavies belonging to strain 13 (Sokal and Rohlf, 1995, p 443), then define a symbol for the observed (sample) mean and the true (population) mean . . . . . [3]

3b. For the following data, compute the observed mean. _____ [1]

litter size = [2.36 2.41 2.39 2.85 2.82 2.73 2.58 2.89 2.78] cavies

3c. Using your symbols from 3a, write a probability statement for the confidence limits that include the true mean 95% of the time. [2]

3d. To compute the 95% confidence limits on your estimate, which t-value should you use?

t = _____ [1]

```
MTB > invcdf c1;    SUBC> t 8.
     0.0100   -2.8965
     0.0250   -2.3060
     0.0500   -1.8595
     0.1000   -1.3968
     0.9000    1.3968
     0.9500    1.8595
     0.9750    2.3060
     0.9900    2.8965
```

Why ? [2]

4. Draw a residual versus fit plot from a single way ANOVA with 5 classes, for which the assumption of homogeneity of error is violated. [2]

5a. Complete the following one-way ANOVA table for which 25% of the variability in the response variable is due to treatment effects (control vs one treatment). . . . . [3]

Source	df	SS	MS	F
Tr	1	250	250	16
error	_____	_____	_____	
total	49	1000		

5b. Add a regression variable (M = body mass) to the ANOVA table you constructed.
Show the new ANOVA table. . . . . [13]
For the regression variable, df = 1 and SS = 100.
Assume: no interactive effect of explanatory variables on the response variable.
SS due to the treatment variable remains unchanged
total SS remains unchanged

Source	df	SS	MS	F
Tr				
Regr (M)				
error				
total				

5c. Circle the effect (increase/decrease) of adding a regression variable (M = body mass) to the ANOVA table you completed in 5a. . . . . [3]

increase decrease in MS error

increase decrease in F-ratio for Treatment

increase decrease in p-value for Treatment