Biology 4605/7220 Name_____
Exam 2a 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 one nominal and at least 1 cardinal scale explanatory variable)
none of the above.

1. Montalvo et al (1993 *Journal of Vegetation Science* 4:213-22) reported number of plant species per 0.04 m^2 plot, in 12 plots at altitudes ranging from 0.64 km to 1.72 km. Does number of plant species vary with altitude ? A = [2] C = [3]

A. name symbol scale

C. source df

B. _____ = _____ + error [2]

D. MTB > glm _____ [2]

SUBC> covariate _____ [1]

E. [1]

2. Rao (1998 *Statistical Research Methods in the Life Sciences*, Duxbury Press, p 574) reports an index of blood glucose level for 8 insulin-dependent diabetic children receiving a new treatment (Tr = New) and another 8 receiving a standard treatment (Tr = St). Age (ranging from 8 to 17) and glycosolated hemoglobin concentrations before the experiment were also reported. Assume (as does Rao) that there is only one interactive effect on the index, that treatment effects on the index depend on glycosolated hemoglobin levels, measured before the experiment.

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 oxygen uptake (µl O_2 mg^{-1} min^{-1}) by the limpet *Acmaea scabra* at 50% salinity (Sokal and Rohlf, 1995, p 332), then define a symbol for the observed (sample) mean and the true (population) mean . . . . . [3]

3b. Compute the observed mean from the following data. _____ [1]

oxygen uptake = [11.11 10.5 9.74 14.6 18.8 11.1 9.74 11.8] µl O_2 mg^{-1} min^{-1}

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 7.
     0.0100   -2.9980
     0.0250   -2.3646
     0.0500   -1.8946
     0.1000   -1.4149
     0.9000    1.4149
     0.9500    1.8946
     0.9750    2.3646
     0.9900    2.9980
```

Why ? [2]

4. Draw a residual versus fit plot from a single way ANOVA with 3 classes, for which the assumption of homogeneity of error is violated. [2]

5a. Complete the following ANOVA table for which 20% of the variability in the response variable is due to regression on Area A . . . . . [3]

Source	df	SS	MS	F
Regr (A)	1	2000	2000	2
error	____	_____	_____	
total	9	10000		

5b. Add a <u>new</u> regression variable (T = temperature), to the ANOVA table you constructed. Show the new ANOVA table . . . . . [13]
For the new regression variable, df = 1 and SS = 1000.
Assume: no interactive effect of explanatory variables on the response variable.
SS due to the old regression variable remains unchanged
total SS remains unchanged

Source	df	SS	MS	F
Regr (A)				
Regr (T)				
error				
total				

5c. Circle the effect (increase/decrease) of adding a <u>new</u> regression variable (T = temperature), to the ANOVA table you constructed in 5a . . . . . [3]

increase decrease in MS error

increase decrease in F-ratio for regression on Area

increase decrease in p-value for regression on Area