Biology 4605/7220
9 November 2015

Name Key

Exam #2b

For each of the following situations (1 through 3):

(A) Define variables in a tabular format, as follows.

name	symbol	scale	Explanatory is Random or Fixed

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) Beneath each term in the model (except β_o) write the degrees of freedom.

(D) 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
none of the above.

1. Does degree of tremor depend on cigarette smoking ? C. L. Hull (1924 *Psychological Monographs* 33:161) measured tremor (number per minute) after smoking from pipes with tobacco (12 subjects) or from pipes with warm moist air (12 subjects).

A.

name	symbol	scale	Random or Fixed	[2+1]
Tremor Number	N	ratio (cardinal)		
Tobacco Trtment	Tr	nominal	Fixed	

B. $N = \beta_o + \beta_{Tr} \cdot Tr + \epsilon$ [2]

(or $\beta_{Tr} \cdot Tr$)

C. 23 = 1 + 22 [3]

D. t-test (one-way ANOVA) [1]

1
2
3
p3 except randomize
p3 randomize DCS

Exam 2b

2. O.L. Lacey (*Statistical Methods in Experimentation*, New York: MacMillan, 1953) wished to determine the effects of glutamic acid injection upon maze learning in the rat. He has a colony of 70 rats at his disposal, each of known weight (grams). Lacey does not define "learning" but assume this is measured as the improvement (in minutes) in time taken to run a maze. Does injection of glutamic acid change learning, taking into account the effects of body size ?

A.

name	symbol	scale	Random or Fixed
Learning Time	T	ratio	
Glutamic Acid	Tr	nominal	Fixed
Weight	W	ratio	Fixed

[3+2]

B. $T = \beta_0 + \beta_{Tr} \cdot Tr + \beta_W \cdot W + \beta_{Tr \cdot W} \cdot Tr \cdot W + \epsilon$ [4]

C. 69 = 1 + 1 + 1 + 66 [5]

D. ANCOVA [1]

3. B. Ostle and L.C. Malone (1988 *Statistics in Research* Iowa State University Press) provide data on average yield of oats (bushels/acre), pre-season precipitation (inches), and growing season precipitation (inches). They present 25 years of data, from a semiarid part of South Dakota.
Does yield depend on pre-season and growing season precipitation ?

A.

name	symbol	scale	Random or Fixed
Oat Yield	Y	ratio	
Precipitation			
Pre Season	Pre	ratio	Fixed
Post Season	Post	ratio	Fixed optional

[3+2]

B. $Y = \beta_0 + \beta_{Pre} \cdot Pre + \beta_{Post} \cdot Post + (\beta_{Interact} \cdot Pre \cdot Post) + \epsilon$ [3]

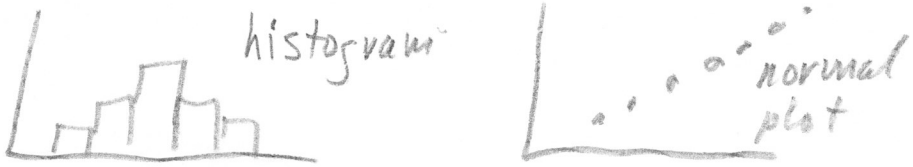
C. 24 = 1 + 1 + 1 + 21 + 22 [4]

D. or 1 + 1 [1]

Multiple Regression

4. The generalized linear model allows error distributions such as binomial, Poisson, normal and others. The General Linear Model assumes errors that are independent, identically distributed (=homogeneous), and normal.

Draw an example of errors that are normal. [2]



Draw an example of errors that are homogeneous. [2]

Draw an example of errors that are independent. [2]

5. Describe how to carry out a randomization test, where the statistic is species diversity, and you wish to test whether the diversity of life on the seafloor increases with ocean depth. [2]

Run GLM when S = diversity D = depth
Calculate statistic (slope, r, r^2, residual MS)
Randomize S, Obtain randomized statistic
Repeat many times (>1000), construct freq. distribution
Calculate p-value from freq. distribution, using the unrandomized statistic.

6. For the following situations, state whether a randomization test is needed (yes/no). n = sample size, p-value calculated from F-distribution, α = criterion for rejection null hypothesis H_o [4]

			errors			
n	p-value	*α*	normal ?	independent?	homogeneous?	randomize?
109	0.006	0.05	yes	yes	no	No
12	0.047	0.05	no	no	no	Yes
9	0.001	0.05	no	no	no	No
8	0.041	0.05	yes	yes	yes	No