

1. Write the general linear model for the following analyses.

Use: Y = response variable

F1 = categorical variable with fixed levels

F2 = additional categorical variable with fixed levels

R1 = categorical variable with random levels

R2 = additional categorical variable with random levels

Z1 = variable on a cardinal scale (ratio scale or interval scale)

Z2 = additional variable on a cardinal scale (ratio scale or interval scale)

Use β_{F1} to denote parameter for F1, β_{F2} to denote parameter for F2, ϵ for normal error *etc.*

Simple regression

GLM Y = _____ [1]

Two-way ANOVA with interaction

GLM Y = _____ [3]

Multiple regression with two explanatory variables, no interaction

GLM Y = _____ [2]

Hierarchical ANOVA

GLM Y = _____ [2]

2. For the following tests, write out the number of categorical and number of ratio scale explanatory variables. [6]

Name of test	Categorical	Ratio Scale
t-test	_____	_____
block design	_____	_____
ANCOVA	_____	_____

3. An experiment was designed to study the effects of three different drugs and three types of stressful situation in producing anxiety in adolescent subjects. The table shows the difference between the pre- and posttreatment scores of 12 subjects who participated in the experiment, for drugs B and C only. (Data from Daniel 1995 Ex 8.16 p337)

Stressful Situation (Factor A)	Drug (Factor B)		Ratio
	B	C	
I	1 3	1 0	_____
II	6 6	6 3	_____
III	7 4	4 5	_____

3a Assign symbols to variables [2]

Name	Symbol
_____	_____
_____	_____
<u>Diff in scores</u>	<u>DiffSc</u>

3b. Write a general linear model to analyze the data [5]

GLM _____ = _____

3c. Compute the mean value in each of the 6 cells in the table, compute the ratio of mean scores of Drug B / Drug C for each stress type, and place this value in the Ratio column in the table. [3]

3d. Do your calculations suggest that there will be interactive effects of stress and drug type on scores? _____ [1]

Why or why not? [1]

3e. Complete the first two columns of the ANOVA table, for the data on 12 subjects shown above. [2]

Source	df
_____	_____

4. A horticulturalist is interested in flower production (*Ntulip*) in relation to shade and watering. An experiment is carried out in 3 beds with 9 plots in each bed. Each plot within each bed is assigned to one of the 9 possible combinations of shade (3 levels) and watering (3 levels).

Name	Symbol
<u>flower production</u>	<u><i>Ntulip</i></u>

5a Assign symbols to each explanatory variable that should be included in the analysis. [3]

4b Write a general linear model to analyze the effects of water, shade, and any interactive effects of water and shade on tulip number, controlled for differences among beds. [3]

GLM _____ = _____

df _____ = _____

4c Write in the degrees of freedom beneath each term in the model, assuming two measurements per plot. [3]

4d How would you examine whether the shade*water effect is consistent across beds? [1]

5. A geneticist analyzes survival (in days) of the fruit fly *Drosophila subobscura* in relation to lifetime production of eggs (nEgg) and egg size as measured by length (LEgg).

5a. What units will the mean survival have ? _____ [1]

Complete the ANOVA table. [9]

Source	df	SS	MS	F
nEgg	___	3.340	_____	_____
LEgg	___	21.842	_____	_____
Error	___	8.665	_____	
Total	24	_____		

5b. What is the variance in survival ? _____ [1]

5c. If egg number is omitted from the analysis of survival in relation to egg length, state what happens to the following (increase or decrease). [3]

Error degrees of freedom _____

MS error _____

F- ratio for egg length _____

6a. Name the assumptions that underlie the accurate computation of p-values from F and t distributions. [4]

6b List one assumption and state how you would check the assumption. [2]