

Name Jemy

Student Number _____

STA 441s 2016 Quiz 9

1. (3 Points) Give your own example of a two-factor experiment in which a random-effects factor is nested within a fixed-effects factor. The random-effects factor is *not* cases (subjects).

Ten stores, ^{each} in Ontario are randomly sampled from Loblaws, Metro, No Frills and FreshCo. Twenty customers are randomly selected from each store and asked to rate their satisfaction

In the study you just described,

- (a) What is the response variable?

Satisfaction ratings

- (b) What are the cases?

Customers

- (c) What are the factors?

Chain and store

- (d) Which factor is fixed, and which is random?

Chain is fixed, Store is random

2. (3 Points) Fifty female and fifty male High School students rated the cuteness of ten pictures of dogs, ten pictures of cats and ten pictures of crocodiles. The data are in a spreadsheet. The spreadsheet has 100 rows, one for each student. There are four columns: Sex, mean rating of dogs, mean rating of cats, and mean rating of crocodiles. Think of this as a two-factor ANOVA.

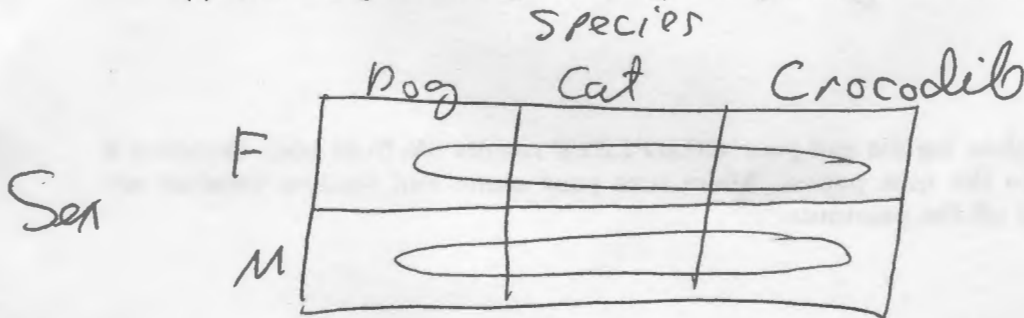
- (a) What are the factors?

Sex of person and species of animal

- (b) Classify each factor as between-cases or within-cases.

Sex is between, Species is within

- (c) Make a diagram showing the nesting/crossing of cases with factors.



3. (2 points) In the SAS part of the homework, four plants of the same variety were randomly selected in an experiment to investigate the concentration of a particular acid. Three leaves per plant were randomly selected and three separate determinations of the acid concentration were obtained per leaf. Give an estimate of the proportion of variance in the acid measurements that is due to plants. Write your answer in the space below. On your printout, circle the number and write "Question 3" beside it.

0.561439, or 56.1439%

4. (2 points) Refer to the SAS part of the homework. In a taste test of wine, 6 professional judges judged 4 wines.
- (a) Give the F -statistic for testing equality of mean ratings for the four wines. Write your answer in the space below. On your printout, circle the number and write "Question 4" beside it.

$F = 57.50$

- (b) Based on your Bonferroni follow-ups, two wines did *not* receive ratings that were significantly different. What were they? Just give 2 numbers in the space below. There is no need to circle anything on the printout.

3 and 4

Attach your complete log file and your **COMPLETE** results file from both Question 3 and Question 4 to the quiz paper. Make sure your name and student number are written clearly on all the printouts.

STA441s16 HW 9 Chack: Nested Plant Data from Kutner et al.

Obs	Plant	Leaf	Acid
1	1	1	11.2
2	1	1	11.6
3	1	1	12.0
4	1	2	16.5
5	1	2	16.8
6	1	2	16.1
7	1	3	18.3
8	1	3	18.7
9	1	3	19.0
10	2	1	14.1
11	2	1	13.8
12	2	1	14.2
13	2	2	19.0
14	2	2	18.5
15	2	2	18.2
16	2	3	11.9
17	2	3	12.4
18	2	3	12.0
19	3	1	15.3
20	3	1	15.9
21	3	1	16.0
22	3	2	19.5
23	3	2	20.1
24	3	2	19.3
25	3	3	16.5
26	3	3	17.2
27	3	3	16.9
28	4	1	7.3
29	4	1	7.8
30	4	1	7.0
31	4	2	8.9
32	4	2	9.4
33	4	2	9.3
34	4	3	11.3
35	4	3	10.9
36	4	3	10.5

STA441s16 HW 9 Chack: Nested Plant Data from Kutner et al.**The FREQ Procedure**

Frequency	Table of Plant by Leaf				
	Plant	Leaf			Total
		1	2	3	
	1	3	3	3	9
	2	3	3	3	9
	3	3	3	3	9
	4	3	3	3	9
	Total	12	12	12	36

**STA441s16 HW 9 Chack: Nested Plant Data from Kutner et al.
Sub-sampling with proc glm****The GLM Procedure**

Class Level Information		
Class	Levels	Values
Plant	4	1 2 3 4
Leaf	3	1 2 3

Number of Observations Read	36
Number of Observations Used	36

**STA441s16 HW 9 Chack: Nested Plant Data from Kutner et al.
Sub-sampling with proc glm**

The GLM Procedure

Dependent Variable: Acid

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	11	530.6322222	48.2392929	381.67	<.0001
Error	24	3.0333333	0.1263889		
Corrected Total	35	533.6655556			

R-Square	Coeff Var	Root MSE	Acid Mean
0.994316	2.492878	0.355512	14.26111

Source	DF	Type I SS	Mean Square	F Value	Pr > F
Plant	3	343.1788889	114.3929630	905.09	<.0001
Leaf(Plant)	8	187.4533333	23.4316667	185.39	<.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Plant	3	343.1788889	114.3929630	905.09	<.0001
Leaf(Plant)	8	187.4533333	23.4316667	185.39	<.0001

**STA441s16 HW 9 Chack: Nested Plant Data from Kutner et al.
Sub-sampling with proc glm****The GLM Procedure**

Source	Type III Expected Mean Square
Plant	$\text{Var}(\text{Error}) + 3 \text{Var}(\text{Leaf}(\text{Plant})) + 9 \text{Var}(\text{Plant})$
Leaf(Plant)	$\text{Var}(\text{Error}) + 3 \text{Var}(\text{Leaf}(\text{Plant}))$

**STA441s16 HW 9 Chack: Nested Plant Data from Kutner et al.
Sub-sampling with proc glm**

**The GLM Procedure
Tests of Hypotheses for Random Model Analysis of Variance**

Dependent Variable: Acid

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Plant	3	343.178889	114.392963	4.88	0.0324
Error	8	187.453333	23.431667		
Error: MS(Leaf(Plant))					

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Leaf(Plant)	8	187.453333	23.431667	185.39	<.0001
Error: MS(Error)	24	3.033333	0.126389		

**STA441s16 HW 9 Chack: Nested Plant Data from Kutner et al.
Pure sub-sampling with proc nested**

The NESTED Procedure

Coefficients of Expected Mean Squares			
Source	Plant	Leaf	Error
Plant	9	3	1
Leaf	0	3	1
Error	0	0	1

Nested Random Effects Analysis of Variance for Variable Acid								
Variance Source	DF	Sum of Squares	F Value	Pr > F	Error Term	Mean Square	Variance Component	Percent of Total
Total	35	533.665556				15.247587	18.001626	100.0000
Plant	3	343.178889	4.88	0.0324	Leaf	114.392963	10.106811	56.1439
Leaf	8	187.453333	185.39	<.0001	Error	23.431667	7.768426	43.1540
Error	24	3.033333				0.126389	0.126389	0.7021

Acid Mean	14.26111111
Standard Error of Acid Mean	1.78257743

Question 3

The GLM Procedure

Class Level Information		
Class	Levels	Values
Judge	6	1 2 3 4 5 6
Wine	4	1 2 3 4

Number of Observations Read	24
Number of Observations Used	24

The GLM Procedure

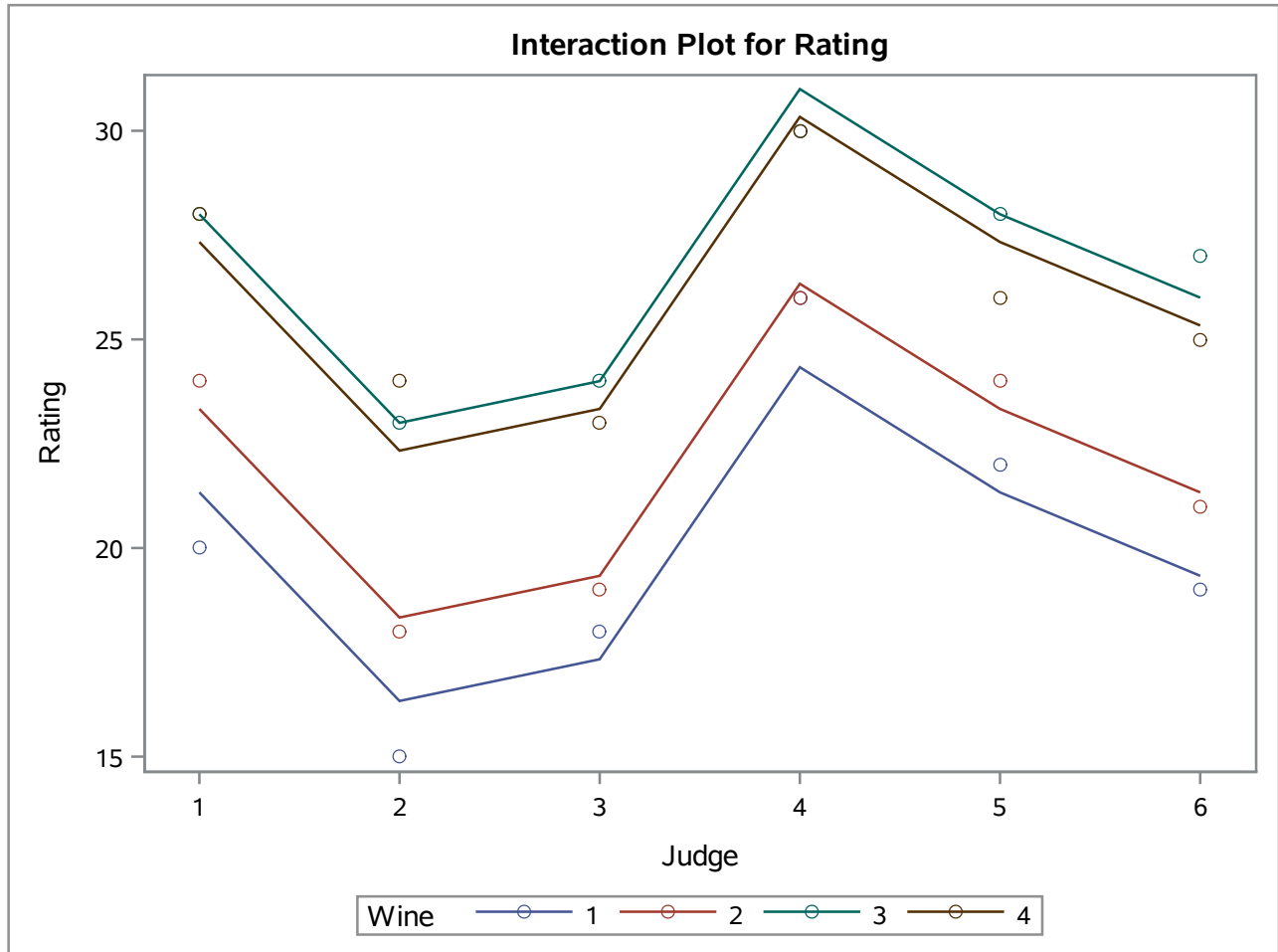
Dependent Variable: Rating

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	8	357.3333333	44.6666667	41.87	<.0001
Error	15	16.0000000	1.0666667		
Corrected Total	23	373.3333333			

R-Square	Coeff Var	Root MSE	Rating Mean
0.957143	4.363925	1.032796	23.66667

Source	DF	Type I SS	Mean Square	F Value	Pr > F
Judge	5	173.3333333	34.6666667	32.50	<.0001
Wine	3	184.0000000	61.3333333	57.50	<.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Judge	5	173.3333333	34.6666667	32.50	<.0001
Wine	3	184.0000000	61.3333333	57.50	<.0001



The GLM Procedure

Source	Type III Expected Mean Square
Judge	$\text{Var}(\text{Error}) + 4 \text{Var}(\text{Judge})$
Wine	$\text{Var}(\text{Error}) + \text{Q}(\text{Wine})$

The GLM Procedure
Tests of Hypotheses for Mixed Model Analysis of Variance

Dependent Variable: Rating

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Judge	5	173.333333	34.666667	32.50	<.0001
Wine	3	184.000000	61.333333	57.50	<.0001
Error: MS(Error)	15	16.000000	1.066667		

Question 4



STA441s16 HW 9 Check: Wine Data
Pairwise matched t-tests
Bonferroni $\alpha/k = 0.05/6 = 0.008333333$

The MEANS Procedure

Variable	Mean	t Value	Pr > t
d12	-2.0000000	-3.46	0.0180
d13	-6.6666667	-10.00	0.0002
d14	-6.0000000	-7.01	0.0009
d23	-4.6666667	-14.00	<.0001
d24	-4.0000000	-7.75	0.0006
d34	0.6666667	1.35	0.2354