

S2013 IS4800/CS6350 Final Exam
Closed Book, Closed Notes, 1.5hrs max

Name _____

When asked for a "Research Model", draw a boxes and arrows diagram depicting variables and their relationships. Label the boxes with the role of the variable(s) contained (IV, DV, etc.) as well as the name(s) of the variable(s).

When asked to "Interpret the results" of a test, you should write the results in both English and publication format.
Example: "There were no significant differences in performance between the Jacuzzi and Sauna groups, $t(42)=5.67, n.s.$ "

1. Descriptives, etc. (5%) For each of the following measures, check off all of the statistics that you should use. Assume interval and ratio measures are approximately normal unless noted, and without using any transformations or dropping samples.

	Mean	Median	Mode	StdDev	Inter-quartile range
Q1. Time to complete task					
Q2. T-shirt size (S/M/L/XL).					
Q3. Score on a single Likert self-report question					
Q4. Number of smart phones owned, positive skew.					
Q5. Owns red shoes (yes/no)					
Q6. Battery weight, bimodal.					

2. Power, etc. (5%) Refer to tables on next page.

2A. Your between-subjects pilot study on the difference in performance between your new CalorieCounter app and the existing WeightWonders app produces the following data on time to enter calories for a meal:

CaloriCounter mean=46.0, SD=3.9

WeightWonders mean=46.4, SD=4.1

What is the effect size of the difference (d): _____

What does Cohen call this effect size (category): _____

How many subjects will you need for a study that is 80% likely to demonstrate a significant difference between the products (given that a difference exists), for two-tail tests and $\alpha=.05$? _____

2B. If you want to run fewer subjects, check all possible changes you could make to your design.

- Increase power. Decrease power.
- Increase α . Decrease α .
- Use a 1-tail test.
- Use a measure with a larger error variance (for same means).
- Use a measure with a smaller error variance (for same means).
- Use a different experimental design and stats.

If yes, assume that your effect size category for the new statistic is the same as the one you found above.

- Use 1-way ANOVA. Number of subjects = _____
- Use Pearson r. Number of subjects = _____
- Use within-subjects. Number of subjects = _____
- Use non-parametrics. Number of subjects = _____

Approximate Number of Participants Needed for 80% Power for the t Test for Dependent Means, Testing Hypotheses at the .05 Significance Level, two-tailed tests.

Effect Size		
Small (d=0.2)	Medium (d=0.5)	Large (d=0.8)
196	33	14

45

TABLE 8-5 Approximate Number of Participants Needed in Each Group (Assuming Equal Sample Sizes) for 80% Power for the t Test for Independent Means, Testing Hypotheses at the .05 Significance Level

	Effect Size		
	Small (.20)	Medium (.50)	Large (.80)
One-tailed	310	50	20
Two-tailed	393	64	26

3. Concepts (5%)

What is a quasi-independent variable?

- A variable you manipulate.
- A variable you do not manipulate.
- Treated as an IV/factor in inferential statistics.
- Treated as a DV/outcome in inferential statistics.
- Can infer causality from effects.
- Results are always correlational.
- Can be combined with true independent variables in a multi-factor study.

4. Data Screening & Analysis (10%)

4A. You survey a sample of your customers, asking them to report how many times per week they use your software. You provide them with a multiple-choice list of responses and get the following data:

Choice	Uses	Number of subjects who picked
a.	5-6	10
b.	6-7	5
c.	8-9	2
d.	10-11	1
e.	11-12	0
f.	13-14	0
g.	15-16	0

4A. How would you describe this distribution (check all that apply):

- Unimodal. Positive skew. Negative skew.
 Bimodal. Possible ceiling effect.
 Possible floor effect. Significant outliers.

4B. Assume this is a ratio measure and you want to see if Uses is significantly greater for male vs. female customers. What are valid approaches for the analysis? Check all that apply.

- t-test for independent means on Uses.
 t-test for independent means on $\log(\text{Uses})$, if this appears normal.
 Wilcoxon/Mann-Whitney test on Uses

Collected data Transformed data

3	
7	
4	
10	
9	
4	
2	
6	

4C. Perform a rank-order transform on the data to the right.

4D. When you perform such a transform?

- To make the results look normal.
- As part of a non-parametric test.
- If the data is bimodal.
- If there are significant outliers.

4E. Below is part of a Baseline Analysis Table for a study.

Measure	Intervention	Control	p
Age	42 (12.3)	39 (10.8)	.670
Height	61 (8.4)	65 (9.2)	.430
IQ	102 (15.4)	84 (11.9)	.003

Check all the following that are correct regarding the 'p' value column.

- Tested using t-test for dependent means.
- Tested using t-test for independent means.
- Tested using X^2 .
- Demonstrates significance on the primary outcome measures.
- Demonstrates that study treatment groups are homogenous.
- Demonstrates that randomization worked.
- Demonstrates that random sampling worked.
- You should prefer these values be less than α .
- You should prefer these values be greater than α .
- Problems indicated invalidate your study results.
- Problems indicated can be corrected in statistical analysis.

5. Study Designs (10%). You want to determine the impact of stimulants on the productivity of your phone tech support staff. You randomly assign each tech to receive free Red Bull, coffee, or bottled water every hour, and also play either classic rock, rap music, or classical music piped into their phone headsets between calls. Productivity measured in ticket resolution time.

5a. What kind of study design is this (check all that apply)?

- Descriptive Demonstration Correlational Experiment
- Between-subjects Within-subjects
- Univariate Multi-variate
- One-factor Two-factor Three-factor

5b. What inferential statistics would you use?

- Pearson r Spearman's rho
- χ^2 Goodness of Fit χ^2 Test for Independence
- t-test for independent means t-test for dependent means
- 1-way ANOVA Full factorial ANOVA
- Mean Median Mode IQR SD

5c. Draw the research model.

6. Study Designs (10%). You want to determine if there are any preferences among cell phone brands used by Northeastern students, so you survey 100 students, asking each which brand they own.

6a. What kind of study design is this (check all that apply)?

- Descriptive Demonstration Correlational Experiment
- Between-subjects Within-subjects
- Univariate Multi-variate
- One-factor Two-factor Three-factor

6b. What statistics could you use?

- Pearson r Spearman's rho
- χ^2 Goodness of Fit χ^2 Test for Independence
- t-test for independent means t-test for dependent means
- 1-way ANOVA Full factorial ANOVA
- Mean Median Mode IQR SD

6c. Draw the research model.

7. Study Designs (10%). You want to compare satisfaction with four different IM clients. You randomly assign participants to use one of the IM clients, conduct a 10 minute chat with the experimenter using the client, and then fill out a 9-item 1-factor composite scale satisfaction questionnaire.

7a. What kind of study design is this (check all that apply)?

- Descriptive Demonstration Correlational Experiment
- Between-subjects Within-subjects
- Univariate Multi-variate
- One-factor Two-factor Three-factor

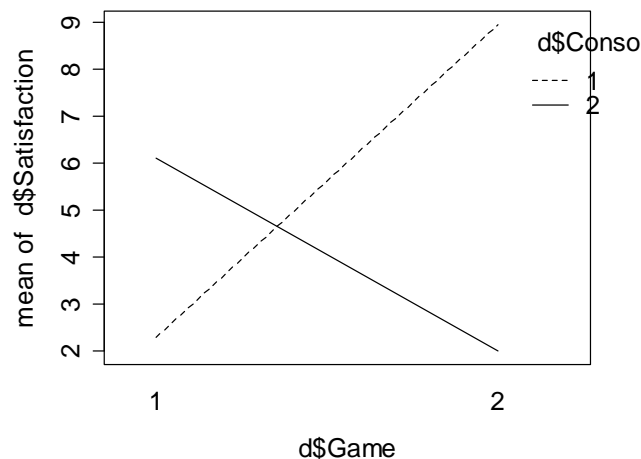
7b. What inferential statistics would you use?

- Pearson r Spearman's rho
- χ^2 Goodness of Fit χ^2 Test for Independence
- t-test for independent means t-test for dependent means
- 1-way ANOVA Full factorial ANOVA
- Mean Median Mode IQR SD

7c. Draw the research model.

8. Study Designs, Hypothesis testing & R (10%)

```
> out <- aov(Satisfaction ~ Game * Console, data=d)
> summary(out)
          Df Sum Sq Mean Sq F value    Pr(>F)
Game       1   1.477   1.477    1.161    0.2941
Console    1   0.022   0.022    0.017    0.8975
Game:Console 1 123.450 123.450   97.032 4.073e-09 ***
Residuals 20  25.445   1.272
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05
> interaction.plot(x.factor=d$Game, trace.factor=d$Console,
                  response=d$Satisfaction)
```



8a. What kind of test is this?

- Pearson r Spearman's rho
 χ^2 Goodness of Fit χ^2 Test for Independence
 t-test for independent means t-test for dependent means
 1-way ANOVA Full factorial ANOVA

8b. What kind of study design would you use this for (check all that apply)?

- Descriptive Demonstration Correlational Experiment
 Between-subjects Within-subjects
 Univariate Multi-variate
 One-factor Two-factor Three-factor

8c. Draw the research model:

8d. Interpret the results (English and publication format):

9. Study Designs, Hypothesis testing & R (10%)

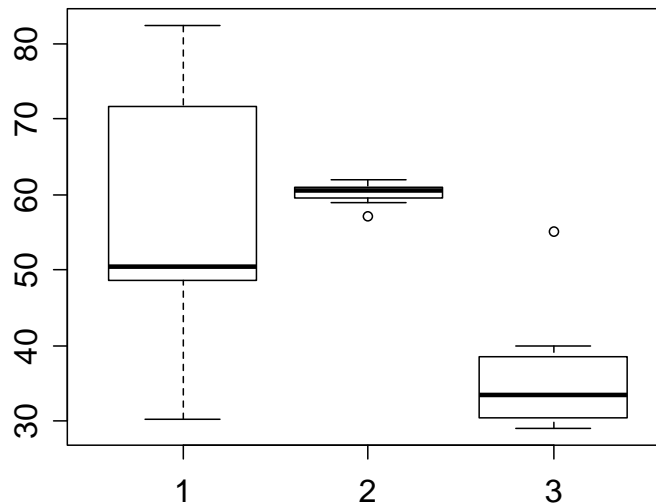
```
> res <- aov(d$performance ~ d$app)
> summary(res)
          Df Sum Sq Mean Sq F value    Pr(>F)
d$app      2 2698.4 1349.23  11.173 0.0004958 ***
Residuals 21 2535.9  120.76
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05

> TukeyHSD(res)
Tukey multiple comparisons of means
 95% family-wise confidence level

Fit: aov(formula = d$performance ~ d$app)

$d$app`
      diff      lwr      upr    p adj
2-1   3.4 -10.44923  17.249231 0.8115252
3-1 -20.6 -34.44923  -6.750769 0.0032466
3-2 -24.0 -37.84923 -10.150769 0.0007564

> boxplot(d$performance~d$app)
```



9a. What kind of test is this?

- Pearson r Spearman's rho
- χ^2 Goodness of Fit χ^2 Test for Independence
- t-test for independent means t-test for dependent means
- 1-way ANOVA Full factorial ANOVA

9b. What kind of study design would you use this for (check all that apply)?

- Descriptive Demonstration Correlational Experiment
- Between-subjects Within-subjects
- Univariate Multi-variate
- One-factor Two-factor Three-factor

9c. Draw the research model:

9d. Interpret the results (English and publication format):

10. Study Proposal. (25%) Sketch a study proposal to compare user productivity (time to complete a set of tasks) between two spreadsheet applications, in which each participant tries each of the applications in turn. If there are parts of the proposal in which you cannot provide actual content, state what you would put there (e.g., in the Introduction you might say "Here is where I would provide references to related work.").

10. Study Proposal, Continued

10. Study Proposal, Continued