Name: _____

PSY 216: Elementary Statistics
Exam 4

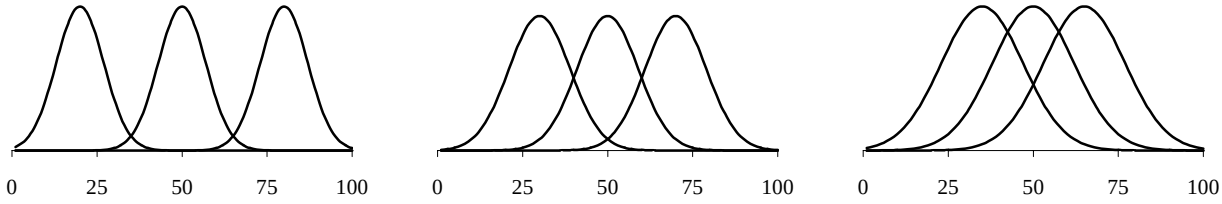
This exam consists of 25 multiple-choice questions and 5 essay / problem questions. For each multiple-choice question, circle the one letter that corresponds to the correct answer. Each multiple-choice question is worth 2 points. If you do not show your work in the essay / problem questions, you cannot receive partial credit. Each of the essay / problem questions is worth 10 points. You have until 1:50 PM to finish the exam. Budget your time wisely.

1. What is the difference between $\alpha_{\text{comparison wise}}$ and $\alpha_{\text{family wise}}$?
   - A. $\alpha_{\text{comparison wise}}$ is the probability of making a Type-I error in a single comparison while $\alpha_{\text{family wise}}$ is the probability of making at least one Type-I error across all the comparisons performed.
   - B. $\alpha_{\text{comparison wise}}$ is the probability of making at least one Type-I error across all the comparisons performed while $\alpha_{\text{family wise}}$ is the probability of making a Type-I error in a single comparison.
   - C. $\alpha_{\text{comparison wise}}$ is the probability of making at least one Type-II error across all the comparisons performed while $\alpha_{\text{family wise}}$ is the probability of making a Type-II error in a single comparison.
   - D. There is no difference -- they are synonyms.

2. Which of the following are appropriate hypotheses for ANOVA?
   - A. $H_0: \mu_1 = \mu_2 = \mu_3 = \mu_4$
     $H_1: \mu_1 \neq \mu_2 \neq \mu_3 \neq \mu_4$
   - B. $H_0: \mu_1 = \mu_2 = \mu_3 = \mu_4$
     H_1: not H_0
   - C. $H_0: \mu_1 \neq \mu_2 \neq \mu_3 \neq \mu_4$
     $H_1: \mu_1 = \mu_2 = \mu_3 = \mu_4$
   - D. $H_0: \mu_1 = \mu_2 \neq \mu_3 = \mu_4$
     $H_1: \mu_1 \neq \mu_2 = \mu_3 \neq \mu_4$

3. Which of the following statements about within-groups variance is / are correct?
   - A. Within-groups variance is a measure of error *and* the effect that the independent variable had on the dependent variable.
   - B. If you want to reject H_0, you want within-groups variance to be as large as possible.
   - C. Within-groups variance is at least partially caused by factors that we did not control in the experiment.
   - D. All of the above.

A B C



4. Of the three sets of distributions shown above, which has the largest within-groups variance?
   A. A
   B. B
   C. C
   D. The within-groups variances are approximately equal in the three sets of distributions.

5. Which of the following statements about between-groups variance is / are correct?
   A. Between-groups variance at least partially measures the effect of the independent variable on the dependent variable.
   B. Between-groups variance at least partially measures sampling error.
   C. If you want to reject H_0, then you want between-groups variance to be as large as possible.
   D. All of the above

6. Of the three sets of distributions shown above question 4, which has the largest between-groups variance?
   A. A
   B. B
   C. C
   D. There is insufficient information to answer this question.

7. What is the definition of Fisher's F ratio?
   A. F = between-groups variance / within-groups variance.
   B. F = within-groups variance / between-groups variance.
   C. F = error / (effect of the IV on the DV + error)
   D. Both answers B and C

8. What are the expected values of F when H_0 is true and when H_0 is false?
   A. If H_0 is true, the expected value of F is 0. If H_0 is false, the expected value of F is > 0.
   B. If H_0 is true, the expected value of F is > 0. If H_0 is false, the expected value of F is 0.
   C. If H_0 is true, the expected value of F is 1. If H_0 is false, the expected value of F is > 1.
   D. If H_0 is true, the expected value of F is > 1. If H_0 is false, the expected value of F is 1.

9. ANOVA assumes that
   A. the variance of the distributions is homogeneous.
   B. the observations are independent of each other.
   C. the sampling error is normally distributed centered around the mean of the distribution.
   D. All of the above

10. What is the primary difference between the various multiple comparison tests (e.g. between Tukey's Honestly Significant Difference and the Chef Bonferroni test)?
   A. Some of the tests are appropriate only for between-subjects designs while others are appropriate only for within-subjects designs.
   B. Some of the tests are appropriate only for single factor designs while others are appropriate only for two factor designs.
   C. The different tests have different statistical power and different amounts of protection from Type-I errors.
   D. Some of the tests are appropriate only for comparing two means at a time while others are appropriate for comparing three or more means at a time.

11. When should multiple comparisons be performed?
   A. They should be performed if the independent variable has more than 2 levels.
   B. They should be performed if the corresponding main effect is statistically significant.
   C. They should be performed if either answer A or answer B is true.
   D. They should be performed only if both answer A and answer B are true.

12. A factorial design
   A. has all possible combinations of the levels of all the independent variables.
   B. can only tell you about main effects and not interactions.
   C. can only occur for between-subjects designs.
   D. can only occur for within-subjects designs.

13. Which of the following statements is true about main effects?
    A. A main effect occurs when an independent variable influences the dependent variable.
    B. There can be as many main effects in a study as there are independent variables.
    C. Main effects can be determined from both single factor experiments and from factorial design experiments.
    D. All of the above.

14. A researcher was interested in the effects of room color (red vs. blue) and clinical depression (present vs. absent) on aggression. The researcher found that room color did not influence aggression for the people with depression, but red rooms caused more aggressive behaviors than blue rooms for people without depression. Which of the following statements is true about this set of results?
    A. There definitely is an interaction of room color and depression.
    B. There probably is an interaction of room color and depression.
    C. There probably is not an interaction of room color and depression.
    D. There definitely is not an interaction of room color and depression.

15. People who ride buses have a 3 point higher environmental concern rating than people who do not ride buses. People with young children have a 2 point higher environmental concern rating than people who do not have young children. People who do not ride buses and do not have young children have a mean environmental concern rating of 2.5. Which of the following is correct if the effects of riding buses and having young children do not interact?
    A. $\overline{X}_{\text{ride buses, have young children}} = \overline{X}_{\text{do not ride buses, do not have young children}}$ + effect of riding buses = 2.5 + 3
    B. $\overline{X}_{\text{ride buses, have young children}} = \overline{X}_{\text{do not ride buses, do not have young children}}$ + effect of having young children = 2.5 + 2
    C. $\overline{X}_{\text{ride buses, have young children}} = \overline{X}_{\text{do not ride buses, do not have young children}}$ + effect of riding buses + effect of having young children = 2.5 + 3 + 2
    D. $\overline{X}_{\text{ride buses, have young children}} = \overline{X}_{\text{do not ride buses, do not have young children}}$ + effect of riding buses + effect of having young children = 2.5 - 3 - 2

16. A researcher conducted a study in which she manipulated whether people received a small reward ($1) or a large reward ($20) for making a decision with unpleasant consequences. She also manipulated whether the person made the decision alone, or in a group of other people who all agreed with the decision. The participants then rated how happy they were with the decision. Each participant in the experiment made two decisions -- one by themselves and one in a group. But each participant received only one type of reward -- either $1 or $20, but not both. What type of ANOVA should the researcher use to analyze the results?
    A. A 2 X 2 between-subjects design ANOVA
    B. A 2 X 2 mixed design ANOVA
    C. A 2 X 2 within-subjects design ANOVA
    D. Any of the above would be appropriate

17. A researcher performed a factorial design study with three independent variables. The higher order interaction was statistically significant. What does this imply?
    A. The nature of the interaction between the first two independent variables is different from the nature of the interaction between the last two IVs.
    B. The nature of the interaction between the first two independent variables is different from the nature of the interaction of the first and last IVs.
    C. The nature of the interaction between any two independent variables is different from the nature of the interaction of any other pair of IVs.
    D. The nature of the interaction between two of the independent variables is different depending on the level of the third IV.

18. What is the difference between parametric and non-parametric statistics?
    A. Parametric statistics make assumptions about how the data are distributed; non-parametric statistics do not.
    B. Parametric statistics are one-tailed while non-parametric statistics are two-tailed.
    C. Non-parametric statistics make assumption about how the data are distributed; parametric statistics do not.
    D. Non-parametric statistics are one-tailed while parametric statistics are two-tailed.

19. Why are non-parametric statistics less desirable than their parametric counterparts?
    A. Non-parametric statistics can be used only with nominally scaled data while parametric statistics can be used with any level of measure.
    B. Non-parametric statistics have less statistical power than their parametric counterparts.
    C. Non-parametric statistics make more assumptions than their parametric counterparts.
    D. All of the above.

20. When would you use the χ^2 one-variable test?
    A. You have a nominally scaled DV that has only two categories.
    B. You have a nominally scaled DV that has more than two categories.
    C. You have a nominally scaled DV and the expected frequencies are unknown.
    D. You have an ordinally scaled DV, a between-subjects IV with two levels and the participants are not matched across conditions.

21. When would you use the binomial test?
    A. You have a nominally scaled DV that has only two categories.
    B. You have a nominally scaled DV that has more than two categories.
    C. You have two nominally scaled DVs and each DV has two or more categories.
    D. You have an ordinally scaled DV, a between-subjects IV with two levels and the participants are not matched across conditions.

22. Which of the following are assumptions made by the χ^2 test?
    A. Each observation must be unique; an individual cannot be in more than one category or counted in the same category more than once.
    B. The minimum expected frequency in each category should be sufficiently large.
    C. The data must correspond to frequencies in the categories and not percentages in the categories.
    D. All of the above.

23. In using a one-way analysis of variance, we assume that each score can be represented by the equation: $X_{ij} = \mu + \alpha_j + \varepsilon_{ij}$. What does this formula mean?
    A. It states that each score (X_{ij}) is composed of three things -- the population mean (μ), the effect of the treatment condition (α_j), and a random error (ε_{ij}) that is centered around 0.
    B. It states that each score (X_{ij}) is composed of three things -- the population mean (μ), the alpha level (α_j), and the effect of the treatment condition (ε_{ij}).
    C. It states that each score (X_{ij}) is composed of three things -- the population mean (μ), the between-groups variance (α_j), and the within-groups variance (ε_{ij}).
    D. It states that each score (X_{ij}) is composed of three things -- the population mean (μ), the alpha level (α_j), and the within-groups (error) variance (ε_{ij}).

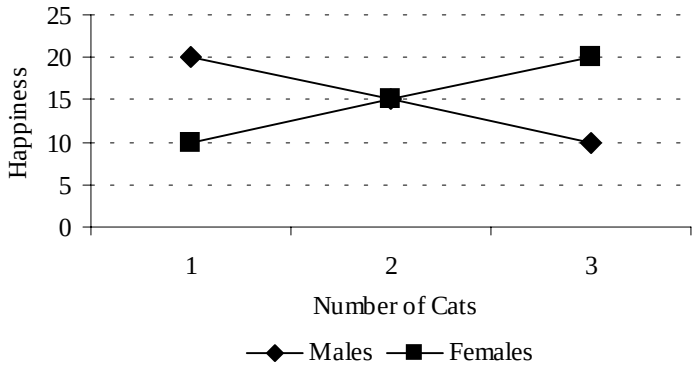
24. η^2 (eta squared) is a measure of
    A. effect size.
    B. statistical power.
    C. the probability of making a Type-I error.
    D. None of the above.

25. Counterbalancing
    A. is a technique for reducing the degree of carryover effects in a repeated-measures design.
    B. is a technique for reducing the degree of carryover effects in a between-subjects design.
    C. tends to increase the between-groups estimate of variance.
    D. All of the above.

26. Describe and discuss factors that influence the size of the critical F. If you want to reject H_0, should the critical F be large or small?

27. For each of the following, state whether the main effects and interaction are likely to be present.

A.



B. People who have been friends for five years are more likely to perform an unpleasant task for their friend than are people who have been friends for only one year. This is true for both males and females, but females are more likely to perform an unpleasant task for a friend than are males.

C. The effect of smoking on GPA is to reduce a person's GPA by 0.4 points. The effect of being on an athletic team on GPA is to reduce a person's GPA by 0.2 points. The mean GPA of people who do not smoke and are not on an athletic team is 3.2. The mean GPA of people who smoke and are not on an athletic team is 2.6. The mean GPA of people who smoke and are on an athletic team is 3.0. The mean GPA of people who do not smoke and are on an athletic team is known, but I won't tell you since you don't need to know it in order to answer the question!

28. Consult the following SPSS ANOVA summary table. Write the results in American Psychological Association style. The two variables in the experiment were the location (LOCATION) of the experiment (in a science lab vs. a run-down office) and the number of dissenters (NUMDIS) present (0 vs. 1 vs. 2).

Tests of Between-Subjects Effects

Dependent Variable: Level of Shock

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	110277.778[a]	5	22055.556	4.460	.001
Intercept	1293368.1	1	1293368.1	261.563	.000
LOCATION	16805.556	1	16805.556	3.399	.070
NUMDIS	87986.111	2	43993.056	8.897	.000
LOCATION * NUMDIS	5486.111	2	2743.056	.555	.577
Error	326354.167	66	4944.760		
Total	1730000.0	72			
Corrected Total	436631.944	71			

a. R Squared = .253 (Adjusted R Squared = .196)

29. A researcher wants to know if the number of people with 0, 1, 2 or 3 children is equal. In a random sample, there were 10 people with no children, 16 people with one child, 22 people with two children, and 12 people with three children. Answer the researcher's question. Show all of your work.

Name: _____

30. **Remove this page from your test and turn in the rest of the test before answering this question. You may not have the rest of your test back once it has been turned in. You may use whatever resources *you* have (including the web) to answer this, and only this, question. Failure to turn in the rest of the test prior to working on this question will automatically result in a score of 0 on the test.**

A researcher conducted a study in which she factorially manipulated the temperature of a room (either 70° or 85°) and manipulated the humidity of the room (25% relative humidity or 95% relative humidity.) Each participant participated in a single condition. She then presented the participants with 10 opportunities to be aggressive and recorded the number of aggressive acts that each person performed. She wants to know if room temperature has an influence on aggressive behavior, whether relative humidity affects aggressive behavior and whether the two variables interact. Use SPSS to analyze her data. Explicitly answer her questions. Write your name on the SPSS output and turn it in with this sheet.

		Relative Humidity	
		25%	95%
Temperature	70°	3	5
		1	2
		2	5
		3	2
		1	5
		2	3
		1	2
		2	3
		1	3
		1	5
	85°	4	3
		3	4
		3	6
		4	3
		4	3
		2	8
		5	6
		5	5
		5	5
		6	5

The numbers in the table represent the number of aggressive acts performed.

Formulae for Exam 4

1. Normal approximation to the binomial distribution: $z = \frac{x - NP}{\sqrt{NP(1-P)}}$, where x = number of observations in the category, N = sample size, and P = probability in question.

2. χ^2 - One variable: $\chi^2 = \sum \left[(O_i - E_i)^2 / E_i \right]$, where O_i = observed frequency of category i, and E_i = expected frequency of category i. DF = number of categories - 1

3. χ^2 - Test of Independence: $\chi^2 = \sum_{i=1}^{r} \sum_{j=1}^{c} \frac{(O_{ij} - E_{ij})^2}{E_{ij}}$, where O_{ij} = observed frequency of category in row i, column j, E_{ij} = expected frequency of category in row i, column j, r = number of rows, c = number of columns, and DF = (r - 1) * (c - 1)

Critical Values of the χ^2 Distribution

	Two-Tailed α Level					
df	0.1	0.05	0.02	0.01	0.002	0.001
1	2.706	3.841	5.412	6.635	9.549	10.827
2	4.605	5.991	7.824	9.210	12.429	13.815
3	6.251	7.815	9.837	11.345	14.796	16.266
4	7.779	9.488	11.668	13.277	16.923	18.466
5	9.236	11.070	13.388	15.086	18.908	20.515
6	10.645	12.592	15.033	16.812	20.791	22.457
7	12.017	14.067	16.622	18.475	22.601	24.321
8	13.362	15.507	18.168	20.090	24.352	26.124
9	14.684	16.919	19.679	21.666	26.056	27.877
10	15.987	18.307	21.161	23.209	27.721	29.588
11	17.275	19.675	22.618	24.725	29.354	31.264
12	18.549	21.026	24.054	26.217	30.957	32.909
13	19.812	22.362	25.471	27.688	32.536	34.527
14	21.064	23.685	26.873	29.141	34.091	36.124
15	22.307	24.996	28.259	30.578	35.627	37.698
16	23.542	26.296	29.633	32.000	37.146	39.252
17	24.769	27.587	30.995	33.409	38.648	40.791
18	25.989	28.869	32.346	34.805	40.136	42.312
19	27.204	30.144	33.687	36.191	41.610	43.819
20	28.412	31.410	35.020	37.566	43.072	45.314
21	29.615	32.671	36.343	38.932	44.522	46.796
22	30.813	33.924	37.659	40.289	45.961	48.268
23	32.007	35.172	38.968	41.638	47.392	49.728
24	33.196	36.415	40.270	42.980	48.811	51.179
25	34.382	37.652	41.566	44.314	50.223	52.619