Introduction to Statistics in Psychology: PSY 201

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Study Guide for Final Exam

Exam Date: Tuesday, December 12, 2023, 8:00 am – 10:00 am
Exam Location: Schleman Hall, Room 313 (same as the regular class location)

The exam will consist of 10 short-answer questions that will either involve some computation or will require a short essay to explain a concept in statistics. Drawings, graphs, and examples are often helpful when answering an essay question. For computations, you can receive partial credit as long as you show your work. Bring a calculator.

For this exam, you should prepare an "information sheet" that you can bring with you to the exam. On a single 8.5 × 11 sheet of paper, you can write (hand written only) anything you think might be helpful. You can use both sides of the paper. Since any information you need can be on your sheet, the exam will not include a listing of equations.

Chapter 1

1. Know the distinctions between populations and samples and between descriptive and inferential statistics.

2. Know the difference between dependent and independent variables. Be able to identify which variables are which for a given study.

3. Be able to compute a percentile (third definition) for a given (small) set of data.

4. Know the properties and limitations of the scales of measurement. Know examples of each. Be able to identify a variable's scale of measurement (when appropriate).

5. Understand the basics of data collection.

6. Understand what a "distribution" refers to and how it is constructed.

7. Know the meaning of the terms positive skew, negative skew, symmetry, kurtosis, bimodal, leptokurtic, and platykurtic.

8. Know the summation notation that is used for the various formulas and how parentheses and squaring should be interpreted in these formulas.

9. Know what a linear transform refers to.

Chapter 2

1. Know how to create a frequency table from a set of raw data and know how to convert it to a bar chart.
2. Understand some of the mistakes that can mislead people with poor graphs.
3. Know how to create and extract information from a grouped frequency table. Know how to create a histogram from such a table.
4. Know how to create and extract information from a frequency polygon.
5. Know how to create and extract information from a cumulative frequency polygon.
6. Know how to create and interpret a bar chart.
7. Know how to create and interpret a line graph.

Chapter 3

1. Understand the various definitions of central tendency: balance scale, smallest absolute deviation, smallest squared deviation.
2. Know how to find/calculate the mode, median, and (arithmetic) mean from a set of data. Know how they are generally affected by the shape of distribution. Know the differences between these measure of central tendency.
3. Understand in what sense the different measures of central tendency are the "middle" of a distribution of scores.
4. Know how the mode, median, and mean are affected by symmetry, and skew in a distribution of scores.
5. Know how to compute variance for a population and for a sample. Understand why there are slightly different formulas.
6. Know how to compute standard deviation for a population and for a sample.
7. Be able to compute the statistics for skew (third moment about the mean) and kurtosis.
8. Know the effect of a linear transformation on the mean and variance of a dataset.
9. Understand the variance sum law (I).

Chapter 4

1. Know the basic properties of the normal distribution.

2. Know how the normal distribution changes for different values of μ and σ.

3. Be able to explain the basics of the Central Limit Theorem.

4. Know how to find an area under the normal distribution (using the on-line app). Know what information these areas provide about proportions of scores in a data set.

5. Know how to find percentiles and percentile ranks for the normal distribution (using the on-line app).

6. Know the properties of the standard normal distribution.

7. Know what z scores are and their properties. What are their "units"?

Chapter 5

1. Know what properties make a data set "bivariate".

2. Understand the basic idea of correlation and correlation coefficients.

3. Understand positive and negative correlations.

4. Understand the difference between a linear and a nonlinear relationship in bivariate data.

5. Know how to compute the Pearson r. (The equations will be given, but you must know how to use them.)

6. Know how the values of r relate to the scatterplot.

7. Understand the effect of a restricted range on the value of r.

8. Understand the variance sum law II.

Chapter 6

1. Understand both the frequentist and subjective approaches to probability. Be able to given an example of a situation where one or the other would apply.

2. Be able to apply probability calculations to (relatively) simple situations (coin flips, cards, dice).

3. Understand, and be able to apply to simple situations, conditional probability.

4. Understand the term "independent" as it applies to the probabilities of events.

5. Understand the "gambler's fallacy" and its relation to independence.

6. Be able to explain (in general, not mathematical, terms) why shared birthdays are common even for a group of just 25 people.

7. Know what the binomial distribution describes. Know how to get various probabilities from the binomial distribution. Know how to use the on-line calculator

8. Know how to compute the mean and variance of the binomial distribution. Know the basic shape of the binomial distribution for small and large values of N and for various values of π.

9. Know the relation between base rates and Bayes' Theorem.

10. Know how to do (simple) probability calculations using Bayes' Theorem.

Chapter 7

1. Understand the challenges of making decisions with noisy data.

2. Be able to identify signal and noise in a given situation. Be able to provide examples of such situations.

3. Be able to explain and compute the signal-to-noise ratio (d').

4. Be able to explain the role of a criterion in decision making.

5. Be able to explain and interpret the different possible decision outcomes.

Chapter 8

1. Understand what a sampling distribution is. For a single mean, know how it is connected to the population distribution, the statistic of interest, and the sample size.

2. Know what the term *standard error of the mean* refers to.

3. Understand how the shape of the population distribution affects (or not) the shape of the sampling distribution of the mean.

4. Understand how the size of the sample affects (or not) the mean of the sampling distribution of the mean. Understand how sample size affects the standard error of the mean.

5. Know the relationship between the mean of the population and the mean of the sampling distribution of the mean.

6. Know the mathematical relationship between the variance of the population, the sample size, and the variance of the sampling distribution of the mean. (Same for standard deviations.)

7. Know the central limit theorem. Be able to describe what it means (not just state the theorem itself).

8. Know the properties of the t-distribution. Know what a t-score is.

9. Be able to explain (in general terms) the concept of degrees of freedom.

10. Know how to use the on-line calculator to find areas under the t-distribution.

11. Know how to relate probabilities to areas under the t-distribution.

Chapter 9

1. Be able to explain (in general terms) why we test means rather than individual scores. Be sure to discuss the sampling distribution of the mean.

2. Know how to set up and interpret a null hypothesis. Understand its relationship to chance or no effect.

3. Be able to explain how we identify a criterion for a one-tailed test.

4. Be able to explain how we identify a criterion for a two-tailed test.

5. Understand how p-values are related to the criterion.

6. Understand what it means to reject the null hypothesis.

7. Know the definitions and properties of Type I and II errors.

8. Know how to interpret a non-significant result.

9. Know the steps of hypothesis testing. Be able to run a test using the on-line calculator.

10. Understand the common misconceptions about significance testing and the proper interpretation.

11. Understand *power* and know how it relates to Type II errors.

12. Be able to interpret a power analysis using the on-line calculator.

13. Understand (in general terms) the relationship between sample size and power.

Chapter 10

1. Know the difference between a point estimate and an interval estimate of a population parameter.

2. Understand why you might want a confidence interval rather than a point estimate of a statistic.

3. Understand why a 95% confidence interval is *not* an interval with a 0.95 probability of containing the population mean.

4. Understand how the term "95%" is related to a probability statement about samples.

5. Know how to find t values that are used in constructing a confidence interval. Be able to use the on-line calculators.

6. Know the relationship between level of confidence and width of a confidence interval.

7. Know how sample size alters the width of a confidence interval.

8. Know how sample size affects (or not) the proportion of intervals that contain the parameter.

9. Understand the relationship between confidence intervals and hypothesis testing.

Chapter 11

1. Know the shape, mean, and standard deviation of the sampling distribution of a proportion, p.

2. Know when the normal distribution approximation to the binomial is generally considered "good enough."

3. Know how to do a hypothesis test for a one-sample proportion.

4. Know how to compute the confidence interval of a proportion.

5. Know how to compute power for a hypothesis test for a one-sample proportion.

6. Understand in general terms, why the sampling distribution of r is skewed.

7. Understand in general terms the need for the z transform of r values. Know the sampling distribution of the z_r values.

8. Know the mean and standard error of the z_r sampling distribution.

9. Understand the need and purpose of the Fisher's z_r transformation for correlations.

10. Know how to do a hypothesis test for a one-sample correlation.

11. Know how to compute the confidence interval of a correlation (r) using the Fisher's z_r transformation.

12. Know how to compute power for a hypothesis test for a one-sample correlation.

Chapter 12

1. Know how to perform a hypothesis test for the difference of two independent means when the sample sizes are the same.

2. Know what assumptions are needed to do the hypothesis test for the difference of two independent means. Know what happens to the Type I error rate when these assumptions are violated.

3. Know how to perform a hypothesis test for the difference of two independent means when the sample sizes are different.

4. Know how to compute a confidence interval for the difference of two independent means.

5. Know how to compute power for a hypothesis test for the difference of two independent means.

6. Be able to perform a hypothesis test for the difference between dependent means (correlated pairs).

7. Be able to build a confidence interval for the difference between dependent means (correlated pairs).

8. Be able to compute power for a hypothesis test of the difference between dependent means (correlated pairs).

9. Understand the relationship between hypothesis test of dependent means and a one-sample test of the mean.

Chapter 13

1. Know how to do a hypothesis test, calculate power, and build a confidence interval for a difference of two sample proportions with independent samples.

2. Know how to do a hypothesis test, calculate power, and build a confidence interval for a difference of two sample proportions with dependent samples.

3. Know how to do a hypothesis test and calculate power for a difference of two sample correlations with independent samples.

Chapter 14

1. Understand how the multiple testing problem influences Type I error rates.

2. Know what "factors" and "levels" refer to in an ANOVA design.

3. Know the relationship between F and t for a two-sample test of independent samples.

4. The following apply for both independent and dependent situations:

5. Know what is tested in a one-way ANOVA. Be able to describe the null hypothesis for such a design.

6. Be able to describe the basic idea of an ANOVA in terms of two estimates of population variance.
7. Be able to compute the degrees of freedom for a one-factor ANOVA.
8. Be able to compute MS terms from SS terms.
9. Be able to compute F from MS terms.
10. Know how to set up a contrast to compare different subsets of means.
11. Understand how to read an ANOVA summary table.
12. Know what kind of information is needed to do a power analysis for an ANOVA.
13. Understand how contrasts reduce power for an experiment.
14. Know how to set up a power analysis that includes an ANOVA and various contrasts.