

Syllabus

PSYC300 - Statistical Methods

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Biography:

I am a Professor of Psychology and have been a faculty member at Lewis-Clark State College since 1976. I earned my Ph.D. and M.Ed. in Counseling Psychology from the University of California, Santa Barbara. I earned a B.S. in Mathematics Education from The Ohio State University.

Course Information

Course title: Statistical Methods

Course number: PSYC300

Course discipline: Psychology

Course description:

This course is a survey of descriptive and inferential statistical concepts commonly used in the treatment of data in social science research. Both the understanding and the application of the concepts will be emphasized. Topics will include: measures of central tendency, measures of variability, correlational methods and hypothesis testing up through simple analysis of variance. Mathematical competency at the high school algebra level is required.

Course date: Monday, August 24, 2009 through Monday, December 14, 2009

Location: WebCT

Course Goals

To satisfactorily complete this course, students must demonstrate the following:

1. Knowledge of and the ability to compute the basic descriptive statistics including measures of central tendency and variability.
2. Knowledge of the concept of probability and how it is used in hypothesis testing.
3. Knowledge of z-scores, distributions, and their usage in statistical methods.
4. Knowledge of and the ability to compute the basic inferential statistics including the t test and analysis of variance.
5. Knowledge of and the ability to compute correlation coefficients and linear regression.

Course Requirements

This course is separated into fourteen lessons and four examinations (following lessons 4, 8, 12, and 14). Each lesson will be graded using a 0 to 30 point scale. The first three examinations are worth a possible 100 points each and the fourth comprehensive examination is worth 200 points. Each examination will assess the objectives outlined in the lessons and will include a section of multiple-choice questions and a section of computational problems and essay questions.

The following criteria will be used to assign your final grade:

- A 828 - 920 total points
- B 736 - 827 total points
- C 644 - 735 total points
- D 552 - 643 total points
- F less than 552 total points

Textbooks

Required reading:

Essentials of Statistics for the Behavioral Sciences (6th edition), Frederick J. Gravetter and Larry B. Wallnau, Thomson/Wadsworth, 6th Edition ©2008, 00-495-38394-5

Required reading:

Study Guide for Gravetter and Wallnau's Essentials of Statistics for the Behavioral Sciences, Frederick J. Gravetter, Thomson/Wadsworth, 6th Edition ©2008, 0-495-38529-8

Lesson 1

Lesson: Introduction to Statistics

Date: Friday, August 28, 2009

Objectives or Goals:

1. Students should be familiar with the terminology and special notation of statistical analysis. The terminology consists of:

Statistical Terms

population

sample

parameter

statistic

descriptive statistics

inferential statistics

sampling error

Measurement Terms

Nominal

Ordinal

Interval

Ratio

discrete variable

continuous variable

real limits

Research Terms

correlational study

experimental study

independent variable

dependent variable

non-experimental study

quasi-independent variable

2. Students should learn how statistical techniques fit into the general process of science.

3. Students should learn the notation, particularly summation notation, that will be used throughout the rest of the book.

Readings: Gravetter & Wallnau - Chapter 1

Assignments: Gravetter & Wallnau - problems # 6, 8, 10, 12, 16, 18, and 24, pages 30 to 32

Lesson 2

Lesson: Frequency Distributions

Date: Thursday, September 3, 2009

Objectives or Goals:

1. Students should understand the concept of a frequency distribution as an organized display showing where all of the individual scores are located on the scale of measurement.

2. Students should be able to organize data into a regular or a grouped frequency distribution table, and understand data that are presented in a table.

3. Students should be able to organize data into frequency distribution graphs, including bar graphs, histograms, and polygons. Also, students should be able to understand data that are presented in a graph.

4. Students should understand that most population distributions are drawn as smooth curves showing relative proportions rather than absolute frequencies.

5. Students should be able to identify the shape of a distribution shown in a frequency distribution graph. Students should recognize symmetrical distributions (including but not limited to normal distributions), as well as positively and negatively skewed distributions.

Readings: Gravetter & Wallnau - Chapter 2

Assignments: Gravetter & Wallnau - problems # 2, 8, 12, and 18, pages 52 to 54.

Lesson 3

Lesson: Central Tendency

Date: Wednesday, September 9, 2009

Objectives or Goals:

1. Students should understand the purpose of measuring central tendency.
2. Students should be able to define and compute each of the three measures of central tendency.
3. Students should understand how the mean is affected when a set of scores is modified (a new score is added, a score is removed, or a score is changed).
4. Students should understand the circumstances in which each of the three measures of central tendency is appropriate.
5. Students should understand how the three measures of central tendency are related to each other in symmetrical and skewed distributions.
6. Students should be able to draw and to understand figures/graphs that display several different means (or medians) representing different treatment conditions or different groups.

Readings: Gravetter & Wallnau - Chapter 3

Assignments: Gravetter & Wallnau - problems # 8, 18, 24, and 26, pages 81 to 83.

Lesson 4

Lesson: Variability

Date: Tuesday, September 15, 2009

Objectives or Goals:

1. Students should understand the general purpose for measuring variability and they should be able to recognize the difference between a distribution of scores with high variability and a distribution of scores with low variability.

2. Students should be able to define and calculate the range and the interquartile range, but they should also realize that these are both relatively crude measures of variability.
3. Students should understand the concept of standard deviation as measuring the standard distance from the mean.
4. Students should be able to calculate SS (sum of squared deviations), variance, and standard deviation for a sample and for a population. In addition, they should understand the concept of an unbiased statistic and the correction for bias that is used in the formula for sample variance.

Readings: Gravetter & Wallnau - Chapter 4

Assignments: Gravetter & Wallnau - problems # 8, 12, 18, and 22 pages 110 to 112.

It is now time for you to take Examination 1 of this course. At this point you should study all the objectives from Lessons 1, 2, 3, and 4, and review the problems and solutions which were part of the written assignments for each of the first four lessons. All material from these objectives will be assessed on this examination. The equations printed inside the cover of the text are provided for your use during the examination session.

Examination 1 will take between one and two hours to complete depending on your personal rate of computation. No time limits are set but the examination must be completed in one sitting. Be sure to bring your calculator to the examination session.

You may take this examination in the Distance Learning Center SGC 212 on the LCSC campus or at any LCSC off campus satellite center.

Lesson 5

Lesson: z-Scores

Date: Monday, September 28, 2009

Objectives or Goals:

1. Students should understand that a z-score provides a precise description of a location in a distribution.
2. Students should be able to transform X values into z-scores, and transform z-scores into X values.
3. Students should understand and be able to describe the effects of standardizing a distribution by transforming the entire set of X values into z-scores.

4. Students should be able to use z-scores to transform any distribution into a standardized distribution with a predetermined mean and a predetermined standard deviation.

Readings: Gravetter & Wallnau - Chapter 5

Assignments: Gravetter & Wallnau - problems # 4, 10, 14, and 28, pages 131 to 133.

Lesson 6

Lesson: Probability and the Normal Distribution

Date: Friday, October 2, 2009

Objectives or Goals:

1. Students should know how to determine the probability of an event.
2. Students should be able to use the unit normal table to find probabilities for specific scores in a normal distribution, and to find the scores that correspond to specific proportions of a normal distribution.
3. Students should be able to combine z-score calculations (Chapter 5) and the unit normal table to find probabilities for scores from a normal distribution, or to find scores associated with specific proportions.

Readings: Gravetter & Wallnau - Chapter 6

Assignments: Gravetter & Wallnau - problems # 2, 6, 8, and 10, page 157 to 158.

Lesson 7

Lesson: Probability and Samples

Date: Thursday, October 8, 2009

Objectives or Goals:

1. Students should be able to define the distribution of sample means and, for a specific sampling situation, describe the distribution by identifying its shape, the expected value of M , and the standard error of M .
2. Students should be able to define and calculate the standard error of M .
3. Students should be able to compute a z-score that specifies the location of a particular sample mean within the distribution of means.

4. Using the distribution of sample means, z-scores, and the unit normal table, students should be able to compute the probability of obtaining specific values for a sample mean obtained from a given population.

5. Students should be able to incorporate a visual presentation of standard error into a graph presenting means for a set of different samples. In addition, you should be able to use the visual presentation of standard error to help determine whether the obtained difference between two sample means is greater than is reasonably expected by chance or whether the sample mean difference is simply due to chance.

Readings: Gravetter & Wallnau - Chapter 7

Assignments: Gravetter & Wallnau - problems # 2, 14, 16, and 20, pages 184 to 187.

Lesson 8

Lesson: Introduction to Hypothesis Testing

Date: Wednesday, October 14, 2009

Objectives or Goals:

1. Students should understand the logic of hypothesis testing.
2. Students should be able to state the hypotheses and locate the critical region.
3. Students should be able to conduct a hypothesis test using a z-score statistic and make a statistical decision.
4. Students should be able to define and differentiate Type I and Type II errors.
5. When an experiment contains a prediction about the direction of a treatment effect, students should be able to incorporate the directional prediction into the hypothesis testing procedure and conduct a directional (one-tailed) hypothesis test.
6. Students should understand the purpose of measuring effect size and power, and they should be able to compute Cohen's d .
7. Students should be able to incorporate a directional prediction into the hypothesis test and conduct a directional (one-tailed) test.

Readings: Gravetter & Wallnau - Chapter 8

Assignments: Gravetter & Wallnau - problems # 4, 6, 8, and 16, pages 228 to 231.

It is now time for you to take Examination 2 of this course. At this point you should study all the objectives from Lessons 5, 6, 7, and 8, and review the problems and solutions that were part of the written assignments for each of these four lessons. All material from these objectives will be assessed on this examination. The equations printed inside the cover of the text are provided for your use during the examination session.

Examination 2 will take between one and two hours to complete depending on your personal rate of computation. No time limits are set but the examination must be completed in one sitting. Be sure to bring your calculator to the examination session.

You may take this examination in the Distance Learning Center SGC 212 on the LCSC campus or at any LCSC off campus satellite center.

Lesson 9

Lesson: Introduction to t Statistic

Date: Wednesday, October 28, 2009

Objectives or Goals:

1. Students should understand when a t statistic is used (instead of a z-score) for hypothesis testing.
2. Students should be able to compute the estimated standard error and the t statistic for a sample mean.
3. Students should understand the concept of degrees of freedom and how it relates to the t distribution.
4. Students should be able to perform a hypothesis test using the t statistic. This includes computing basic statistics for the sample (mean and variance) and computing the estimated standard error for the sample mean.
5. Students should be able to compute Cohen's d and the percentage of variance accounted for (r^2) to measure effect size.

Readings: Gravetter & Wallnau - Chapter 9

Assignments: Gravetter & Wallnau - problems #12, 14, and 20, pages 254.

Lesson 10

Lesson: Independent t Test

Date: Tuesday, November 3, 2009

Objectives or Goals:

1. Students should be able to describe and recognize the experimental situations where an independent-measures t statistic is appropriate for statistical inference.
2. Students should be able to use the independent-measures t statistic to test hypotheses about the mean difference between two populations or between two treatment conditions.
3. Students should be able to list the assumptions that must be satisfied before an independent-measures t statistic can be computed or interpreted.
4. Students should be able to evaluate the magnitude of the mean difference by computing either Cohen's d or r^2 (the percentage of variance accounted for).

Readings: Gravetter & Wallnau - Chapter 10

Assignments: Gravetter & Wallnau - problems # 12 and 22, pages 283 to 285.

Lesson 11

Lesson: Related Samples t Test

Date: Monday, November 9, 2009

Objectives or Goals:

1. Students should understand the structure of a research study that produces data appropriate for a repeated-measures t hypothesis test as compared to the independent-measures design.
2. Students should know the difference between repeated measures and a matched-subjects research design.
3. Students should be able to use the repeated-measures t statistic to test hypotheses about the mean difference between two treatment conditions.
4. Students should be able to evaluate the magnitude of the mean difference by computing either Cohen's d or r^2 (the percentage of variance accounted for).

5. Students should understand the relative advantages and disadvantages of repeated-measures studies compared to independent-measures studies, and should recognize the situations where each type of study is appropriate.

Readings: Gravetter & Wallnau - Chapter 11

Assignments: Gravetter & Wallnau - problems # 4, 8, and 24, pages 307 to 309.

Lesson 12

Lesson: Estimation

Date: Monday, November 16, 2009

Objectives or Goals:

1. Students should be able to use sample data to compute point estimates and interval estimates of an unknown population mean using the single-sample t statistic.
2. Students should be able to compute point estimates and interval estimates of population mean differences using the independent-measures t or the repeated-measures t statistics.
3. Students should understand how the size of the sample influences the width of a confidence interval.
4. Students should understand how the sample size and the percentage of confidence influence the width of a confidence interval.

Readings: Gravetter & Wallnau - Chapter 12

Assignments: Gravetter & Wallnau - problems # 4, 6, 14, and 22, pages 331 to 334.

It is now time for you to take Examination 3 of this course. At this point you should study all the objectives from Lessons 9, 10, 11, and 12, and review the problems and solutions that were part of the written assignments for each of these four lessons. All material from these objectives will be assessed on this examination. The equations printed inside the cover of the text are provided for your use during the examination session.

Examination 3 will take between one and two hours to complete depending on your personal rate of computation. No time limits are set but the examination must be completed in one sitting. Be sure to bring your calculator to the examination session.

You may take this examination in the Distance Learning Center SGC 212 on the LCSC campus or at any LCSC off campus satellite center.

Lesson 13

Lesson: Introduction to Analysis of Variance

Date: Thursday, December 3, 2009

Objectives or Goals:

1. Students should understand the basic purpose for analysis of variance, terminology, special notation, and the general logic that underlies this statistical procedure.
2. Students should be able to perform an analysis of variance to evaluate the data from a single-factor, independent-measures research study.
3. Students should understand when post tests are necessary and the purpose that they serve. Students should be able to use post test techniques such as Tukey's HSD and the Scheffè test.
4. Students should be able to report the results of an analysis of variance using either a summary table or an F-ratio (including df values). Also, you should be able to understand and interpret these reports when they appear in scientific literature.
5. Students should be able to compute η^2 (the percentage of variance accounted for) to measure effect size for the sample means in an analysis of variance

Readings: Gravetter & Wallnau - Chapter 13

Assignments: Gravetter & Wallnau - problems # 8 and 18, pages 373 to 376.

Lesson 14

Lesson: Correlation and Regression

Date: Tuesday, December 8, 2009

Objectives or Goals:

1. Students should understand the Pearson correlation and what aspect of a relationship it measures.
2. Students should know the uses and limitations of measures of correlation.
3. Students should be able to compute the Pearson correlation by regular formula [using either the definitional or the computational formula for SP (the sum of products of deviations)] or the z-score formula.

4. Students should be able to use a sample correlation to test a hypothesis about the corresponding population correlation.
5. Students should understand the Spearman correlation and how it differs from the Pearson correlation in terms of the data that it uses and the type of relationship that it measures.
6. Students should understand and be able to compute the linear regression equation for predicting Y values from the X values in a set of correlational data.

Readings: Gravetter & Wallnau - Chapter 15

Assignments: Gravetter & Wallnau - problems # 4, 8, 10, and 22, pages 467 to 470.

It is now time for you to take the Final Examination of this course. At this point you should study all the objectives from **ALL 14 lessons** along with the review the problems and solutions that were part of the written assignments for all lessons. All material from these objectives will be assessed on this examination. The equations printed inside the cover of the text are provided for your use during the examination session.

The Final Examination will take between one and a half and three hours to complete depending on your personal rate of computation. No time limits are set but the examination must be completed in one sitting. Be sure to bring your calculator to the examination session.

You may take this examination in the Distance Learning Center SGC 212 on the LCSC campus or at any LCSC off campus satellite center.