Syllabus

PSYC300 - Statistical Methods
Fall Semester 2013
Name: Dan Mayton
Email: dmayton@lcsc.edu
Phone: 208-792-2280

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 26, 2013 through Monday, December 16, 2013
Location: Blackboard Learn
Distance Learning Office SGC 212
http://www.lcsc.edu/dl/

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.


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 52 total points

**Textbooks**

Either:


Or


**Fall Semester Office Hours and Proctoring Services**

LCSC Distance Learning Office Hours: Sam Glenn Complex Room 212 (208) 792-2239

**Hours:** Monday - Friday 7:30am - 5:00 pm

*Saturday To be announced  *Saturday hours typically begin the Saturday after Labor Day

Distance Learning requires all students to show a current photo ID issued by LCSC, an employer, or a city/state/federal government agency before being allowed to test. Students taking exams must begin and end within the regularly scheduled hours. Arrive with enough time to allow full time for your exam.

No tests will be given one (1) hour before closing unless previously arranged with their office.

NIC Testing Center, located in Lee Kildow Hall


If you require proctoring services, please contact Angela Nibler at annibler@lcsc.edu or Elizabeth Weldy at eaweldy@lcsc.edu for assistance.
Lesson 1

Lesson: Introduction to Statistics
Date: Friday, August 30, 2013

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
**Lesson #1 Assignment**

1. Identify the two elements of an experiment that make this type of research study different from other research methods.

2. A researcher would like to evaluate the claim that large doses of vitamin C can help prevent the common cold. One group of participants is given a large dose of the vitamin (500 mg per day), and a second group is given a placebo (sugar pill). The researcher records the number of colds each individual experiences during the 3-month winter season.
   a. Identify the dependent variable for this study.
   b. Is the dependent variable discrete or continuous?
   c. What scale of measurement (nominal, ordinal, interval, or ratio) is used to measure the dependent variable?
   d. What research method is being used (experimental or correlational)?

3. A researcher studying the effects of environment on mood ask participants to sit alone in a waiting room for 15 minutes at the beginning of an experiment. Half of the individuals are assigned to a room with dark blue walls, and the other half are assigned to a room with bright yellow walls. After 15 minutes in the waiting room, each person is brought into the lab and given a mood-assessment questionnaire.
   a. Identify the independent and dependent variables for this study.
   b. What scale of measurement is used for the independent variable?

4. Define and differentiate between a discrete variable and a continuous variable.

5. Two scores, X and Y, are recorded for each of n = 4 subjects. For these scores, find the value of each expression.
   a. ΣX
   b. ΣY
   c. ΣXY

<table>
<thead>
<tr>
<th>Subject</th>
<th>X</th>
<th>Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>B</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>C</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>D</td>
<td>4</td>
<td>2</td>
</tr>
</tbody>
</table>

6. For the following set of scores, find the value of each expression:
   a. ΣX²
   b. (ΣX)²
   c. Σ(X-3)
   d. Σ(X-3)²

<table>
<thead>
<tr>
<th>X</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>
Lesson 2

Lesson: Frequency Distributions
Date: Thursday, September 5, 2013

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

Lesson #2 Assignment

1. An instructor obtained the following set of scores from a 10-point quiz for a class of 26 students:

   8, 5, 4, 5, 7, 6, 4, 3, 4, 5, 6, 4, 5, 10, 6, 9 5, 7, 8, 2, 6, 7, 4

   a. Place the scores in a frequency distribution table.
   b. Sketch a histogram showing the distribution.
   c. Using your graph answer the following questions:
      (1) What is the shape of the distribution?
      (2) As a whole, how did the class do on the quiz?
          Were most scores high or low?
          Was the quiz easy or hard?

2. For the following scores, construct a frequency distribution table using
   a. An interval width of 5.
   b. An interval width of 10.
   64, 75, 50, 67, 86, 66, 62, 64, 71, 47, 57, 74, 63, 67, 56, 65, 70 87, 48, 50,
   41, 66, 73, 60, 63, 45, 78, 68, 53, 75
3. Schmidt (1994) conducted a series of experiments examining the effects of humor on memory. In one study, participants were shown a list of sentences, of which half were humorous and half were nonhumorous. Schmidt then measured the number of each type of sentence recalled by each participant. Following are hypothetical results similar to those obtained by Schmidt.

a. Identify the independent variable and the dependent variable for this study.
b. Sketch two histograms, one showing the distribution of recall scores for humorous sentences and one for nonhumorous sentences.
c. Based on your histograms, does it appear that humor has an effect on memory? Explain your answer.

<table>
<thead>
<tr>
<th>Number of Sentences Recalled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Humorous sentences</td>
</tr>
<tr>
<td>Nonhumorous sentences</td>
</tr>
<tr>
<td>4  5  2  4</td>
</tr>
<tr>
<td>6  7  6  6</td>
</tr>
<tr>
<td>2  5  4  3</td>
</tr>
<tr>
<td>1  3  5  5</td>
</tr>
</tbody>
</table>

Lesson 3

Lesson: Central Tendency
Date: Wednesday, September 11, 2013

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
Lesson #3 Assignment
1. Find the mean, median, and mode for the following sample of scores:

   8, 7, 9, 9, 10, 6, 9, 9, 4, 8

2. A sample of \( n = 8 \) scores has a mean of \( M = 12 \). One new score is added to the sample and the new mean is found to be \( M = 13 \). What is the value of the new score?

3. For each of the following situations, identify the measure of central tendency (mean, median, or mode) that would provide the best description of the “average” score:
   a. A researcher asks each individual in a sample of 50 adults to name his/her favorite season (summer, fall, winter, spring).
   b. An insurance company would like to determine how long people remain hospitalized after a routine appendectomy. The data from a large sample indicate that most people are released after 2 or 3 days but a few develop infections and stay in the hospital for weeks.
   c. A teacher measures scores on a standardized reading test for a sample of children from a middleclass, suburban elementary school.

4. On a standardized reading achievement test, the nationwide average for seventh-grade children is \( \mu = 7.0 \). A seventh-grade teacher is interested in comparing class reading scores with the national average. The scores for the 16 students in this class are as follows:

   8, 6, 5, 10, 5, 6, 8, 9, 7, 6, 9, 5, 14, 4, 7, 6

   a. Find the mean and the median reading scores for this class.
   b. If the mean is used to define the class average, how does this class compare with the national norm?
   c. If the median is used to define the class average, how does this class compare with the national norm?

Lesson 4
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Lesson: Variability
Date: Tuesday, September 17, 2013

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 they should also realize this is a relatively crude measure 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

Lesson #4 Assignment

1. For the following sample: 2, 2, 4, 1, 3, 2, 1, 2
   a. Calculate the range and the standard deviation
   b. Add two points to every score, then compute the range and the standard deviation again. How is the variability affected by adding a constant to every score?

2. Calculate SS, variance, and standard deviation for the following sample of $n = 4$ scores: 0, 3, 0, 3. (Note: The computational formula for SS works best with these scores.)

3. Calculate SS, variance, and standard deviation for the following population of $N = 6$ scores: 5, 0, 9, 3, 8, 5. (Note: The definitional formula for SS works well with these scores.)

4. For the following population of $N = 5$ scores: 11, 2, 0, 8, 4
   a. Sketch a histogram showing the population distribution.
   b. Locate the value of the population mean in your sketch, and make an estimate of the standard deviation (as done in Example 4.2).
   c. Compute SS, variance, and standard deviation for the population. (How well does your estimate compare with the actual value of $\sigma$?)

5. For the following population of scores: 1, 6, 9, 0, 4
   a. Find the mean for the population, and compute the deviation score for each individual.
   b. Show that the deviation scores sum to zero.
   c. Square each deviation, and find the sum of the squared deviations (SS).
   d. Now assume that the set of scores is a sample instead of a population, and repeat parts a, b, and c.

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 that 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, the NIC Testing Center, or with an approved proctor.

Lesson 5

Lesson:  z-Scores  
Date:  Thursday, September 26, 2013

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

Lesson #5 Assignment
1. A population has a mean of $\mu = 50$ and a standard deviation of $\sigma = 10$.
   a. For this population, find the z-score corresponding to each of the following scores.

      $X = 55 \quad X = 40 \quad X = 35 \quad X = 48 \quad X = 70 \quad X = 65$

   b. For the same population, find the score ($X$ value) corresponding to each of the following z-scores.

      $z = -2.00 \quad z = 1.50 \quad z = -0.50 \quad z = 0.60 \quad z = 1.00 \quad z = 0$

2. Find the z-score corresponding to a score of $X = 50$ for each of the following distributions.
   a. $\mu = 60$ and $\sigma = 5$
   b. $\mu = 40$ and $\sigma = 5$
   c. $\mu = 60$ and $\sigma = 20$
   d. $\mu = 40$ and $\sigma = 20$
3. For a population with a standard deviation of $\sigma = 4$, a score of $X = 44$ corresponds to $z = -0.50$. What is the population mean?

4. A population consists of the following $N = 5$ scores: 0, 6, 4, 3, and 12.
   a. Compute $\mu$ and $\sigma$ for the population.
   b. Find the $z$-score for each score in the population.
   c. Transform the original population into a new population of $N = 5$ scores with a mean of $\mu = 60$ and a standard deviation of $\sigma = 8$.

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Lesson 6

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Lesson: Probability and the Normal Distribution
Date: Wednesday October 2, 2013

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

Lesson #6 Assignment

1. A jar contains 10 black marbles and 40 white marbles.
   a. If you randomly select a marble from the jar, what is the probability that you will get a white marble?
   b. If you are selecting a random sample of $n = 3$ marbles and the first 2 marbles are both white, what is the probability that the third marble will be black?

2. For each of the following $z$-score values, sketch a normal distribution and draw a vertical line at the location of the $z$-score. Then, determine whether the body is to the right or the left of the $z$-score and find the proportion of the distribution located in the body.
   a. $z = 0.25$
   b. $z = -1.50$
   c. $z = 1.75$
   d. $z = -0.40$

3. Find each of the following probabilities for a normal distribution.
   a. $p(z > -0.25)$
   b. $p(z > 1.75)$
   c. $p(z < 0.90)$
   d. $p(z < -1.25)$
4. For a normal distribution, identify the z-score location that would separate the distribution into sections so that there is
   a. 60% in the body on the right-hand side
   b. 85% in the body on the right-hand side
   c. 90% in the body on the left-hand side
   d. 95% in the body on the left-hand side

Lesson 7

Lesson: Probability and Samples
Date: Tuesday October 8, 2013

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

Lesson #7 Assignment
1. For each of the following, assume that the sample was selected from a population with $\mu = 75$ and $\sigma = 20$.
   a. What is the expected value of $M$ for a sample of $n = 4$ scores?
   b. What is the standard error of $M$ for a sample of $n = 4$ scores?
   c. What is the expected value of $M$ for a sample of $n = 25$ scores?
   d. What is the standard error of $M$ for a sample of $n = 25$ scores?
2. A random sample of \( n = 16 \) scores is selected from a normal distribution with a mean of \( \mu = 50 \) and standard deviation of \( \sigma = 10 \).
   a. What is the probability that the sample mean will have a value between 45 and 55?
   b. What is the probability that the sample mean will have a value between 48 and 52?
   c. What range of values has a 95% probability of containing the sample mean?

3. The distribution of SAT scores is normal with a mean of \( \mu = 500 \) and a standard deviation of \( \sigma = 100 \). If a sample of \( n = 25 \) SAT scores is obtained, the sample mean should be \textit{around} \( \mu = 500 \).
   a. What range of values should contain the sample mean 90% of the time? (That is, find the middle 90% of the distribution sample means.)
   b. What range of values should contain the sample mean 95% of the time?
   c. What range of values should contain the sample mean 99% of the time?

4. A normal distribution has \( \mu = 35 \) and \( \sigma = 8 \).
   a. Sketch the distribution of sample means for samples of \( n = 4 \) selected from this population. Show the expected value of \( M \) and the standard error in your sketch.
   b. For a sample of \( n = 4 \), what is the probability of selecting a random sample with a mean greater than \( M = 32 \)?
   c. Sketch the distribution of sample means for samples of \( n = 16 \) selected from this population. Show the expected value of \( M \) and the standard error in your sketch.
   d. For a sample of \( n = 16 \), what is the probability of selecting a random sample with a mean greater than \( M = 32 \)?

Lesson 8

Lesson: Introduction to Hypothesis Testing
Date: Monday October 14, 2013

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

Lesson #8 Assignment
1. Briefly explain the advantage of using an alpha level of .01 versus a level of .05. In general, what is the disadvantage of using a smaller alpha level?

2. The term error is used two different ways in the context of a hypothesis test. First, there is the concept of standard error, and second, there is the concept of a Type I error.
   a. What factor can a researcher control that will reduce the risk of a Type I error?
   b. What factor can a researcher control that will reduce the standard error?

3. A researcher would like to test the effectiveness of a newly developed growth hormone. The researcher knows that under normal circumstances laboratory rats reach an average weight of $\mu = 950$ grams at 10 weeks of age. The distribution of weights is normal with $\sigma = 30$. A random sample of $n = 25$ newborn rats is obtained, and the hormone is given to each rat. When the rats in the sample reach 10 weeks old, each rat is weighed. The mean weight for this sample is $M = 974$.
   a. Identify the independent and the dependent variables for this study.
   b. Assuming a two-tailed test, state the null hypothesis in a sentence that includes the independent variable and the dependent variable.
   c. Using symbols, state the hypotheses ($H_0$ and $H_1$) for the two-tailed test.
   d. Sketch the appropriate distribution, and locate the critical region for $\alpha = .05$.
   e. Calculate the test statistic ($z$-score) for the sample.
   f. What decision should be made about the null hypothesis, and what decision should be made about the effect of the hormone?

4. Under some circumstances a 6-point treatment effect can be very large, and in some circumstances it can be very small. Assume that a sample of $n = 16$ individuals is selected from a population with a mean of $\mu = 70$. A treatment is administered to the sample and, after treatment, the sample mean is found to be $M = 76$. Notice that the treatment appears to have increased scores by an average of 6 points.
   a. If the population standard deviation is $\sigma = 20$, is the 6-point effect large enough to be statistically significant? Use a two-tailed test with $\alpha = .05$.
   b. If the population standard deviation is $\sigma = 20$, compute Cohen’s $d$ to evaluate the actual size of the 6-point effect.
   c. If the population standard deviation is $\sigma = 8$, is the 6-point effect large enough to be statistically significant? Use a two-tailed test with $\alpha = .05$.
   d. If the population standard deviation is $\sigma = 8$, compute Cohen’s $d$ to evaluate the actual size of the 6-point effect.
5. Researchers have often noted increases in violent crimes when it is very hot. In fact, Reifman, Larrick, and Fein (1991) noted that this relationship even extends to baseball. That is, there is a much greater chance of a batter being hit by a pitch when the temperature increases. Consider the following hypothetical data. Suppose that over the past 30 years, during any given week of the major league season, an average of \( \mu = 12 \) players are hit by wild pitches. Assume the distribution is nearly normal with \( \sigma = 3 \). For a sample of \( n = 4 \) weeks in which the daily temperature was extremely hot, the weekly average of hit-by-pitch players was \( M = 15.5 \). Are players most likely to get hit by pitches during hot weeks? Set alpha to .05 for a one-tailed test.

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, the NIC Testing Center, or with an approved proctor.

Lesson 9

Lesson: Introduction to t Statistic
Date: Thursday, October 24, 2013

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

**Lesson #9 Assignment**

1. Last fall, a sample of $n = 25$ freshmen was selected to participate in a new 4-hour training program designed to improve study skills. To evaluate the effectiveness of the new program, the sample was compared with the rest of the freshman class. All freshman must take the same English Language Skills course, and the mean score on the final exam for the entire freshman class was $\mu = 74$. The students in the new program had a mean score of $M = 78$ with $SS = 2400$.
   a. On the basis of these data, can the college conclude that the students in the new program performed significantly better than the rest of the freshman class? Use a one-tailed test with $\alpha = .05$.
   b. Can the college conclude that the students in the new program are significantly different from the rest of the freshman class? Use a two-tailed test with $\alpha = .05$.

2. The herbal supplement ginkgo biloba is advertised as producing an increase in physical strength and stamina. To test this claim, a sample of $n = 36$ adults is obtained and each person is instructed to take the regular dose of the herb for a period of 30 days. At the end of 30-day period, each person is tested on a standard treadmill task for which the average, age-adjusted score is $\mu = 55$. The individuals in the sample produce a mean score of $M = 58.5$ with $SS = 5040$.
   a. Are these data sufficient to conclude that the herb has a statistically significant effect using a two-tailed test with $\alpha = .05$?
   b. What decision would be made if the researcher used a one-tailed test with $\alpha = .05$? (Assume that the herb is expected to increase scores.)

3. When adults are given a set of items to hold in memory, they automatically rehearse the items to prevent forgetting. Young children, however, do not spontaneously use rehearsal. As a result, when given a small set of items to remember, 2-year-old children on average can recall only $\mu = 2$ items. A researcher would like to determine whether memory can be improved by teaching 2-year-old children to use rehearsal. A sample of $n = 16$ children is obtained and the children are trained to use rehearsal during a memory task. After training, the children in the sample show an average recall of $M = 4.3$ items, with $SS = 60$.
   a. Use a one-tailed test with $\alpha = .05$ to determine whether the data are sufficient to conclude that the rehearsal training produces a significant increase in memory.
   b. Compute Cohen's $d$ and $r^2$ for these data to measure the effect size.

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**Lesson 10**

Lesson: Independent t Test
Date: Wednesday, October 30, 2013
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

Lesson #10 Assignment

1. The researcher from the previous problem attempted to repeat the experiment using larger samples. The data for the second attempt are as follows:

<table>
<thead>
<tr>
<th></th>
<th>Treatment 1</th>
<th>Treatment 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>$n$</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>$M$</td>
<td>58</td>
<td>52</td>
</tr>
<tr>
<td>$SS$</td>
<td>420</td>
<td>540</td>
</tr>
</tbody>
</table>

a. Calculate the variance for each of the two samples and then compute the pooled variance.

b. Do these data indicate a significant difference between the two treatments? Use a two-tailed test with $\alpha = .05$.

2. Stephen Schmidt (1994) conducted a series of experiments examining the effects of humor on memory. He collected a set of humorous sentences and then modified each one to produce a nonhumorous version of the same sentence. The humorous sentences were then presented to one group of participants and the nonhumorous sentences were presented to another group. Each group was then given a test to determine how many sentences they could recall. Data similar to those obtained by Schmidt are shown in the following table.

<table>
<thead>
<tr>
<th>Number of Sentences Recalled</th>
<th>Humorous sentences</th>
<th>Nonhumorous sentences</th>
</tr>
</thead>
<tbody>
<tr>
<td>4  5  2  4</td>
<td>5  2  4  2</td>
<td></td>
</tr>
<tr>
<td>6  7  6  6</td>
<td>2  3  1  5</td>
<td></td>
</tr>
<tr>
<td>2  5  4  3</td>
<td>3  2  3  3</td>
<td></td>
</tr>
<tr>
<td>3  3  5  3</td>
<td>4  1  5  3</td>
<td></td>
</tr>
</tbody>
</table>
a. Do the data provide enough evidence to conclude that humor has a significant effect on memory? Use a two-tailed test at the .05 level of significance.
b. Calculate Cohen’s $d$ to evaluate the size of the effect.
c. Calculate the percentage of variance explained the treatment, $r^2$, to measure effect size.

Lesson 11

Lesson: Related Samples t Test
Date: Tuesday, November 5, 2013

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

Lesson #11 Assignment
1. A researcher conducts an experiment comparing two treatment conditions and obtains data with 10 scores for each treatment condition.
   a. If the researcher used an independent-measures design, how many subjects participated in the experiment?
   b. If the researcher used a repeated-measures design, how many subjects participated in the experiment?
   c. If the researcher used a matched-subjects design, how many subjects participated in the experiment?

2. A sample of difference scores ($D$ values) from a repeated-measures experiment has a mean of $M_D = 5.00$ with a variance of $s^2 = 16$.
   a. If $n = 4$, is this sample sufficient to reject the null hypothesis using a two-tailed test with $\alpha = .05$?
   b. Would you reject $H_0$ if $n = 16$? Again, assume a two-tailed test with $\alpha = .05$. 
3. A researcher studies the effect of cognitive psychotherapy on positive self-regard. The number of positive statements made about oneself is recorded for each participant during the first meeting. After 8 weekly therapy sessions, the measures are repeated for each person. For the following data,
   a. Calculate the difference scores and $M_D$.
   b. Compute $SS$, sample variance, and estimated standard error.
   c. Is there a significant treatment effect? Use $\alpha = .05$, two tails.

<table>
<thead>
<tr>
<th>Participant</th>
<th>Before treatment</th>
<th>After treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td>B</td>
<td>6</td>
<td>13</td>
</tr>
<tr>
<td>C</td>
<td>9</td>
<td>12</td>
</tr>
<tr>
<td>D</td>
<td>5</td>
<td>8</td>
</tr>
</tbody>
</table>

Lesson 12

Lesson: Estimation
Date: Monday, November 11, 2013

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

Lesson #12 Assignment

1. For the following studies, state whether estimation or hypothesis testing is required. Also, is an independent- or a repeated-measures t statistic appropriate?
   a. An educator wants to determine how much mean difference can be expected for the population in SAT scores following an intensive review course. Two samples are selected. The first group takes the review course, and the second receives no treatment. SAT scores are subsequently measured for both groups.
b. A psychiatrist would like to determine whether a new medication has any effect on psychotic symptoms. A sample of patients is assessed and then placed on drug therapy for 2 weeks. The severity of their symptoms is assessed again at the end of the treatment.

c. A researcher would like to determine how much people’s moods are affected by seasonal changes. A sample of 100 adults is obtained and each individual is given a mood-analysis questionnaire in the summer and again in the winter.

d. A researcher would like to determine whether participation in sports has an effect on self-esteem for high school students. The researcher obtains a sample of 50 students who are active in varsity sports and a comparison sample of 50 students who do not participate in any high school sports. Each student is given a self-esteem questionnaire.

2. A sample of \( n = 16 \) scores is obtained from an unknown population. The sample has a mean of \( M = 46 \) with \( SS = 6000 \).

   a. Use the sample data to make an 80% confidence interval estimate of the unknown population mean.

   b. Make a 90% confidence interval estimate of \( \mu \).

   c. Make a 95% confidence interval estimate of \( \mu \).

   d. In general, how is the width of a confidence interval related to the percentage of confidence?

3. A developmental psychologist would like to determine how much fine motor skill improves for children from age 3 to age 4. A random sample of \( n = 15 \) three-year-old children and a second sample of \( n = 15 \) four-year-olds are obtained. Each child is given a manual dexterity test that measures fine motor skills. The average score for the older children was \( M = 40.6 \) with \( SS = 430 \) and the average for the younger children was \( M = 35.4 \) with \( SS = 410 \). Using the data,

   a. Make a point estimate of the population mean difference in fine motor skills.

   b. Make an interval estimate so you are 95% confident that the real mean difference is in your interval.

   c. Make an interval estimate so you are 99% confident that the real mean difference is in your interval.

   d. Based on your answers from (b) and (c), do the data indicate a significant change using a two-tailed test with \( \alpha = .05 \)? Is the difference significant with \( \alpha = .01 \)?

4. A researcher would like to estimate how much reaction time is affected by a common over-the-counter cold medication. The researcher measures reaction time for a sample of \( n = 36 \) participants. Each is then given a dose of the cold medication and reaction time is measured again. For this sample, reaction time increased after the medication by an average of \( M_D = 24 \) milliseconds with \( s = 8 \).

   a. Make a point estimate of the mean difference in reaction time caused by the medicine.

   b. Make a 95% confidence interval estimate of the population mean difference.

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, the NIC Testing Center, or with an approved proctor.

Lesson 13

Lesson: Introduction to Analysis of Variance
Date: Thursday, November 21, 2013

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 n2 (the percentage of variance accounted for) to measure effect size for the sample means in an analysis of variance

Readings: Gravetter & Wallnau - Chapter 13

Lesson #13 Assignment
1. The following data represent the results from an independent-measures experiment comparing three treatment conditions. Use an analysis of variance with \( \alpha = .05 \) to determine whether these data are sufficient to conclude that there are significant differences between the treatments.
2. A developmental psychologist is examining problem-solving ability for grade school children. Random samples of 5-year-old, 6-year-old, and 7-year-old children are obtained with \( n = 3 \) in each sample. Each child is given a standardized problem-solving task, and the psychologist records the number of errors. The data are as follows:

<table>
<thead>
<tr>
<th>Treatment</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>( N = 12 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>5</td>
<td>6</td>
<td></td>
<td>( G = 60 )</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>10</td>
<td></td>
<td>( \Sigma X^2 = 392 )</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>5</td>
<td>6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[ T = 12 \quad T = 16 \quad T = 32 \]
\[ SS = 8 \quad SS = 12 \quad SS = 16 \]

\[ G = 30 \]
\[ \Sigma X^2 = 138 \]

\[ T = 15 \quad T = 12 \quad T = 3 \]
\[ SS = 2 \quad SS = 8 \quad SS = 2 \]

**a.** Use these data to test whether there are any significant differences among the three age groups. Use \( \alpha = 0.05 \).

**b.** Use the Scheffé test to determine which groups are different.
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

**Lesson #14 Assignment**
1. For the following set of data,

<table>
<thead>
<tr>
<th>X</th>
<th>Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

a. Sketch a graph showing the location of the five X, Y points.
b. Just looking at your graph, estimate the value of the Pearson correlation.
c. Compute the Pearson correlation for this data set.

2. It is well known that similarity in attitudes, beliefs, and interests plays an important role in interpersonal attraction (see Byrne, 1971, for example). Thus, correlations for attitudes between married couples should be strong. Suppose a researcher developed a questionnaire that measures how liberal or conservative one’s attitudes are. Low scores indicate that the person has liberal attitudes, whereas high scores indicate conservatism. The following hypothetical data are scores for married couples.
<table>
<thead>
<tr>
<th>Couple</th>
<th>Wife</th>
<th>Husband</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>11</td>
<td>14</td>
</tr>
<tr>
<td>B</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>C</td>
<td>18</td>
<td>15</td>
</tr>
<tr>
<td>D</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>E</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>F</td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td>G</td>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td>H</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

Compute the Pearson correlation for these data, and determine whether or not there is a significant correlation between attitudes for husbands and wives. Set alpha at .05, two tails.

3. Assuming a two-tailed test with \( \alpha = .05 \), how large a correlation is needed to be statistically significant for each of the following samples?
   a. A sample of \( n = 15 \) individuals
   b. A sample of \( n = 30 \) individuals
   c. A sample of \( n = 92 \) individuals

4. A psychologist would like to determine whether there is any consistent relationship between intelligence and creativity. A random sample of \( n = 18 \) people is obtained and the psychologist administers a standardized IQ test and creativity test to each individual. Using these data, the psychologist obtains a Pearson correlation of \( r = +0.20 \) between IQ and creativity.
   a. Do the sample data provide sufficient evidence to conclude that a real (nonzero) correlation exists in the population? Test at the .05 level of significance.
   b. If the same correlation, \( r = 0.20 \), was obtained for a sample of \( n = 102 \) people, what decision would be made about the population correlation?

5. For the following set of data,

<table>
<thead>
<tr>
<th>X</th>
<th>Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>14</td>
</tr>
<tr>
<td>3</td>
<td>7</td>
</tr>
</tbody>
</table>

   a. Compute the Pearson correlation.
   b. Find the linear regression equation for predicting \( Y \) from \( X \).
   c. Use the regression equation to compute the predicted \( Y \) for each value of \( X \).
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, the NIC Testing Center, or with an approved proctor.

**REMINDER:**

**ALL LESSONS NEED TO BE TURNED IN AND ALL EXAMS MUST BE COMPLETED NO LATER THAN DECEMBER 16TH !!!**

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**Syllabus Addendum**

**Consumer Information**
In 2008, the federal government required all post-secondary institutions offering federal financial aid programs to provide key data to both prospective and current students. To comply with this requirement, Lewis-Clark State College has developed a consumer information page, which may be accessed at [http://www.lcsc.edu/studentconsumerinformation/](http://www.lcsc.edu/studentconsumerinformation/)

**Disability Accommodations**
Students requiring special accommodations or course adaptations due to a disability and/or a health-related issue should consult their course instructors and the LCSC Student Counseling Center immediately (RCH 111, 792-2211). Official documentation may be required in order to provide an accommodation and/or adaptation.

**Student Rights and Responsibilities**
Students have the responsibility for knowing their program requirements, course requirements, and other information associated with their enrollment at LCSC. Students should review the LCSC General Catalog ([http://www.lcsc.edu/catalog/](http://www.lcsc.edu/catalog/)) and the LCSC Student Handbook (available at [http://www.lcsc.edu/studentservices/contactus.htm](http://www.lcsc.edu/studentservices/contactus.htm)) for more information.

**Accidents/Student Insurance**
Students participating in LCSC classes normally must look to their personal health insurance policy (Student Health Insurance Plan or comparable private coverage) should an accident occur. In the event of an accident, please seek medical help, if necessary, and report the incident to LCSC Security (792-2226). Fieldtrips or other special student activities may also require...
students to submit a signed participation waiver (forms can be obtained from the supporting Division Office).

**Enrollment Verification/Attendance**
Students who are not actively pursuing their classes may have to repay part or all of their financial aid awards depending upon the circumstances.

**Academic Dishonesty**
Academic dishonesty, which includes cheating and plagiarism, is not tolerated at LCSC. Individual faculty members will impose their own policies and sanctions regarding academic dishonesty. Students who are accused of being academically dishonest may be referred to the VP for Student Affairs for official disciplinary action.

**Illegal File Sharing**
Students using LCSC’s computers and/or computer network must comply with the college’s appropriate use policies and are prohibited from illegally downloading or sharing data files of any kind. Specific information about the college’s technology policies and its protocols for combating illegal file sharing may be found on the VP for Student Affairs’ web page (http://www.lcsc.edu/studentservices/).

**Diversity Vision Statement**
Regardless of race, color, age, sex, religion, national origin, disability, veteran status, or sexual orientation, you will be treated and respected as a human being. http://www.lcsc.edu/culturaldiversity/

Addendum Updated August 2013