**Math 120 OL Intro to Statistics - Spring 2020**
***Course Syllabus***


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Office Hours: MWF 10:30-11:20 p.m. or by appointment

***Course Description*:** Beginning statistical theory and practice are introduced through topics of data collection, sampling techniques, organization and presentation of data, measurement of central tendency, probability concepts, discrete and continuous probability distributions, statistical estimation, hypothesis testing, correlation analysis, linear regression and analysis of variance. Prerequisite: MATH 111 or equivalent

***Text(s)*:** Intro Stats, 4th Ed.
DeVeaux, Velleman, Bock
ISBN: 978-0-321-82527-8

***Academic Services:*** BLC provides free tutoring. You can make arrangements through the Academic Resource Center, http://www.blc.edu/academic-resource-center. For disability services please contact Carrie Pfeifer at (507) 344-7577 or in her office in the Academic Resource Center.

***Institutional Objectives:***

1. Recognize that the historic Christian faith professes that God the Holy Trinity is the source of all knowledge and truth, and that His wisdom is most clearly revealed in the life, death, and resurrection of Jesus Christ.
2. Demonstrate intellectual, creative, and problem-solving skills.
3. Demonstrate an understanding of personal and public responsibility.
4. Develop habits of thinking that apply to a fulfilling life of learning.

***Course Outcomes:*** At the completion of the course, the student should be able to:

1. Communicate statistical concepts using correct technical language.
2. Create and interpret various graphical representations of data including histograms, dotplots, bar charts, pie charts, and scatterplots.
3. Analyze data using various statistical measures including the mean, median, standard deviation, percentiles and z-scores.
4. Use concepts of linear regression to describe and analyze bivariate data.
5. Simulate and calculate probabilities.
6. Identify and analyze types of data collection and research design.
7. Apply the Central Limit Theorem to data situations related to sampling distributions.
8. Construct and interpret confidence intervals for population means and proportions.
9. Conduct hypothesis testing for population proportions, means and variances for a single population and also between two populations.
10. Use the Chi-Square distribution for statistical inference and analysis of variance.

***Course Grade*:** The distribution of your grade is as follows:

| | |
|---|---|
| 45 percent | Unit Exams and Final Exam |
| 35 percent | Homework |
| 8 percent | Project |
| 12 percent | Discussions and Quizzes |

Final grades will be based on the percentages shown below. I reserve the right to lower, but not raise these cutoff points. The cutoff points are:

| | | | | | |
|---|---|---|---|---|---|
| >92.5% | A | 82.5-87.49% | B | 70.0-77.49% | C |
| 90.0-92.49% | A- | 80.0-82.49% | B- | 60.0-69.99% | D |
| 87.5-89.99% | B+ | 77.5-79.99% | C+ | 0-59.99% | F |

***Homework:*** There will be fifteen homework assignments. Typically, they will be assigned at the beginning of the week and due about one week later. All homework must be written *and readable* (I strongly suggest typing your assignments). **Late work will be accepted with a 50% penalty.** ***Additionally, you must email me when submitting late work so that I know to grade it.*** Homework will be graded for its accuracy as well as its clarity and organization. Homework in this math course is different than in other math courses you have taken in the past; the assignments resemble reports more so than anything else. All explanations must be made in your own words. Thus, any assignment that is exceedingly similar to another student's assignment will result in a grade of zero.

***Discussions:*** Reading the textbook is mandatory for the course. At the beginning of each chapter, there will be a forum in which you must post your reflection on the chapter and reply to at least one other student's post. Each forum discussion is worth 4 points: one point for each question answered, one point for accurate writing and grammar, and one point for a **meaningful and constructive** reply to another student's post.

***Exams:*** There will be three exams, each of which will cover multiple chapters. All students will be notified on Moodle the week prior to the date that the exam will occur. A comprehensive final examination will be given during the week of May 6th-9th**.** Students must take the final exam during this time, no exceptions.

***Missed Work or Exams:*** Missed exams will not be made up. Exceptions will be made only at the discretion of the instructor *provided arrangements are made in advance.* I realize in the case of extreme emergencies this may not be possible. In that case, I should be contacted as soon as possible. Verification of the emergency should be provided. The exam given in place of the missing exam will NOT be the same as the original exam, but will cover the same material, as well as reflecting the fact that you had more time to study. That is, there is no guarantee of having the same level of difficulty. If there is a known and legitimate conflict with an exam date, you must contact me before 5 p.m. the day before the exam is due and schedule a time to make-up the exam within 48 hours of its original time.

***Course Outline:*** The direction of the course is as follows:

Unit 1: Exploring and Understanding Data

Chapter 1: Stats Starts Here
- Data, Types of Variables
- The 5 W's

Chapter 2: Displaying and Describing Categorical Data
- Frequency Tables, Bar Charts, Pie Charts, Contingency Tables
- Conditional Distributions

Chapter 3: Displaying and Summarizing Quantitative Data
- Shape, Center, Spread
- Boxplots and 5-Number Summaries
- Mean and Standard Deviation

Chapter 4: Understanding and Comparing Distributions
- Comparing Groups with Graphical Displays
- Outliers

Chapter 5: The Standard Deviation as a Ruler and the Normal Model
- Z-scores
- The Normal Model and 68-95-99.7 Rule
- Finding Normal Percentiles

Unit 2: Exploring Relationships Between Variables and Gathering Data

Chapter 6: Scatterplots, Association, and Correlation
- Scatterplots
- Correlation and the Correlation Coefficient

Chapter 7: Linear Regression
- Least Squares and the Line of Best Fit
- Methods for Finding the Least Squares Line
- $R^2$ and variance
- Assumptions and Conditions required for Regression

Chapter 8: Regression Wisdom
- Residuals
- Interpolation and Extrapolation
- Outliers, Leverage and Influence
- Lurking Variables and Causation

Chapter 9: Understanding Randomness
- Randomness in simulation
- Using random number generators

Chapter 10: Sample Surveys
- The 3 Big Ideas of Sampling
- Populations, Parameters, and the Sample Statistic
- SRS and Types of Sampling
- What makes a valid survey; types of biases possibly present

Chapter 11: Experiments and Observational Studies
- Types of Studies
- Experiments and the Principles of Experimental Design
- Control groups, Placebos, Blinding, and Confounding

Unit 3: Randomness and Probability, Sampling, Intro to Confidence Intervals and Hypotheses

Chapter 12: From Randomness to Probability
- Law of Large Numbers
- Sample Spaces, Trials, Components, Events and Outcomes
- Theoretical, Subjective, and Empirical Probability
- Formal Probability Rules

Chapter 13: Probability Rules!
- The General Addition Rule
- Conditional Probability
- The General Multiplication Rule
- Independence
- Picturing Probability: Tables, Venn Diagrams and Trees
- Bayes' Rule

Chapter 15: Sampling Distribution Models
- Sampling Distributions for Proportions
- Assumptions and Conditions associated with the Normal Model
- The Central Limit Theorem

Chapter 16: Confidence Intervals for Proportions
- Standard Error
- Calculating and Interpreting Confidence Intervals
- Margin of Error
- Assumptions and Conditions
- Sample Size Requirements

Chapter 17: Testing Hypotheses About Proportions
- Null and Alternative Hypotheses (one- and two-tail)
- P-values
- The Process of Hypothesis Tests

Unit 4: From the Data at Hand to the World at Large

Chapter 18: Inferences About Means
- t-Distributions and Degrees of Freedom
- Assumptions and Conditions for t-Distributions
- Confidence Intervals for Means
- Using a t-Table
- Hypothesis Tests for Means
- Choosing a Sample Size

Chapter 19: More About Tests and Intervals
- Alpha/Significance Levels
- Critical Values
- Type I and Type II Errors
- Power
- Effect Size

***Confidentiality and Mandatory Reporting:*** As an instructor, one of my responsibilities is to help create a safe learning environment on our campus. It is my goal that you feel able to share information related to your life experiences in classroom discussions, in your written work, and in our one-on-one meetings. I will seek to keep information you share private to the greatest extent possible. However, I am required to report information regarding sexual misconduct or information about a crime that may have occurred on BLC's campus with the college. According to policy, faculty and staff are "required to report any knowledge they have about sexual assault, relationship violence, or stalking to the Title IX Coordinator." To report and request help from Bethany Lutheran College following an incident, you can contact the police (911) or Bethany Campus Security (507.344.7888). If you wish, you may remain anonymous and report via the website https://forms.blc.edu/title-ix-reporting/. The following individuals are trained to provide you with support that may also remain confidential. Please reach out to them for assistance:

Chaplain Don Moldstad: 507.344.7312
Mark DeGarmeaux: 507.344.7429
Doyle Holbird: 507.344.7753
WLCFS Counseling services: 800.438.1772 option #1

***Disclaimer:*** The instructor reserves the right to alter any portion of the syllabus or curriculum as necessary. If this occurs, the instructor will notify everyone both in class and via email.

**Teaching Standards for Education Program – Middle Level Mathematics Endorsement**

| Substandard | Text | Assessment |
|---|---|---|
| 8710.3320 (Middle Level Mathematics) | | |
| Sub. 3.C. A teacher with a middle level endorsement for teaching mathematics in grades 5 through 8 must demonstrate knowledge of fundamental concepts of mathematics and the connections among them. The teacher must know and apply: | | |
| Sub. 3.C.5. concepts of data investigations: | | |
| 3.C.5.a | data and its power as a way to explore questions and issues | •The students share and discuss a variety of variables they would like to explore, then decide how best to organize these variables in a qualitative or quantitative fashion. Data is collected from all class members, and this data is used to apply the methods of summarizing, displaying and analyzing both quantitative and categorical variables. Similar activities are then completed using different data sets in homework (Ch. 1-2 In-Class Activity, Homework #2)<br>•The students complete a class project where they pose a question, then explore a way to answer that question by collecting data, organizing it and then summarizing that data in both a visual display and in text. (Graded Midterm Project) |
| 3.C.5.b | investigation through data, including formulating a problem; devising a plan to collect data; and systematically collecting, recording, and organizing data | •The students complete a graded class project where they formulate a problem or question that they are interested in investigating, devise an appropriate survey or observational study to collect data on their topic of interest, and—using a systematic, random and unbiased method—collect the data. They then organize the data and summarize it in both a visual display and in text, using statistical analysis to interpret and arrive at a response to the original question. (Graded Midterm Project)<br>•The students collect data by designing surveys, observational studies, and experiments. (Ch. 11 In-Class Activity, Exam #2)<br>•The students differentiate between the many methods of sampling and compare the usefulness of each in various applications (Homework #8, Exam #2) |
| Sub. 3.C.5.c | data representation to describe data distributions, central tendency, and variance through appropriate use of graphs, tables, and summary statistics; and | •The students relate shapes of frequency distributions to a variety of data set scenarios (Ch. 2 & 3 In-class activities, Homeworks #2 and #3)<br>•The students describe a data set using measures of center and a 5-number summary (Ch. 3 In-class activity, Homework #3) |
| Sub. 3.C.5.d | analysis and interpretation of data, including summarizing data; and making or evaluating arguments, predictions, recommendations, or decisions based on an analysis of the data; and | •The students calculate probabilities related to the Normal distribution and categorize the event as likely or unlikely based upon the p-value (Ch. 5 In-class activity, Homework #4, Exam #1) |
| Sub. 3.C.6. concepts of randomness and uncertainty: | | |
| Sub. 3.C.6.a | inference and the role of randomness and sampling in statistical claims about populations; | •The students use the Normal distribution to calculate probabilities related to IQ scores (Homework #4), fuel effiency (Ch. 5 In-class activity) and fictitious class exam scores (Exam #1) |

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|---|---|---|
| Sub. 3.C.6.b | probability as a way to describe chance or risk in simple and compound events; | •The students calculate simple and compound probabilities using the addition and multiplication rules to analyze dice games, card games and slot machines as well as other chance scenarios (such as selecting groups with certain characteristics). (Ch. 12 & 13 In-class activities, Homeworks #9 and #10, Exam #3) |
| Sub. 3.C.6.c | predicting outcomes based on exploration of probability through data collection, experiments, and simulations; and | •The students calculate simple and compound probabilities using the addition and multiplication rules to analyze dice games, card games and slot machines as well as other chance scenarios (such as selecting groups with certain characteristics) and use them to form opinions about whether it is wise to participate. (Ch. 12 & 13 In-class activities, Homeworks #9 and #10, Exam #3)<br>•The students use a simulation and the method of cluster sampling to predict the proportion of diseased fish in a lake (Ch. 9 In-Class Activity) |
| Sub. 3.C.6.d | predicting outcomes based on theoretical probabilities and comparing mathematical expectations with experimental results. | •The students apply theoretical probability to groups with characteristics of known proportions and uses these to predict potential group characteristics (Ch. 12, Homework #9)<br>•The students apply theoretical probability to games of chance in order to predict outcomes that. These games are then simulated in an in-class activity. The difference between the theoretical proportion and population proportion is discussed in conjunction with confidence intervals (Ch. 12 and 16 In-Class Activity)<br>•The students demonstrate knowledge of sampling distributions and sampling variability, namely that the mathematical expectation (population mean) is not typically the same as the experimental results (sample mean). (Ch. 12, Homework #11) |
| Sub. 3.D A teacher with a middle level endorsement for teaching mathematics in grades 5 through 8 must understand the content and methods for teaching reading, including: | | |
| Sub. 3.D.2. ability to use a wide range of instructional practices, approaches, methods, and curriculum materials to support reading instruction, including: | | |
| Sub. 3.D.2.e.iv | text with diagrams and graphs; and | •The students share and discuss a variety of procedural and conceptual knowledge during in-class group work including asking and answering clarifying questions of each other (Ch. 3, 4, 9 In-class activities)<br>•The students' homework assignments are posed in questions that routinely require them to communicate clearly, completely and correctly the mathematical processes used to solve problems as well as elaborate on their reasons for choosing the processes they did (All homeworks) |