Math 103: Statistics
Guttman Community College
1:15 – 2:45 pm, Mondays, Tuesdays & Fridays

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Office Hours: By Appointment

Catalogue Description and Overview
This course will provide students with an in-depth understanding of the fundamental concepts and computational methods of statistics. These concepts will be developed through the question of how to estimate an unknown quantity using sample data. Students will learn to incorporate the foundational concepts of mathematics with statistical analysis to describe and solve real-life problems and questions. Students will be taught to use estimation as well as to be precise and accurate. The course will also focus on teaching math study skills so students may assess and enhance their learning, their processes and their results. Students will use statistical software, or Microsoft Excel to carry out a semester-long project involving data description and analysis. Students will work collaboratively and write using appropriate mathematical and non-mathematical language in order to successfully complete their projects.

The topics addressed include: displaying categorical data using tables, bar graphs, and circle graphs; drawing conclusions about categorical data; displaying quantitative data using dot plots, stem-and-leaf plots, histograms and box-and-whisker plots; describing data distributions using measures of center (mode, mean, and median) and measures of spread (standard deviation, range and IQR); Displaying bivariate data using scatterplots; analyzing bivariate data using linear regression; elementary probability; normal probability distributions, sampling distributions; confidence intervals and hypothesis testing of the proportion and the mean.

Co-requisites or Pre-requisites: Demonstration of Elementary Algebra Proficiency

Credits/Contact Hours: 3 credits/4.5 contact hours

CUNY Pathways Category: Mathematics and Quantitative Reasoning

Course Learning Outcomes:
Upon successful completion of the course, students will be able to:

1. Identify and apply the concepts of numeracy to solve statistical and mathematical problems both with and without technological assistance.
2. Represent and know how to read, collect and organize data in written and graphical forms as well as interpret the data and make appropriate inferences from their readings.
3. Demonstrate an understanding of proportional relationships and how statistical inference is based in probability.
4. Design a project involving sample data from a variety of fields and appropriate statistical data analysis including formulating a question, selecting data and recognizing which statistical model is most appropriate for different data types and to answer different questions.

5. Recognize and understand functions as a way of modeling correspondence between two variables and employ appropriate statistical language, correct written English, and illustrative graphical depictions to communicate the relationship.
6. Construct, compute and accurately interpret confidence intervals and hypothesis tests and determine if the data supports a hypothesis to a given level of significance.
7. Demonstrate the ability to work collaboratively and independently on assignments in and outside a classroom setting.
8. Estimate mathematical quantities and evaluate the accuracy of their answers and adjust their work when necessary.

Guttman Learning Outcomes

Upon successful completion of this course, you will be able to do the following:

Broad, Integrative Knowledge:

b. Exhibits an understanding of how different disciplines create knowledge and approach problem-solving

Intellectual Skills for Life-Long Learning

c. Presents accurate mathematical calculations and operations, and explains how they are used to solve problems and to interpret data.
d. Utilizes both quantitative and qualitative data to explore and understand important issues.
e. Locates, evaluates and cites multiple information resources in projects, papers and presentations.
f. Demonstrates ability to use appropriate technologies, acquire new ones and to resolve technology problems to meet academic, professional and personal goals
g. Displays ability to assess own work and its relative value

Required Texts/Readings

Illowsky, B., Dean, Susan. *Introductory Statistics.* Texas, Houston: OpenStax. Download for free at https://openstax.org/details/books/introductory-statistics

Required Materials

Access to the Internet
CUNY Blackboard student account with integrated MyOpenMath: https://www.myopenmath.com/

Classroom Policies and Expectations for Classroom Participation & Engagement

Policy on attendance: do not skip class unless unavoidable – always email instructor if absent for any reason. As with any professional obligation, absences are to be avoided to promote success.

Participation and Activities: You are expected to demonstrate your participation and engagement with the course by completing a set of activities. Every week you will be given an activity to practice the new material individually or in small groups. You will submit your completed work by the deadline

Assignments and Assessment

Regular Problem Sets: Integrated into the class Blackboard

Short Quizzes: Regular Quizzes after each Homework

Chapter Tests: There will be four tests during the semester. These will be given during class and will be completed individually. No make-up tests will be given unless prior arrangements are made and the reason for the absence was unavoidable.

Group Project/Signature Assignment: The signature assignment for this course requires you to organize and analyze data using the statistical techniques that you have learned during the course. You will pose a research question, gather or identify data that can be used to help answer your question, analyze the data, and write a paper or give a presentation (depending on the choice of the instructor) that describes your data analysis and conclusions. Specific details about this assignment will be distributed by your instructor.

Technology Use:
You are encouraged to make appropriate use of technology throughout this course. We will use both Excel and Geogebra Statistics software that will help streamline needed computations. Note that during tests and quizzes any technology that is used should be used for computational purposes only. Access to other people and/or the internet is not allowed during tests and quizzes.

College-wide Policies

Policy on Academic Honesty

Guttman Community College considers intellectual honesty to be the cornerstone of all academic and scholarly work. GCC views any form of academic dishonesty as a serious matter and requires all instructors to report every case of academic dishonesty to its Academic Integrity Officer, who keeps records of all cases. All work submitted or posted by students in this course must be their own. Submission of writing or ideas which are not the original work of the student, or which is not adequately referenced, is considered plagiarism. Unintentional plagiarism is still plagiarism, so if you have any question about whether or not to acknowledge a source, acknowledge it. And if you are still uncertain, be sure to ask. Refer to Article II of your Student Grievance Procedures for further details on academic honesty and Guttman's academic integrity procedures, at [Academic Policies url link] Penalties for academic dishonesty include academic sanctions, such as failing or otherwise reduced grades, and/or disciplinary sanctions, including suspension or expulsion.

Disability Support Services

In compliance with the American Disability Act of 1990 (ADA) and with Section 504 of the Rehabilitation Act of 1973, Guttman Community College is committed to ensuring educational parity and accommodations for all students with documented disabilities and/or medical conditions. It is recommended that all students with documented disabilities (Emotional, Medical, Physical and/ or Learning) consult the Office of AccessABILITY located in Room 506 to secure necessary academic accommodations. For further information and assistance please call 646-313-8061 or speak to your Student Success Advocate or Career Strategist.

Critical Incident Management

Guttman expects students to respect the rights, privileges and property of other people. Faculty are required to report disruptive behavior that interrupts their ability to teach, compromises the safety of the learning environment or inhibits students' ability to learn.

Viewpoint Tolerance

Some of the issues covered during the seminar may evoke strong emotions. Students, faculty and staff must be able to disagree respectfully with others on topics that are personally very important to them. **Civility is essential to all scholarly discourse**.

Expectations for Out-of-Class Time

For every one instructional credit hour in class, a Guttman student is expected to spend at least two hours out-of-class studying, reading, writing, researching and working on projects, and preparing for tests. E.g. for a 3 credit course that meets for 3 hours each week, a student is expected to spend at least 6 hours outside of class time doing related course work. If a course provides more time in class than one hour for one credit, the additional time may offset out- of- class time expectations.

Assessment

Means of Formative and Summative Assessment

1. Regular homework assignments
2. Regular quizzes after each homework assignment
3. Four in-class tests, some of which may include a take-home portion. Tentative test dates are October 17(*Class 11), October 25 (Class 17), November 22 (Class 28), December 9 (Class 36)*
4. A semester-long project to be written in phases, including:
    a. The formulation of a research question
    b. the design of data collection and sampling methods
    c. collecting data
    d. descriptive analysis of the database population represented graphically, mathematically and in text
    e. calculating correlation coefficients and performing linear regression analysis
    f. calculating confidence interval and performing an hypothesis test
    g. final paper and presentation
5. Regular discussion question

Grading:

Attendance and participation	10%
MyOpenMath Homework	10%
Quizzes	10%
Chapter Tests	50%
Semester-long project:	20%

Overall grades will be based on the following scale

Letter Grade	Quality Points (GPA)	100-Point Scale
A+	4.0	97-100%
A	4.0	93-96.9%
A-	3.7	90-92.9%
B+	3.3	87-89.9%

B	3.0	83-86.9%
B-	2.7	80-82.9%
C+	2.3	77-79.9%
C	2.0	73-76.9%
C-	1.7	70-72.9%
D+	1.3	67-69.9%
D (passing)	1.0	60-66.9%
F	0	0-59.9%
NC*	Not calculated	0-59.9%

Incompletes are rarely given and will only be considered under the following circumstances: The student has completed the majority of the work for the course, the student is passing the course based on the work completed at the time the incomplete is requested, and there are extenuating circumstances that prohibit the completion of a small portion of the course.

***Conferences**:* Students will have one conference with the professor to discuss their progress. Students and the professor will work together in order to insure a comfortable and successful class.

Calendar:
Classes 1-5
Unit 1. Sampling and Data

Objectives
• Recognize and differentiate between key terms; *data, frequency, quantitative variables, qualitative variables, discrete variable, continuous variable, population, sample, statistic, parameter, mean, and proportion.*
• Find and use rates, including percentages.
• Know how to draw a random sample and understand that random sampling reduces bias.
• Create and interpret frequency, relative frequency, and cumulative frequency tables.
• Distinguish between observational studies and controlled experiments.
• Identify explanatory and response variables, treatments, control and treatment groups, and possible lurking variables.
• Understand what it means for an experiment to be blind or double blind.

Reference: Chapter 1 of Introductory Statistics- OpenStax
Section 1.1. Definitions of Statistics, Probability, and Key Terms
Section 1.2. Data, Sampling, and Variation in Data and Sampling
Section 1.3. Frequency, Frequency Tables, and Levels of Measurement
Section 1.4. Experimental Design and Ethics

Classes 6-11
Unit 2. Descriptive Statistics

Objectives
• Know how to make histograms, dotplots, stemplots, bar graphs, and box plots and interpret the graphs in context. • Calculate and interpret the measures of center of data: mean, median, and mode. • Calculate and interpret the measures of location of data: median, quartiles, and percentiles. • Calculate and interpret the measures of spread of data: variance, standard deviation, interquartile range, and range. • Identify the shape of data distribution. • Use the 1.5-rule to identify outliers. • Know how measures of center and spread are related to the shape of a data distribution. • Compare centers and spreads of distributions of samples informally. • Write comparison statements between samples of data in context. • Determine and interpret *z*-scores and compare values from different data sets using *z*-scores.

Reference: Chapter 2 of Introductory Statistics- OpenStax
Section 2.1. Stem-and-Leaf Graphs (Stemplots), Line Graphs, and Bar Graphs
Section 2.2. Histograms, Frequency Polygons, and Time Series Graphs
Section 2.3. Measures of the Location of the Data
Section 2.4. Box Plots
Section 2.5. Measures of the Center of the Data
Section 2.6. Skewness and the Mean, Median, and Mode
Section 2.7. Measures of the Spread of the Data

Test 1

Classes 12-14
Unit 3. Linear Regression and Correlation

Objectives
• Discuss basic ideas of linear regression and correlation. • Describe and interpret strength, trend, and shape of scatterplots. • Calculate and interpret the correlation coefficient. • Explain the difference between correlation and causation. • Create and interpret a line of best fit and know how to use the regression line to predict values of the response variable. • Identify outliers and describe how outliers might affect correlation and the regression line.

Reference: Chapter 12 of Introductory Statistics- OpenStax
Section 12.1. Linear Equations
Section 12.2. Scatter Plots
Section 12.3. The Regression Equation
Section 12.5. Prediction

Classes 15-16
Unit 4. Probability Topics

Objectives
• Understand that probability is a long-term relative frequency. • Know the difference between empirical and theoretical probabilities and how to calculate them. • Understand that The Law of Large Numbers enables us to use empirical probabilities to estimate theoretical probabilities. • Calculate probability from contingency tables.

Reference: Chapter 3 of Introductory Statistics- OpenStax
Section 3.1. Terminology
Section 3.4. Contingency Tables

Test 2

Classes 17-19
Unit 5. Probability Distribution Functions and the Normal Distribution

Objectives
• Recognize and understand discrete probability distribution functions, in general. • State the properties of a normal probability distribution. • Use the Empirical Rule to find probabilities related to normal distributions. • Use technology to determine probabilities associated with normal distributions and interpret the probabilities. • Find and interpret *z*-scores related to normal distributions.

Reference: Chapters 4 and 6 of Introductory Statistics- OpenStax
Section 4.1. Probability Distribution Function (PDF) for a Discrete Random Variable
Section 6.1. The Standard Normal Distribution
Section 6.2. Using the Normal Distribution

Classes 20-22
Unit 6. The Central Limit Theorem & Confidence Intervals for Sampling Proportions

Objectives
• Apply and interpret the central limit theorem for sample proportions. • Find, interpret and use confidence intervals for a single population proportion. • Use confidence intervals to compare two population proportions.

Reference: Chapter 7/8/10 of Introductory Statistics- OpenStax
Section 7.3. Using the Central Limit Theorem
Section 8.3. A Population Proportion
Section 10.3. Comparing Two Independent Population Proportions
Reference: OpenIntro Statistics
6.2.2 Confidence intervals for p1-p2
Reference: See Attachment
Section 7.4 - Population and Sample Proportion

Classes 23-28

Unit 7. Hypothesis Tests for Proportions

Objectives
• Conduct and interpret hypothesis tests for a single population proportion. • Understand the meaning of a p-value and how it is used. • Understand the meaning of significance level and how it is used. • Differentiate between Type I and Type II Errors. • Conduct and interpret hypothesis tests for two population proportions.

Reference: Chapter 9 of Introductory Statistics- OpenStax
Section 9.1. Null and Alternative Hypotheses
Section 9.2. Outcomes and the Type I and Type II Errors
Section 9.3. Distribution Needed for Hypothesis Testing
Section 9.4. Rare Events, the Sample, Decision and Conclusion
Section 9.5. Additional Information and Full Hypothesis Test
Section 10.3. Comparing Two Independent Population Proportions

Test 3

Classes 29-33
Unit 8. Central Limit Theorem & Confidence Intervals for Sampling Means

Objectives
• Apply and interpret the central limit theorem for sample means. • Find, interpret and use confidence intervals for a single population mean. • Discriminate between problems applying the normal and the Student's t distributions. • Calculate the sample size required to estimate a population mean and a population proportion given a desired confidence level and margin of error. • Use confidence intervals to compare two population means. •

Reference: Chapter 8 of Introductory Statistics- OpenStax
Section 7.1. The Central Limit Theorem for Sample Means
Reference: OpenIntro Statistics
5.3.1 Confidence interval for a difference of means

Classes 33-36
Unit 9. Hypothesis Test for Sampling Means

Objectives
• Classify hypothesis tests by type. • Conduct and interpret hypothesis tests for a single population mean, σ unknown. • Conduct and interpret hypothesis tests for two population means, σ unknown.

Reference: Chapter 8 of Introductory Statistics- OpenStax
Section 8.1. A Single Population Mean using the Normal Distribution

Section 8.2. A Single Population Mean using the Student t Distribution
Section 10.1. Two Population Means with Unknown Standard Deviations

Test 4