MTH556: Advanced Probability and Statistics

Credit Hours: 3

Contact Hours: This is a 3-credit course, offered in accelerated format. This means that 16 weeks of material is covered in 8 weeks. The exact number of hours per week that you can expect to spend on each course will vary based upon the weekly coursework, as well as your study style and preferences. You should plan to spend 14-20 hours per week in each course reading material, interacting on the discussion boards, writing papers, completing projects, and doing research.

Faculty Information

Faculty contact information and office hours can be found on the faculty profile page.

Course Description and Outcomes

Course Description:
This graduate-level course will introduce students to a wide range of probability and statistical concepts, with a foundation in calculus. The topics range across probability plots, probability density functions, and point estimates. Students will gain understanding and skills that go well beyond basic undergraduate statistics courses. Previous undergraduate coursework (at least 4-8 credits of undergraduate statistics and at least 12 credits of undergraduate calculus) is assumed. This course will offer best practices for dual credit course instruction and discussion of standard pedagogy.

Course Overview:
This course will introduce students to a wide range of probability and statistical concepts. The topics range from probability density functions to confidence intervals and go well beyond treatments in basic introductory statistics courses. This course will also include discussions of standard pedagogy and the linking of concepts to the undergraduate mathematics curriculum.

Course Learning Outcomes:

1. Calculate values for probability density functions.
2. Compute the expectation for a continuous random variable.
3. Describe properties of the normal distribution.
4. Construct probability plots.
5. Explain jointly distributed random variables.
6. Solve problems using methods of point estimation.
7. Reflect on implications for application of mathematical concepts in the classroom.

Participation & Attendance

Prompt and consistent attendance in your online courses is essential for your success at CSU-Global Campus. Failure to verify your attendance within the first 7 days of this course may result in your withdrawal. If for some reason you would like to drop a course, please contact your advisor.

Online classes have deadlines, assignments, and participation requirements just like on-campus classes. Budget your time carefully and keep an open line of communication with your instructor. If you are having technical problems, problems with your assignments, or other problems that are impeding your progress, let your instructor know as soon as possible.

Course Materials

Required:

Devore, J. (2016). *Probability and statistics for engineering and the sciences* (9th ed.). Boston, MA: Cengage Learning. ISBN: 9781305251809

Suggested:

NOTE: *All non-textbook required readings and materials necessary to complete assignments, discussions, and/or supplemental or required exercises are provided within the course itself. Please read through each course module carefully.*

Course Schedule

Due Dates

The Academic Week at CSU-Global begins on Monday and ends the following Sunday.

- Discussion Boards: The original post must be completed by Thursday at 11:59 p.m. MT and Peer Responses posted by Sunday 11:59 p.m. MT. Late posts may not be awarded points.
- Check Your Understanding Exercises: These exercises occur at various points in the week's content to see which areas you will need to focus on. You may take these exercises as many times as you need. The Check Your Understanding exercises will not affect your final grade.
- Students have one attempt on the midterm and final exams. The time limit is 400 minutes for each exam, and the exam must be completed in one sitting.
- Critical Thinking: Assignments are due Sunday at 11:59 p.m. MT.
- Live Classroom: Although participation is not required, Live Classroom sessions are held during Weeks 3 and 6. There are two total sessions.

Week #	Readings	Assignments
1	• Chapter 4.1-4.3 in *Probability and Statistics for Engineering and the Sciences*	• Discussion (25 points)

	• Norton, A. (2015, August). The wonderful gift of mathematics. *The Mathematics Educator*, 24(1), 3-20. Retrieved from http://tme.journals.libs.uga.edu/index.php/tme/article/view/277 • Farnsworth, D. L. (2004). A calculus theorem motivated by a statistics problem. *The College Mathematics Journal*, 35(2), 126-129	
2	• Chapter 4.4-4.6 in *Probability and Statistics for Engineering and the Sciences* • Evans, B. (2015, May). Student attitudes, conceptions, and achievement in introductory undergraduate college statistics. *The Mathematics Educator*, *17*(2). Retrieved from http://tme.journals.libs.uga.edu/index.php/tme/article/view/185 • Farnsworth, D. L. (2000). The geometry of statistics. *The College Mathematics Journal, 31*(3), 200-204.	• Discussion (25 points) • Critical Thinking (80 points)
3	• Chapter 5.1-5.3 in *Probability and Statistics for Engineering and the Sciences* • Franklin, C. (2015, May). Common core state standards and the future of teacher preparation in statistics. *The Mathematics Educator*, 22(2). Retrieved from http://tme.journals.libs.uga.edu/index.php/tme/article/view/252 • Devlin, K. (2005). A mathematician at the ballpark. *The College Mathematics Journal*, 36(3), 255-256.	• Discussion (25 points) • Critical Thinking (80 points) • Live Classroom (0 points)
4	• Chapter 5.4-5.5 in *Probability and Statistics for Engineering and the Sciences* • Fothergill, L. (2015, May). Aspects of calculus for preservice teachers. *Mathematics Educator, 21*(1), n. 1. Retrieved from http://tme.journals.libs.uga.edu/index.php/tme/article/view/231 • Rossman, A. J., & Chance, B. L. (1999). Teaching the reasoning of statistical inference: A "top ten" list. *College Mathematics Journals, 30*(4), 297-305.	• Discussion (25 points) • Critical Thinking (80 points) • Midterm Exam (200 points)
5	• Chapter 6.1 in *Probability and Statistics for Engineering and the Sciences* • Cannon, A. R. (1999). Decoding a scrambled text: A hands-on project to illustrate sampling and variability. *College Mathematics Journal, 30*(5), 416. • Eves, H. W. (2002). A very brief history of statistics. *College Mathematics Journal, 33*(4), 306-308.	• Discussion (25 points) • Critical Thinking (80 points)
6	• Chapter 6.2 in *Probability and Statistics for Engineering and the Sciences* • Norton, S. (1999). Statistics and mathematics—trouble at the interface?/breaking misconceptions—statistics and its relationship to mathematics/mathematics: Governess or handmaiden? *College Mathematics Journal, 30*(2), 152. • Statistical issues in HIV research. (1999). *College Mathematics Journal, 30*(1), 71.	• Discussion (25 points) • Critical Thinking (80 points) • Live Classroom (0 points)
7	• Chapter 7.1-7.2 in *Probability and Statistics for Engineering and the Sciences*	• Discussion (25 points)

	• Norton, S. (1999). Risk—A motivating theme for an introductory statistics course. *College Mathematics Journal, 30*(1), 75. • Reflections on statistics: Learning, teaching, and assessment in grades K-12. (1998). *Journal for Research in Mathematics Education, 29(*2), 238.	
8	• Chapter 7.3-7.4 in *Probability and Statistics for Engineering and the Sciences* • Groth, R. E. (2007). Toward a conceptualization of statistical knowledge for teaching. *Journal for Research in Mathematics Education, 38*(5), 427. • Leung, K., Rasmussen, C., Shen, S. S. P., & Zazkis, D. (2014). Calculus from a statistics perspective. *College Mathematics Journal, 45*(5), 377.	• Discussion (25 points) • Final Exam (200 points)

Assignment Details

This course includes the following assignments/projects:

Module 1

None

Module 2

CRITICAL THINKING ASSIGNMENT (80 points)
Choose one of the following two assignments to complete this week. Do not complete both assignments. Identify your assignment choice in the title of your submission.

Note that while there are two options for this Critical Thinking Assignment, there is only one rubric. Review the rubric to confirm that you are meeting the assignment requirements.

Option #1: College Freshmen Student Lesson: Relationship between Calculus and Statistics
It is not uncommon for college students to take Calculus I, II, and III. It is also not uncommon for students to take a statistics course while in their first year of college. On the surface, these two types of courses may seem very different in content. Or are they? Are calculus and statistics related?

Based on your readings from Chapters 4 and 5 of the textbook, you'll have noticed calculus concepts appearing in various examples, definitions, and formulas.

For this assignment, your task is to create a lesson that could be delivered to a group of college freshmen who have completed Calculus I, II, and III and a college statistics course. The goal is to show these students how concepts from statistics and calculus are related.

Requirements:

- Prepare a 35-minute PowerPoint presentation of 15 slides.
- Incorporate two fully solved example problems in the presentation.

What you do with the remainder of the presentation is up to you. Include whatever background information you think the students need, either something informative or something that will hold their attention, or a combination of both.

Some suggestions to enhance your presentation include the use of video, audio, animations of mathematical concepts, and calculator applications. Be innovative!

Submit your completed assignment to the **Assignments** page by the end of Week 2.

Review the **Module 2 Critical Thinking Assignment Rubric** for full details on how you will be graded on this assignment.

Option #2: College Freshmen Student Lesson: Calculus in the Real World
It is not uncommon for first-year college students to take Calculus I, II, and III. It is also not uncommon for students to take a college statistics course while still in high school. On the surface, these two types of courses may seem very different in content. Or are they? Are calculus and statistics related?

Based on your readings from Chapters 4 and 5 of the textbook, you'll have noticed calculus concepts appearing in various examples, definitions, and formulas.

For this assignment, your task is to create a lesson that could be delivered to a group of college freshmen who have completed Calculus I, II, and III and a college statistics course. The goal is to show these students how concepts you are learning in this class (MTH556) apply to the real world.

Requirements:

- Prepare a 35-minute PowerPoint presentation of 15 slides.
- Incorporate two fully solved example problems in the presentation.

What you do with the remainder of the presentation is up to you. Include whatever background information you think the students need, either something informative or something that will hold their attention, or a combination of both.

Some suggestions to enhance your presentation include the use of video, audio, animations of mathematical concepts, and calculator applications. Be innovative!

Submit your completed assignment to the **Assignments** page by the end of Week 2.

Review the **Module 2 Critical Thinking Assignment Rubric** for full details on how you will be graded on this assignment.

Module 3

CRITICAL THINKING ASSIGNMENT (80 points)
Choose one of the following two assignments to complete this week. Do not complete both assignments. Identify your assignment choice in the title of your submission.

Note that while there are two options for this Critical Thinking Assignment, there is only one rubric. Review the rubric to confirm that you are meeting the assignment requirements.

Option #1: Sample Midterm Exam Questions
For this assignment, your task is to create a five-question midterm exam for this class. Which types of questions do you think will actually be on the midterm?

Create the actual questions, and then complete an answer key with a full solution for each question. Questions can be multiple choice, short answer, true/false, and computational, and may take other forms as well. A minimum of one computational question is required.

For multiple-choice, short-answer, and true/false questions, an explanation of why the answers are correct must be included.

Submit your completed assignment to the **Assignments** page by the end of Week 3.

Review the **Module 3 Critical Thinking Assignment Rubric** for full details on how you will be graded on this assignment.

Option #2: Sample Practice Exercise Questions
For this assignment, your task is to select five problems from the textbook exercises in Chapter 5, any section. These problems should highlight the key concepts covered up to this point in the course.

For each problem you select, complete the following:

- Indicate the specific problem (e.g., Chapter 5.1, #4).
- Write out the question.
- Provide a full solution to the question.

Submit your completed assignment to the **Assignments** page by the end of Week 3.

Review the **Module 3 Critical Thinking Assignment Rubric** for full details on how you will be graded on this assignment.

Module 4

MIDTERM EXAM (200 points)

CRITICAL THINKING ASSIGNMENT (80 points)
Choose one of the following two assignments to complete this week. Do not complete both assignments. Identify your assignment choice in the title of your submission.

Note that while there are two options for this Critical Thinking Assignment, there is only one rubric. Review the rubric to confirm that you are meeting the assignment requirements.

Option #1: Presentation on Chapter 5, Section 5.1 – Jointly Distributed Random Variables
For this assignment, your task is to create a PowerPoint presentation that provides an overview of this section in Chapter 5 of your textbook.

Requirements:

- Include a minimum of 10 slides.
- Include at least two example problems to illustrate the content presented.

What you do with the remainder of the presentation is up to you. Include whatever background information you think the students need, either something informative or something that will hold their attention, or a combination of both.

Some suggestions to enhance your presentation include the use of video, audio, animations of mathematical concepts, and calculator applications. Make the presentation engaging!

Submit your completed assignment to the **Assignments** page by the end of Week 4.

Review the **Module 4 Critical Thinking Assignment Rubric** for full details on how you will be graded on this assignment.

Option #2: Presentation on Chapter 5, Section 5.2 – Expected Values, Covariances, and Correlation

For this assignment, your task is to create a PowerPoint presentation that provides an overview of this section in Chapter 5 of your textbook.

Requirements:

- Include a minimum of 10 slides.
- Include at least two example problems to illustrate the content presented.

What you do with the remainder of the presentation is up to you. Include whatever background information you think the students need, either something informative or something that will hold their attention, or a combination of both.

Some suggestions to enhance your presentation include the use of video, audio, animations of mathematical concepts, and calculator applications. Make the presentation engaging!

Submit your completed assignment to the **Assignments** page by the end of Week 4.

Review the **Module 4 Critical Thinking Assignment Rubric** for full details on how you will be graded on this assignment.

Module 5

CRITICAL THINKING ASSIGNMENT (80 points)
Choose one of the following two assignments to complete this week. Do not complete both assignments. Identify your assignment choice in the title of your submission.

Note that while there are two options for this Critical Thinking Assignment, there is only one rubric. Review the rubric to confirm that you are meeting the assignment requirements.

Option #1: Gulf Real Estate Properties, Inc., Sales
Background: Gulf Real Estate Properties, Inc., is a real estate firm located in southwest Florida. The company, which advertises itself as an "expert in the real estate market," monitors condominium sales by collecting data on location, list price, sales price, and the number of days it takes to sell each unit. Each condominium is classified as *gulf view* if it is located directly on the Gulf of Mexico, or as *no gulf view* if it is located on the bay or on a golf course.

Sample data from the Multiple Listing Service in Naples, Florida, provided sales data for 40 *gulf view* condominiums and 18 *no gulf view* condominiums. The complete data set is in the file named **Real Estate,** linked on the Critical Thinking Assignment page.

Requirements for this assignment are as follows:

1. Provide descriptive statistics (mean, medium, range, and standard deviation) summarizing each of the three variables for the 40 *gulf view* condominiums.
2. Provide descriptive statistics (mean, medium, range, and standard deviation) summarizing each of the three variables for the 18 *no gulf view* condominiums.
3. Provide a 95% confidence interval estimate of the population mean sales price and population mean number of days to sell for the *gulf view* condominiums.
4. Provide a 95% confidence interval estimate of the population means sales price and population mean number of days to sell for the *no gulf view* condominiums.
5. Given the assumption that the branch manager requested estimates of the mean selling price of *gulf view* condominiums with a margin of error of $40,000, and the mean selling price of *no gulf view* condominiums with a margin of error of $15,000, if you use 95% confidence, how large should the same size be for each?

Submit your completed assignment to the **Assignments** page by the end of Week 5.

Review the **Module 5 Critical Thinking Assignment Rubric** for full details on how you will be graded on this assignment.

Option #2: Beltway Shoe Company Sales
Background: Beltway Shoe Company sells luxury leather shoes in the United States. The company monitors its shoe sales by collecting randomly chosen data from store locations throughout the country. They record original price, sales price, and number of days it takes to sell each unit. Each pair of shoes is classified as *eastern region* if it is sold in the eastern part of the United States, or as *western region* if it is sold in the western part of the United States. Randomly chosen samples provided sales data for 50 western regions and 50 eastern regions. The complete data set is in the file named **Shoes**, linked on the Critical Thinking Assignment page.

Requirements for this assignment are as follows:

1. Provide descriptive statistics (mean, medium, range, and standard deviation) summarizing each of the three variables for the 50 western region shoes. Are there any outliers in the data set for any of the three variables? If there are any outliers in any category, list them and state for which category they are an outlier.
2. Provide descriptive statistics (mean, medium, range, and standard deviation) summarizing each of the three variables for the 50 eastern region shoes. Are there any outliers in the data set for any of the three variables? If there are any outliers in any category, list them and state for which category they are an outlier.
3. Provide a 90% confidence interval estimate of the *population* mean sales price and *population* mean number of days to sell for pairs of Beltway shoes in the eastern region.
4. Provide a 90% confidence interval estimate of the *population* mean sales price and *population* mean number of days to sell for pairs of Beltway shoes in the western region.
5. Assuming a branch sales manager requested estimates of the mean selling price of western region shoes with a margin of error of $5, and the mean selling price of eastern region shoes with a margin of error of $4, if you use 90% confidence, how large should the sample size be for each?

Submit your completed assignment to the **Assignments** page by the end of Week 5.

Review the **Module 5 Critical Thinking Assignment Rubric** for full details on how you will be graded on this assignment.

Module 6

CRITICAL THINKING ASSIGNMENT (80 points)
Choose one of the following two assignments to complete this week. Do not complete both assignments. Identify your assignment choice in the title of your submission.

Note that while there are two options for this Critical Thinking Assignment, there is only one rubric. Review the rubric to confirm that you are meeting the assignment requirements.

Option #1: Springdale Shopping Survey
Background: The major shopping areas in the community of Springdale include Springdale Mall, West Mall, and the downtown area of Main Street. A telephone survey has been conducted to identify the strengths and weakness of these areas, and to find out how they fit into the shopping activities of local residents. The 150 respondents were also asked to provide information about themselves and their shopping habits. The data are provided in the file **Shopping**, linked on the Critical Thinking Assignment page. The variables in the survey can be found in the file **Coding**, also linked on the Critical Thinking Assignment page.

For this assignment, some of the estimation techniques presented in this module apply to the Springfield shopping survey results. You may assume that the respondents represent a simple random sample of all potential respondents within the community, and that the population is large enough that application of the finite population correction would not make an appreciable difference in the results.

Managers associated with shopping areas like these find it useful to have point estimates of variables describing the characteristics and behaviors of their customers. In addition, it is helpful for them to have some idea as to the likely accuracy of these estimates. Therein lies the benefit of the techniques presented in this module and applied here.

Requirements for this assignment are as follows:

1. Item C in the **Shopping** file lists variables 7, 8, and 9, which represent the respondents' general attitudes toward each of the three shopping areas. Each of these variables has numerically equal distances between the possible responses, and for purposes of analysis, they may be considered to be of the interval scale of measurement. For this step, complete the following:
    a. Determine the point estimate; then construct the 95% confidence interval for μ_7 = the average attitude toward Springdale Mall.
    b. Repeat this point estimate determination for μ_8 and μ_9, the average attitudes toward the downtown area of Main Street and the West Mall, respectively.
2. Given the breakdown of responses for Item F, Variable 26, Gender of Respondents, determine the point estimate; then construct the 95% confidence interval for π_{26} = the population proportion of males.
3. Given the breakdown of responses for Item F, Variable 28, Marital Status of Respondents, determine the point estimate; then construct the 95% confidence interval for π_{28} = the population proportion in the *single or other* category.
4. Assume the managers have requested estimates of the mean attitudes toward each mall, with a margin of error of 0.05 for each mall. If the managers want to have 95% confidence that the sample mean will fall within this margin of error, how large should the sample size be for each mall?

Submit two documents to the **Assignments** page by the end of Week 6: an Excel file showing the raw data, and your formulas and computations; and a Word document with your numeric answers to questions 1-4.

Review the **Module 6 Critical Thinking Assignment Rubric** for full details on how you will be graded on this assignment.

Option #2: People Living in NYC Survey

Background: A consulting firm was hired to perform a survey on people living in New York City. The survey was completed monthly for six months by 445 randomly selected people in different boroughs. There are a number of items on the survey, but six basic biographical items are studied for this assignment. The data for the people surveyed in one monthly survey can be found in the file **Survey**, linked on the Critical Thinking Assignment page. The variables that were used for the basic biographical data are found on the last page of the **Survey** document.

For this assignment, some of the estimation techniques presented in this module are applied to the NYC survey results. You may assume that the respondents represent a simple random sample of all potential respondents within the community, and that the population is large enough that application of the finite population correction would not make an appreciable difference in the results.

NYC governmental agency personnel like to have point estimates of variables describing the biographical information of people living within the different boroughs. It is very helpful for them to have some idea regarding the likely accuracy of these estimates as well. Therein lies the benefit of the techniques presented in this module and applied here.

1. Requirements for this assignment are as follows: Item A in the description of the data collection instrument lists Variables 1 through 5, which represent the respondents' general attitudes toward each of the five boroughs. Each of these variables has numerically equal distances between the possible responses, and for purposes of analysis, they may be considered to be of the interval scale of measurement. For this step, complete the following:
    a. Determine the point estimate; then construct the 95% confidence interval for μ_1 = the average attitude toward Manhattan.

b. Repeat this point estimate determination for μ_2 through μ_5, the average attitudes toward Brooklyn, Queens, The Bronx, and Staten Island, respectively.

2. Given the breakdown of responses for Variable 6 (highest level of education), determine the point estimate; then conduct the 95% confidence interval for π_6 = the population proportion of doctoral degrees.
3. Given the breakdown of responses for Variable 7 (marital status of respondents), determine the point estimate; then conduct the 95% confidence interval for π_7 = the population proportion in the *single or other* category.
4. Assume that governmental agencies requested estimates of the mean attitude toward each borough, with a margin of error of 0.05 for each borough. If the governmental agency personnel want to have 95% confidence that the sample will fall within this margin of error, how large should the sample sizes be for each borough?

Submit two documents to the **Assignments** page by the end of Week 6: an Excel file showing the raw data, and your formulas and computations; and a Word document with your numeric answers to questions 1-4.

Review the **Module 6 Critical Thinking Assignment Rubric** for full details on how you will be graded on this assignment.

Module 8

FINAL EXAM (200 points)

Course Policies

Course Grading

20% Discussion Participation
0% Live Classroom
40% Critical Thinking Assignments
40% Midterm and Final Exams

Grading Scale and Policies

A	95.0 – 100
A-	90.0 – 94.9
B+	86.7 – 89.9
B	83.3 – 86.6
B-	80.0 – 83.2
C+	75.0 – 79.9
C	70.0 – 74.9
D	60.0 – 69.9
F	59.9 or below

In-Classroom Policies
For information on late work and incomplete grade policies, please refer to our **In-Classroom Student Policies and Guidelines** or the Academic Catalog for comprehensive documentation of CSU-Global institutional policies.

Academic Integrity
Students must assume responsibility for maintaining honesty in all work submitted for credit and in any other work designated by the instructor of the course. Academic dishonesty includes cheating, fabrication, facilitating academic dishonesty, plagiarism, reusing /re-purposing your own work (see *CSU-Global Guide to Writing and APA Requirements* for percentage of repurposed work that can be used in an assignment), unauthorized possession of academic materials, and unauthorized collaboration. The CSU-Global Library provides information

on how students can avoid plagiarism by understanding what it is and how to use the Library and Internet resources.

Citing Sources with APA Style
All students are expected to follow the *CSU-Global Guide to Writing and APA Requirements* when citing in APA (based on the APA Style Manual, 6th edition) for all assignments. For details on CSU-Global APA style, please review the APA resources within the CSU-Global Library under the "APA Guide & Resources" link. A link to this document should also be provided within most assignment descriptions in your course.

Disability Services Statement
CSU–Global is committed to providing reasonable accommodations for all persons with disabilities. Any student with a documented disability requesting academic accommodations should contact the Disability Resource Coordinator at 720-279-0650 and/or email ada@CSUGlobal.edu for additional information to coordinate reasonable accommodations for students with documented disabilities.

Netiquette
Respect the diversity of opinions among the instructor and classmates and engage with them in a courteous, respectful, and professional manner. All posts and classroom communication must be conducted in accordance with the student code of conduct. Think before you push the Send button. Did you say just what you meant? How will the person on the other end read the words?

Maintain an environment free of harassment, stalking, threats, abuse, insults or humiliation toward the instructor and classmates. This includes, but is not limited to, demeaning written or oral comments of an ethnic, religious, age, disability, sexist (or sexual orientation), or racist nature; and the unwanted sexual advances or intimidations by email, or on discussion boards and other postings within or connected to the online classroom.

If you have concerns about something that has been said, please let your instructor know.