

DS 623: Math & Statistics for Data Science

School of Technology & Computing

3 Credits, Graduate Course
Fall 2021

Access to the Internet is required.

All written assignments must be in Microsoft-Word-compatible formats.

See the library's APA Style Guide tutorial for a list of resources that can help you use APA style.

Faculty Information

Professional experience information for instructors is found under *Faculty Information* in the online course menu.

Contact Information

Contact information for instructors is found under *Faculty Information* in the online course menu.

Faculty Name:

Email:

Office Hours and Response Time: Please email me to set up a meeting. I will respond within 24 hours during the weekdays and 48 hours on the weekends.

Bio:

Course Description

This course is designed to provide mathematics concepts and applied statistics useful for data science with a statistical programming language. The fundamental mathematical tools needed to understand machine learning include linear algebra, analytic geometry, matrix decompositions, vector calculus, optimization, probability, and statistics. Topics of applied statistics range from syntax basics of the chosen statistical programming language, descriptive statistics, and data visualizations to inferential statistics and regressions. Students completing this course will have an understanding of building intuition and practical experience with applying mathematical and statistical concepts to data science.

Course Resources

Required and recommended resources to complete coursework and assignments are found on the course [Reading List](#). Note: resources listed under "Required - Must Purchase" should be purchased from a vendor of the student's own choosing; resources listed under "Available from the Library" are available at no cost to students.

Course Outcomes

As a result of this course, students will know or be able to do the following:

- Understand fundamental mathematical concepts used in data science.
- Apply machine learning algorithms to real-world models using a programming language.
- Analyze machine learning models and algorithms using mathematical and statistical concepts .
- Evaluate and interpret probabilistic and statistical models in data science.

- Create a positive and informed perspective on the role of mathematics and statistics in data science.

Grading Scale

The grades earned for the course will be calculated using City University of Seattle’s decimal grading system, found in the current University Catalog (<https://www.cityu.edu/catalog/>).

Grading rubrics with details on how each assignment will be graded are located under *Assignments* and/or in *My Grades* in the online course menu. Students should review the rubric for each assignment prior to completing their work in order to understand how it will be assessed.

OVERVIEW OF REQUIRED ASSIGNMENTS	% OF FINAL GRADE	POINTS
The Muddiest Point (MP)	5%	50 = 5 points * 10 modules
Concept Test (CT)	5%	50 = 5 points * 10 modules
Discussion Board (DB)	10%	100 = 10 points * 10 modules
Hands-On Skill (HOS)	20%	200 = 25 points * 8 modules
Programming Exercise (PE)	30%	300 = 30 points * 10 modules
Knowledge Check (KC)	10%	100 = 10 points * 10 modules
Team Project (TP)	20%	Proposal: 30 points Progress: 70 points Final Report: 70 points Final PPT: 30 points Subtotal: 200 points
TOTAL	100%	1,000 points

Course Assignments and Grading

The instructor will provide grading rubrics that provide more detail as to how this assignment will be graded.

The Muddiest Point (MP)

Before class, students are required to submit the Muddiest Point (MP) activity. The purpose of this activity is to stimulate student engagement. The instructor uses the MP to assess how students understood the required readings. The instructor also uses the MP to customize the lecture scope to implement Just-in-Time Teaching (JiTT). The MP consists of writing a brief reflective essay (<= 50 words) identifying the most confusing part (i.e., the MP) of the content covered in the upcoming module. If a student understood all concepts, the student needs to explain the most exciting aspect. There is one multiple-choice question from the required reading to demonstrate that the student understood the required readings.

Criteria	% of Grade
Participation	30%

Writing	40%
Citation	10%
Correctness	20%
TOTAL	100%

Concept Test (CT)

The instructor poses a problem based on key concepts of a lecture. After reflecting on the problem, students submit their response and the instructor review them without providing a correct answer. Students discuss their thought process and solution with a peer. Students then commit to an answer and re-submits their responses. Instructor reviews responses and thought processes with the correct or most compelling answer.

Criteria	% of Grade
Engagement	100%
TOTAL	100%

Discussion Board (DB)

A student posts an answer to a weekly discussion topic in Discussion Board. The student also posts a response to two other students' posts by the end of each module. Comments and questions should be clear and thoughtful, with correct grammar, spelling, and punctuation. The instructor will grade the quality of your discussion postings on both content and response.

Components	% of Grade
Participation	50%
Writing	50%
TOTAL	100%

Hands-on Skill (HOS)

The instructor will assign hands-on skill exercises to a pair of students in class or individually online. Students pair up and practice exercises to learn specific programming languages, application programming interfaces (APIs), or tools related to the programming assignments or virtual labs. Two quizzes measure hands-on skills acquired.

Criteria	% of Grade
Skill Exercise	64%
Engagement	20%
Correctness	16%
TOTAL	100%

Programming Exercise (PE)

The students must individually perform the programming exercise. Programs must be executable and robust. Non-executable programs will not receive any credits. Programs should deliver correct answers on all valid input and produce comprehensible error messages on invalid input. Programs also run correctly on all test

data given within an assigned period. Students should write programs that are easy for other people to read.

Criteria	% of Grade
Program Execution	40%
User Requirement	40%
Program Documentation	20%
TOTAL	100%

Knowledge Check (KC)

Weekly quizzes measure knowledge concepts acquired. Focus on the underlying principles and concepts rather than memorization to solve the quizzes.

Criteria	% of Grade
Correctness	100%
TOTAL	100%

Team Project (TP)

Teams consist of three to four students. Each team will use an instructor-approved topic relevant to the course.

The paper is to be between 6 and 7 pages. The required template for class submissions comes from international organizations, the Education Special Interest Group and the Computing Education + Information systems Applied Research. ([EDSIG/CONISAR](#)). The instructor may recommend teams submit their paper to conferences. Submissions are optional and will not impact the course grade. Additional revisions may be required after the course.

Three report templates and one presentation template are provided. The file name consists of team project number, team number, and the list of your team members. For example, "TP01 T03 Sam John Mark."

- TP01 for the proposal - "TP01 T0X Author1 Author2 Author3.docx"
- TP02 for the progress report - "TP02 T0X Author1 Author2 Author3.docx"
- TP03 for the final report - "TP03 T0X Author1 Author2 Author3.docx"
- TP04 for the final presentation slide - "TP04 T0X Author1 Author2 Author3.pptx"

As in any scholarly writing, students should not merely copy information from another author. Students should use evidence to support the contentions they have drawn from their findings and critically analyze related literature. In essence, each paper needs to be an analytical paper, not a summary of readings.

In addition, a team slide deck presentation is required.

- The presentation consists of 15+4 slides: 15 slides for content and 4 slides for cover, agenda, key reference, and Q&A.
- The PPT template is provided. Your team can change design and color.

- A presentation video (15 minutes) is required.
- A demo video (a maximum of 1-2 minutes) may be included. The demo time is included in the 15 minutes presentation.

Four submissions are required according to the following schedule:

- Proposal (1 page; 30 points) - Starting (Module 1) & Ending (Module 3)
- Progress Report (3-4 pages; 70 points; graded after the proposal has been submitted) - Starting (Module 4) & Ending (Module 7)
- Final Report (6-7 pages; 70 points; graded after the progress has been submitted) - Starting (Module 8) & Ending (Module 10)
- Final PPT (15+4 slides, 30 points; graded after the final report has been submitted) - Starting (Module 8) & Ending (Module 10)

Students are expected to use the assigned readings, videos, and other materials throughout the quarter. Students will need to utilize additional sources that were not assigned by the professor. While stylized after an industry report, nonetheless, students are expected to employ APA formatting of citations, footnotes, and bibliography. Students must cite the sources of all ideas, facts, and information used that are not their own, even if they have put the information into their own words. Failure to do so is plagiarism, although the oversight is unintentional. To avoid plagiarism, check <https://library.cityu.edu/howto/apa-writing/avoid-plagiarism/>.

Project Description

(To be determined by the SME.)

Team Project (TP) Report

The student will provide a report formatted based on a template provided by the instructor. Students are required to improve the writing iteratively and incrementally every week. The revision will always happen during a quarter. Students will add new required sections to the existing paper every week.

The final report is the culmination of applied research and activities conducted throughout the quarter. The final report/paper provides a detailed problem and its solution likely to be encountered by a company or organization described in a case study supplied by the student.

Criteria	% of Grade
Structure	20%
Content	30%
Writing	30%
Reference	10%
Collaboration	10%
TOTAL	100%

Team Project (TP) Presentation

The student will report on the research outcomes, development, or other project efforts to an academically appropriate committee in a public forum. The nature of the presentation content

will determine the specific makeup of the audience. The student will choose the format of the presentation, in consultation with the advisor. The layout and design must be appropriate and adequate to represent the outcomes of the effort. While students must make some form of a visual presentation, the presentation of the results may include publishing in a refereed publication, publication in a trade or popular magazine or journal, broadcast in an appropriate medium, or, in exceptional cases, limited dissemination within a closed community.

Each presenter will have 15 minutes for presentation and 5 minutes for questions and answers. Each presenter must keep the total presentation time limit strictly.

Criteria	% of Grade
Structure	20%
Visual Presentation	30%
Verbal Quality & Engagement	30%
Team Collaboration	20%
TOTAL	100%

Course Policies

Course policies on topics such as *Late Assignments*, *Participation*, and *Professional Writing* are found under *Course Information* in the online course menu. Students are responsible for reviewing and applying these policies while enrolled in this course.

University Policies

Students are responsible for understanding and adhering to all of City University of Seattle's academic policies. The most current versions of these policies can be found in the [University Catalog](#) that is linked from the CityU Web site.

Title IX Statement

City University of Seattle and its faculty are committed to supporting our students and seeking an environment that is free of bias, discrimination, and harassment. If students have encountered any form of sexual misconduct (e.g. sexual assault, sexual harassment, stalking, domestic or dating violence), we encourage them to report this to the University. If a student speaks with a faculty member about an incident of misconduct, that faculty member must notify CityU's Title IX coordinator and share the basic fact of the experience. The Title IX coordinator will then be available to assist students in understanding all of the options and in connecting students with all possible resources on and off campus.

To view CityU's sexual misconduct policy and for resources, please visit the [Title IX](#) and [Campus Safety](#) pages in the my.cityu.edu portal.

Religious Accommodations

Washington state law requires that City University of Seattle develop a policy for accommodation of student absences or significant hardship due to reasons of faith or conscience, or for organized religious activities. The University's policy, including more information about how to request an accommodation, is available in the University Catalog. Accommodations must be requested within the first two weeks of this course using the Religious Accommodations Request Form found on the student dashboard in the my.cityu.edu student portal.

Academic Integrity

Academic integrity in students requires the pursuit of scholarly activity that is free from fraud, deception and unauthorized collaboration with other individuals. Students are responsible for understanding CityU's policy on academic integrity and adhering to its standards in meeting all course requirements. A complete copy of this policy can be found in the [University Catalog](#) under *Student Rights and Responsibilities* on the page titled *Academic Integrity Policy*.

Attendance

Students taking courses in any format at the University are expected to be diligent in their studies and to attend class regularly.

Regular class attendance is important in achieving learning outcomes in the course and may be a valid consideration in determining the final grade. For classes where a physical presence is required, a student has attended if they are present at any time during the class session. For online classes, a student has attended if they have posted or submitted an assignment. A complete copy of this policy can be in the [University Catalog](#) under *Student Rights and Responsibilities* on the page titled *Attendance*.

Support Services

Disability Services Accommodations Statement

Students with a documented disability who wish to request academic accommodations are encouraged to contact Disability Support Services to discuss accommodation requests and eligibility requirements. Please contact Disability Support Services at disability@cityu.edu or 206.239.4752 or visit the [Disability Support Services](#) page in the my.cityu.edu portal. Confidentiality will be observed in all inquiries. Once approved, information about academic accommodations will be shared with course instructors.

Library Services

CityU librarians are available to help students find the resources and information they need to succeed in this course. Contact a CityU librarian through the [Ask a Librarian](#) service, or access [library resources and services online](#), 24 hours a day, seven days a week.

Smarthinking Tutoring

CityU students have access to free online tutoring offered through Smarthinking, including writing support, from certified tutors 24 hours a day, seven days a week. Contact CityU's Student Support Center at help@cityu.edu to request a username and password.

Rubrics for DS 623

The Muddiest Point (MP) Rubric

Description

Before class, students are required to submit the Muddiest Point (MP) activity. The purpose of this activity is to stimulate student engagement. The instructor uses the MP to assess how students understood the required readings. The instructor also uses the MP to customize the lecture scope to implement Just-in-Time Teaching (JiTT). The MP consists of writing a brief reflective essay (≤ 50 words) identifying the most confusing part (i.e., the MP) of the content covered in the upcoming module. If a student understood all concepts, the student needs to explain the most exciting aspect. There is one multiple-choice question from the required reading to demonstrate that the student understood the required readings.

Rubric Detail

100%	Levels of Achievement			
Criteria	Below Standard	Approaching Standard	At Standard	Exceeds Standard
Graduate Percentage Scale	0.00%-68.74%	68.75%- 86.24%	86.25%-93.74%	93.75%-100%
Participation Weight 30%	No submission	Late submission	On-time submission	On-time submission
Writing Weight 40%	No submission. Submission states the concept without explanation and shows grammatically incorrect in many places.	Submission states the concept without justification and shows partially grammatically correct.	Submission clearly states the concept and justifies why the topic was exciting or clearly explains what the student could not understand.	Submission clearly states the concept and justifies why the topic was exciting or clearly explains what the student could not understand. In addition, the submission is 50 words or less and shows critical thinking.
Citation Weight 10%	Does not include quote or citation.	Quote is included but the citation is incorrect or does not expand on the represented idea.	Quote is included with correct citation. The quote helps to explain the represented idea.	Quote is included with correct citation. The quote expands upon and explain the represented idea.

Correctness Weight 20%	Submission does not answer the questions correctly or fails to answer the question.	Submission does not answer the questions correctly or fails to answer the question.	Submission answers the questions correctly.	Submission answers the questions correctly.
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Concept Test (CT) Rubric

Description

The instructor poses a problem based on key concepts of a lecture. After reflecting on the problem, students submit their response and the instructor review them without providing a correct answer. Students discuss their thought process and solution with a peer. Students then commit to an answer and re-submits their responses. Instructor reviews responses and thought processes with the correct answer.

Rubric Detail

100%	Levels of Achievement			
Criteria	Below Standard	Approaching Standard	At Standard	Exceeds Standard
Graduate Percentage Scale	0.00%-68.74%	68.75%- 86.24%	86.25%-93.74%	93.75%-100%
Engagement Weight 100%	Submission does not show an answer or shows an answer without justification.	Submission shows an answer with justification, but there is no peer student engagement.	Submission includes an answer, justification, and peer engagement.	Submission includes an answer, justification, and peer engagement with critical thoughts.

Discussion Board (DB) Rubric

Description

A student posts an answer to a weekly discussion topic in Discussion Board. The student also posts a response to two other students' posts by the end of each module. Comments and questions should be clear and thoughtful, with correct grammar, spelling, and punctuation. The instructor will grade the quality of your discussion postings on both content and response.

Rubric Detail

100%	Levels of Achievement			
Criteria	Below Standard	Approaching Standard	At Standard	Exceeds Standard
Graduate Percentage Scale	0.00%-68.74%	68.75%- 86.24%	86.25%-93.74%	93.75%-100%
Participation Weight 50%	Submission does not post answer and responses.	Submission answers the question and posts responses	Submission answers the question and posts response	Submission answers the question with references and

		to only one student.	to two students.	posts responses to more than two students.
Writing Weight 50%	No submission.	Submission posts responses with spelling errors, grammar errors, and punctuations.	Submission is coherent with only two spelling or grammar errors.	Submission is coherent and grammatically correct with no errors.

Hands-on Skill (HOS) Rubric

Description

The instructor will assign hands-on skill exercises to a pair of students in class or individually online. Students pair up and practice exercises to learn specific programming languages, application programming interfaces (APIs), or tools related to the programming assignments or virtual labs. Two quizzes measure hands-on skills acquired.

Rubric Detail

100%	Level of Achievement			
Criteria	Below Standard	Approaching Standard	At Standard	Exceeds Standard
Graduate Percentage Scale	0.00%-68.74%	68.75%- 86.24%	86.25%-93.74%	93.75%-100%
Skill Exercise Weight 70%	Submission does not show answers or shows answers without evidence.	Submission shows answers with minimal evidence.	Submission shows answers with some evidence.	Submission shows answers with full evidence.
Engagement Weight 20%	Student does not engage in the exercise.	Student engages minimally in the exercise.	Student engages fully in the exercise.	Student mentors the other student to learn and succeed.
Correctness Weight 10%	Answers none or 57.49% less of the questions correctly.	Answers 57.50% above or 76.24% less of the questions correctly.	Answers 76.25% above or 93.74% less of the questions correctly.	Answers 93.75% above or all the questions correctly.

Programming Exercise (PE) Rubric

Description

The students must individually perform the programming exercise. Programs must be executable and robust. Non-executable programs will not receive any credits. Programs should deliver correct answers on all valid input and produce comprehensible error messages on invalid input. Programs also run correctly on all test data given within a reasonable amount of time. Students should write programs that are easy for other people to read.

Rubric Detail

100%	Levels of Achievement			
Criteria	Below Standard	Approaching Standard	At Standard	Exceeds Standard
Graduate Percentage Scale	0.00%-68.74%	68.75%-86.24%	86.25%-93.74%	93.75%-100%
Program Execution Weight 40%	No program submission. Submitted. However, the program is not executable at all.	The program is partially executable on all test data without any error or warning messages.	The program is fully executable on all test data with limited error, warning, or interaction messages.	The program is fully executable on all test data with meaningful error, warning, or interaction messages.
User Requirement Weight 40%	The program does not meet valid user requirements at all.	The program partially meets valid user requirements. The program does not meet invalid user requirements at all.	The program fully meets valid user requirements. However, the program partially meets invalid user requirements.	The program fully meets valid and invalid user requirements.
Program Documentation Weight 20%	The program does not show comments. The program does not follow programming style.	The program partially shows comments. The program partially follows programming style.	The program fully shows comments. However, the program partially follows programming style, vice versa.	The program fully shows comments. At the same time, the program fully follows programming style.

Knowledge Check (KC) Rubric Description

Weekly quizzes measure knowledge concepts acquired. Focus on the underlying principles and concepts rather than memorization to solve the quizzes.

Rubric Detail

100%	Levels of Achievement			
Criteria	Below Standard	Approaching Standard	At Standard	Exceeds Standard
Graduate Percentage Scale	0.00%-68.74%	68.75%- 86.24%	86.25%-93.74%	93.75%-100%
Correctness	Answers none or 57.49% less of the	Answers 57.50% above or 76.24%	Answers 76.25% above or 93.74%	Answers 93.75% above or all the

Weight 100%	questions correctly.	less of the questions correctly.	less of the questions correctly.	questions correctly.
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Team Project (TP) Report Rubric

Description

The student will provide a report formatted based on a template provided by the instructor. Students are required to improve the writing iteratively and incrementally every week. The revision will always happen during a quarter. Students will add new required sections to the existing paper every week.

Rubric Detail

100%	Levels of Achievement			
Criteria	Below Standard	Approaching Standard	At Standard	Exceeds Standard
Graduate Percentage Scale	0.00%-68.74%	68.75%- 86.24%	86.25%-93.74%	93.75%-100%
Structure Weight 20%	Does not utilize template format.	Sometimes adheres to template, falls short or exceeds page count.	Frequently adheres to template. Follows page count.	Displays mastery of template qualities, able to fit formulated ideas and diagrams into template.
Content Weight 30%	Student does not use resources or evidence to support the topic, or those used are not relevant or scholarly. Information used is summarized or generalized rather than analyzed.	Student uses a limited range of resources and evidence to support topic, some of which lack relevance and scholarship. Interpretation or application of how the evidence supports the topic is lacking or generalized.	Student incorporates an appropriate variety of relevant scholarly resources and evidence to support almost every point. Student provides some interpretation and explanation of how the evidence supports the topic.	Student incorporates an appropriate variety of relevant scholarly resources and evidence to support every point. Student provides full interpretation and explanation of how the evidence supports the topic.
Writing Weight 30%	Ideas are unclear, lack detail, and/or random. Paper/presentation has no or minimal organization. Ideas appear to be arranged in a	Writing contains spelling, punctuation, and/or grammatical errors that may temporarily confuse the	Writing contains spelling, punctuation, and/or grammatical errors, but these do not impede understanding.	Writing is almost entirely free of spelling, punctuation, and/or grammatical errors. Sentences are varied, clearly

	random order. Few or inappropriate transitions between paragraphs/ideas, and ideas are not developed clearly. Does not appropriately respond to the assignment.	reader, but do not generally impede the overall understanding. Sentence structure is generally correct, but may be wordy, unfocused, repetitive, or confusing. There is some use of relatively vague, general, or inappropriate words.	Sentences are generally clear, well structured, and focused, but some may be awkward or ineffective. Usually uses words accurately and effectively, but sometimes may be too general.	structured, carefully focused, and fit assignment's purpose and audience. Words chosen for their precise meaning and an appropriate level of specificity is used.
Reference Weight 10%	More than 10 errors in APA document formatting (including: punctuation, capitalization, title page, numbers, use of abbreviations, biased language, pronoun errors, headers/footers, levels of heading).	Between 5 and 10 errors in APA document formatting (including: punctuation, capitalization, title page, numbers, use of abbreviations, biased language, pronoun errors, headers/footers, levels of heading).	Between 0 and 4 errors in APA document formatting (including: punctuation, capitalization, title page, numbers, use of abbreviations, biased language, pronoun errors, headers/footers, levels of heading).	No errors in APA document formatting (including punctuation, capitalization, title page, numbers, use of abbreviations, biased language, pronoun errors, headers/footers, levels of heading).
Collaboration Weight 10%	Disengaged, misses deadlines, and fails to support team.	Minimally contributes to team effort. Contributes when asked.	Performs tasks as assigned, on time.	Completes all material on or ahead of time. Assists other team members, leads activities, and picks up unfinished tasks.

Team Project (TP) Presentation Rubric Description

The student will report on the research outcomes, development, or other project efforts to an academically appropriate committee in a public forum. The nature of the presentation content will determine the specific makeup of the audience. The student will choose the format of the presentation, in consultation with the advisor. The layout and design must be appropriate and adequate to represent the outcomes of the effort. While students must make some form of a visual presentation, the presentation of the results may include publishing in a refereed publication, publication in a trade or popular magazine or journal, broadcast in an appropriate medium, or, in exceptional cases, limited dissemination within a closed community.

Each presenter will have 15 minutes for presentational and 5 minutes for questions and answers. Each presenter must keep the total presentation time limit strictly.

Rubric Detail

100%	Research Paper - Levels of Achievement			
Criteria	Below Standard	Approaching Standard	At Standard	Exceeds Standard
Graduate Percentage Scale	0.00%-68.74%	68.75%- 86.24%	86.25%-93.74%	93.75%-100%
Structure Weight 20%	Does not utilize template format.	Sometimes adheres to template, falls short or exceeds page count.	Frequently adheres to template. Follows page count.	Displays mastery of template qualities, able to fit formulated ideas and diagrams into template.
Visual Presentation Weight 30%	High text content, no visual pictures, spelling errors, relies on slide for presentation	Reading slides, little visual content, spelling errors diagrams, pictures, engaging material	Slides contain written info without errors, some visual content, elaborated upon by presenter	Visually appealing, minimal words all spelled correctly, innovative designs, animation
Verbal Quality & Engagement Weight 30%	Monotone, reads from slides, goes significantly over or under presentation time. No eye contact.	Wordy, mumbles, relies on slides to prompt presentation. Minimal eye contact.	Relies on slides, explain wording on slides to present. Good tonal modulation. Good eye contact.	Uses slides to give visual cues to presentation. Well prepared, cohesive verbiage. Engaging presenter uses eye contact and voice modulation.
Collaboration Weight 20%	Disengaged, misses deadlines, and fails to support team.	Minimally contributes to team effort. Contributes when asked.	Performs tasks as assigned, on time.	Completes all material on or ahead of time. Assists other team members, leads activities, and picks up unfinished tasks.