Boston University Metropolitan College

MET CS544

FOUNDATIONS OF ANALYTICS AND DATA VISUALIZATION

Spring2025 MET CS544 A3 (Wednesdays 18:00-20:45 ET)
Course Format (On Campus: 685-725 Comm Ave CAS 116)

Instructor Name: Hong Pan, Ph.D., Professor Pan (He/Him/His)
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URL: https://www.bu.edu/csmet/profile/hong-pan/
TA: TBD | Email: TBD
Student Hours: **Instructor**: Wed 17:30-18:00, 20:45-21:15 ET in CAS 116 in person | **TA:** TBD

	January								February								March								April								May							
	Su	Mo	Tu	We	Th	Fr	Sa		Su	Mo	Tu	We	Th	Fr	Sa		Su	Mo	Tu	We	Th	Fr	Sa		Su	Mo	Tu	We	Th	Fr	Sa		Su	Mo	Tu	We	Th	Fr	Sa	
				1	2	3	4	W02							1	W06							1	W11			1	2	3	4	5	W15						1	2	3
	5	6	7	8	9	10	11	W03	2	3	4	5	6	7	8	W07	2	3	4	5	6	7	8	W12	6	7	8	9	10	11	12	W16	4	5	6	7	8	9	10
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W01	19	20	21	22	23	24	25	W05	16	17	18	19	20	21	22	W09	16	17	18	19	20	21	22	W14	20	21	22	23	24	25	26		18	19	20	21	22	23	24
W02	26	27	28	29	30	31		W06	23	24	25	✓	27	28		W10	23	24	25	26	27	28	29	W15	27	28	29	30					25	26	27	28	29	30	31
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Class Begins | Class Regular Meetings | No Class, Substitute Monday | Spring Break | ✓ Midterm Exam | Study Period | Final Exam

Course Description

This course aims to provide students with the mathematical and practical background required in data analytics. Probability, statistics concepts, and the R statistical computing and graphics tool will be reviewed. Different data types are investigated, along with data summarization techniques and plotting. Data populations using discrete, continuous, and multivariate distributions are explored. The course analyzes errors during measurements and computations. Confidence intervals and hypothesis testing topics are also examined. The concepts covered in the course are demonstrated using R.

Laboratory Course.

Prereq: MET CS546 and (MET CS520 or MET CS521), equivalent knowledge, or instructor's consent.

Course Objectives/Outcomes:

By completion of the course, you will:

- Understand the fundamentals of study designs, use graphical and other means to explore data, build and assess basic statistical models, employ a variety of formal inference procedures, and draw an appropriate scope of conclusions from the analysis.
- Be able to write clearly, speak fluently, and construct effective visual displays and compelling written summaries to communicate statistical findings and results.

Books and Resources

Required Textbook: Moore, D.S., McCabe, G.P., & Craig, B. (2021). Introduction to the Practice of Statistics (10th ed.) Publisher: Macmillan, ISBN: 9781319377656. (Barnes & Noble at BU (Store 480), 910 Commonwealth Ave, Boston, MA 02215. Phone: 617-415-9160. URL: bu.bncollege.com) **refer to as IPS10**

Your course materials have been integrated directly into your course to enhance your learning experience and simplify access to suitable materials for your class (Click the "Course Materials (B&N First Day)" link located on your course's Blackboard home page).

BENEFITS OF THIS PROGRAM
- Exclusive preferred pricing
- Guaranteed the suitable materials
- Single Sign-On
- Ready to go on day one
- Course materials charge will be placed on your student account
- Option to Opt-Out on the first day of class.

Boston University will bill you at the discounted price as a First Day course material charge on your student account later in the semester. Please be advised that Opt-Out is NOT recommended, as these materials are required to complete the course. You can choose Opt-Out on the first day of class, but you will be responsible for purchasing your course materials at the Opt-Out price. For more information and FAQs, click here.

Recommended Resources:
- **Primers**: Please use this helpful arithmetic review to gain confidence in basic operations.
- **Supporting Textbook Materials:** https://nhorton.people.amherst.edu/ips9/
- **Khan Academy:** Statistics and Probability **[Refer to as KA-SP]**

Recommended Reference Books:
- Hadley Wickham, Mine Çetinkaya-Rundel, and Garrett Grolemund. **R for Data Science (2e)**. https://r4ds.hadley.nz/
- Hadley Wickham, Danielle Navarro, and Thomas Lin Pedersen. **ggplot2: Elegant Graphics for Data Analysis (3e)**. https://ggplot2-book.org/
- Max Kuhn and Julia Silge. **Tidy Modeling with R**. https://www.tmwr.org
- James Long and Peter Teetor. (2019). **R cookbook (2e)**. https://rc2e.com
- Winston Chang. **R graphics cookbook (2e)**. https://r-graphics.org
- Garrett Grolemund. **Hands-On Programming with R**. https://rstudio-education.github.io/hopr/

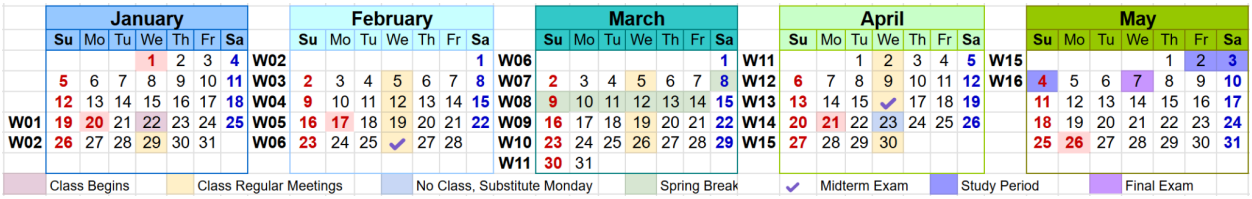
Courseware

- **Blackboard** at https://learn.bu.edu/
- **R and RStudio**: Installation Instructions and Free MET Virtual Lab | R package `mosaic` cheatsheet and Student Guide. You will do all of your analysis with the open source (and

free!) programming language R. You will use RStudio as the main program to access R. Think of R as an engine and RStudio as a car dashboard — R handles all the calculations and produces the actual statistics and graphical output. At the same time, RStudio provides an excellent interface for running R code.

- If you are learning R as a beginner, please utilize the interactive learning tool **Swirl** at https://swirlstats.com/ and progress with at least one submodule (~15 minutes) daily.

Class Calendar and Schedule



Week/Dates	Course Content	Readings IPS10	Guided Notes
Week 01	Always Plot Your Data	Chapter 1	Unit 1, A1-3, C1-6, K U1-2
Week 02	Don't Forget Your SOCS	Chapter 1	Unit 1, A4-6, C3-6, K U2-3
Week 03	Bell Curve: The Universal Ruler	Chapter 1	Unit 2, A7-9, C7, C18-19, K U4
Week 04	Describing Relationships	Chapter 2	Unit 3, A10-14, C8, K U5
Week 05	Gathering Data	Chapter 3	Unit 4, A15-17, C9-12, K U6
Week 06	Quantifying Uncertainty	Chapter 4	Unit 5, A18-19, C13-14, K U7-8, Exam I
Week 07	Anticipating Patterns	Chapter 4	Unit 6, A20-21, C15-17, K U9
Week 08	Happy Spring Break!		
Week 09	Sampling Distributions	Chapter 5	Unit 7, A22, C20, K U10
Week 10	Two Sides of the Same Coin	Chapters 6-8	Unit 8, A24, C20-23, K U11
Week 11	Unlikely to Happen by Chance	Chapters 6-8	Unit 9, A25,28,26, C26-28, K U12
Week 12	Inference for Differences	Chapters 6-8	Unit 10, A27-28, K U13
Week 13	Inference for Relationships	Chapters 9-10	Units 11-12, A29-30, C29,32, K U14-15, Exam II
Week 14	No Class, Substitute Monday		
Week 15	Introduction to Machine Learning		Final Exam Study Guide
Week 16	Final Exam	Cumulative	

*All Exams are in-person and in pencil-n-paper form, allowing one 2-sided 8.5x11-sized cheat sheet.
**Week 14, Wednesday, April 23, is Administrative Monday for the Patriots' Day: No class meeting.

Course Activities

1. Homework Assignments

There will be **12 Homework Assignments**, assigned one week before the due date, focused on applying theory learned in the class to analyze a data set in R. Assignment submissions should be in a single **PDF** file. The R code used to generate your results should be appended to the end of your assignment.

2. Quizzes

There will be **2 Midterm Exams (60 minutes) and 10 Weekly Quizzes (15 minutes)** at the beginning of class time to assess students' understanding of concepts presented in the class. Students should ensure adequate preparation before starting the Midterm Exams and the weekly quizzes. Please note that it won't be possible to do well on the exams and quizzes without reviewing the course materials. The *lowest midterm exam score* may be replaced by the final exam score (if the final exam score is higher).

3. Attendance and Participation

There will be **in-classroom practices and exit tickets,** which will be submitted at the end of class.

4. Final Project

The project is open-ended, and students can choose the topics. In this project, students will frame and solve problems using the quantitative capabilities of Statistical Machine Learning with R. Students will draft a formal proposal and submit it for approval by the Teaching Team (5%), then carry out the project, write a project report, and prepare a 3-minute presentation in the classroom in the final week of the course (95%).

5. Final Examination

- The final exam will be comprehensive and cover the entire course's material.
- The final exam will be closed notes and closed books in pen-n-paper format.
- All the exams and quizzes allow one 2-sided Letter-sized cheat sheet you prepared for yourself.

6. Reflective Journal

Keep a personal journal of critical reflections: To reflect on one's journey throughout the learning process, to log essential moments of growth and key learning during this process, to reflect on personal development or change about learning, including lessons learned about self, the way of learning, and any accomplishments or challenges. A link to the live Google doc of your reflective journal shall be included at the beginning of each Assignment submission.

Class Policies

- **As this is an on-campus class, your attendance is not just a requirement but a critical factor in your success.** Punctuality is also expected, as we understand that statistics can

be challenging, and attending class is essential for your understanding. If, for any reason, you have to miss a class, please notify me immediately. Your commitment to attendance and punctuality is crucial for your success in this course. **If you have to miss a class, please fill out this Google form IN ADVANCE.**

- **Reading Assignments** are specified in the Course Schedule to help you check your understanding and form quality questions for discussion during class meetings.
- **Homework assignments** will be posted on Canvas and graded for completion. The 4-bin grading scale (EMRN: Excellent/Exemplary, Meets Expectations, Revision Needed, Not Assessable) will provide feedback for two chances of revision within 2 weeks. **Do not search for homework solutions online**.
- **Late Policy**: The assignment due dates are created intentionally to help you manage time effectively and to receive timely formative feedback to facilitate learning. You are expected to turn in your assignments by the due dates and are provided with another week for a maximum of 2 revisions if needed. The answer keys will be released 1 week after the due date, after which no work will be accepted. You are allowed **3 Late Work Tokens** for the course by **completing this Google Form**.
- **Grading Policies: All assignments will be graded on the EMRN 4-bin grading scale to provide timely feedback for revisions. A maximum of two revisions and one extra week are allowed per assignment.**
- **Laptop Requirement:** Students should have a personal laptop. We will use laptops in the classroom to write R programs, and you will also need the laptop for quizzes. Please have your computer **FULLY CHARGED** before coming to the school every week!
- **Academic Conduct Code** – Cheating and plagiarism will not be tolerated in any Metropolitan College course. They will receive no credit for the assignment or examination, which may lead to disciplinary action. Please take the time to review the Student Academic Conduct Code: http://www.bu.edu/met/metropolitan_college_people/student/resources/conduct/code.html. This should not be understood as a discouragement from discussing the material or your particular approach to a problem with other students in the class. On the contrary – you should share your thoughts, questions, and solutions. Naturally, if you choose to work in a group, you will be expected to come up with more than one highly original solution rather than the same mistakes.

Grading Scale

A system of multiple grading schemes is adopted to promote equitable learning and assessment experiences and provide space for growth and development. You will be provided with a Google Sheet "WHAT IF Grade Calculator" to track your progress.

- **Student Work:** [35~70%]
  - **Class Activities & Participation**
  - **12 Homework Assignments**
  - **Final Project and Presentation**

- **Assessments**: [30~65%]
    - **10 Weekly Quizzes**
    - **2 Midterm Exams**
    - **Final Exam: Cumulative**

Extra Credit: No individual extra credit will be given for this class. The instructor will determine whether extra credit is needed by examining the distribution of grades for the whole class.

Grading Scale for this Course:

Final grades will be assigned according to the following ranges:

A 93.50-100%	B+ 86.50-89.49%	C+ 76.50-79.49%	D 60.00-69.49%
A- 89.50-93.49%	B 83.50-86.49%	C 73.50-76.49%	F <60%
	B– 79.50-83.49%	C– 69.50-73.49%	

Our Classroom Community

At Boston University, faculty and students work together to build a respective, inclusive learning environment. We aim to create and maintain a positive and supportive classroom atmosphere where all members' diversity, backgrounds, and perspectives are valued and respected. The following guidelines will help us work toward this goal and clarify expectations for engagement in and with each other in this course.

1. **Cooperative Learning:** While cooperative learning via group discussion is encouraged (and the final grades will not be curved to promote peer learning), you should write your answers independently. Exam problems will often be similar to assigned homework problems. Therefore, you are personally responsible for knowing how to solve each homework problem (even if you worked in a group on the homework). **So you must understand how to solve the homework problems!**
2. **During Class**: Cell phones may not be used during class. Laptop computers must be put away during class time, except for class activity time. Tablets (e.g., iPads) may be used only for note-taking if they are flat on the desk like a traditional notebook. Students may not use tablets to look at web pages, play games, etc. **Pencil-and-paper note-taking is encouraged, and the Cornell Note-Taking Method is recommended.**
3. **Communication:** The best way to contact me is through email. Please give me 48 hours to respond. After that time, please follow up if you have not heard from me in case your email was lost in the shuffle. **Emailing your professor or teaching assistants should be treated as professional communication.** Emails should have an appropriate greeting and ending; students should refrain from using any kind of "shortcuts," abbreviations, acronyms, slang, etc., in the email text. Emails not meeting these standards may not be answered. Email questions must be sent a reasonable amount of time before a due date.

Statement of Support

- Take care of yourself. Do your best to maintain a healthy lifestyle this semester by eating well, exercising, avoiding substance abuse, getting enough sleep, and taking some time to relax. This will help you achieve your goals and cope with stress.

- All of us benefit from support during times of struggle. Many helpful resources are available on campus, and an essential part of the college experience is learning how to ask for help. Asking for support sooner rather than later is almost always helpful.
- If you or anyone you know experiences any academic stress, difficult life events, or feelings like anxiety or depression, we strongly encourage you to seek support.

Tips for Success:

1. **Three Simple Rules for Success** (that can benefit anyone who wants to be better in life):
    a. **Know the text**: Complete the reading assignments before class meeting time
    b. **Have a head full of ideas**: Bring questions to the classroom & willing to participate
    c. **Show up on time**: Coming in a few minutes early liberates you, allowing you time to get comfortable and composed before you need to be at your very best
2. **Learning** statistics **by doing** statistics:
    a. **Conceptual understanding** over memorizing
    b. **Experimenting** over being perfect
    c. **Process** over product
3. **Learning statistics is like learning a new language**: **Practice makes perfect!**
4. **Time** commitment and management (**at least 9 hours per week outside of class**) and **practice regularly** (**at least 15 minutes per day** will make a big difference within the short semester).
5. ***"The secret of getting ahead is getting started." – Mark Twain.***

Syllabus Statement

This syllabus is not a contract. The instructor reserves the right to alter course requirements and/or assignments based on new materials, class discussions, or other legitimate pedagogical objectives.