

Course Lead Faculty Contact Information



Course Lead Faculty: Dr. Carrie Dugan

Pronouns: She/Her

Email: carrie.dugan@northwestern.edu I will respond to email within 24 – 48 hours.

Links: [LinkedIn Profile](#)

Optional Synchronous Meetings: Weeks 1, 5, and 9.

Biography

Dr. Dugan has a BS in Mathematics from Marshall University and a PhD in Mathematics from Kent State University. After completing her undergraduate degree, she spent many years working as a defined benefit pension actuary for a large insurance firm and a few smaller consulting firms. Later in life she left her career as an actuary to pursue her PhD and has been teaching in higher education since 2000. She has taught a wide range of both undergraduate and graduate math and data science courses. Dr. Dugan has also written numerous math and data science course for online delivery. She began her teaching career in the traditional brick-and-mortar environment but has been teaching solely online since 2008. She lives in Northeast Ohio with her husband.

DSP Instructor Contact Information



DSP Instructor: Dr. Narayana Darapaneni

Pronouns: He/Him

Email: narayana.darapaneni@northwestern.edu

Links: <https://www.linkedin.com/in/darapaneni/>

Office Hours: TBA

Optional Synchronous Meetings: Weeks 2, 3, 4, 6, 7 and 8.

Biography

Dr. Narayana holds a PhD in Mathematics from Pierre and Marie Curie University, Paris, France. After completing his PhD, he worked as quantitative researcher, algorithmic trader, trader researcher and portfolio manager. He joined Great Learning in 2017 as Professor & Program Director, Big Data and Machine Learning. Now he is Professor & Academic Director, Artificial Intelligence and Machine Learning. He also takes care of Artificial Intelligence and Machine Learning research at Great Learning. His research interests include health analytics, computer vision applications, Psephology, security analytics, legal analytics etc. He has published over 30 research articles in international journals and conferences.

DSP Teaching Assistant Contact Information



DSP Teaching Assistant: Gowtham Swaminathan

Pronouns: He/Him

Email: gowtham.s@greatlearning.in

Biography

Gowtham holds a Bachelor's degree in Electrical and Electronics Engineering and Master's Degree in Power Electronics and Drives from Anna University Chennai. He has 6 years of teaching experience in the field of Electrical and Electronics Engineering and 3 years of research experience in the field of Machine Learning. He has completed his Post Graduation Course in AIML from Great Learning and he is currently working as Data Scientist at Great Learning and leading the Academics and Support Team. His research interest includes Data Analytics, Deep learning, Software Engineering and Deployment for AIML algorithms. To his credit he has published over 20 research articles in international journals and conferences.

Course Description

Students learn techniques for building and interpreting mathematical models of real-world phenomena in and across multiple disciplines, including linear algebra, discrete mathematics, probability, and calculus, with an emphasis on applications in data science and data engineering. Provides students with a firm understanding or review of these fields of mathematics prior to enrolling in courses that assume understanding of mathematical concepts.

Course Objectives

By the end of this course, you will be able to:

- Apply linear programming methods to real-world models.
 - Analyze and interpret mathematical models.
 - Calculate and analyze derivatives and integrals of real-world models.
 - Evaluate and interpret probabilistic models.
 - Solve applications involving multivariate calculus.
 - Optimize outcomes modeled by graphs and trees.
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Prerequisites

There are no prerequisites for this course.

Diversity Statement

I truly believe that we are all unique individuals and each of us adds value to the world around us. We all deserve respect and equity regardless of our backgrounds or identities. I embrace the knowledge that I have gained from my students over the years and look forward to learning more from you. Your opinions, approaches, knowledge, and experiences are important to me and I welcome broadening my experiences and knowledge by working with you. I teach with the approach that I am more than simply a subject matter expert. I am here to not only guide you, but to work alongside you as you take this journey through this course.

Required and Optional Readings and Resources

Required Readings

- Lippman, D., Rasmussen, M. (2018). *Precalculus: An Investigation of Functions*. Available via: <http://www.opentextbookstore.com/precalc/>

- Lane, D.M., et al. *Online Statistics Education: An Interactive Multimedia Course of Study*. Available via: <http://onlinestatbook.com/2/index.html>
- Sekhon, R., Bloom R. (2020). *Applied Finite Mathematics*. LibreTexts. Available via [https://math.libretexts.org/Bookshelves/Applied_Mathematics/Book%3A_Applied_Finite_Mathematics_\(Sekhon_and_Bloom\)](https://math.libretexts.org/Bookshelves/Applied_Mathematics/Book%3A_Applied_Finite_Mathematics_(Sekhon_and_Bloom))
- Strang, G. (2020). *Calculus Volume 1*. OpenStax [ISBN-13: 9781947172135]. Available via <https://openstax.org/details/books/calculus-volume-1>
- Strang, G. (2020). *Calculus Volume 2*. OpenStax [ISBN-13: 9781947172142]. Available via <https://openstax.org/details/books/calculus-volume-2>
- Illowsky, B., Dean, S. (2018). *Introductory Statistics*. OpenStax [ISBN-13: 9781947172050]. Available via <https://openstax.org/details/introductory-statistics>
- Strang, G. (2020). *Calculus Volume 3*. OpenStax [ISBN-13: 9781947172166]. Available via <https://openstax.org/details/books/calculus-volume-3>
- Lippman, D. (2017). *Math in Society*. Available via <http://www.opentextbookstore.com/details.php?id=1>

Additional required readings and media are posted on Canvas, including timely news articles, academic research, and videos that you will review in order to complete some assignments and participate in discussion forums.

Optional Readings and Resources

Clearly labeled optional readings and resources may be provided throughout the course. You are also encouraged to search for additional resources on your own and share your findings with the class. The primary source for optional media used throughout the course can be found at mathispower4u.com.

Assignment Overview and Grading Breakdown

Grading and feedback turnaround will be no more than one week from the due date. You will be notified if turnaround will be longer than one week.

The discussion forums will be graded based on a rubric. The rubric for each discussion will be available in the course. To view the discussion forum rubric, click the gear icon in the upper right corner of the page and choose Show Rubric.

Module	Assignment	Description	Points/Percentage
Modules 1 – 10	Discussions	Weekly class participation is determined by posting to discussion forums. You will be expected to provide quality insights in class discussion forums in a timely	15%

		fashion and interact with others in a manner that provides depth and insight into the discussion. Initial discussion posts based on the prompt provided will be due by 11:59pm CT on Thursday of each week and at least two additional posts to peers will be due by 11:59pm CT on Sunday of each week.	
Modules 1 – 9	Problem Sets	Weekly assignments of problems will be completed in MyOpenMath (MoM) The problems will be based on the weekly readings and the point values may vary. These assignments be due by 11:59pm CT on Sunday of each week.	35%
Modules 3, 6, 9	Quizzes	There will be three quizzes in weeks 3, 6, and 9. The week 3 quiz will cover material from weeks 1 and 2. The quiz in week 6 will cover material from weeks 3, 4, and 5. The quiz in week 9 will cover material from weeks 6, 7, and 8. These are neither proctored nor timed and will be due at 11:59 CT on Sunday of the week in which they are assigned.	30%
Module 10	Final Exam	A timed final exam will be assigned in week 10 based on the readings and material from weeks 1 through 9. The exam will consist of 10 questions and will become available to the students no later than 12am CT on Monday of week 10. The exam will have a two-hour time limit and completion of the exam will be based on a time that is convenient for the student within the last week of class. This assignment will be due at 11:59pm CT on the last day of class.	20%
Total			100%

Grading Scale

Grade	Points
A	93-100
A-	90-92
B+	87-89
B	83-86
B-	80-82
C+	77-79
C	73-76
C-	70-72
F	Below 70

The School of Professional Studies does not award D grades in graduate coursework.

Late Work Policy

[Unless otherwise noted, all assignments due by 11:59 PM (Central Time) on Sunday of the week in which they are assigned. This includes exams and participation in the discussions. Late work is not accepted unless prior arrangements have been made with the instructor. Discussion posts after the week has ended will not be accepted.

Online Communication and Interaction Expectations

Discussion Forums

The purpose of the discussion boards is to allow students to freely exchange ideas. It is imperative to remain respectful of all viewpoints and positions and, when necessary, agree to respectfully disagree. While active and frequent participation is encouraged, cluttering a discussion board with inappropriate, irrelevant, or insignificant material will not earn additional points and may result in receiving less than full credit. Frequency matters but contributing content that adds value is paramount. Please remember to cite all sources—when relevant—in order to avoid plagiarism. Please post your viewpoints first and then discuss others' viewpoints.

The quality of your posts and how others view and respond to them are the most valued. A single statement mostly implying “I agree” or “I do not agree” is not counted as a post. Explain, clarify, politely ask for details, provide details, persuade, and enrich communications for a great discussion experience. Please note, there is a requirement to respond to at least two fellow

class members posts. Also, remember to cite all sources—when relevant—in order to avoid plagiarism.

All initial posts addressing the prompt are due by 11:59 CT on Thursdays each week and there is a requirement to respond to at least two fellow class members' posts. The detail of what is expected is available in the discussion rubric.

Online Communication Etiquette

Beyond interacting with your instructor and peers in discussions, you will be expected to communicate by Canvas message, email, and sync session. Your instructor may also make themselves available by phone or text. In all contexts, keep your communication professional and respect the instructor's posted availability. To learn more about professional communication, please review the [Communicating Effectively with Faculty](#) guide.

Just as you expect a response when you send a message to your instructor, please respond promptly when your instructor contacts you. Your instructor will expect a response within two business days. This will require that you log into the course site regularly and set up your notifications to inform you when the instructor posts an announcement, provides feedback on work, or sends you a Canvas message. For guidance on setting your notifications, please review [How do I set my Canvas notification settings as a student?](#) It is also recommended that you check your u.northwestern e-mail account regularly, or forward your u.northwestern e-mail to an account you check frequently.

Participation and Attendance

This course will not meet at a particular time each week. All course goals, session learning objectives, and assessments are supported through classroom elements that can be accessed at any time. To measure class participation (or attendance), your participation in discussion boards is required, graded, and paramount to your success in this course. Please note that any scheduled synchronous meetings are optional. While your attendance is highly encouraged, it is not required, and you will not be graded on your attendance or participation.

Student Support Services

AccessibleNU

This course is designed to be welcoming to, accessible to, and usable by everyone, including students who are English-language learners, have a variety of learning styles, have disabilities, or are new to online learning. Be sure to let me know immediately if you encounter a required element or resource in the course that is not accessible to you. Also, let me know of changes I can make to the course so that it is more welcoming to, accessible to, or usable by students who take this course in the future.

Northwestern University and [AccessibleNU](#) are committed to providing a supportive and challenging environment for all undergraduate, graduate, professional school, and professional studies students with disabilities who attend the University. Additionally, the University and AccessibleNU work to provide students with disabilities and other conditions requiring accommodation a learning and community environment that affords them full participation, equal access, and reasonable accommodation. The majority of accommodations, services, and auxiliary aids provided to eligible students are coordinated by AccessibleNU, which is part of the [Dean of Students Office](#).

SPS Student Services

The Department of [Student Services](#) supports the academic and professional growth of SPS students. The Student Services team guides students through academic planning, policies, and administrative procedures, and promotes a supportive environment to foster student success. Students are encouraged to actively make use of the resources and staff available to assist them: Academic and Career Advisers, Counseling and Health Services, Student Affairs, Legal Services, Financial Aid and Student Accounts, among other services.

For a comprehensive overview of course and program processes and policies and helpful student resources, please refer to your [SPS Student Handbook](#).

Academic Support Services

Northwestern University Library

As one of the leading private research libraries in the United States, Northwestern University Library serves the educational and information needs of its students and faculty as well as scholars around the world. Visit the [Library About](#) page for more information or contact Distance Learning Librarian Tracy Coyne at 312-503-6617 or tracy-coyne@northwestern.edu.

Program-Specific Library Guides

- [Data Science](#)
- [Statistics](#)

Additional Library Resources

- [Connectivity: Campus Wireless and Off-Campus Access to Electronic Resources](#)
- [Getting Available Items: Delivery to Long-Distance Patrons](#)
- [Quick Access to Major Newspapers](#)
- [Reserve a Library Study Room](#)
- [Resources for Data Analysis](#)
- [Schaffner Library Top Resources](#)

- [Sign up for an in-person or online Research Consultation Appointment](#)
- [Social Science Data Resources](#)

The Writing Place

The Writing Place is Northwestern's center for peer writing consultations. Consultations are free and available to anyone in the Northwestern community: undergraduates, graduate students, faculty, or staff. To book an appointment, go to [The Writing Place](#) website.

The Math Place

The Math Place is a free tutorial service provided to students currently enrolled in Northwestern University's School of Professional Studies courses or in other Northwestern University courses. Students of all levels can benefit from the individual tutoring provided from this service, whether they are taking undergraduate or graduate level courses. To book an appointment, go to [The Math Place](#) website.

SPS Learning Studios

Learning studios are available to students who would like additional support in commonly used tools and topics, including: statistics, Excel, and coding in R. An instructor is available to answer your questions as you work through self-paced content and exercises. Students can self-enroll for free by visiting the SPS [Academic Services](#) page.

Read&Write Gold

Read&Write Gold is an optional text reading and writing program with numerous beneficial features. Originally developed to assist users with print disabilities, such as visual impairments, dyslexia, ADHD, etc., this program provides a wide array of tools to assist with reading, writing, and notetaking. One of the most useful tools is the text-to-speech function, which students may use to convert digital text into an audio format.

Read&Write Gold is available for free to all Northwestern students, faculty, and staff. Visit the [Northwestern IT site on Read&Write Gold](#) for more information about the software, as well as instructions on how to download it.

Academic Integrity at Northwestern

Students are required to comply with University regulations regarding academic integrity. If you are in doubt about what constitutes academic dishonesty, speak with your instructor or graduate coordinator before the assignment is due and/or examine the University website. Academic dishonesty includes, but is not limited to, cheating on an exam, obtaining an unfair advantage, and plagiarism (e.g., using material from readings without citing or copying another student's paper). Failure to maintain academic integrity will result in a grade sanction, possibly as severe as failing and being required to retake the course, and could lead to a suspension or expulsion.

from the program. Further penalties may apply. For more information, visit [The Office of the Provost's Academic Integrity page](#).

Some assignments in SPS courses may be required to be submitted through Turnitin, a plagiarism detection and education tool. You can find [an explanation of the tool here](#).

Course Technology

This course will involve a number of different types of interactions. These interactions will take place primarily through the Canvas system. Please take the time to navigate through the course and become familiar with the course syllabus, structure, and content and review the list of resources below.

Systems Requirements for Distance Learning

Students and faculty enrolled in SPS online classes should have access to a computer with the [Minimum System Requirements](#).

Canvas

The [Canvas Student Center](#) includes information on communicating in Canvas, navigating a Canvas course, grades, additional help, and more. The [Canvas at Northwestern](#) website provides information of getting to know Canvas at Northwestern and getting Canvas support. The [Canvas Student Guide](#) provides tutorials on all the features of Canvas. For additional Canvas help and support, you can always click the Help icon in the lower left corner to begin a live chat with Canvas support or contact the Canvas Support Hotline.

The [Canvas Accessibility Statement](#) and [Canvas Privacy Policy](#) are also available.

My Open Math

All assignments for this course, including the final exam will be completed using [My Open Math](#) (MoM). MoM is an open source platform for completing assignments involving math. Detailed information on accessing MoM is provided in Canvas.

Zoom

We will use Zoom for optional synchronous meetings. The [Zoom support page](#) provides additional guidance for using Zoom.

The [Zoom Privacy Policy](#) and the [Accessibility Features on Zoom](#) are also available.

Please note that any scheduled synchronous meetings are optional. While your attendance is highly encouraged, it is not required and you will not be graded on your attendance or participation. These synchronous sessions will be recorded, so you will be able to review the session afterward.

Panopto

Videos in this course may be hosted in Panopto. If you have not used Panopto in the past, you may be prompted to login to Panopto for the first time and authorize Panopto to access your Canvas account. You can learn more about using Panopto and login to Panopto directly by visiting the Panopto guide on the [Northwestern IT Resource Hub](#). Depending on the assignment requirements of this course, you may be asked to create videos using Panopto in addition to viewing content that your instructor has provided through Panopto.

The [Panopto Privacy Policy](#) and the [Accessibility Features on Panopto](#) are also available.

Python

Students in this course have the option to use the programming language Python to complete assignments. Python can be downloaded at [Anaconda](#). Download and install the most recent Python 3.x version of Anaconda. Additional documentation on downloading and installing Anaconda can be found at [Anaconda Documentation](#). After installation, you should be able to access the Anaconda Navigator. It is recommended you use Jupyter Notebook for any work in Python. This can be accessed via Anaconda.

For a sampling of problems that have been solved using Python, go to the [Python Practice](#) module in Canvas.

Required Technical Skills

Students in an online program should be able to do the following:

- Communicate via email and Canvas discussion forums.
- Use web browsers and navigate the World Wide Web.
- Use the learning management system Canvas.
- Use integrated Canvas tools (e.g., Zoom, Panopto).
- Use applications to create documents and presentations (e.g., Microsoft Word, PowerPoint).

Required Digital Literacy Skills

In order to be successful in an online course, students should be able to locate, evaluate, apply, create, and communicate information using technology.

Students in this online course should be able to do the following:

- Create, name, compose, upload, and attach documents.
- Download, modify, upload, attach document templates.
- Create, name, design, and upload presentations.
- Access and download Course Reserve readings; read and review PDF documents.
- Access and use a digital textbook.
- Participate in threaded discussions by contributing text responses, uploading images, sharing links.
- Using a quizzing tool to answer multiple choice, true/false, matching, and short response questions within a given time period.
- Follow directions to engage with a remote proctor by text, webcam, and audio.
- Use a video player to review content, including pausing and restarting video.

Technical Help and Support

The [SPS Help Desk](#) is available for Faculty, Students and Staff to support their daily IT needs. For additional technical support, contact the [Northwestern IT Support Center](#).

Permissions

Instructional Materials

This course was developed in partnership with Distance Learning staff in the School of Professional Studies at Northwestern University. Every effort has been made to responsibly acquire instructional materials for this class, by adhering to copyright law, obtaining permission from copyright holders, selecting Open Educational Resources (OERs) and Creative Commons (CC) materials, and using citations to credit the work of others.

The same is expected of students in this course. Please review the Academic Integrity statement for more information.

Sharing Course Content

Content within this course--including assignment descriptions, exam questions, and other course components--may not be distributed outside of the course, either to other students or on the Internet more broadly.

Student Ownership of Content

Students retain ownership of all content developed while completing this course, as dictated by the university [Copyright Policy](#) ("copyright ownership resides with the Creator(s) of copyrightable works").

Per the Family Educational Rights and Privacy Act ([FERPA](#)), if your instructor wishes to share your work with future students, your permission must be obtained in writing.

Your instructor may limit access to the course after a cutoff date. When you complete the course, please ensure that you have saved all work. You may not be able to return to the course to download your submissions.

Course Schedule

Module 1

Learning Objectives

- ✎ Create and interpret models involving linear functions.
- ✎ Calculate correlation coefficients and least squares lines.
- ✎ Interpret the meanings of correlation coefficients and least squares lines.

Readings & Media

Required Readings

- Precalculus: [Section 1.1 – Functions and Function Notation](#)
- Precalculus: [Chapter 2 – Linear Functions](#)
- Onlinestatbook: [Chapter 4 – Describing Bivariate Data \(Sections A – E\)](#)
- Onlinestatbook: [Chapter 14 – Introduction to Simple Linear Regression \(Sections A – E\)](#)

Assignments

- Introductions Discussion (not graded)
- Module 1 Discussion
- Module 1 Problem Set

Module 2

Learning Objectives

- ✎ Solve systems of linear equations using the Echelon method, Gauss-Jordan Method and inverse matrices.
- ✎ Manipulate matrices using addition, subtraction, and multiplication.
- ✎ Apply Cramer's Rule to systems of linear equations.

Readings & Media

Required Readings

- College Algebra: [Chapter 7 – Sections 7.1, 7.2, 7.5, 7.6, 7.7, 7.8](#)

Assignments

- Module 2 Discussion
- Module 2 Problem Set

Module 3

Learning Objectives

- ≠ Set up and solve linear programming models involving real-world scenarios.
- ≠ Apply the Simplex method to linear programming models.
- ≠ Create and solve the dual of linear programming models.

Readings & Media

Required Readings

- Applied Finite Mathematics: [Chapter 3](#)
- Applied Finite Mathematics: [Chapter 4](#)

Assignments

- Module 3 Discussion
- Module 3 Problem Set
- Module 3 Quiz (covers Modules 1 and 2)

Module 4

Learning Objectives

- ≠ Determine conditional probabilities.
- ≠ Apply Bayes' Theorem.
- ≠ Calculate expected values for discrete probability distributions.

Readings & Media

Required Readings

- Math in Society: [Probability](#)

Assignments

- Module 4 Discussion
- Module 4 Problem Set

Module 5

Learning Objectives

- ≠ Calculate average rates of change.
- ≠ Calculate and interpret the derivative of various types of functions.
- ≠ Apply the chain rule to composite functions.

Readings & Media

Required Readings

- Calculus Volume I: [Chapter 2 – Limits \(Sections 2.1 – 2.4\)](#)
- Calculus Volume I: [Chapter 3 – Derivatives \(Sections 3.1 – 3.6, and 3.9\)](#)

Assignments

- Module 5 Discussion
- Module 5 Problem Set

Module 6

Learning Objectives

- ≠ Determine relative and absolute extrema.
- ≠ Identify intervals of increase and decrease using derivatives.
- ≠ Analyze the shape of a graph using derivatives.
- ≠ Solve applications involving differentiation.

Readings & Media

Required Readings

- Calculus Volume I: [Chapter 4 – Applications of Derivatives \(Sections 4.3 – 4.7\)](#)

Assignments

- Module 6 Discussion
- Module 6 Problem Set
- Module 6 Quiz (covers Modules 3, 4, and 5)

Module 7

Learning Objectives

- ≠ Calculate integrals of various types of functions.
- ≠ Apply the Fundamental Theorem of Calculus to real-world problems.
- ≠ Analyze uniform and normal probability distributions involving real-world scenarios.
- ≠ Determine the mean and variance of continuous probability distributions.

Readings & Media

Required Readings

- Calculus Volume 2: [Chapter 1 – Integration \(Sections 1.1 – 1.6\)](#)
- Calculus Volume 2: [Chapter 3 – Section 3.1](#)
- Introductory Statistics: [Chapter 5 – Continuous Random Variables \(Sections 5.1 - 5.3\)](#)
- Introductory Statistics: [Chapter 6 – The Normal Distribution \(Sections 6.1 - 6.2\)](#)

Assignments

- Module 7 Discussion
- Module 7 Problem Set

Module 8

Learning Objectives

- ≠ Evaluate functions of several variables.
- ≠ Solve applications involving partial derivatives.
- ≠ Identify relative extrema and saddle points.
- ≠ Use Lagrange multipliers to optimize functions subject to constraints.

Readings & Media

Required Readings

- Calculus Volume 3: [Chapter 4 – Differentiation of Functions of Several Variables \(exclude Section 4.6\)](#)

Assignments

- Module 8 Discussion
- Module 8 Problem Set

Module 9

Learning Objectives

- ≠ Create graphs to model real-world networks.
- ≠ Construct Euler and Hamilton paths and circuits.
- ≠ Determine the shortest path.
- ≠ Solve applications involving minimum spanning trees.

Readings & Media

Required Readings

- Math in Society: [Graph Theory](#)

Optional Readings

- Supplemental Notes for Graph Theory I: [pages 3 – 28](#)

Assignments

- Module 9 Discussion
- Module 9 Problem Set
- Module 9 Quiz (covers Modules 6, 7, and 8)

Module 10

Learning Objectives

- ≠ None

Assignments

- Module 10 Discussion
- Final Exam