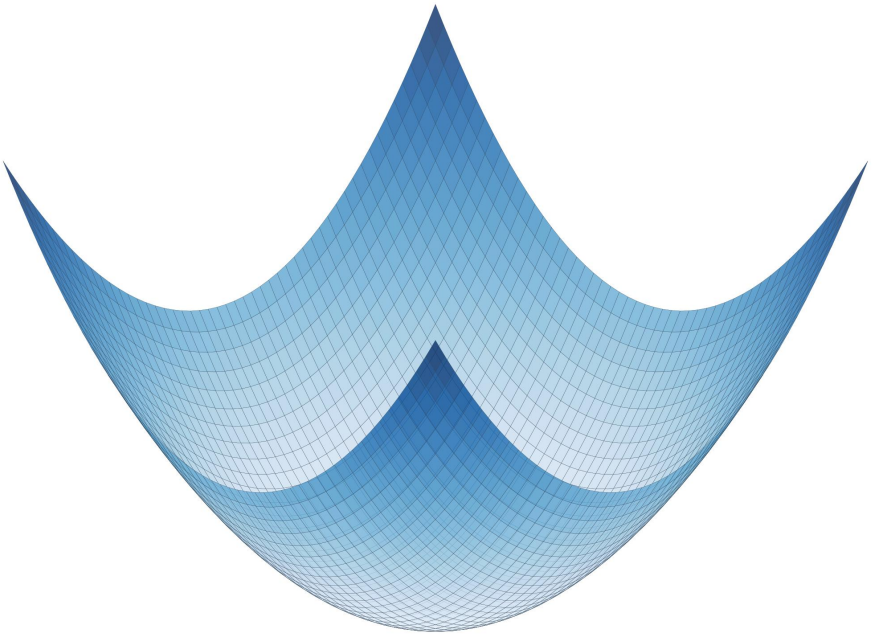

MATHEMATICS FOR DATA SCIENCE

Course Information

Course: CIS-170-01FTM: MATHEMATICS FOR DATA SCIENCE

Schedule: Monday, Wednesday, Friday: 9:00 AM - 9:50 AM

Course: CIS-170-02FTE: MATHEMATICS FOR DATA SCIENCE

Schedule: Monday, Wednesday, Friday: 8:00 AM - 8:50 AM

Semester: Fall 2025

Location: Library 126

Credits: 3 (both sections)

Instructor Information

Instructor: Dr. Chad Redmond

Office: Library 416

Email: credmond@mercyhurst.edu

Phone: (814) 969-2269

Office Hours

Days/Times: Monday, Wednesday, Friday: 11:00 AM - 12:10 PM

Location: Library 416 (My Office)

Evening Hours: Monday, Wednesday: 8:15 PM - 9:30 PM

Evening Location: Cyber Security Labs

Course Description

An exploration of essential mathematical foundations required for data science applications, with a focus on calculus concepts and their practical implementations. Students will study Calculus I topics including lines, functions, derivatives, and tangent lines, along with Calculus III concepts such as surfaces, traces, partial derivatives, and the gradient vector. A central emphasis is placed on gradient descent optimization, which serves as the backbone for modern machine learning algorithms. The course covers linear regression, multiple regression, and logistic regression, demonstrating how gradient descent applies to these fundamental data science techniques. Students will develop interactive web applications to visualize and

illustrate mathematical concepts, gaining both theoretical understanding and practical programming experience. The course emphasizes collaborative development using GitHub, GitHub Codespaces, and GitHub Copilot, preparing students to work effectively in modern data science environments where mathematical rigor meets computational implementation.

Learning Objectives

Calculus I Foundations:

- Analyze and manipulate linear equations, understanding slope, intercepts, and geometric interpretations
- Work with various function types including polynomial, exponential, logarithmic, and trigonometric functions
- Calculate derivatives using differentiation rules and interpret their meaning as rates of change
- Construct tangent lines to curves and understand their geometric and analytical significance
- Apply derivative concepts to solve optimization problems in single-variable contexts

Calculus III & Multivariable Analysis:

- Visualize and analyze three-dimensional surfaces and their mathematical representations

- Generate and interpret traces of surfaces in different coordinate planes
- Compute partial derivatives and understand their geometric and practical interpretations
- Calculate and apply the gradient vector for optimization and directional analysis

Optimization & Gradient Descent:

- Implement gradient descent algorithms for both single and multivariable optimization problems
- Understand the mathematical theory behind gradient descent and its convergence properties
- Apply gradient descent to minimize cost functions in machine learning contexts
- Analyze learning rates, convergence criteria, and optimization challenges

Regression Methods & Applications:

- Derive and implement linear regression using both analytical and gradient descent approaches
- Extend to multiple regression with multiple predictor variables and matrix formulations
- Understand and implement logistic regression for classification problems
- Apply gradient descent optimization to train regression models effectively
- Evaluate model performance and understand the mathematical basis of common metrics

Web Development & Visualization:

- Build interactive web applications that demonstrate mathematical concepts and algorithms

- Create dynamic visualizations of functions, derivatives, surfaces, and optimization processes
- Develop user interfaces that allow real-time exploration of mathematical parameters
- Implement mathematical algorithms in web-based environments for educational and practical use

Collaborative Development Tools:

- Demonstrate proficiency in using GitHub for version control and collaborative mathematical programming
- Utilize GitHub Codespaces for cloud-based development of mathematical applications
- Apply GitHub Copilot for AI-assisted coding in mathematical and data science contexts
- Follow best practices for documenting mathematical code and sharing reproducible analyses

Grading

Grade Components:

- Quiz 1: 75 points
- Quiz 2: 75 points
- Quiz 3: 75 points
- Quiz 4: 75 points
- Final Exam: 100 points
- Attendance: 100 points
- Participation: 100 points

Total Points: 600

Grade Scale:

Grade	Points Required
A	550-600
B+	500-549
B	400-499
C+	350-399
C	300-349
D+	250-299
D	200-249
F	Below 200

Tentative Schedule

Date	Day	Topics
August 20	Wednesday	Orientation to GitHub, Codespaces, and Copilot
August 22	Friday	Making and Publishing a Simple Web App
August 25	Monday	Plotting
August 27	Wednesday	Slope
August 29	Friday	Equation of a Line
September 1	Monday	Labor Day (no class)

Date	Day	Topics
September 3	Wednesday	Meaning of the Equation of a Line
September 5	Friday	Other Important Functions
September 8	Monday	Tangent Lines
September 10	Wednesday	Practice Quiz
September 12	Friday	Quiz 1
September 15	Monday	SymPy
September 17	Wednesday	Equations of Tangent Lines
September 19	Friday	Gradient Vector in 2D
September 22	Monday	Visualizing Gradient Descent
September 24	Wednesday	Implementing Gradient Descent
September 26	Friday	Mean Squared Error
	Monday	Line of Best Fit

Date	Day	Topics
September 29		
October 1	Wednesday	Animating Gradient Descent
October 3	Friday	3D Plotting
October 6	Monday	Quiz 2
October 8	Wednesday	Midterm Re-cap
October 10	Friday	Fall Break (no class)
October 13	Monday	Surfaces
October 15	Wednesday	Plotting on Surfaces
October 17	Friday	Traces
October 20	Monday	Tangent Lines on Traces
October 22	Wednesday	Partial Derivatives
October 24	Friday	Gradient Vector in 3D
October 27	Monday	Gradient Descent in 3D
October 29	Wednesday	Linear Regression
October 31	Friday	Quiz 3
November 3	Monday	Linear Regression via Gradient Descent
November 5	Wednesday	Multiple Regression

Date	Day	Topics
November 7	Friday	Applications of Linear Regression
November 10	Monday	Polynomial Regression
November 12	Wednesday	Classification and Decision Boundaries
November 14	Friday	Confusion Matrices
November 17	Monday	Sigmoid Functions
November 19	Wednesday	Log Loss
November 21	Friday	Logistic Regression
November 24	Monday	Animating Logistic Regression
November 26	Wednesday	Thanksgiving Break (no class)
November 28	Friday	Thanksgiving Break (no class)
December 1	Monday	Classification with Two Features
December 3	Wednesday	Quiz 4

Date	Day	Topics
December 5	Friday	Course Re-cap

Academic Honesty Policy

Students are expected to adhere to Mercyhurst University's Academic Honesty Policy. Please review the complete policy at:

https://www.course-catalog.com/mercyhurst/C/2023-2024/content/academic-affairs/academic-honesty/41

ADA Accommodations & Accessibility

Mercyhurst University values inclusion and is committed to the goal of providing equal opportunities for all. It is our policy and practice to create accessible learning environments consistent with federal and state law.

Students who are currently eligible should verify as instructed and contact me to discuss how their accommodations will be implemented in this class.

Students who have not been determined eligible, but have a temporary limitation (e.g., broken leg) or permanent medical, physical, sensory, learning,

cognitive, or mental health disability issue that requires accommodations, should contact the ADA Coordinator to make a request. Requests for accommodations can be made at any time throughout the calendar year and at any point in a student's enrollment.

Please contact Susan Reddinger, ADA Coordinator and Compliance Officer, at ada@mercyhurst.edu, 814-824-2362, or in Old Main 300. Additional information can be found on the student hub https://lakersmercyhurst.sharepoint.com/sites/StudentsHub under the Services tab.

Students with questions about Academic Support, please refer to the Hub https://lakersmercyhurst.sharepoint.com/sites/StudentsHub and select the Academic Resources tab, then Academic Support for more information.

Title IX

Mercyhurst is committed to providing an environment free from sex discrimination, including sexual harassment and sexual violence. Please refer to the HUB: https://lakersmercyhurst.sharepoint.com/sites/StudentsHub and select the Resources tab, then Title IX – Sexual Respect from the dropdown for more information.

If you would like to file a sexual misconduct complaint, please contact Ann Miller, Title IX Coordinator and

> Compliance Officer, titleix@mercyhurst.edu , 814-824-2363, Egan Hall 311. Please be aware that in compliance with Title IX, educators must report incidents of sexual assault/harassment, stalking, domestic/dating violence, sex discrimination, and hostile environment harassment. If you disclose any of these situations in class, in papers, or to a faculty or staff member personally, they are required to report it to the Title IX Coordinator (or any of the Deputy Title IX Coordinators).