Math 118 Introduction to Functions of Several Variables

Summer II 2021—July 12 to August 13, 2021

Instructor:	Dr. Ning Jia	**Office:**	Virtual
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Class Meetings:	MW 1:00-4:15pm	**Location:**	Virtual

Course Pages: Our class will be online, with live sessions held during class meeting times through Zoom. Please check our Canvas page regularly for all announcements, assignments, supplementary materials and schedule.

Office Hours:

- There will be virtual office hours each week, schedule will be announced by the end of first week.
- By appointment. Please feel free to email me to request a meeting outside of my regular office hours.

Textbooks:

- Kuttler, A First Course in Linear Algebra https://lyryx.com/wp-content/uploads/2017/06/Kuttler-LinearAlgebra-AFirstCourse-2017A.pdf
- McCallum, et. al., Calculus: Multivariable, Wiley, 7th Edition (You can purchase/rent the ebook at wiley.com. If you choose to purchase it elsewhere, please make sure you have the 7th edition.)

Course Description: A combination of linear algebra and differential calculus of several variables. Matrix representation of linear equations, Gauss elimination, vector spaces, independence, basis and dimension, projections, least squares approximation, and orthogonality. Three-dimensional geometry, functions of two and three variables, level curves and surfaces, partial derivatives, maxima and minima, and optimization. Intended for students in the social sciences, especially Economics.

Prerequisites: Math 112 or equivalent. Please seek instructor consent if you have not taken Math 112 at Yale University before.

Grading Policy:

In-Class Quizzes..... 20%
In-Class Participation..... 10%
Homework..... 40%
Final Exam..... 30%

Important Date:

Final Exam ..... August 11th, 1:00-4:15pm

In-Class Quizzes: We will have 10 meeting times, and will have a 20-25 minute quiz at the beginning of each of the fist 9 classes. The first quiz is for information purpose only and will

not count toward your grade. Each of the other quizzes is worth 3.75% of your total grade, for the total of 30%.

You will receive a code at the beginning of class to access the quiz in Canvas, and then you will be required to submit your quiz through Canvas after you are done. You will need to provide documentation to support your absence to class, if you want to make up the quiz.

In-Class Participation: You are expected to attend each class, leave video on during the entire duration of the class, and participate in all class activities such as discussions and short exercises. Your performance for each in-class participation is worth 1% of your total grade, for the total of 10%.

Homework: There will be 9 homework assignments, due either Thursday or Sunday nights at 11:59pm (EST) in Canvas. Homework must be submitted through Canvas following instructions. No late submissions accepted without proper supportive documentation. Each homework is worth 4.44% of your total grade, for the total of 40%.

Final Exam: Final exam will take place on Aug 11th during regular class time: 1:00-4:15pm with proctoring service.

Detailed Class outline:

Week 1 Lecture 1 (Kuttler)	Part 1: Introduction, logistics Part 2: 1.1 Systems of Equations, Geometry, algebraic procedures Part 3: 1.2.1 Elementary Operations, 1.2.4 Rank and Homogeneous Systems
Week 1 Lecture 2 (Kuttler)	Part 1: 2.1.1-2.1.5 Adding and multiplying matrices Part 2: 2.1.6-2.1.7 Transpose, Identity and inverse matrices Part 3: Markov Chain
Week 2 Lecture 1 (Kuttler)	Part 1: 2.1.9-2.2.3 Elementary matrices, LU factorization Part 2: 4.1-4.6 Vectors in R^n, algebra in R^n geometric meaning, length of vector, parametric lines
Week 2 Lecture 2 (Kuttler)	Part 1: 4.7-4.9. Dot product, planes in R^n, cross product Part 2: 4.10 Spanning, linear independence and basis in R^n
Week 3 Lecture 1 (Kuttler)	Part 1: 4.11.1-4.11.3 Orthogonality and the Gram Schmidt process Part 2: 4.11.4-4.11.5 Orthogonal projections and least squares
Week 3 Lecture 2 (McCallum)	Part 1: 12.1-12.2 Functions of two variables, graphs and surfaces Part 2: 12.3 Contour diagrams Part 3: 12.4 Linear functions
Week 4 Lecture 1 (McCallum)	Part 1: 12.5-12.6 Functions of 3 variables, limits and continuity Part 2: 14.1. Partial derivatives Part 3: 14.2: Computing partial derivatives
Week 4 Lecture 2 (McCallum)	Part 1: 14.5 Gradients and Directional Derivatives in Space Part 2: 14.6 The Chain Rule Part 3: 14.7 Second-Order Partial Derivatives
Week 5 Lecture 1 (McCallum)	Part 1: 15.1 Critical Points: Local Extrema and Saddle Points Part 2: 15.2 Optimization Part 3: 15.3 Constrained Optimization: Lagrange Multipliers If time allows: application in econometrics
Week 5 Lecture 2	Final Exam

Grades will be determined based on the following cutoffs (cutoffs are strict. For example, a total of 92.9% will be an A-, etc.)

Letter Grade Equivalent:	Percentage Earned:
A	93-100
A-	90-92
B+	87-89
B	83-86
B-	80-82
C+	77-79
C	73-76
C-	70-72
D+	67-69
D	60-66
F	Below 60