



## Santa Clara University

### Leavey School of Business

### Course Outline

#### **MSIS2402/2502**

Mathematics for Analytics and Finance with R  
Fall 2024

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Instructor: Dr. Sami Najafi  
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Phone (Fax): 408.554.4110  
Class Schedule:

- M W | 5:45 PM - 7:20 PM Rm 208 Lucas Hall
- T Th | 5:45 PM - 7:20 PM Rm 208 Lucas Hall
- T Th | 7:35 PM - 9:10 PM Rm 208 Lucas Hall

#### Online Class Options:

- Online students can audit in-person classes as well.

Teaching Assistant: Jinxin (Alex) Wu

#### Office Hours:

- Sami Najafi:
  - By appointment
- Lutos Liu:
  - Fridays, starting from Week 2: 11:00 AM - 12:00 PM (via Zoom)
  - Additional times available by appointment

### Course Description:

Delivering the right products and services to the appropriate audience, in the optimal location, at a competitive cost, and precisely when needed, is the cornerstone of a company's competitiveness. Failure to accomplish this renders other strengths inconsequential in the long term. This elevates the role of mathematical decision-making models and quantitative analysis to the core functions of a business, serving as key drivers of profitability. Without robust mathematical frameworks and thorough analysis, even the most ingenious strategies or business models will fall short.

This course aims to equip students with a foundational understanding of essential mathematical principles used in analytics and financial decision-making. The curriculum is divided into four major components: single-variable calculus, matrix algebra, multivariable calculus and optimization, as well as probability and statistics.

Throughout the duration of the course, the focus will be on practical algebraic computations, illustrating their utility in resolving real-world business challenges and decision-making models. By engaging in hands-on calculations involving variables, students will gain proficiency in mathematical modeling, setting the stage for the application of calculus. This approach diverges from the traditional “definition-theorem-proof” methodology often encountered in conventional applied mathematics courses, providing a more applied, problem-solving orientation.

## Learning Objectives:

In this course, students will acquire proficiency in the essential mathematical concepts below:

- Single variable calculus
- Matrix algebra
- Multivariable calculus and optimization
- Probability and statistics

These foundational skills are indispensable for comprehending a wide range of quantitative subjects in analytics, finance, marketing, and economics.

## Recommended Readings:

### Modules 1-4: Calculus, Matrix Algebra, and Optimization:

- **Main Textbook:** Haeussler, E., Paul, R.S., & Woods, R.J. (2018). *Introductory mathematical analysis for business, economics and the life and social sciences* (14th Ed.). Pearson.
- **Additional References:**
  - Abbott, Stephen. *Understanding analysis*. Vol. 2. New York: Springer, 2001.
  - Deisenroth, Marc Peter, A. Aldo Faisal, and Cheng Soon Ong. *Mathematics for machine learning*. Cambridge University Press, 2020.
  - Kochenderfer, Mykel J., and Tim A. Wheeler. *Algorithms for optimization*. Mit Press, 2019.
  - Simon Carl P, and Lawrence Blume. *Mathematics for Economists*, Norton & Company, Inc, 2010
  - Jehle, Geoffrey, Philip Reny. *Advanced microeconomic theory*. Pearson, 2010.

### Modules 5-8: Probability and Statistics:

- **Main Textbook:** Berenson, M., Levine, D., Szabat, K. A., & Krehbiel, T. C. (2014). *Basic business statistics: Concepts and applications*. Pearson higher education (13th Ed.).
- **Additional References:**
  - Ross, Sheldon M. *A first course in probability*. Boston: Pearson, 2019.
  - Ross, Sheldon M. *Introduction to probability models*. Academic press, 2014.
  - Durrett, R. *Probability: Theory and Examples*, Cambridge University Press, 2020.
  - Grimmett, Geoffrey, and David Stirzaker. *Probability and random processes*. Oxford university press, 2020.
  - Rosenthal, Jeffrey S. *First Look At Rigorous Probability Theory*, A. World Scientific Publishing Company, 2006.

## Learning R:

- **Main Textbook:** Long, James D., and Paul Teetor. *R cookbook: proven recipes for data analysis, statistics, and graphics*. O'Reilly Media, 2019.
- **Additional References:**
  - Shmueli, Galit, et al. *Data mining for business analytics: concepts, techniques, and applications in R*. John Wiley & Sons, 2017

The primary textbooks and supplemental materials are not required, but I highly recommend purchasing or renting them for a comprehensive understanding of the course material. Working the problems from the main textbooks is optional, but it is an excellent way for you to improve your understanding. I will assign weekly homework problem sets online in Camino and will provide detailed solutions for each after their due dates.

## Evaluation and Grades

Grades are a measure of the performance of a student in individual courses.

<b>Attendance</b>	<b>10%</b>
<b>Weekly Assignments</b>	<b>30%</b>
<b>Group Project</b>	<b>20%</b>
<b>Midterm Exam</b>	<b>20%</b>
<b>Final Exam</b>	<b>20%</b>

### Attendance Policy:

Attendance accounts for 10% of your overall grade. Each absence will result in a proportional reduction from the Attendance and Participation component of your grade. Exceptions may be made for documented medical reasons or other extenuating circumstances.

A grace period of 15 minutes will be permitted at the beginning of each class. Arriving after the grace period will mark you as 'late.' Three instances of being late will be equivalent to one absence, which will then be subject to the attendance policy described above. Exceptions may be made for extenuating circumstances if documentation is provided.

### Weekly Assignments:

The course includes several weekly problem sets that collectively contribute to 30% of your final grade. You may attempt each problem set twice, and the system will automatically retain your higher score. To maximize your opportunity for partial credit, I highly recommend that you submit detailed solutions at the end of each problem set.

**Submission Policy:** Problem sets are typically due by the **end of the day on Sundays**. While the submission link will not close after the due date, a late submission penalty of 10% per day will be applied, starting immediately after the due date and time. Exceptions to these penalties may be made for documented medical emergencies or other extenuating circumstances, subject to my discretion.

### Group Project:

The group project constitutes 20% of your final grade. In this assignment, your team will focus on optimizing support staffing decisions at Tesla to minimize the operational costs. You will employ R programming to solve this optimization problem (which, although fictitious, has been written by me to simulate real-world complexities.) Teams may consist of 2 to 4 students. While the case study may

seem straightforward, its central objective is to provide hands-on experience in formulating and resolving real-world optimization issues by using R.

### Midterm Exam:

The midterm exam accounts for 20% of your final grade and will cover material from Modules 1-4. The exam is in-class and written, with questions closely mirroring those found in the weekly assignments. Students are allowed to bring only **a 2-letter-sized cheat sheet** of their own. Students can also bring a any calculator of their choice. No other electronic devices (laptop, cell phone, smart watch, etc) or internet access will be permitted during the exam.

### Final Exam:

The final exam accounts for 20% of your final grade and will cover material from Modules 5-8. The exam is in-class and written, with questions closely mirroring those found in the weekly assignments. Students are allowed to bring only **a 2-letter-sized cheat sheet** of their own. Students can also bring a any calculator of their choice. No other electronic devices (laptop, cell phone, smart watch, etc) or internet access will be permitted during the exam.

### Planned Grade Scale for The Term:

Grade	Score Range
A	93.0% - 100.0%
A-	90.0% - 93.0%
B+	87.0% - 90.0%
B	84.0% - 87.0%
B-	81.0% - 84.0%
C+	78.0% - 81.0%
C	75.0% - 78.0%
C-	72.0% - 75.0%
D+	69.0% - 72.0%
D	66.0% - 69.0%
D-	63.0% - 66.0%
F	60.0% - 63.0%

### Grade Rounding Policy:

Note that a student's grade may be rounded up if it is *extremely close* to a higher-grade threshold. For instance, if a student has earned a grade of 89.9% or more, it might be rounded up to 90%, thereby elevating the grade to an 'A-'. However, if for example, the student has got 89.8% the grade is typically *not* be bumped up.

### Disability Accommodation Policy

To request academic accommodations for a disability, students must be registered with Disability Resources, located in Benson 216. If you would like to register with Disabilities Resources, please visit their office or call (408) 554-4109. You will need to register and provide professional documentation of a disability, prior to receiving academic accommodations.

The University is committed to academic excellence and integrity. Students are expected to do their own work and to cite any sources they use. A student who is guilty of a dishonest act in an examination, paper, or other work required for a course, or who assists others in such an act, may, at the discretion of the instructor, receive a grade of "F" for the course. In addition, a student found guilty of a dishonest act may be subject to sanctions, up to and including dismissal from the University, as a result of the student judicial process as described in the Student Handbook. A student who violates copyright laws, including those covering the copying of software programs, or who knowingly alters official academic records from this or any other institution is subject to similar disciplinary action.

## **Academic Integrity Policy**

As an institution of higher education rooted in the Jesuit tradition, Santa Clara University is committed to creating and sustaining an environment that facilitates students' academic, personal, and ethical development. This commitment balances freedom of individual choice and expression with the expectation that individual members of the community will:

- Be honest
- Demonstrate self-respect and respect for others
- Demonstrate respect for the law and University policies, procedures, and standards.

Students are expected to do their own work and to cite any sources they use. A student who is guilty of a dishonest act in an examination, paper, or other work required for a course, or who assists others in such an act, may, at the discretion of the instructor, receive a grade of "F" for the course. In addition, a student found guilty of a dishonest act may be subject to sanctions, up to and including dismissal from the University, as a result of the student judicial process as described in the Student Handbook. A student who violates copyright laws, including those covering the copying of software programs, or who knowingly alters official academic records from this or any other institution is subject to similar disciplinary action.

## Tentative Session Schedule

**Note:** The following schedule serves as a guide for the course's progression, outlining the topics to be covered in each module with predicted number of sessions dedicated to each module.

Module	Topics Covered	Sessions (approx.)	Suggested Readings
1	Exponential and Logarithmic Functions, Differentiation, and Optimization	1,2,3,4,5	Haeussler: Chapters 4, 11, 12, 13
2	Integration and Its Applications	5,6,7	Haeussler: Chapters 14, 15
3	Matrix Algebra	7,8,9	Haeussler: Chapter 6
4	Multivariate Calculus and Optimization	9,10,11,12	Haeussler: Chapter 17
5	Basic Probability Concepts	13,14	Brenson: Chapter 4 (Sections 4.1-4.3)
Midterm Exam	Covers Modules 1- 4	14 or 15	Haeussler: Chapter 8
6	Discrete Random Variables and Probability Distributions	16,17	Brenson: Chapter 5
Group Project Assigned	—	14 or 15	Haeussler: Chapter 9 (Sections 9.1-9.2)
7	Continuous Random Variables and Distributions	18, 19	Brenson: Chapter 6; Haeussler: Chapter 16
8	Sampling Distributions and Confidence Intervals / Workshop - Tesla	19, 20	Brenson: Chapters 7, 8
9	Fundamentals of Hypothesis Testing and One-Sample Tests	Optional	Brenson: Chapter 9 (Sections 9.1-9.3)
Final Exam	Covers Modules 5 – 8 (Module 8 only if covered)	Finals week	—