Calculus I

(STM 1001, 4.5 credits)

The University of Austin

Instructor: David Puelz
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Meeting Schedule: M/W/F from 11:30a-12:45p
Office Hours: Please consult the webpage

Course Description

Calculus drives our understanding of change and motion, powering modern science, technology, and data-driven fields from physics to AI. This course reinvents how we learn calculus by blending computing, modeling, and statistics, using R-based computation to make ideas directly relevant to the digital age. Students will move beyond rote symbolic work to apply calculus in real-world modeling and analysis, building the skills needed for modern scientific and analytical thinking.

Course Objectives

- Understand and apply functions as tools for mathematical modeling
- Use computational methods to explore and analyze mathematical relationships
- Master differentiation and apply it to solve optimization problems
- Develop skills in mathematical analysis and approximation techniques

Required Readings

Please obtain a copy of the first book. The second resource is an online website that is linked.

→ *Mathematical Modeling and Applied Calculus* (MMAC) – Alex M. McAllister and Joel Kilty

→ *Mosaic Calculus* (MC) – Danny Kaplan

Course Cadence

There will be 5 quizzes and 5 homework assignments. The quizzes will be on the Fridays of weeks 2, 4, 6, 8, and 10. The homeworks will be due on Fridays at 11:30a (start of class) on the same days as the quizzes. The quiz content will be related to the homework, and we will mark up the quizzes in class directly after finishing the quiz. We will have a final exam during the scheduled exam time (on week 11 of the course).

Evaluation

The class grade is comprised of the following:
– Homework (20%)
– Exam (30%)
– Quizzes (50%)

Topics

1. Introduction and Functions (computing, pattern-book functions, visualization)
2. Modeling (parameters, function assembly, fitting, dimensions)

3. Differentiation (rates of change, derivative rules, optimization, approximation)

Below is a timeline for the term. It is subject to change as we make our way through these topics. Please also pay attention to the course website. I will include supplemental readings beyond those in our textbooks.

Week	**Topics**	**Reading**
Week 1 (Jan 5)	Functions, notation, R basics, visualization	MC: 1–4; MMAC: §1.1–1.7
Week 2 (Jan 12)	Pattern-book functions and data	MC: 5–7; MMAC: §1.1–1.7
Week 3 (Jan 19)	Parameters, assembling functions, multivariable	MC: 8–10; MMAC: §1.2, §2.1–2.2
Week 4 (Jan 26)	Fitting, polynomials, dimensions & units	MC: 11–16; MMAC: §2.3–2.4, §1.5, §2.5
Week 5 (Feb 2)	Continuous change, rate of change, evanescent h	MC: 17–19; MMAC: §3.1–3.3
Week 6 (Feb 9)	Constructing derivatives, concavity, smoothness	MC: 20–22; MMAC: §4.1–4.3, §3.4
Week 7 (Feb 16)	Derivatives of assembled functions, optimization	MC: 23–24; MMAC: §4.4–4.5, §5.1–5.2
Week 8 (Feb 23)	Optimization, partial derivatives, gradients	MC: 24–26; MMAC: §5.3–5.4
Week 9 (Mar 2)	Taylor polynomials, review & synthesis	MC: 27; MMAC: Ch. 7
Week 10 (Mar 9)	Review and synthesis	MC: 27; MMAC: Ch. 7
Week 11 (Mar 16)	*final exam week*	

Accessibility Statement

Please review the University Accessibility Statement in the student catalog. Students having special needs should email Accomodations@uaustin.org. Disability Support Services: The University will make reasonable accommodations for students with disabilities in compliance with Section 504 of the Rehabilitation Act and the Americans with Disabilities Act. The purpose of accommodations is to provide equal access to educational opportunities for eligible students with academic and/or physical disabilities.

Attendance Policy

Attendance is mandatory. If you don't show up, you will fail the course. Each student may miss up to 10% of classes for any reason—no excuse required and without penalty—corresponding to 1, 2, or 3 classes in a 1.5, 3.0, or 4.5 credit course, respectively. Any additional absences will result in a final grade penalty of 12% (1.5 credits), 6% (3.0 credits), or 4% (4.5 credits), regardless of the reason. Missing more than 25% of classes—including the allowable absences—without a medical excuse will result in failing the course. Being more than 20 minutes late to class counts as an unapproved absence.

Showing Work

On all course deliverables, there is an expectation of showing how you got to an answer. If you show a partially correct sequence of steps to a wrong answer, you may be awarded partial credit (at the discretion of the instructor). If you only write down the correct answer, you will not receive any credit. I will not award credit to random guessing and shoddy, vague, or unclear supporting work. This is part of the pedagogical design–demonstrate to me that you know what you're doing!

Late Policy

Sometimes we have bad days, bad weeks, and bad terms. In an effort to accommodate any unexpected, unfortunate personal crisis, I have built a grace policy into the course: that is, a one-time,

three-day grace period for one homework assignment. You do not have to utilize this policy, but if you find yourself struggling with unexpected personal events, I encourage you to e-mail me and our TA as soon as possible to notify us that you are using our grace policy. **All other late assignments will be penalized 20 percentage points per day or partial day that they are late.**

STEM Center Learning Objectives

This is an intellectual foundations course that contributes to the following STEM Center learning objectives:

→ Speak, read, and write in mathematical language.

→ Formulate and solve quantitative problems using appropriate technical language, models, and techniques.

→ Collect and analyze data using appropriate technology tools.

→ Communicate technical solutions clearly through writing, speaking, and visualization.

Final Course Notes: AI Help, Academic Misconduct, etc.

I encourage the use of ChatGPT and other AI tools for coding. They are tremendously useful calculators that will continue to grow in importance. I have zero tolerance for submitting work that is not your own, regardless of whether it is plagiarized or copied from a fellow student. If this occurs on either the homework or project, I will issue an automatic zero for the deliverable. Finally, if you are reading this sentence, please send me a note stating, "I have read the syllabus!", and I'll give you 2 bonus points on your raw final exam grade! These points are valid if you send me a note before the first Friday of the term.