MATH 102: Single Variable Calculus II

Spring 2024

Contact Information

Instructor: Jacob Kesten
Office: HBH 50 (in the basement)
Email: jgk3@rice.edu

Course Information

Meeting Times: MWF 9:00-9:50 AM
Location: GRB W211
Student Hour: Th 10:30-11:30 AM HBH 09

Introduction

The invention (discovery?) of Calculus in the 1660s was groundbreaking. Today, calculus has applications in a variety of subjects, including science, pure and applied math, economics, medicine, engineering, video game design, computer science, statistics, architecture, weather forecasting, and more. Last semester in Math 101, you saw how calculus is the "study of change" by learning about derivatives, integrals, and how they connect. This semester, our main goal will be to see how calculus is the "study of approximation." We will learn how complicated functions can be viewed as almost polynomials, the nicest functions around! We will then see how this allows calculators and computers to evaluate these more complicated functions without too much error. Further, we will learn how to harness the power of these and other technologies to aid in our learning of calculus, how technology comes up short, and why we still require humans to learn mathematics.

Structure

Mathematics is very hard to learn passively. You must be engaged and actively performing mathematics to learn mathematics. Hence, my goal this semester is to use a variety of active learning techniques, including but not limited to flipped classroom, group work, small group and student-led discussions, problem-based learning, and think-pair-share. Much of class will be dedicated to problem-solving and active collaboration before we come back as a whole class to discuss ideas and solutions.

Inclusivity Statement

Mathematics is a beautiful subject that should be accessible to all who wish to enter this interesting world, regardless of background. Currently, mathematics as a field has not adequately supported members of underrepresented groups, resulting in many people being excluded from mathematics and creating a lack of diversity in the field. My goal as a mathematics teacher is to create a classroom where every student is welcomed into the world of mathematics, where every student is comfortable, where every student feels that their ideas and perspectives are valued, and where every student receives the support needed for them to learn and succeed.

To this end, I am committed to using a variety of teaching and learning techniques, as what works for one student may not work for others. Additionally, much of classwork will include collaboration and discussion. It is my hope that this will promote diverse exchange of ideas and a feeling of community in the classroom. While I will do my best to create and encourage inclusivity and diversity, coming from a place of privilege, I may not always know the best way to do this, or what each of you needs in terms of support. I ask that you please be patient with me and reach out to me if you have any suggestions, concerns, or critiques, so that I can take these into account and together we can create an environment that is conducive to learning for each of you.

If you are uncomfortable emailing or talking to me directly, please use the anonymous feedback form: https://forms.gle/MPcnShjE2HufUSQAA. This will be linked on Canvas as well. Thank you!

Essential Questions

- Approximating Functions: How do we do it? When is it useful and when is it not? How do we measure accuracy, and how accurate should we aim to be?
- With the rise of calculators and AI, what is the value of training humans in mathematics? What can we do that calculators cannot?
- Is math better learned individually or as a collaborative endeavor? How do you best learn math? What approaches help you the most and what new approaches do you think would be most helpful?

Learning Outcomes

- Students will further develop their understanding of the relationship between limits and approximations and work to apply these ideas to functions. We will then assess the validity and usefulness of such approximations for a range of applications. (Taylor Series)
- Students will learn how calculators and AI do math in order to evaluate when such a tool will be useful to a problem. In addition, students will be able to formulate equations and questions that can be input into calculators or computer systems to obtain useful results. (Integration and Series)
- Students will work individually and collaboratively through a variety of active learning techniques. They will evaluate the efficacy of these approaches and provide feedback.

Textbook

Calculus: Early Transcendentals by Stewart, Clegg & Watson, 9th edition

Students will also be required to have a Cengage Account so that they can access WebAssign. If you have already purchased this for another class, it should still work. If you do not already have an account, you will need to purchase it at the Rice discounted rate of $100.

Major Topics Covered

Students will be comfortable with the following topics, understand the connections between them, as well as with previous material in Math 101, and be able to apply them to novel problems, especially those that pertain to the essential questions above.

- Integration Techniques: IBP, Trig Sub, Partial Fractions, Improper Integrals (Stewart Ch. 7)
- Infinite Series Convergence: Divergence Test, Integral Test, p-Test, Comparison Tests, Alternating Series Test, Ratio and Root Test (Stewart Ch. 11)
- Power Series: Taylor and Maclaurin Series, Approximating Polynomials, Error Bounds (Stewart Ch. 11)
- Calculus with Parametric and Polar Curves: Derivatives, Integrals, Arc Length (Stewart Ch. 10)
- Further Topics: Complex Numbers, Fourier Series (Supplemental Notes)

Exams

There will be two midterm exams during the semester and a final exam during the exam period. All exams are comprehensive, and assume a working knowledge of Math 101. The two midterm exams will be held on **Thursday, February 15, 2024** and **Thursday, March 21, 2024**, both from **7:00-9:00 PM CDT**, location TBD.

Make-up exams will be allowed on a case-by-case basis. If you believe you may need a make-up exam, please reach out as soon as possible and we can discuss the details. Make-up exams must be requested at least one week in advance of the set exam time, except in the case of an emergency.

The final exam date is yet to be determined but will be during the exam period as scheduled by the registrar. **It is the policy of the mathematics department that no final may be given early to accommodate student travel plans.** If you make travel plans that later turn out to conflict with the scheduled final exam, then it is your responsibility to reschedule your travel plans or take a zero on the final.

All exams are pledged according to the Rice University Honor Code, and the Honor Code should be written and signed on the first page of each exam. **No books, notes, or calculators will be allowed to be used on exams. Discussing exam questions with other students is prohibited until all students have taken the exam.**

Quizzes

Throughout the semester, there will be ~3 short quizzes. Each of these will consist of 2-3 problems that should be solved under "exam conditions." This means **no external resources (no textbook, internet, or calculators), no collaboration, and you are expected to follow the time limit of 30 minutes.** Quizzes will be take-home, posted on Friday, and you have until Sunday 11:59PM to submit on Gradescope, meaning you can take them at any point throughout the weekend. Students will be asked to sign the honor code on each of these. The goal of the quizzes is to give you practice with exam-like questions and exam conditions so that you are prepared for and familiar with the expectations on exams.

Homework

There will be both daily homework and a weekly written homework assignment. The daily homework assignments will be assigned and autograded on WebAssign. Each will consist of a few problems meant to review the previous class material and/or prepare you for topics in the next class. These will be due at the start of each class.

The written assignments will consist of longer problems that will encourage more critical thinking and synthesis of concepts. These will be graded for accuracy. Written assignments will be posted by Monday night on Canvas and due on **Sundays at 11:59PM CDT** on Gradescope each week.

Homework assignments are not pledged, and you are encouraged to work collaboratively. When doing so, I recommend discussing problems together, but writing solutions independently to ensure that each member of the group understands the solution thoroughly. **Finding solutions online or from a solutions manual is still prohibited.**

Exposition of Solutions

An important part of math is being able to present arguments clearly and concisely so that other people can read and understand your logic. Because of this, all solutions are expected to be legible and easy to follow. All steps should be written out with explanations that indicate how you went from one step to the next. I recommend, but do not require, the use of full sentences to clearly express your thinking and logic in between equations. For this reason, **work that is hard to follow or understand (either because it is messy, illegible, or not thorough enough) will lose points**. I will do my best to model good mathematical exposition in class, but if you are still struggling with this, please come see me and we can discuss what you can do to improve.

Student Hours and Help Sessions

Student hours are dedicated times each week when I will be in my office, available for students to ask questions, discuss topics, or just chat. These times will be decided in the first week of classes and announced both in class and on Canvas. If you cannot make these but still wish to meet, please send me an email and we can schedule a time.

In addition to student hours, the math department organizes Help Sessions throughout the week. These are held from **6:30PM-8:30PM on Sunday, Monday, Tuesday, Wednesday, and Thursday**. The locations are TBD and will be announced in class and on Canvas. I highly encourage you to attend these and use them to your advantage, especially if you are struggling with understanding concepts.

Grade Policies

Homework will account for 15% of your grade (5% for daily homework and 10% for written assignments). 10% of the grade will be quizzes, and the remaining 75% will be exams (22.5% Midterm 1, 22.5% Midterm 2, 30% Final).

The resulting numerical score will be normalized against scores from all current sections of Math 102 and then translated to a letter grade using the standard Rice University 10-point grade scale. Any adjustments to this scheme will only improve your final letter grade.

Note: This grade policy is consistent with other sections of Math 102.

Absence Policies

You are not required to attend class. As much of class is dedicated to active learning and group work, please keep in mind the disservice you do your peers by failing to attend, as well as the disservice you do yourself.

Rice Honor Code

In this course, all students will be held to the standards of the Rice Honor Code, a code that you pledged to honor when you matriculated at this institution. If you are unfamiliar with the details of this code and how it is administered, you should consult the Honor System Handbook at http://honor.rice.edu/honor-system-handbook/. This handbook outlines the University's expectations for the integrity of your academic work, the procedures for resolving alleged violations of those expectations, and the rights and responsibilities of students and faculty members throughout the process.

Disability Resource Center

If you have a documented disability or other condition that may affect academic performance you should: 1) make sure this documentation is on file with the Disability Resource Center (Allen Center, Room 111 / adarice@rice.edu / x5841) to determine the accommodations you need; and 2) talk with me to discuss your accommodation needs.

Mental Health Statement

Reports suggest that about 1 in 5 college students suffers from anxiety, depression, bipolar disorder or other mental health issues. If you are having trouble completing your coursework, please reach out to the Wellbeing and Counseling Center. Rice University provides cost-free mental health services through the Wellbeing and Counseling Center to help you manage personal challenges that threaten your personal or academic well-being. If you believe you are experiencing unusual amounts of stress, sadness, or anxiety, the Student Wellbeing Office or the Rice Counseling Center may be able to assist you. The Wellbeing and Counseling Center is located in the Gibbs Wellness Center and can be reached at 713-348-3311 (available 24/7).

Title IX Responsible Employee Notification

Rice encourages any student who has experienced an incident of harassment, pregnancy discrimination or gender discrimination or relationship, sexual, or other forms interpersonal violence to seek support through The SAFE Office. Students should be aware when seeking support on campus that most employees, including myself, as the instructor/TA, are required by Title IX to disclose all incidents of non- consensual interpersonal behaviors to Title IX professionals on campus who can act to support that student and meet their needs. For more information, please visit safe.rice.edu or email titleixsupport@rice.edu. For more information about Title IX, please contact Title IX Compliance Officer Richard Baker.

Religious Accommodations

If an assignment of exam conflicts with a religious observance, please reach out to me as soon as possible and accommodations can be discussed. Please note that you will need to inform me of possible conflicts in a timely manner, meaning at least one week before the due date of the conflicting assignment so that there is time to plan and schedule accordingly.

Tentative Course Schedule

Monday, January 8, 2024
Review Integration, U-sub

Wednesday, January 10, 2024
Integration by Parts

Friday, January 12, 2024
Trig Sub

Monday, January 15, 2024: NO CLASS

Wednesday, January 17, 2024
Trig Sub Practice Day

Friday, January 19, 2024
Trig Integrals

Monday, January 22, 2024
Integration of Rational Functions

Wednesday, January 24, 2024
Rational Functions/Strategies of Integration

Friday, January 26, 2024
Strategies of Integration

Monday, January 29, 2024
Improper Integrals

Wednesday, January 31, 2024
Improper Integrals

Friday, February 2, 2024
Asymptotics and "little-o" notation

Monday, February 5, 2024
Improper Integrals Practice

Wednesday, February 7, 2024
Sequences

Thursday, February 8, 2024
Sequences (MST)

Friday, February 9, 2024: NO CLASS

Monday, February 12, 2024
Review for Midterm 1

Wednesday, February 14, 2024
Series: Intro, Int, Div, p-test, Harmonic

Thursday, February 15, 2024
Exam 1: Through Sequences

Friday, February 16, 2024
Geo Series and Comparison Tests

Monday, February 19, 2024
Alternating Series, Absolute Convergence

Wednesday, February 21, 2024
Ratio and Root Tests

Friday, February 23, 2024
Series Convergence Practice

Monday, February 26, 2024
Power Series Interval of Convergence

Wednesday, February 28, 2024
Power Series Diff. and Integration

Friday, March 1, 2024
Functions from Geo Series

Monday, March 4, 2024
Taylor and Maclaurin Series

Wednesday, March 6, 2024
Taylor and Maclaurin Series

Friday, March 8, 2024
Taylor and Maclaurin Series

Monday, March 11, 2024-Friday, March 15, 2024: SPRING BREAK

Monday, March 18, 2024
Review for Exam 2

Wednesday, March 20, 2024
Review for Exam 2

Thursday, March 21, 2024
Exam 2: Through Taylor Series

Friday, March 22, 2024
Applications of Taylor Polynomials

Monday, March 25, 2024
Taylor Polynomials Practice Day

Wednesday, March 27, 2024
Parametric

Friday, March 29, 2024
Parametric

Monday, April 1, 2024
Parametric

Wednesday, April 3, 2024
Arc Length and Surface Area

Friday, April 5, 2024
Polar

Monday, April 8, 2024: NO CLASS

Wednesday, April 10, 2024
Polar

Friday, April 12, 2024
Polar Practice Day

Monday, April 15, 2024
Complex Numbers

Wednesday, April 17, 2024
Complex Numbers and Fourier Series

Friday, April 19, 2024
Fourier and Last Day Loose Ends

Syllabus Change Policy

This syllabus is only a guide for the course and is subject to change with advanced notice.