Math 3311 - Introduction to Proof and Analysis (Fall 2021)

Instructor: Ross Parker (rhparker@smu.edu)
Course hours: Tuesday/Thursday 11 am - 12:20 pm
Location: Dedman Life Science Building 0132
Website: Canvas
Office Hours: TBA

Course Description

This course is an introduction to writing mathematical proofs, including mathematical notation, methods of proof, and strategies for formulating mathematical arguments. In particular, you will apply proof strategies to basic concepts in real analysis, which is the branch of mathematics that covers sequences and functions involving real numbers. The course will cover the following topics: direct proofs, set theory, mathematical induction, proofs using the contrapositive, proofs by induction, functions, and relations.

Learning goals

In this course, you will:

- Learn to use basic proof techniques, including direct proof, proof by contradiction, proof by contrapositive, proof by cases, and proof by mathematical induction, to make rigorous mathematical arguments.
- Acquire a working knowledge of set theory, functions, and relations.
- Demonstrate effective written and verbal communication of mathematical concepts.
- Explore examples from diverse fields of mathematics, including unsolved problems.
- Have fun (or as much fun as possible) doing these things!

Nuts and Bolts

Class format: This course will be taught in two 80-minute sessions per week. For the sanity of everyone involved, there will be a brief break of some form in the middle of each class session. Since this is a small class, I will incorporate class participation and in-class activities as much as possible. Although I like to think I'm entertaining, no one wants to hear anyone lecture for 80 minutes straight!

Please feel free to interrupt me at any time to ask me to repeat something, clarify a point, request I slow down, fix my handwriting, point out a mistake I have made, etc. Since this class focuses on learning skills and techniques rather than content, we can go over material as much as needed.
I will post surveys a few times throughout the course and welcome your feedback and suggestions for improvement.

- Although I will not formally take attendance, I *strongly* recommend attending class. You will only be able to participate in class activities and ask questions if you attend class.

- I request that during class you refrain from using electronic devices for non course-related purposes. I know that I cannot compete with TikTok and Snapchat for your attention, but I like to think that I am engaging and entertaining, and I will do the best I can to make the time we have together as useful as possible.
- All exams will be taken during regularly scheduled class time. If you have accommodations for extra time, please contact me to make the necessary arrangements. Final exam must be taken during the block of time scheduled by the university.
- Homework assignments can be submitted either on paper or electronically via Canvas. See below for more details.
- Office hours will start the second week of class. Please come to office hours for any questions about the course material, the homework, etc. I am always happy to procrastinate my own research to talk with students! If you would like to meet but cannot attend scheduled office hours, please contact me to schedule an alternative time. Days and times for office hours will be determined during the first week of class. There will also be an option for virtual office hours via Zoom.

Prerequisites: C- or higher in MATH 1338 or MATH 1340.

Textbook: Jay Cummings. *Proofs: A Long-Form Mathematics Textbook*, 2021. Costs $16 on Amazon:
`https://www.amazon.com/Proofs-Long-Form-Mathematics-Textbook-Math/dp/B08T8JCVF1`.

Reading: Specific reading assignments will be given on the main Canvas page for the course. Reading assignments are designed to help you understand the course material.

Homework: There will be problem sets due every **Thursday**, starting the second week of class. These will be posted at least one week in advance. Homework can either be submitted in person at the beginning of class on Thursday or can be submitted electronically on Canvas by the start of class on Thursday. If you opt for electronic submission, **please submit your assignment as a single PDF file**. If you write your problems on paper, I recommend the CamScanner app to scan them to PDF.

Learning mathematics, like getting to Carnegie Hall, is all about practice, practice, practice. For all assigned problems, you must show all of your work. This means you should display the process used, not just state a final result. Your goal is to convince me you know how to do the problem, not just what the answer is.

You are encouraged to discuss assignments with other students, but you must write up your own solution independently. When you have collaborated with other students, please acknowledge this by adding a note such as "I discussed question X with person A and person B." If you use any electronic resources, please indicate that as well. Identical or clearly copied assignments will be treated as violations of the honor code.

Do not postpone the problem sets until the last minute, as some answers may not come to you immediately, but then become clear a day later. If you are stuck on a problem, seek help from office hours or discussing with other students. Finally if you are not able to complete a question,

write a short note to describe what you tried and what you think may be important. Credit on assignments will come from a serious effort as much as anything else.

Homework grading: Each homework problem will be graded on a five-point holistic scale. Grading for exam problems will be similar.

- Excellent (5): Problem shows good effort and understanding and is essentially correct (except perhaps for typos or equivalent). All relevant work is shown.
- Good (4): Problem shows good effort. There are some mistakes but no significant gaps in understanding.
- Satisfactory (3): Problem shows good effort, but there is at least one significant gap in understanding.
- Fair (2): Either problem shows only moderate effort, or there are many significant gaps in understanding.
- Poor (1): Problem was submitted, but minimal effort is shown.
- No credit (0): Problem was not submitted.

Homework policy: Late assignments will in general not be accepted. If you turn in every assignment, your lowest homework grade will be dropped.

Midterm exams: There will be two midterm exams, which will be administered during regular class time.

- Tuesday, Sep 28
- Tuesday, Nov 2

Please contact me if you have an accommodation for extra time to make the appropriate arrangements. The exams will not be cumulative, although you may need to use techniques which were tested on the first exam on the second exam. All students are expected to take exams as scheduled, except as noted below. If you must miss an exam for one of these reasons, or for serious illness or injury, please contact me as soon as possible.

Final exam: The final exam has been scheduled by the university for Saturday, December 11 from 11:30am - 2:30pm. By university policy, the final exam must be taken during this block of time. The final exam is cumulative, although it will emphasize material taught since the second midterm.

Exam policy: The following policies will be in effect for the midterm and the final exams.

- You may not use a calculator or any electronic devices during the exam. Since this course requires no computation, a calculator is not useful.
- You may use a study sheet for each exam. You must make the study sheet yourself. Study sheets must be one side of a single standard 8.5x11 sheet of paper. You may only write on one side of the paper. You may write whatever you want on it. You will be asked to turn in your study sheet on Canvas along with the exam.

- You may not use the textbook, class notes, or any other paper references during the exam.

Final project: There will be a final project for this course. You will choose a theorem from any branch of mathematics or a famous unsolved problem in mathematics. **Your topic is subject to my approval, and it cannot be something we have discussed in class.** Each student must choose a different theorem or unsolved problem. I am more than happy to help you find a topic you find interesting. You will then write a brief report about the theorem or problem, including a rigorous statement of the theorem or problem, why it is important, and why you find it interesting. You will have multiple opportunities for revision and to incorporate feedback. You will also give a brief (five minute)presentation about the theorem or problem during the last week of class. (Baked goods will be involved). This is intended to be fun. More information about the final project, including a timeline, will be provided in the first few weeks of the course.

Grades: The grade for this class is computed as follows:

Homework	30%
Midterm Exams	30% (15% each)
Final Exam	20%
Final Project	20%

If your final exam grade is higher than your lowest midterm exam grade, that midterm grade will be replaced with the final exam grade.

Communication: Email is the best way to reach me. During the week, I will try to respond within 24 hours. Email responses may be slower on the weekends, but I will try to reply by Sunday evening. For complex questions, I may ask you to talk with me during office hours.

COVID-19

SMU is temporarily requiring masks (two or more layers covering the nose and mouth) in indoor spaces on campus, including classrooms, event and meeting spaces, and common areas in all buildings and residential halls regardless of vaccination status. Any changes to this policy will be posted clearly in Canvas announcements.

Diversity Statement

While mathematics, in its idealized form, is objective, the practice and teaching of mathematics is not immune from social issues of race, gender, disability, nationality, and socioeconomic status. Pop culture and the media have not made this any better, from Teen Talk Barbie telling us that "math class is tough" to mathematicians and scientists being portrayed in movies and television as "nerdy white males" such as Tony Stark. I will use the following four axioms by Federico Ardila-Mantilla (San Francisco State University) as a foundation for our time together.

- Axiom 1. Mathematical talent is distributed equally among different groups, irrespective of geographic, ðemographic, and economic boundaries.
- Axiom 2. Everyone can have joyful, meaningful, and empowering mathematical experiences.
- Axiom 3. Mathematics is a powerful, malleable tool that can be shaped and used differently by various communities to serve their needs.

- Axiom 4. Every student deserves to be treated with dignity and respect.

It is my intent that students from all diverse backgrounds and perspectives be well-served by this course. I am committed to a climate of mutual respect both inside and outside of the classroom. To that end,

- I want you to feel comfortable to ask any question you want, to ask me for clarification, or to ask me to slow down, both in class and in office hours. There are no bad questions!
- I want you to feel comfortable "making mistakes" when participating in class. There will be no judgment on my part. I make mistakes all the time. It is a natural part of the learning process.
- If you feel like your performance in the class is being impacted by your experiences outside of class, please do not hesitate to come and talk with me.
- If something was said in class (by me or anyone else) that made you feel uncomfortable, please talk to me about it. If you prefer to speak with someone outside of the course, the Diversity and Inclusion Officers are an excellent resource.
- If you have a name and/or set of pronouns that differ from those that appear in your official records, please let me know.
- If you have any learning differences that you believe will affect your performance in this class, please come talk to me about how best to accommodate these.
- I will provide a web address at which you can submit anonymous feedback.

Honor Code

The SMU Honor Code applies to all homework and exams in this course. Work submitted for evaluation must represent your own individual effort. Any giving or receiving of aid without my express consent on academic work submitted for evaluation shall constitute a breach of the SMU Honor Code.

I take honor code violations very seriously, and will report all violations to the SMU Honor Council. The minimum penalty for a violation is a grade of 0 on the assignment, and the maximum penalty is immediate failure of the course. These penalties are in addition to those imposed by the SMU Honor Council. Examples of honor code violations include:

- Copying homework solutions from any source: online, another student, or a tutor.
- Allowing another student to copy your homework.
- Cheating on an exam.

See the SMU Honor Code website for more information.

Disability Accommodations

Students needing academic accommodations for a disability must first register with Disability Accommodations and Success Strategies (DASS). Students can call 214-768-1470 or visit to begin the process. Once registered, students should then schedule an appointment with the professor as early in the semester as possible, present a DASS Accommodation Letter, and make appropriate arrangements. Please note that accommodations are not retroactive and require advance notice to implement.

Religious Observance

Religiously observant students wishing to be absent on holidays that require missing class should notify their professors in writing at the beginning of the semester, and should discuss with them, in advance, acceptable ways of making up any work missed because of the absence. (See University Policy No. 1.9.)

Excused Absences for University Extracurricular Activities

Students participating in an officially sanctioned, scheduled University extracurricular activity should be given the opportunity to make up class assignments or other graded assignments missed as a result of their participation. It is the responsibility of the student to make arrangements with the instructor prior to any missed scheduled examination or other missed assignment for making up the work. (see University Undergraduate Catalogue.)