Math 828: Real Analysis I

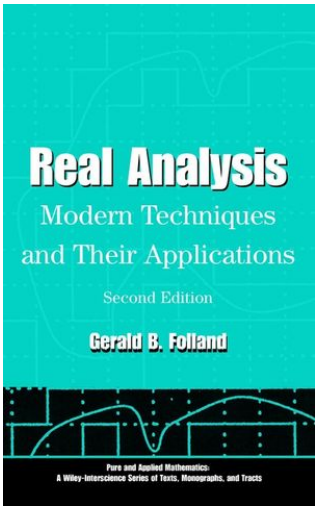
Lecture: Mondays, Wednesdays, and Fridays 10:20 - 11:10 am in C304 Wells Hall.

Instructor: Brent Nelson (brent@math.msu.edu). Office hours in D215 Wells Hall on Mondays 3:00 - 4:00 pm, Tuesdays 3:30 - 4:30 pm, and by appointment.

Grader: Jacob Gloe (gloejaco@msu.edu). Office hours on Zoom Mondays 2:00 - 3:00 pm and by appointment.

Course Webpage: https://www.math.msu.edu/~banelson/828.html

Textbook: Though **not** required, we will follow the material in the book: Gerald B. Folland, *Real Analysis: Modern Techniques and Their Applications*, Wiley, 2nd Edition. Lecture notes will be posted regularly that can substitute for the book.



An additional resource that you might find helpful (and which is available for free online): Sheldon Axler, *Measure, Integration & Real Analysis*, Springer.

Course Description: The focus of this course is on abstract measure theory and integration, which offer generalizations of Riemann integration that one learns about in calculus. A *measure* μ on a set X gives a way to associate a weight or mass to a subset of X (subject to some natural constraints), and in turn this allows one to define an *integral* $\int_X f\, d\mu$ for so-called *measurable* functions $f\colon X \to \mathbb{C}$. While the notion of a measure may seem simple at first, the resulting theory is full of interesting (and at time pathological) examples and has applications to many fields of mathematics: probability theory, functional analysis, topological group theory etc.

We will begin by formally defining measures and exploring examples, including the Lebesgue measure. Next, we will define measurable functions and their integrals, which will allow us to compare different measures on the same space. We will also see what kinds of convergence of functions $f_n \to f$ implies convergence of their integrals, and explore differentiability in the context of the Lebesgue measure. Finally, we will use functional analysis to study classes of measurable functions called L^p-spaces. This material corresponds to Chapter 1 - 3 and 6. Time permitting we may also cover Chapters 4 and 5.

In-Class Tone: My aim is to foster an open and inclusive atmosphere in class. Therefore questions, participation, collaboration, and curiosity are strongly encouraged. Math can be hard, especially when we aren't honest with ourselves about whether or not we understand something. Confusion is not a sign of weakness, nor is asking for help. If you need help beyond class time and office hours, please do not hesitate to contact me so that we can work out additional times to meet.

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Grading: Your course grade will be determined according to the following scheme:

Homework	60%
Exams	40%

Details for the above components are provided below. A gradebook will be maintained in D2L, but you are also welcome to ask me for your current grade at any time. If you believe there is an error with the grading of any course material, **you must notify the instructor within 14 calendar days** of when it was completed, otherwise it will not be given further consideration.

Homework: There will be a total of 10 homework assignments. The lowest two homework scores will be automatically dropped, and the remaining eight will count equally toward your overall homework score. These will be posted on the course webpage, and will be collected at the beginning of lecture on Wednesdays. No late homework will be accepted, but extensions may be granted on an individual basis. Collaboration is encouraged so long as your written work is clearly your own.

Exams: The course will have two in-class midterm examinations and a final exam. The lowest exam score will be automatically dropped, and the remaining two will count equally toward your overall exam score. Exam corrections will be offered for each midterm exam (but not the final exam):

- Choose one question from the exam and prepare a solution for it or any of its parts.
- Schedule a time to meet with the instructor and present the solution (no notes allowed).
- You can earn up to full credit for the question back.
- The deadline for the presentations will be two weeks from the date graded exams were returned.

Please check early in the semester for time conflicts with these exams:

Midterm 1	Wednesday, October 6th	10:20 - 11:10 am	C304 Wells Hall
Midterm 2	Wednesday, November 17th	10:20 - 11:10 am	C304 Wells Hall
Final Exam	Friday, December 17th	7:45 - 9:45 am	Ernst Bessey Hall 218

No make-up midterm exams will be offered, but any student having two other final exams scheduled the day of this final exam may take a make-up exam given the next day. If you qualify for the make-up final exam, you must fill out a request at C212 Wells Hall no later than Friday, December 10th at 12:00pm (noon) and provide a recent copy of your schedule as documentation. You will NOT be allowed to take the make-up final without registering.

Academic Integrity: Cheating will not be tolerated. Students who cheat may receive a 0.0 on the assignment or fail the course. This includes plagiarism and copying another's work. MSU policies on academic misconduct can be found here.

Student Accommodations: If the Resource Center for Persons with Disabilities (RCPD) has determined that you eligible for testing or classroom accommodations, then you should submit a Verified Individualized Services and Accommodations document (VISA) to the instructor no later than Friday, September 24th.

COVID Policies: Students are expected to follow all current MSU COVID Directives. In particular, students are expected to wear masks in class for the first weeks of the semester. In the event of a campus shutdown, lectures will be delivered virtually via Zoom.

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Course Calender: The following is a tentative schedule for the course.

Week 1	9/1 - 9/3	Class begins on 9/1, follow Monday's schedule
Week 2	9/6 - 9/10	No class on 9/6 (Labor Day) Homework 1 due on 9/8
Week 3	9/13 - 9/17	Homework 2 due on 9/15
Week 4	9/20 - 9/24	Homework 3 due 9/22
Week 5	9/27 - 10/1	Homework 4 due 9/29
Week 6	10/4 - 10/8	**Midterm 1** on 10/6
Week 7	10/11 - 10/15	Homework 5 due 10/13
Week 8	10/18 - 10/22	Homework 6 due 10/20
Week 9	10/25 - 10/29	No class 10/25 (Fall Break)
Week 10	11/1 - 11/5	Homework 7 due 11/3
Week 11	11/8 - 11/12	Homework 8 due 11/10
Week 12	11/15 - 11/19	**Midterm 2** on 11/17
Week 13	11/22 - 11/26	No Class on 11/28 (Thanksgiving)
Week 14	11/29 - 12/3	Homework 9 due 12/1
Week 15	12/6 - 12/10	Homework 10 due 12/8
Finals Week	12/13 - 12/17	**Final Exam** on 12/17 (7:45 - 9:45 am)

Other important dates:

- Wednesday 9/8 – Online open add period for fall semester ends at 8:00 pm.
- Monday 9/27 – Last day to drop with Tuition Refund (drop must be before 8:00 pm)
- Wednesday 10/20 – Middle of Semester. Last day to drop a course without a grade being reported (drop must be before 8:00 pm).
- Friday 12/10 – Last day of classes.

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