MATH 630, REAL ANALYSIS I, FALL 2023

MWF 1-1:50 MTH B0421

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Mid-term exam: Wednesday, October 11. This will be in-person, taking place during the regular class time.
Final exam: Thu, Dec. 14, 1:30pm - 3:30pm

Course description
The posted syllabus for Math 630 is
"Lebesgue measure and the Lebesgue integral on $\mathbb{R}$, differentiation of functions of bounded variation, absolute continuity and fundamental theorem of calculus, L^p spaces on $\mathbb{R}$, Riesz-Fischer theorem, bounded linear functionals on L^p, measure and outer measure, Fubini's theorem."
We will definitely cover these topics.

For your information, the posted qualifying exam syllabus for Real Analysis is
"Lebesgue measure and integration on the real line, differentiation and monotone functions, absolute continuity, functions of bounded variation, the Fundamental Theorem of Calculus. L^p spaces on the real line, including the Hölder and Minkowksi inequalities, the Riesz-Fischer Theorem, bounded linear functionals on $L^p(R)$. Convergence theorems: Fatou's Lemma, monotone convergence theorem, dominated convergence theorem, Egoroff's theorem, Vitali's convergence theorem, convergence in measure, convergence in L^p."

The prerequisite for this course is Math 411 (or equivalent). Math 630 requires more mathematical maturity than Math 411.
Required resources
We will use Elms/Canvas.
Textbook: Measure and Integral by Wheeden and Zygmund, Second edition.

Date: December 7, 2023.

We will cover:
Chapter 1 (mostly background)
Chapter 2 through 8 (the core of this course)
Chapters 9, 10 if time permits.

There will be several problem sets. Some problems will be taken from old qualifying exams, available on the math department web site:
https://www-math.umd.edu/quals.html

Policies and Resources for Graduate Courses

It is our shared responsibility to know and abide by the University of Maryland's policies that relate to all courses, which include topics like:
Academic integrity
Conduct
Accessibility and accommodations
Harassment
Attendance and excused absences
Grades and appeals
Copyright and intellectual property
Please see the University's website for graduate course-related policies at: https://gradschool.umd.edu/course-related-policies

Communication with the instructor

Email: If you need to communicate with me, please email me at matei@umd.edu. This works better than sending messages through Canvas. Email is best for academic, administrative and confidential matters (such as excused absences), while math questions are best answered in person, during office hours or right after class. I will do my best to answer emails within 24 hours.

ELMS: I will send important announces via ELMS messaging. You must make sure that your email and announcement notifications are enable in ELMS. You are responsible for checking your email and Canvas/ELMS inbox regularly.

Grading: Homework = 30%, one mid-term exam 30%, final exam 40%. Students who get less than 45% of the maximum possible score will receive an F, and D $\in [45, 50)$, $C \in [50, 60)$.

There will be a "curve" for the A-B cut-off, but the precise number will be determined at the end of the course Once the exact cut-offs are set, they are firm. To be fair to everybody, I have to establish clear standards and apply them firmly and consistently.

We will use + and − for A and B grades.

All scores will be posted on the course ELMS page. If you have questions about any of your grades, please email me. If I have made a mistake, I will immediately correct it. After the in-class exam students have one week from when the exam is returned to appeal the grading. Similarly, students have one week after a homework grade is posted to appeal the grading.

Appeals for the final grade must be made in writing. No appeals for regrading work done during the semester can be made after the day of the final exam.

Make-up policy: Make-up exams will be offered only in case of illness, religious observance, participation in a University activity at the request of University authorities, or other compelling circumstances.

Late homework will not be accepted. In case of illness, religious observance, participation in a University activity at the request of University authorities, or other compelling circumstances, students will not be penalized for missed homework. In such cases, you should see a blank rather than a 0 in Canvas.

The University's policy on religious observance and classroom and tests states that students should not be penalized for participation in religious observances. Students are responsible for notifying the instructor of projected absences within the first two weeks of the semester. This is especially important for final examinations.

Academic integrity

The exams will be in-class, closed book, closed notes.

On exams students must write by hand and sign the following pledge:

I pledge on my honor that I have not given or received any unauthorized assistance on this examination.

This does not apply to homework, where it is acceptable to exchange ideas with other people, in person or electronically. However, AI generated content is not allowed.

During exams, students are expected to apply the ideas they learn to some problems that are significantly different from the examples and homework they have seen.

Resources and Accommodations

Students who require special examination conditions must register with the office of Accessibility and Disability Services (ADS) in Shoemaker Hall. Documentation must be provided to the instructor. Proper forms must be filled and provided to the instructor before every exam.

You should also know there are a wide range of resources to support you with whatever you might need (UMD's Student Resources and Services website may help). If you feel it would be helpful to have someone to talk to, visit UMD's Counseling Center or one of the many other mental health resources on campus.

Link to other policies, suggestions, and information regarding the following topics:
https://www-math.umd.edu/images/CoursePolicies.pdf
Tips for Success
Participation
Names/Pronouns and Self-identifications
Communication with Peers
Notice of Mandatory Reporting

Assigned homework

Homework should be scanned and entered in Canvas as a PDF files (rather than individual pictures). Many free phone apps will convert pictures to PDF files. The files should be legible. If the quality is too low, the assignment may not be graded. Some assigned problems are hard. You should expect to spend several hours on them.

All problem sets are due in Canvas at 11:59 PM.

Problem set 1, due Wednesday, September 6
1) Prove Theorem 1.12 (i).

Suggested outline of proof:
Our definition of compactness is: E is compact if every open cover of E has a finite subcover. Prove:
(a) If E is compact then E is closed and bounded.
(b) Prove that any closed cube in $\mathbb{R}^n$ is compact. Hints will be given in class.
(c) Prove that closed subsets of compact sets are compact.
(d) Conclude that E closed and bounded implies E compact.

Also, WZ Chapter 1: 18 (hint: the complement of F is a countable union of disjoint intervals), 19, 20

Problem set 2, due Wednesday, September 13:
WZ Chapter 2: 1, 3, 5, 6, 7 (just $V(x)$).

Problem set 3, due Friday Sept. 22

WZ Chapter 3: 5, 9, 10, 17, 20 (you can cite the result of exercise 18), 34.

Problem set 4, due Wednesday, October 4
WZ Chapter 4: 5, 12
Qualifying exams,
January 2023 (incorrectly titled "January 17, 2022") Analysis qual Problem 3
January 2019, problem 1. You don't need to know Fatou's lemma for this problem.

The mid-term exam is on Wednesday, October 11.

Problem set 5, due Wednesday October 18.
WZ, Chapter 5: 6, 9, 13, 21, 23
Qualifying exams:
August 2022, Problem 2. You should look up the definition of $L^p[0,1]$.
August 2021, Problem 5.

Problem set 6, due Friday, October 27
Ch 6: 2, 5, 6, 13

Problem set 7, due Monday, November 13
Ch 7: 2, 8, 9, 10, 11
Qualifying exam
January 2023, Problem 5
August 2021, Problem 1
January 2021, Problems 1, 3

Problem set 8, due date TBD, after Thanksgiving.
Ch 8: 6, 8, 11 , 13, 15, 17
January 2023 Problem 1
August 2021 Problem 3
January 2021 Problem 5 (the case $1 < p < 2$ may be different from the case $p = 2$).

Practice problems (not to be turned in)
August 2023, Problem 3
August 2019, Problem 1
January 2019, Problem 3
We will go over these in class.