

# MATH 420/507 101 2022W1

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## Real Analysis: measure and integration.

**2022. Term 1. Sept. 6 – Dec. 7.**

Instructor: Young-Heon Kim. <https://personal.math.ubc.ca/~yhkim/>

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**Class Time: MWF 11am - 11:50am.**

**First class: Sept 7. Wednesday.**

**Class location: [P. A. Woodward Instructional Resources Centre, Room 1](#)**

<https://learningspaces.ubc.ca/classrooms/irc-1>

**Office Hours: TBA**

**Main goal:** to develop working knowledge, intuition and skills in measure theory.

\*\* Measure theory is at the heart of modern mathematics. It is not only foundational but also has immediate practical relevance in many areas, including mathematical analysis, PDEs, probability, geometry, applied mathematics, optimization, data science, etc. Mastering it will enable you to become a strong mathematician; measure theory is a key technical tool by itself, and the training you gain while learning measure theory will help you step up to a higher level mathematics.

**Main topics:**

- measurable sets and measures
- measurable functions, integration and convergence theorems
- differentiation of measures
- $L_p$  spaces and inequalities

**Text:** G. Folland, Real Analysis: Modern Techniques and Their Applications, 2nd. ed.

- This is a masterpiece! Do as many exercises as possible in this book.

**Office hours:** TBA

**Canvas:** Canvas is the main platform for communication. All relevant information will be posted in the Canvas, including HW and lecture notes. You have to submit your HW through Canvas.

**Evaluation:**

## **HW: 40%. [No late HW will be accepted.]**

- Your solutions should be readable and easy to understand. Especially, handwriting should be clear and neat. Poor presentations will get low or even zero mark.
- A subset of the assigned problems will be graded. We will not announce which problems will be graded.
- Out of 11 problem sets only the best 9 sets will be counted towards the final grade. This policy is made to allow you to skip a problem set, but \*only in the case\* you have emergencies or medical reasons. Because of this policy no academic concession requests will be granted unless it is for a very serious reason affecting more than two weeks.

## **Midterm (In class): 10%**

- **Midterm exam (In class). Wed. Oct. 26.**

## **Final: 50%. 3hrs exam. TBA**

- Grades will likely be subject to scaling.

**Collaboration on HW:** You may discuss HW problems with each other. However, the solutions that you write up should be in your own words. Copying from each other is not permitted. If you find a solution or hint from the internet, a book, or elsewhere, then you should cite your source, including the names of people you discussed with.

## **Piazza vs Canvas email:**

The piazza forum is for discussions between students. The instructor will not monitor it. If you have course related questions for the instructor, then please use the Canvas Mail. Of course, visiting the office hours is a great way to communicate with the instructor.

**Please avoid using the instructor's math email address, unless urgent, to help the instructor keep his math mailbox under the storage limit; using the Canvas email will also help your message be not classified as a spam and missed.**

## **Course Topics Schedule (subject to change):**

- Sigma algebras, outer measures, and measures: 1 week
- Borel and Lebesgue measure: 1 week
- Integration: 2 weeks
- Convergence of functions and integrals: 2 weeks
- Product measures: 1 week
- Differentiation of measure (Radon-Nykodym theorem): 1.5 week.
- $L_p$  spaces. Jensen's inequality. Hoelder inequality. Minkowski inequality: 1 week.
- Differentiation of measure (Lebesgue differentiation theorem): 1.5 week
- An additional topic if time permits

## HW schedule:

- HW1: due Thursday, Sept. 15 10pm.
- HW2: due Thursday, Sept. 22 10pm.
- HW3: due Thursday, Sept. 29 10pm.
- HW4: due Thursday, Oct. 6 10pm.
- HW5: due Thursday, Oct. 13 10pm.
- HW6: due Thursday, Oct. 20 10pm.
- **Midterm exam (In class). Wednesday, Oct 26.**
- HW7: due Thursday, Nov 3 10pm.
- HW8: due Thursday, Nov. 10 10pm.
- HW9: due Thursday, Nov. 17 10pm.
- HW10: due Thursday, Nov. 24 10pm.
- HW11: due Thursday, Dec. 1 10pm.

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Other general information (academic concessions, access and diversity, academic integrity, etc)  
please go to:

<https://www.math.ubc.ca/general-syllabus-information> (<https://www.math.ubc.ca/general-syllabus-information>)

## Course Summary:

Date	Details	Due
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