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Real Analysis: measure and integration.

2021. Term 1. Sept. 7 – Dec. 7.

Instructor: Young-Heon Kim

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

Class location: West Mall Swing Space Room 409

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: Only in Zoom. TBA

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

Evaluation:

HW: 50%. weekly. **[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 marks.

graded.

◦ Out of 12 problem sets only the best 10 sets will be counted towards the final grade. This policy is made to allow you to skip a problem set, *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.

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 your solutions from each other is not permitted. If you find a solution or hint from the internet, a book, or elsewhere you should cite your source, including the names of people you discussed with (see the note on academic integrity below).

Piazza vs Canvas Discussions and 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, personalized or for the whole class, then please use the Canvas (Discussions for the class-wide questions, the Canvas Mail for personalized questions). Of course, visiting the office hours is a great way to communicate with the instructor. Please avoid using my math email address, unless urgent, to help me keep my math mailbox under the storage limit; using the Canvas email will also help your message to 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.
- Differentiation of measure (Lebesgue differentiation theorem): 1.5 week
- BV functions: 1 week
- L_p spaces. Jensen's inequality. Hoelder inequality. Minkowski inequality: 1 week.

HW schedule: All times are the Vancouver time.

◦ HW1: due Thursday, Sept. 16 10pm.

- HW3: due Thursday, Sept. 30 10pm.
 - HW4: due Thursday, Oct. 7 10pm.
 - HW5: due Thursday, Oct. 14 10pm.
 - HW6: due Thursday, Oct. 21 10pm.
 - HW7: due Thursday, Oct. 28 10pm.
 - HW8: due Thursday, Nov. 4 10pm.
 - HW9: due Thursday, Nov. 11 10pm.
 - HW10: due Thursday, Nov. 18 10pm.
 - HW11: due Thursday, Nov. 25 10pm.
 - HW12: due Thursday, Dec. 2 10pm.
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Covid-19 related:

To protect others and oneself, I hope people in the class make all the effort, including wearing masks, getting vaccinations, and sanitizing their hands as often as possible.

RECOMMENDATIONS FOR STUDENTS

1. Attendance

If you feel ill, you should not attend class in person. Stay home and use the self-assessment tool at <https://bc.thrive.health/>

for guidance. Appropriate concessions will be provided to you, including lecture streaming or recording. Please contact the instructor if you have any questions about these concessions, including concessions around missing an assessment.

If you do not feel ill, you are expected to attend class in person. Math is challenging; and active, in-person participation is important to your academic success.

You are encouraged to make connections early in the term with other students. Members of your study group can support each other by sharing notes and ideas, and by checking in on each other.

If you feel ill on a final exam day, you should not attend the exam. You must apply for deferred standing (an academic concession) through Science Advising no later than 48 hours after the missed exam. Students who are granted deferred standing write the final exam/assignment at a later date.

More information is available at

<https://science.ubc.ca/students/advising/concession>.

2. Masking

You are expected to wear a mask to class.

In general, you must follow UBC's campus rules, available at

3. Asking questions

Questions during and after class are always appreciated. If you would like to ask questions after class, either wait in your seat (if there is time), or talk to the instructor outside. Do not crowd the instructor.

4. Vaccinations

UBC and public health authorities strongly recommend, and your instructor and fellow students would very much appreciate, that you be fully vaccinated against COVID-19. The recommendations are here:

<https://covid19.ubc.ca/health-guidance-and-vaccines/>. More information is available at <http://www.vch.ca/covid-19/covid-19-vaccine>.

Academic integrity:

Students are expected to uphold the academic honesty standards that are summarized below. Some specific remarks:

You may collaborate with your classmates when working on homework assignments, but you are required to submit solutions written up by you using your own words.

In homework assignments, if you find a solution on the internet, a book, or elsewhere, you are required to cite the source. Pretending that someone else's work is yours is plagiarism and subject to disciplinary action -- see <http://www.calendar.ubc.ca/vancouver/index.cfm?tree=3,54,111,959>

Do not post your homework assignments and your solutions on any note-sharing websites.

You are expected to work on the synchronous assessments by yourself. Collaboration on quizzes and the final exam is not allowed.

During synchronous assessments, the use of note-sharing websites, discussion boards (piazza etc.), and private communications with anyone other than the instructors are not allowed.

For a detailed list and explanation of academic misconduct, as defined by UBC, and its potential consequences, see: <http://www.calendar.ubc.ca/vancouver/index.cfm?tree=3,54,111,959>

University policies

Academic Honesty and Standards

Academic honesty is essential to the continued functioning of the University of British Columbia as an institution of higher learning and research. All UBC students are expected to behave as honest and responsible members of an academic community. Breach of those expectations or failure to follow the appropriate policies, principles, rules, and guidelines of the University with respect to academic

It is the student's obligation to inform himself or herself of the applicable standards for academic honesty. Students must be aware that standards at the University of British Columbia may be different from those in secondary schools or at other institutions. If a student is in any doubt as to the standard of academic honesty in a particular course or assignment, then the student must consult with the instructor as soon as possible, and in no case should a student submit an assignment if the student is not clear on the relevant standard of academic honesty.

If an allegation is made against a student, the Registrar may place the student on academic hold until the President has made his or her final decision. When a student is placed on academic hold, the student is blocked from all activity in the Student Service Centre.

Statement on UBC Policies and Resources to Support Student Success

UBC provides resources to support student learning and to maintain healthy lifestyles but recognizes that sometimes crises arise and so there are additional resources to access including those for survivors of sexual violence. UBC values respect for the person and ideas of all members of the academic community. Harassment and discrimination are not tolerated nor is suppression of academic freedom. UBC provides appropriate accommodation for students with disabilities and for religious and cultural observances. UBC values academic honesty and students are expected to acknowledge the ideas generated by others and to uphold the highest academic standards in all of their actions. Details of the policies and how to access support are available at <https://senate.ubc.ca/policies-resources-support-student-success>

Statement from the Provost's office pertaining to the potential restrictions to international students' online learning experiences as a result of remote learning:

During this pandemic, the shift to online learning has greatly altered teaching and studying at UBC, including changes to health and safety considerations. Keep in mind that some UBC courses might cover topics that are censored or considered illegal by non-Canadian governments. This may include, but is not limited to, human rights, representative government, defamation, obscenity, gender or sexuality, and historical or current geopolitical controversies. If you are a student living abroad, you will be subject to the laws of your local jurisdiction, and your local authorities might limit your access to course material or take punitive action against you. UBC is strongly committed to academic freedom, but has no control over foreign authorities (please visit <http://www.calendar.ubc.ca/vancouver/index.cfm?tree=3,33,86,0> for an articulation of the values of the University conveyed in the Senate Statement on Academic Freedom). Thus, we recognize that students will have legitimate reason to exercise caution in studying certain subjects. If you have concerns regarding your personal situation, consider postponing taking a course with manifest risks, until you are back on campus or reach out to your academic advisor to find substitute courses. For further information and support, please visit:

Course Summary:

Date	Details	Due
Thu Sep 16, 2021	 HW1-1 (https://canvas.ubc.ca/courses/79846/assignments/1028804)	due by 10pm
	 HW1-2 (https://canvas.ubc.ca/courses/79846/assignments/1028805)	due by 10pm
	 HW1-3 (https://canvas.ubc.ca/courses/79846/assignments/1028819)	due by 10pm
	 HW1-4 (https://canvas.ubc.ca/courses/79846/assignments/1028821)	due by 10pm
	 HW1-5 (https://canvas.ubc.ca/courses/79846/assignments/1028826)	due by 10pm
	 HW1-6 (https://canvas.ubc.ca/courses/79846/assignments/1028829)	due by 10pm