

# PMath 451/651 Measure Theory

**Professor:** Kenneth Davidson

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**Graduate TAs:** Sean Monahan and Mani Thamizhazhagan

**Office hours** Starting Jan. 14th on Zoom.

- Mondays at 2:00 PM Waterloo time.
- Thursdays at 10:00 AM Waterloo time.

**Textbook:** G.B. Folland, *Real Analysis, modern techniques and their applications*, 2nd. ed.

**Course notes:** *Measure Theory, Notes for Pure Math 451* by Kenneth R. Davidson

## Outline:

- (1) Measures
- (2) Measurable Functions
- (3) Integration
- (4) Differentiation and signed measures
- (5)  $L^p$  spaces
- (6) Some point set topology
- (7) Linear functionals on  $C_c(X)$  and  $C_0(X)$
- (8) A taste of probability (time permitting)

## Grading

- Assignments are worth 65%.
- Final overall assessment, a timed open book assignment on Crowdmark, worth 35%.

**How the course will run.** The course will be entirely online. All materials will be available on Learn. There will be an introductory video to introduce me and explain things on Learn, and also on my webpage until Jan. 15.

My course notes will cover almost exactly what I will cover in the course. However Folland's book is great, has exercises, covers a lot more material, and I highly recommend it.

Each Sunday night, I will post new video lectures for the upcoming week.

There will be regular assignments. They will be a mix of True/False, short answer and longer exercises. They must be submitted on Crowdmark before the due date.

Solutions to the assignments will be posted on Learn after the due date.

Piazza is an online forum for posting questions and answers. Use this to post questions that you have about the course and assignments. Also use it to answer questions of your classmates. I will 'approve' good answers and good questions, and add comments.

There will be two office hours each week. They will be run live on Zoom.

The final exam will be a wrap-up open book assignment. It will be a timed assessment on Crowdmark with a flexible start time on a date provided by the registrar. It will be a 2.5 hour exam, but you will have 3 hours to allow time to upload your answers.

Academic integrity: I am teaching the course assuming that you are taking it because you want to learn the material. This is a central course that is important for any subsequent analysis courses that you may want to take. It is in your interest and mine that you strive to learn the material yourself. That means not asking for or receiving too much assistance from classmates or from google. I hope that you enjoy the course and find it challenging, and respect the right of your classmates to do the same.

*The University Senate mandates that every course outline must contain the following information.* Please note that some UW policies are changed by Covid-19, and these guidelines are not updated.

**Academic Integrity:** In order to maintain a culture of academic integrity, members of the University of Waterloo community are expected to promote honesty, trust, fairness, respect and responsibility. Refer to

[www.uwaterloo.ca/academic-integrity/](http://www.uwaterloo.ca/academic-integrity/)

for more information.

**Grievance:** A student who believes that a decision affecting some aspect of his/her university life has been unfair or unreasonable may have grounds for initiating a grievance. Read *Policy 70, Student Petitions and Grievances, Section 4*,

<http://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-70>.

When in doubt please be certain to contact the department's administrative assistant who will provide further assistance.

**Discipline:** A student is expected to know what constitutes academic integrity to avoid committing academic offenses and to take responsibility for his/her actions. A student who is unsure whether an action constitutes an offense, or who needs help in learning how to avoid offenses (e.g., plagiarism, cheating) or about "rules" for group work/collaboration should seek guidance from the course professor, academic advisor, or the undergraduate associate dean. For information on categories of offenses and types of penalties, students should refer to *Policy 71, Student Discipline*,

<http://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-71>.

For typical penalties check *Guidelines for the Assessment of Penalties*,

<http://www.adm.uwaterloo.ca/infosec/guidelines/penaltyguidelines.htm>.

**Appeals:** A decision made or penalty imposed under *Policy 70, Student Petitions and Grievances* (other than a petition) or *Policy 71, Student Discipline* may be appealed if there is a ground. A student who believes he/she has grounds for an appeal should refer to *Policy 72, Student Appeals*,

<http://www.adm.uwaterloo.ca/infosec/Policies/policy72.htm>.

**Students with disabilities:** The *AccessAbility Services*, located in the new addition to Needles Hall, Room 1401, collaborates with all academic departments to arrange appropriate accommodations for students with disabilities without compromising the academic integrity of the curriculum. If you require academic accommodations to lessen the impact of your disability, please register with the Access Ability Services at the beginning of each academic term.

*The Mathematics Faculty asks that all course outlines contain the following additional information.*

**Mental Health Support:** The Faculty of Math encourages students to seek out mental health support if needed. Here are some resources that are available to you.

*On-campus Resources:*

- Campus Wellness <https://uwaterloo.ca/campus-wellness/>
- Counselling Services: [counselling.services@uwaterloo.ca](mailto:counselling.services@uwaterloo.ca)/ 519-888-4567 ext 32655
- MATES: one-to-one peer support program offered by Federation of Students (FEDS) and Counselling Services: [mates@uwaterloo.ca](mailto:mates@uwaterloo.ca)
- Health Services: located across the creek from the Student Life Centre, 519-888-4096.

*Off-campus Resources:*

- Good2Talk (24/7): Free confidential help line for post-secondary students. Phone: 1-866-925-5454
- Here 24/7: Mental Health and Crisis Service Team. Phone: 1-844-437-3247
- OK2BME: set of support services for lesbian, gay, bisexual, transgender or questioning teens in Waterloo. Phone: 519-884-0000 extension 213

**Diversity:** It is our intent that students from all diverse backgrounds and perspectives be well served by this course, and that students' learning needs be addressed both in and out of class. We recognize the immense value of the diversity in identities, perspectives, and contributions that students bring, and the benefit it has on our educational environment. Your suggestions are encouraged and appreciated. Please let us know ways to improve the effectiveness of the course for you personally or for other students or student groups. In particular:

- We will gladly honour your request to address you by an alternate/preferred name or gender pronoun. Please advise us of this preference early in the semester so we may make appropriate changes to our records.
- We will honour your religious holidays and celebrations. Please inform of us these at the start of the course.
- We will follow AccessAbility Services guidelines and protocols on how to best support students with different learning needs.