THE COURSE

Real Analysis

INSTRUCTOR

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Office Hours: 1:30–2:20 MWF, or by7 appointment.

TEXT

Measure and Integral An introduction to Real Analysis,
by Wheeden and Zygmund, Dekker 1977

MATERIAL COVERED

Wheeden expanded Zygmund's notes (University of Chicago) into an excellent text, that takes a concrete approach to the Lebesgue integral. You may expect to be asked to think deeply and simply, so make it your business to learn every Definition, with examples and non-examples, learn every Theorem, paying particular attention to hypotheses that are and are not there. Then *master* every proof, asking questions in class and at office hours when you are puzzled, mystified, lost, and so on. Your most important difficulty may be to overcome your natural tendency to protect and nurture your ignorance by hiding it!

After noticing **(7.23)** we'll start with **(7.24)** thru **(7.32)** and skip section 6, on covex functions, until we are about to start Chapter 8.

After that, we'll have a brief digression on some abstract topics: several "systems" of families of sets more general than σ-algebras, namely fields, π-systems, λ-systems and monotone classes. Our study will include Dynkin's π-λ Theorem and products of σ-algebras. The source is Patrick Billingsley's *Probability and Measure,* Second Edition.

We'll then turn to Chapter 6. There is a subtle contrast between this material and the abstract material: the product σ-algebra is a *construct,* whereas Chapter 6 deals (in effect) with the problem of identifying the product σ-algebra as a sub-σ-algebra of an *existing* σ-algebra. The sub-σ-algebra is essentially the same as the extant one, but is not the same. For example, if Z is a null set in $\mathbb{R}^m$ and N a non-measurable set in $\mathbb{R}^n$ then $Z \times N$ is a null set in $\mathbb{R}^{n+m}$ but is not in the product σ-algebra.

Section 36 of Billingsley's book deals with products of arbitrarily many σ-algebras. and it covers many "inadequacies" of such products.

We will (briefly!) add to the applications in Chapter 6 Section 5.4.

Following all this come Chapters 8 – 11. Chapter 8 will be covered very quickly, and we will skip over Chapter 9 to cover 10 and 11. To 10 we have to add the Riesz Representation Theorem, with Rudin's *Real and Complex Analysis* as the source.

I would like to include Tempered distributions as well, but that is just a Goal right now.

GRADING

There will be 1 or 2 Midterm examinations. February 20 and April 2 are the tentative dates for the Midterm examinations. Homework exercises from the text will be assigned weekly and scored by a papergrader (not yet assigned). There will be challenging or intriguing Further Problems, assigned irregularly, scored by me, and there will be a Final Exam.

Each Midterm may involve material covered in lectures up to the Midterm! Thus, you are responsible for material covered in the lectures! Midterm questions may include homework questions, even those not yet turned in. It is therefore important for you to work steadily on homework and Further Problems, not in spurts!

Your grade in this course will reflect what you did in it, not your ability or potential. It is very important, then, for you to be able to put your work on paper, under time pressure. If you have problems taking tests, there are people on campus who might be able to help you overcome them. Ask about it at an office hour!

You'll have a GPA grade for each Midterm, for the sum of your homework scores, for the sum of your Further Problem scores, and for the Final. These are your "grading items." The weighting of the grades, though subject to

change, is, at present: 12% for each Test, 20% for Further Problems, homework 22%, and 34% for the Final. Grades will perhaps amount to 80–85% for A, 65–70% for B, 50–55% for C, 40–45% for D.

Each grading item will have "Gradelines" assigned to it. For example, if the B gradeline is 70, the A gradeline is 85, and your score is 80, then your GPA grade, G, for that item is $G := 3 + \dfrac{80-70}{85-70} = 3.67$ (G is rounded to 2 places). In other words, your GPA grade is B, plus 2/3 of the way between B and A. Your GPA grade, G, on any grading item is computed using your score on it, and numbers g (the grade corresponding to the highest gradeline smaller or equal to your score), glb (the highest gradeline smaller than or equal to your score), gla (the lowest gradeline greater than your score):

$$G = g + \frac{\text{your score} - \text{glb}}{\text{gla} - \text{glb}}$$

where glb is the gradeline just below your score,
gla is the next gradeline – above your score,
and g is the grade number: 5 for a 100% score, 4 for the A gradeline, 3 for B, etc.
If your score falls on a gradeline, then $G = g$. If your score is 100% on a Test, your $G = 5$.
When the G are combined, with weights, and added, the result is your GPA grade for the course. If your total is within 0.025 of one of the University of Minnesota's official GPA numbers that define one of the valid letter or letter-plus-or-minus grades, your grade is "borderline." Case-by-case decisions are made then, whether to award the higher or the lower grade. One important factor is the direction your grades have taken at the course's end.

Be sure to talk to me in advance if you have to miss an assignment or exam! If you do miss and you don't make arrangements in advance, or at least let me know, your G for that item is zero!

If, for documented reasons beyond your control, you're passing and you can't complete the course, your grade up to that point may "stay with you" as part of an Incomplete; all I's must be issued according to department guidelines.

SCHOLASTIC CONDUCT
Please read the (appropriate for you) notices in the IT Bulletin, the CLA Bulletin, and so on. You are encouraged to work with others in understanding what problems say, setting up solutions, and so on. If you get ideas from a reference or from someone else, GIVE CREDIT! You must submit as YOUR work only what YOU have done yourself: DON'T COPY! Graders will be asked to bring answers that look alike to my attention; I'll give the score to the *first* of "identical" and zero to any others with the notation that the solution is a "duplicate." You should then see me about the matter!