Math 323: Real Analysis
Middlebury College, Spring 2020

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Class MWF 1:45–2:35, Warner 203

Office hours MW 3:00–4:30 & T 1:00–2:30 and by appointment, Warner 504

Text A. N. Carothers, *Real Analysis*

Introduction

Welcome to Math 323! In this course, we will study abstract mathematical concepts such as sets, metric spaces, convergence, etc., with an eye toward answering fundamental questions about the real numbers and real-valued functions. Many of the relevant concepts will be new, while others (such as limits, derivatives, integrals, linear spaces, etc.) will build from your knowledge of calculus and linear algebra.

Our goals will be threefold: first, to build a conceptual understanding of a wide variety of mathematical concepts; second, to gain the fluency with mathematical language necessary to crystallize these concepts into precise definitions; and third, to learn the formal proofs that rigorously establish the fundamental logical relationships among these concepts. (Computation and applications will play little part in this course.)

Coursework and Evaluation

Toward the three goals listed above, students will be responsible for answering conceptual and logical questions, giving precise formal definitions of terms, and both stating and *proving* the logical relationships studied in the course.

There will be one midterm examination, two shorter quarter-term exams, and a comprehensive final (each of which may have in-class and/or take-home components), in addition to problem assignments and occasional quizzes. The honor code will be in effect for all examinations and assignments (please see your student handbook for more information); *collaboration and, particularly, the use of outside resources will be allowed only as explicitly stated*.

Students will be required to maintain a ***problem binder*** containing neat, well-presented solutions to assigned problems. In addition to the collection of individual problem sets for review during the term, this binder will be collected at the end of the term for evaluation.

Text

Our principal text for this course is A.N. Carothers's *Real Analysis*, of which we aim to cover a fair portion of the first two parts; problems from the text will be assigned throughout the term, with solutions to selected problems posted online.

Assigned readings and problems will form the basis of your comprehension of the material, as there is far too much material to cover in full during class meetings. Class time will be spent giving an overview of the material, as well as fleshing out and/or discussing the more subtle details of the text, *not* simply regurgitating its contents. Carothers's text is insightful and well-written, and while fully understanding it will take serious time and effort, that time and effort will be very well spent.

As background, students will be responsible for the information contained in a few handouts and readings from Myrtle Lewin's *An Introduction to Mathematical Analysis* and A. J. White's *Real Analysis: an Introduction*.

Class meetings

Class meets thrice per week, as detailed above. Do your best to come to class alert, ready to think and ask questions; class time is the time to clear up concerns from your text readings, flesh out the material with examples, etc. Please do not spend your time in class mindlessly copying down what is written on the board; it is much more important to follow along and think, taking minimal notes on key points, which can later be examined and expanded upon as a means of strengthening and checking your understanding.

Keep in mind that the *methods of reasoning* that motivate and produce what is discussed and written on the board is what you're after—thus, the majority of what you see on the board should not be viewed as what it *is* that you are to learn, but rather as the *product* of what you are to learn. Handouts and online flashcards (on the course webpage) will supplement and/or summarize many of the key definitions and methods, and your text contains proofs of the major theorems that we'll discuss in class, so your notes should focus on ***key ideas***, ***methods***, ***concepts***, ***pictures***, ***observations***, and ***examples***, not the details of definitions and proofs that can be found elsewhere.

Examinations and grading

Examinations will target the responsibilities listed in "Coursework and Evaluation" section above; in particular, examinations will include some combination of (1) conceptual and logical (short answer or true/false) questions about the concepts studied and their relationships to one another, (2) definition and explanation of terms, and (3) statements and proofs of results. Take-home portions of exams will focus largely on logical questions and proofs, but students *will* be responsible for proving results from the text and/or homework on the in-class portions, as well.

Course grades will be based upon the following components: three exams during the term, the final exam/project, and homework/quizzes, each of which counts for 20%. ***The Honor Code*** will be in effect for all examinations, in class and/or take-home. Succinctly, the policy is that you may use, exclusively: yourself; writing implements; blank paper; and the examination. Any exceptions to this will be explicitly given before the exam.