Analysis I (Math 317)
Fall 2010

1 Technicalities

Instructor: Clay Shonkwiler (cshonkwi@haverford.edu)
Office: KINSC H213 (phone: 795.3366)
Course web page: http://www.haverford.edu/math/cshonkwi/teaching/m317f10
Text: *Understanding Analysis*, by Stephen Abbott
Discussion Sections: Monday 3:00–4:00, Wednesday 2:00–3:00 in H012.
Office Hours: Monday 1:30–3:00, Wednesday 9:30–10:30, 3:00–5:00, Thursday 1:00–3:00, Friday 1:00–2:00. Also, the Math Question Center is open Sunday–Thursday from 7:00–9:00 in KINSC H011; this is a good place to discuss questions with other students, supervised by faculty.

2 Summary of the Course

The goal of this course is to develop the theory of real numbers, limits, continuity, differentiation and integration. These are the same concepts that a typical calculus course (like Math 113) deals with, so hopefully you already have an intuitive understanding of them. However, in this course we want to get a little more serious and replace intuitive notions with rigorous definitions, give careful proofs of theorems that get taken for granted in calculus classes, and develop an abstract framework for understanding it all.

In particular, we will try to make sense of the following:

- What are the real numbers?
- What is the limit of an infinite sequence? How can we make sense of infinite series?
- What is the structure (i.e. topology) of the space of real numbers and how can we use that structure to understand functions?
- What does it mean for a function to be continuous? What properties do continuous functions have (e.g. Extreme Value Theorem, Intermediate Value Theorem)?
- What is a derivative? What is an integral? What's the relationship between them (e.g. the Fundamental Theorem of Calculus)?

In order to address these issues with precision, you will need to develop a better understanding of and a greater facility with mathematical language. Internalizing this language and learning to write correct and convincing proofs will be a major focus of this course. To that end, we will discuss how to make sense of mathematical definitions and statements and work through strategies and techniques for analyzing and constructing proofs.

3 Homework

There will be weekly homework assignments, typically due Thursday at 5:00. Homework is an important part of any math class, as it is impossible to *learn* mathematics without actually *doing* mathematics. The goal of the assignments is to deepen your understanding of the concepts, tools

and techniques discussed in class, as well as to give you the opportunity to practice explaining your mathematical thinking. The importance of effective communication is vital: knowledge without the ability to communicate that knowledge is of limited value. As such, to get full credit on a problem your solution must be clear and well-written.

Each homework problem is worth 5 points, with the points divided between content (4 points) and exposition (1 point). Any problem with a score of 3 or below may be re-written and re-submitted *with your original solution* within one week of the original due date. The average score will be recorded. The grading scale for content points is:

4 points: A completely correct solution.

3 points: A solution demonstrating a good understanding of the problem, but with some minor mistakes or omissions.

2 points: An attempted solution which is incorrect due to a significant error, but which employs a reasonable strategy.

1 point: An attempted solution which contains the beginnings of some good ideas.

0 points: Not a serious attempt at a solution.

The point for exposition will be awarded for solutions which exhibit both clear writing and clear organization. You should write each solution so that a fellow-student can understand it.

Unless you have received pre-approval from me, **late homework** will be subject to a 50% penalty and must be turned in no more than 1 week after the original due date. Solutions to homework problems will be posted to Blackboard; it is your responsibility not to consult those solutions until after you have submitted a late assignment.

Collaboration on homework is not only allowed, it is highly encouraged. The process of doing mathematics is a strange mixture of the social and the antisocial: it is often the case that you will understand a problem and its solution better when you discuss it with someone else, but it is also essential that you work through the details on your own so that you don't use another's understanding as a crutch. As such, you should follow these guidelines when collaborating:

- You must work on each problem on your own before discussing it with your collaborators.
- When discussing a problem with your collaborators, you should work on a white board, a blackboard, or a colored sheet of paper. *You should work in groups of no more than 4 at a time*; in larger groups it is virtually impossible for everybody to contribute to the discussion and develop their own understanding of the problem.
- You should write up your solution separately from your collaborators and without reference to the white board, blackboard, or colored sheets of paper containing your joint work so as to communicate your own understanding of the problem. If you cannot write up your solution without referring to your collaboration materials, then you probably have not understood the problem and should throw away your solution, work further on your own, and re-start the collaborative process.
- You must indicate with whom you collaborated on your homework. Who you work with may change from problem to problem, so please note your collaborators separately for each problem.

Online or other outside resources are not allowed unless you have received my permission ahead of time.

Please contact me if you have any questions; you may also want to refer to the math department's guidelines on collaboration (http://www.haverford.edu/math/collaboration.html).

4   Exams:

There will be two midterm exams and a final. Each midterm will take the place of a homework assignment and will consist of two parts:

Part I: Self-scheduled, closed-book, 90 minutes. Covers basic definitions, true/false, short answer, etc.

Part II: Take-home, open-book. Longer examples and proofs.

The final will follow the same format, with Part I consisting only of material covered after the second midterm and Part II being cumulative.

Collaboration is not allowed on any of the exams.

5   Grading

Your final grade in the course will be determined by:

Homework: 30%
Midterms: 20% each
Final: 30%

6   Accommodations

If you think you may need accommodations in this course due to the impact of a disability please meet with me privately as soon as possible. You should also contact Rick Webb, Coordinator, Office of Disabilities Services (rwebb@haverford.edu, 610-896-1290) to confirm your eligibility for appropriate accommodations. Doing so early in the semester will help prevent unnecessary inconvenience.

7 Anticipated Schedule

Week	Subjects
08.30–09.03	The real numbers and completeness
09.06–09.10	Consequences of completeness, cardinality
09.13–09.17	The limit of a sequence
09.20–09.24	Subsequences, Cauchy sequences
09.27–10.01	Infinite series
10.04–10.08	Infinite series (cont.), **Midterm #1 due 10.07**
10.11–10.15	FALL BREAK
10.18–10.22	Open, closed, and compact sets
10.25–10.30	Connectedness and Baire's Theorem
11.01–11.05	Functional limits and continuity
11.08–11.12	Properties of continuity, **Midterm #2 due 11.11**
11.15–11.19	Differentiation
11.22–11.26	Differentiation (cont.)
11.29–12.03	Integration
12.06–12.10	Integration (cont.)