

Introduction to Methods of Proof

MATH 248

Sections 01 & 02

Loyola Marymount University

Fall 2009

Many people who have never had occasion to learn what mathematics is confuse it with arithmetic and consider it a dry and arid science. In actual fact it is the science which demands the utmost imagination.

–Sofya Kovalevskaya, 1890

By registering for this course, you are agreeing to the terms and policies expressed in this syllabus.

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Office Hours: Mondays 2:00 – 4:00 pm; Wednesdays 9 – 9:50 am; Thursdays 3 – 5 pm.
Additional times arranged by appointment.

Meeting times and places:

Section 01: TR 10:50 am – 12:05 pm; University Hall 2711

Section 02: TR 1:35 – 2:50 pm; University Hall 2727

Required Textbook: Chartrand, G.; Polimeni, A.; and Zhang, P. *Mathematical Proofs: A Transition to Advanced Mathematics. Second Edition.* Addison Wesley, New York, 2008. ISBN: 0-321-39053-9

It is your responsibility to have a copy of this textbook by the end of the first week of classes.

Prerequisites: Math 132 or the equivalent. Students who received a letter grade of D in Math 132 are ***strongly encouraged*** to retake them before taking Math 248.

Important Dates:	October 8:	Midterm Examination I
	October 15:	Midterm Deficiency Reports Due
	November 6:	Last day to withdraw or apply for Credit/NoCredit
	November 19:	Midterm Examination II
	November 26:	No Class (Thanksgiving Break)
	December 15:	Final Examination Section 01
	December 17:	Final Examination Section 02

Course Format:

This course will rely heavily on student participation. You will each be required to present homework problems and participate in lectures and in-class group or individual work. It is imperative that you read your textbook and come prepared to participate in class.

Course Description and Goals:

The main goal of this course is to prepare you to be successful in your upper division mathematics courses by providing you with a solid foundation in how to read, write, and understand mathematical proofs. A *proof* is a method of communicating a mathematical truth from one mathematician to another. A properly presented proof will contain no ambiguity: there will be no doubt as to its correctness. In addition to learning various techniques for writing a mathematical proof, one of the goals of this class is for you to gain the ability to recognize whether or not your proofs are correct.

We will cover various sections of chapters 1 – 11 in our textbook, which includes topics such as sets, logic, proof techniques, equivalence relations, functions, and number theory. You will learn the methods of direct proof, proof by contradiction, proof by contrapositive, proof by counterexample, proof by cases, proof by construction, and proof by mathematical induction.

Most importantly, this course seeks to:

- Improve your ability to think logically, analytically, and abstractly
- Improve your ability to read, communicate (both orally and in writing), and understand the language of mathematics
- Increase your appreciation of the role and importance of mathematical proofs within mathematics

Learning Outcomes:

Upon successful completion of this course the student should be able to:

- recognize and appreciate the importance of the ability to precisely define, and provide examples and counterexamples, of mathematical concepts.
- formulate conjectures based on patterns and examples.
- determine the veracity of a given mathematical statement.
- define and provide examples and counterexamples of the fundamental concepts of the course, including but not limited to: set-theoretic concepts, equivalence relations, congruence, integers modulo n , functions, injectivity, surjectivity, function composition, set cardinality, and the Division Algorithm.
- understand logical constructions such as negations, disjunction, conjunction, implication, equivalence, biconditional, quantifiers, and contradictions.
- construct and identify a variety of proof methods such as: direct proof, proof by contradiction, proof by contrapositive, proof by cases, proof by counterexample, proof by induction, and proof by construction.

- better appreciate the role and importance of mathematical proofs within mathematics.

Assignments:

Mathematics is not a spectator sport: in order to fully understand the material you need to take time to practice with the ideas, think about the concepts, and work through numerous examples and problems. Working problems on your own is the best way to learn and improve your mathematical skills. I encourage you to discuss the homework with me and your classmates, **work together on your assignments**, and check your solutions, but I expect that you hand in your own work: meaning that you write up your solutions independently and in your own handwriting.

Please note that representing another person's work, including the work of an author of a solutions manual, as your own constitutes a breach of academic integrity.

Homework will be assigned and collected on Tuesdays and Thursdays. **Homework is due at the beginning of class.** Please write your assignments legibly and **staple** your pages. Write your name on each assignment. **Late homework**, *which means anytime after the lecture begins*, **will not be accepted** under any circumstances. Therefore, if you are late to class, or ill and unable to do the assignment, you will receive no credit for your homework. If you know you will miss class due to illness or for some other reason, please give your completed assignment to a classmate or slide it under my office door. Calculators and computers may be used on assignments

You will not know ahead of time which problems will be graded, so you should give your best effort on all of them!

The main goal of this class is to improve your ability to explain mathematics, which takes a lot of practice! Therefore, after grading your initial solutions to the homework problems, I will provide you with the opportunity to rewrite some of your solutions.

Policy Regarding Rewrites:

1. You must turn in a reasonable original attempt to qualify for a rewrite.
2. If you receive an 'R' next to one of your solutions, you should rewrite your solution. **If you choose not to submit a revision, you will receive no credit for that problem.**
3. You have one attempt to rewrite your solution. Your rewrites are due in the class meeting following the class in which your homework is returned to you.
4. A rewritten solution should be **stapled** to the original assignment **with the original assignment on top.** Rewrites from one assignment should not be combined with rewrites from another assignment. Rewrites must not be combined with new homework.
5. The score on the rewritten solution will replace any previous scores for that problem.

Your lowest homework score will be dropped when computing your final grade.

You should feel free to ask me to review your solutions and provide you with comments. If you are having difficulty with any topic, please see me for help *as soon as possible*.

Definition/Example Quizzes:

A quiz will occur weekly during class on Thursdays except for weeks in which there is an examination. *No partial credit will be given on quiz problems.*

The purpose of the quizzes is to ensure you are staying on top of the material and they will consist of definitions and simple examples/non-examples. Knowing precise definitions of mathematical objects is imperative to being able to prove something about them! You may not use calculators, notes, or your text on the quizzes. Make-up quizzes will not be given under any circumstances.

Your lowest quiz score will be dropped when computing your final grade.

Presentations:

Since one of the goals of this course is to improve your ability to communicate mathematics to others, you will be responsible for presenting your solution to a homework problem at least three times during the semester. I will assign the problems to be presented in the class prior to the presentation. Your presentation will be graded on a three-point scale:

- 3 An entirely correct solution.
- 2 A solution showing strong evidence of conceptual understanding, but perhaps containing several minor computational errors.
- 1 An attempt at a solution that reveals little evidence of conceptual understanding.
- 0 No reasonable attempt made to solve the problem.

Your presentation should be aimed at your classmates and not your professor! You should feel free to come see me during my office hours to review your solution with you prior to the date of your presentation. During your presentation, you should explain your reasoning and solution and be prepared to answer any questions that your classmates may have.

Examinations:

The final examination for Section 01 occurs on **Tuesday, December 15, 2009 from 11 am – 1 pm in University Hall 2711**. The final examination for Section 02 occurs on **Thursday, December 17, 2009 from 11 am – 1 pm in University Hall 2727**. The final exam will be comprehensive. *You must receive a passing grade on the final examination to guarantee that you pass this class.* There will be two in-class midterm examinations during the semester in addition to the final exam. The midterms will take place on: **Thursday, October 8 and Thursday, November 19**. You may not use books, notes, or calculators during these examinations. I will arrange a make-up examination only in a

verified extraordinary circumstance. In this case, please see me as soon as possible.

Please contact me during the first week of the semester if you have a conflict with any of these dates!

Portfolio:

At the end of the semester you will submit a portfolio showcasing your work from the course. For each chapter, you will select a homework problem that you did not receive full credit for on your first attempt and you will include your original solution as well as your rewritten (correct) solution together with a short paragraph describing why your original solution was incorrect and what you did to correct it. Your portfolio will also include original and rewritten problems from quizzes and examinations. **Therefore, you should save all of your homeworks, quizzes, and exams (initial attempts and rewritten versions) to use for this assignment!** More detailed information about the portfolio will be given at the end of the semester.

Expectations:

The author of your textbook and your professor believe that you can think! Therefore, there will not be a worked example in the text or in class that resembles *every* homework, quiz, or exam problem. You should expect to spend approximately **two hours outside of class for each hour in class** on this course. I expect that you attend and participate in class, take careful notes, read your textbook, review your class notes, attempt every homework problem, and that you come see me if you run into any difficulties!

Students with Disabilities:

If you have a disability (physical, learning, or psychological) for which you are or may be requesting an accommodation, please contact me during the first week of the semester. In addition, you should visit the Disability Support Services Office in the Learning Resource Center located in Daum Hall, 2nd Floor, 310.338.4535. All discussions will remain confidential. Please visit www.lmu.edu/dss for additional information.

Grading Policy:

Your final course grade will be computed as follows:

Assignments:	25%
Quizzes:	10%
Homework Presentations/Class Participation:	5%
Portfolio:	5%
Midterm Examinations:	30%
Final Examination:	25%

You must receive a passing grade on the final examination to guarantee that you pass this course. I guarantee at least an A- to students scoring 90% or higher, at least a B- to students scoring 80% or higher, at least a C- to students scoring 70% or higher, and at least a D to students scoring 60% or higher. I reserve the right to *raise* grades higher than this scale dictates, based on considerations such as homework performance, class

participation, attendance, and improvement over the semester. *Extra credit is not offered in this course.*

I will not discuss grading issues via e-mail. If you have questions or concerns regarding your grade, please visit my office hours or arrange a time to meet with me.

Academic Integrity:

Students are expected to abide by the Loyola Marymount University Honor Code as stated in the current Undergraduate Student Bulletin. Please familiarize yourself with the University's policy regarding academic dishonesty, which can be found on pages 58 – 59 of the 2008 – 2010 Bulletin or at

http://www.lmu.edu/about/services/registrar/Bulletin/Academic_Degree_Requirements_and_Policies.htm. Please note that representing another person's work, including a classmate, the work of an author of a solutions manual, or using information from a website, as your own constitutes a breach of academic integrity. If the instructor concludes that a student has violated the standards for academic integrity established by the University for this course, then she may impose penalties as she deems appropriate to the offense (which can range from receiving no credit for the work in question to expulsion) and shall report the violation to the appropriate parties.

Possible Changes:

If necessary, this syllabus and its contents are subject to revision and **YOU** are responsible for any changes or modifications announced in class.

Special Requests:

- Please do **not** put your SSN on **anything** you give me!
- Please check your e-mail at least once a day! I occasionally will send out announcements, homework hints, etc. via e-mail and would not want you to miss out!
- The use of cellular phones, MP3 players, and other electronic equipment is strictly forbidden during class. The distractions they cause disrupt class. Cell phones must be turned OFF (not left on vibrate) and ear pieces must be removed prior to entering our classroom. If your cell phone rings, if you are seen typing a text message, or if you are seen pushing buttons on an iPod, cell phone, etc., you will be asked to leave the classroom immediately and you will receive no credit for the participation portion of your grade, or any work that was to be done in class, for that day.
- As an LMU Lion, by the Lion's Code, you are pledged to join the discourse of the academy with honesty of voice and integrity of scholarship and to show respect for staff, professors, and one another.