MAT 101: Introduction to Calculus & Analytic Geometry

Syllabus - Fall 2006

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1 Essential Course Information

1.1 Instructor Contact Info:

Instructor:	Blair D. Sullivan
Office:	Fine 311
Office Hours:	Mon/Wed 11-11:30 AM; Tues/Thurs 2-3 PM
Email:	bdowling@math.princeton.edu
Phone:	609 258 6468

1.2 Grader Contact Info:

Grader:	Atoshi Chowdhury
Email:	atoshic@princeton.edu

1.3 Class Time/Location:

Meetings:	10:00–10:50 Monday, Wednesday, & Friday
Location:	Jadwin A08

1.4 Textbook/References

1. *Calculus: Early Transcendentals*, Vol. 1 - Custom Edition for Princeton, Pearson, 2006.
2. A. Banner (2005) *Lecture Notes*.
3. D.P. Story (2000) *Algebra Review in Ten Lessons*.

The manuscripts for 2 and 3, as well as additional course references can be found at: *http://blackboard.princeton.edu*. There is also a course website with the syllabus and essential information at: $http://www.math.princeton.edu/\sim bdowling/mat101.html$.

2 Course Description

How can you tell if this math class is right for you? In this class, we assume no previous knowledge of calculus, only familiarity with basic aspects of algebra and trigonometry (which we will review). The sequence MAT 101-102 is intended to cover the same material as MAT 103 (perhaps with some additions). In fact, the university counts MAT 101-102 as formally

equivalent to MAT 103. We will cover approximately the first three and a half chapters of Thomas' *Calculus*, as well as the preparatory material in D.P. Story's *Algebra Review*.

This course will concentrate mainly on application, with theoretical aspects being introduced as necessary. In high school, you perhaps studied the notion of a function as a rule describing how one quantity varies with respect to another. In this course, we will make a detailed study of functions of one variable concentrating in particular on ways to quantify *how things change*. The main goal of the class is to introduce and study the properties of the derivative of a function as a tool for solving certain concrete problems (e.g. optimization).

The first few classes will provide an accelerated review of notions from pre-calculus and high school mathematics. We will start with lines in the Cartesian plane, and their properties. These form the building blocks for much of calculus, and offer intuition into the more abstract concepts that follow. From lines, we will move on to the abstract definition of a function in one variable, and introduce more important examples - polynomials, trig functions, and exponentials. For these basic classes of functions, we will determine the average rate of change, and use this as a stepping stone into the central notion of this course: the derivative of a function.

Our rough definition of a derivative is as the *instantaneous* rate of change of a function, or equivalently the slope of its tangent line. To fix this notion in our minds, we introduce the idea of a limit and segue into a discussion of the continuity of functions. These latter ideas, though abstract at first, are foundational and turn out to be of central importance for the rest of the course.

At this stage, we shall be ready to deal properly with derivatives. We show how to regard the derivative as a function in its own right. With some motivation for the inherent usefulness of derivatives in hand, we will proceed to give techniques for computing derivatives, including the product and quotient rules. Then we may give one of the first concrete applications of differential calculus: problems of related rates, which scientifically play a fundamental role in determining how related quantities in a system change with respect to each other.

Next, we will attempt to understand in more detail how the derivative describes the qualitative aspects of a function. The main applications of this knowledge, besides help with graphing functions by hand, will be in optimizing functions or determining when a function assumes its maximum and minimum values, and ap- proximating functions, or getting some idea of how complicated functions behave over small intervals.

Finally, we will discuss further applications and special situations found in differential calculus, to be determined as time allows.

3 Grading

Your grade in this course will be determined based on the following distribution:

Homework	25%
Quizzes	10%
Midterm	25%
Final Exam	40%

There is no formal curve given for any single assignment. The final grades will be determined based on your relative performance in the class, conforming to the following guidelines:

A+: An A performance, combined with significant work beyond the require- ments of the course. (We do not usually award this grade at Princeton University.)
A: Complete mastery of the material and ability to communicate this mastery verbally and in writing in a clear and precise way.
A-: Near-complete mastery of all aspects of the course, excellent ability to communicate.
B+: Strong familiarity with all aspects of the course and near-complete mastery of most; good ability to commuicate.
B and B-: Strong familiarity with most sections of the course, good ability to communicate.
C and C-: Moderate familiarity with most sections of the course, adequate ability to communicate. Or: a strong performance in most sections of the course combined with a poor performance in a few sections.
D: Familiarity with some parts of the course, a conscientious attention to the requirements of the class.
F: Flagrant neglect of the course, or failure to fulfill a course requirement.

4 Homework and Quizzes

4.1 Homework and Assigned Readings

Homework and assigned readings will be given out weekly. Please note that *completing the homework exercises is the most important thing you can do to master the material of this course.*

Assignments are due **in class** one week from their handout date. The assignments will also be available on Blackboard by 5 pm on the day they are given out in class. Homeworks will be graded by the course grader, and questions about your scores on these assignments should addressed directly to her. No late assignments will be accepted without instructor permission in advance.

You are allowed to collaborate with other students on the homeworks, however each student should write up his or her own solutions independently. Copied homeworks are subject to a grade of zero and reporting to the dean. Your solutions **must be legible** to get any credit, and should (whenever possible) include a brief explanation of your method of solution. Answers should not just be a string of formulas.

4.2 Quizzes

In addition, pop quizzes based on the material in the reading assignments and the basic techniques used in the homework may be given during any class. If you are up to date on reading, and have completed the homework as assigned, these quizzes should serve as a review for you. There is no collaboration allowed on quizzes. Your lowest score will be dropped from your final grade calculation. As such, there will be no make up quizzes without an excuse from the dean of your college.

5 Examinations

There will be one midterm and one final examination. Both will be timed exams (not take-home) designed to test your ability to perform basic computations similar to those in the homework, your comprehension of the assigned reading, and your ability to solve problems you have never seen before. The tests cover material presented in class as well as the assigned reading in the textbook and required reference materials. The final exam will be cumulative, but will emphasize topics covered after the midterm.

Make up tests will not be given unless the instructor is notified at least 24 hours in advance that you will be missing a test *and* a valid excuse which warrants a make up test is given.

6 Honor Code

All work done in this course is subject to the Princeton University Honor Code, as found in the undergraduate *Announcement* and the *Rights, Rules, and Responsibilities* publication.

7 Other Important Information:

7.1 Special Accommodations

If any student needs special accommodations because of a documented disability or cultural practices, please contact the instructor during the first week of classes. Accomodations are subject to the Princeton University policy on learning disabilities, available at:
$http://www.princeton.edu/odoc/services/learning\_disabilities/$.

7.2 Email Policy

Please feel free to email me at any time with questions or comments on the course material and presentation. I will respond to your emails as soon as possible, and in accordance with the following guidelines unless otherwise stated in class for a given time period (over breaks, etc):

- Emails received between 8 am and 5 pm Monday-Friday will be answered the same day (before midnight)
- Emails received after 5 pm Sunday-Thursday (and before 8 am the following morning) will be answered by noon the following day.
- Emails received between 5 pm Friday and 8 am on Monday will be answered by noon on Monday.
- Questions sent via email after 5 pm on the day before an examination are **not** guaranteed to be answered prior to the test.

7.3 Calculators & Computers

This course is designed to teach you to understand and be able to work differential calculus problems without the use of a calculator or other computational device. As such, **no calculators** will be allowed on in-class quizzes or examinations, and you are strongly encouraged to complete your homework without the use of one.

8 Course Outline

The following is a preliminary (non-comprehensive) course outline. Additional readings/topics may be assigned during the semester. Please refer to the Blackboard website for complete reading assignments and homework problems each week. This schedule is subject to change at the instructor's discretion.

Week:	**Topics/Events:**	**Reading:**
Sept. 15	Syllabus, Expectations, Non-Graded Quiz	start Sept 18-22 reading
Sept. 18-22	Algebra & Trig. Review	Story: Lessons 1-10, Thomas: 1.1-1.3, Appendix B Banner: Chap. 1-2
Sept. 25-29	Functions - Exponentials, Logarithms, and Inverses	Thomas: 1.5-1.6, Banner: 9.1-9.2
Oct. 2-6	Limits - Definition, Polynomials, One-Sided, and at Infinity	Thomas: 2.1-2.4, Banner: Chap. 3-4
Oct. 9-13	More Limits, Continuity, & Tangents	Thomas: 2.5-2.7 Banner: 5.1, 14.2
Oct. 16-20	Derivatives & Differentiation (Polynomials, Exponentials, Products, Quotients)	Thomas: 3.1-3.3 Banner: 5.2, 6
Oct. 23-25 Oct. 27	Midterm Review and Exam No Class	Review
Oct. 30-Nov. 3	Fall Break	N/A
Nov. 6-10	Derivatives of Trig Functions, Chain Rule, Parametric Eqns & Implicit Differentiation	Thomas: 3.4-3.6 Banner: 7, 8.1
Nov. 13-17	Derivatives of Inverse, Log, and Inverse Trig Functions, Related Rates	Thomas: 3.7-3.9 Banner: 8.2, 9.3-9.5, 10.1-10.2
Nov. 20-22 Nov 24	Linearization & Differentials Thanksgiving Break	Thomas: 3.10 Banner: 13.2
Nov. 27-Dec. 1	Extreme Values, Mean Value Theorem, First Deriv. Test	Thomas: 4.1-4.3 Banner: 11.1-11.3
Dec. 4-8	Concavity, Sketching, Applied Optimization	Thomas: 4.4-4.5, Banner: 11.4-11.5, 12, 13.1
Dec. 11-15	Selected Additional Topics	TBA
January TBA	Final Exam	N/A