Math 10a - Fall 2012
Methods of Mathematics: Calculus, Statistics and Combinatorics

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Lectures: Monday, Wednesday and Friday, 8:00-9:00am, 105 Stanley

Professor: Bernd Sturmfels (office 925 Evans, e-mail `bernd@math.berkeley.edu`)

Office Hours: Monday 11:30am-12:30pm and Tuesday 8:00-9:00am.

Graduate Student Instructors:

- Natth Bejraburnin, office hours Tuesday 4-5pm and Friday 11-12am in 787 Evans.
- Ralph Morrison, office hours Monday 1:30-2:30pm and Thursday 1:30-2:30pm in 941 Evans.
- Ngoc Tran, office hours Monday 1-2pm and Wednesday 1-2pm in 391 Evans.
- Markus Vasquez, office hours Wednesday 2-3pm and Thursday 2-3pm in 1056 Evans.

For extra help: check out the Student Learning Center. Their 1-unit course meets meets TuTh 11-12:30 in 113 Chavez.

Special Office Hours and Review Sessions:

Tuesday, Nov 27, 1-2pm: Ngoc in 334 Evans
Wednesday, Nov 28, 1-2pm: Ngoc in 334 Evans
Thursday, Nov 29, 1-2pm: Ngoc in 334 Evans
Friday, Nov 30, 1-2pm: Ngoc in 340 Evans
Monday, Dec 3, 4-6pm: Natth in 35 Evans (Review)
Wednesday, Dec 5, 8-10am: Bernd in 105 Stanley (Review)
Wednesday, Dec 5, 1:30-3:30pm: Ralph in 941 Evans
Wednesday, Dec 5, 4:00-5:00pm: Markus in 31 Evans (Review)
Thursday, Dec 6, 2:00-4:00pm: Markus in 1056 Evans
Thursday, Dec 6, 5:30-6:30pm: Ralph in 941 Evans
Friday, Dec 7, 1-3pm: Natth in 762 Evans
Monday, Dec 10, 9:00-10:30am: Bernd in 939 Evans

Course Description

This is the first semester of an introductory college-level mathematics course. It is primarily intended for majors in the life sciences. Math 10a covers: Introduction to differential and integral calculus of functions of one variable. Representation of data, elementary probability theory, statistical models and testing. The syllabus appears below. The continuation in the spring (Math 10b) will cover: Elementary combinatorics and discrete probability theory. Introduction to graphs, matrix algebra, linear equations, difference equations, differential equations.

Daily Syllabus

1. Friday, August 24: Sets and Functions, Polynomials, Hardy-Weinberg Law, Composition of Functions
2. Monday, August 27: Exponential Function, Tumor Growth, Inverse Function, Logarithm Function, Log-Log Plots
3. Wednesday, August 29: Statistics Basics, Data Types, Histograms, Step Functions

4. Friday, August 31: Coin Tosses, Simulated Data, Gaussian Function, Normal Distribution
5. Wednesday, September 5: Axioms for Area, Integral of Step Function, Properties of Integral, Limits
6. Friday, September 7: Area under a Curve, Riemann Integral, Left and Right Endpoint Approximations, Midpoint Rule, Trapezoid Rule
7. Monday, September 10: Random Variables, Outcomes, Events, Discrete Probability, Binomial Distribution
8. Wednesday, September 12: Cumulative Distributions, Continuous Probability Distributions, Normal Distribution Revisited
9. Friday, September 15: Slope of a Line, Slope of a Curve, Derivative of a Function
10. Monday, September 17: Power Rule, Constant Multiple Rule, Sum Rule, Difference Rule, Product Rule, Chain Rule, Quotient Rule
11. Wednesday, September 19: Implicit Differentiation, Higher Derivatives
12. Friday, September 21: Graphing Functions, Extrema, Inflection Points, Asymptotes
13. Monday, September 24: Local Extrema, Critical Points, Convex/Concave, Second Derivative Test, Global Maxima and Minima
    Wednesday, September 26: Review for First Midterm
    Friday September 28: First Midterm Exam
14. Monday, October 1: Approximation of Functions, Taylor Polynomials
15. Wednesday, October 3: Taylor Polynomials and Numerical Optimization
16. Friday, October 5: Newton's Method
17. Monday, October 8: Infinite Sums and Series
18. Wednesday, October 10: More General Series, Test for Divergence, Ratio Test, Root Test, Power Series, Taylor Series
19. Friday, October 12: Poisson Distribution, Sequences and Assembly of DNA sequences
20. Monday, October 15: Box Models, Long Run Behavior, Expected Value, Standard Error, Sampling Distribution, Central Limit Theorem
21. Wednesday, October 17: Parameters and Statistics, Sampling, Bias and Variability
22. Friday, October 19: Statistical Models
23. Monday, October 22: Estimators, Likelihood Function, Maximum Likelihood Estimation
24. Wednesday, October 24: Multiple Random Variables, Joint Density Function, Independence
25. Friday, October 26: Multinomial Distribution, Hardy-Weinberg Model, Genetics Example, Body Temperature Example
    Monday, October 29: Review for Second Midterm
    Wednesday, October 31: Second Midterm Exam
26. Friday, November 2: Antidifferentiation
27. Monday, November 5: Existence of Antiderivatives, Indefinite Integrals
28. Wednesday, November 7: Fundamental Theorem of Calculus, Area Function
29. Friday, November 9: Chain Rule Revisited, Substitutions in Definite Integrals, Exploiting Symmetry
30. Wednesday, November 14: Integration by Parts
31. Friday, November 16: Hypothesis testing, Type 1 and 2 errors, Test statistic, Rejection regions, P-value
32. Monday, November 19: Z-tests
    Wednesday, November 21: Statistics Review
33. Monday, November 26: Student's t curve, T-tests
    Wednesday, November 28: Calculus Review
    Friday, November 30: Ralph's Review

Lecture Notes and Text Books

The slides for each lecture and the homework problems have been assembled into a reader. A hard copy of the Math 10A reader can be purchased for $29.25 at Copy Central. The reader is also available for free to registered students as a pdf file on BSpace. We also recommend that you purchase the custom edition of Stewart's Calculus. For supplementary material on Statistics please use the free online notes and lectures posted by Professor Philip Stark. A custom edition of Rosen's Discrete Mathematics will be made available for Math 10B.

Reading and Writing

Students are expected to study the lecture notes in the reader BEFORE the date of the respective lecture. Writing is an essential part of studying mathematics and other quantitative subjects. Please use this course as an opportunity to practise your writing skills. You are expected to use complete sentences in all your written work. We will take this into consideration when grading the homework and the exams.

Homework and Quizzes

A homework set is assigned for each lecture. Solutions will be posted on BSpace after the due dates. Each lecture has at least five problems, for a total of at least 15 problems per week. The homework is always due on Monday of the following week, starting on August 27. No late homework can be accepted. Your GSI will verify that you are working the assigned problems, but only one problem per lecture will be fully graded.
There will be a quiz in your GSI section on every Friday, starting on August 31.

Midterm Exams and Final Exam

There will be two in-class midterms, on Friday, September 28, and on Wednesday, October 31. A review session will be held in the lecture preceding the midterm. *No books, notes, electronic devices, scratch paper or collaboration are permitted at any exam*. The final exam will be on Monday, December 10, 7-10pm, in 220 Hearst Gymnasium. Please plan your holiday travels accordingly. Your student photo ID is required at all exams. No make-up exams will be given.

Grading

Homework 10%, Quizzes 10 %, Midterms 20% each, Final 40%. If a student does not take midterm #1, then midterm #2 will count for 40% of the grade. If a student takes midterm #1 but not midterm #2, the final exam will count for 60%. Students who take neither midterm will fail the course. There will be no make-up exames. Incomplete grades are very rarely given, and only for a documented serious medical problem or genuine emergency, provided you have a C average on previous coursework.

Weekly Syllabus for Math 10b (taught in Spring 2013 by C. Evans)

- Week 1: Finite sets, functions, balls and boxes (the 12-fold way)
- Week 2: Counting, permutations, binomial coeficients
- Week 3: Discrete probability theory, conditional probability, Bayes' rule.
- Week 4: The Poisson approximation to the binomial distribution and Poisson random variables
- Week 5: Difference equations, recursion
- Week 6: Algorithms and dynamic programming
- Week 7: Differential equations I
- Week 8: Differential equations II
- Week 9: Inference for discrete distributions
- Week 10: Least squares and correlation
- Week 11: Linear equations
- Week 12: Matrix algebra
- Week 13: Relations and partially ordered sets
- Week 14: Graphs, trees and phylogenetics