MATHEMATICS S-102, SUMMER 2006
SETS, COUNTING, AND PROBABILITY

Last revised: June 26, 2006

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Office: Quincy House 102, 617-493-3100. Quincy 102 opens off the Quincy House courtyard, near the raised cubical library. I also have an office in the Science Center, but the Quincy House location is a much more pleasant place.
Email: `bamberg@tiac.net`
Home phone numbers: 508-460-6569 and 518-873-2429. Email is more reliable, even on weekends.

Office Hours: Thursdays, 10-noon in Quincy 102. This time is guaranteed – just drop in without notice. I will also often be available in Quincy 102 on Wednesdays all day, between 8 AM and 9 PM, and on Tuesdays between 10 and noon, but please send me an email or phone 3-3100 to make an appointment for those times. I am also happy to answer your questions by email.
Course Assistant: Nick Vidnovic`nvidnovic@gmail.com`412-337-6179.
Course Website:
`http://courses.fas.harvard.edu/sum/31976`

Goals and Prerequisites: This is an introductory but mildly rigorous course in discrete probability theory and its applications. The only prerequisite is high-school algebra, but you should be good at it!

It would also be nice if you are familiar with the geometric series

$$1 + x + x^2 + x^3 + \cdots = \frac{1}{1-x}.$$

Other infinite series that arise will be treated on an ad hoc basis.

No calculus is required, though it may turn out that many of the students in the course have studied calculus.

Placement Tests: You should take the online placement test. Just follow the link from the course description, or log in to the main summer school website. You will need to download Mozilla/Netscape, since IE does not display the mathematics correctly.

Course Meetings: Lectures for the course were captured on video last fall. There is a lecture (usually 2 hours in length) to view before each class. Access to the lectures is through the Lecture Videos page on the course website.

For each lecture, there is an outline that can serve as partial notes for the lecture. Download this from the Outlines page of the website and print it before viewing the lecture.

Discussion sections will meet Tuesdays and Thursdays from 1:30-3 P.M. in 53 Church St L01. These will be dedicated to presentations of key proofs and example problems by non-distance students and to answering questions about the lectures that distance students have submitted by email. For distance learners, videos of these sections will be available online within a day.

You can download the proofs and problems for section, along with the homework problems to be handed in, from the Assignments page of the course website. It is a good idea to glance through the six section topics before viewing the lecture, especially if you are a local student who will be explaining one of these topics in section.

There are three students who plan to attend every section: Douglas Helfman, Kathleen Tuffy , and Ken Umeki.

There are three students who are local but who say they do not plan to attend every section: Jason Agosta, John Bachman, and Sean German.

I am counting on local students to do the section presentations, since otherwise people will just see lots of me and the sections will be too much like the lectures.

Here is the plan: Kathy and Doug are responsible for topics 1, 3, and 5, but they can ask me to do one of the three. Ken, Jason, and John are responsible for topics 2, 4, and 6, but if Jason and/or John cannot be in class, I will do one or two of these even topics.

Sean will have to be in class on the two quiz days and can do an odd topic then. On quiz days, when there are only four topics, Ken and either Kathy or Doug will get the day off.

For more detail about online videos, see
`http://www.summer.harvard.edu/2006/DistanceEd`

Text: Elementary Probability, Stirzaker, Second Edition, Cambridge University Press, 2003, ISBN# 0-521-53428-3 (at the Harvard Coop or online from amazon.com, etc.) Amazon.com claims that it ships in 24 hours. Order early, since you will want to have the book before the first class!

Homework Assignments: Homework (five to eight problems) will be assigned for each class and will be due at the start of the next class. Homework that is submitted by fax or electronically for distance learners is due half an hour before the start of class, so that the course assistant can pick it up or print it out and bring it to class. Your corrected homework will be available

to you at the following class. If you are a distance learner, it can be faxed or emailed back to you.

The nicest form in which to submit your homework would be a .pdf file, but it takes some effort to learn how to do this. I learned LaTeX without a book or manual by just taking someone else's files, ripping out all the content, and inserting my own, and so can you. You will need to download freeware MiKTeX (see http://www.miktex.org/) and WinEdt(see http://www.winedt.com/). WinEdt is shareware which turns into nagware after 31 days. If distance learners become skillful at making .pdf files, they can perhaps also participate by each creating a written version of each section topic.

When in WinEdt, use the LaTeX button to compile, Accessories...DVI Preview to look at the result, and the PDF LaTeX button to create a .pdf file. To learn how to do fractions, sums, binomial coefficients, etc., just find an example in the notes and copy what I did. All the LaTeX source for lecture outlines and assignments is on the Web site, so you can find working examples for anything that you need to do.

If you create a .pdf file or simply scan your handwritten homework into a file, upload the file to the Web site. On the main page is a dropbox for each assignment.

If you submit your homework by fax, send it to 617-384-8395. This fax machine is monitored by someone who can verify that your homework has arrived on time. Please use the cover sheet that you can download from the course Web site. At the same time, upload a short text file to the dropbox, saying that you have sent homework by fax, so that we will be sure to look for the fax.

Electronic submissions to the dropboxes are much more convenient for us than fax!!

Nick Vidnovic, the course assistant, will run electronic office hours for each problem set. These will be held 7-8 PM on Monday and Wednesday evenings (excluding June 26 and July 3). They will take place on the discussion forums located on the course Web site. During this time, Nick will be logged into the forums and will provide rapid replies to any messages that are posted. Outside of this time, the board will be freely available to students to exchange questions, answers, and hints. Please email Paul or Nick if you are having trouble registering for the forums.

You are encouraged to discuss the course with your fellow students and with the instructors, *but you should always write your homework solutions out yourself in your own words.*

Exams: There will be two in-class quizzes and one final exam. The quizzes will be roughly 60 minutes each, and the final is scheduled for three hours. There will be an opportunity to retake each quiz, but the maximum possible score from a makeup quiz is 80%. There will be only one chance to take the final exam, but you can try a practice exam a day of two in advance.

As in all distance education courses that have in-class examinations, including those that are offered only via the Internet, students whose primary residence throughout the term is in the six-state New England region are expected to take the examinations on campus as scheduled. Distance education students whose primary residence throughout the term is outside of the six-state New England are expected to arrange to take their examinations in absentia and must submit proctor information via the online system. Go to `http://www.summer.harvard.edu/` and log in, then go to "distance education" on the main menu to access proctor information. Students should contact Academic Services, (617) 495-0977, for more information. If you live in New England but more than 2 hours from Cambridge (e.g. Presque Isle, ME), you can contact Academic Services and petition to be treated as if you lived outside New England).

Two Quizzes:	Thursday, July 13
	repeated Wednesday, July 19 (80% maximum)
	Tuesday, August 1
	repeated Friday, August 4 (80% maximum)
Final Exam:	Tuesday, August 15, comprehensive, with fairly uniform coverage

Programming Assignments: Students enrolled for graduate credit in computer-related fields will be expected to complete two programming assignments in PHP. PHP is a freely available, modern language that makes it easy to create interactive Web pages. It is easy to learn if you have programmed in C++, Java, Perl, or Basic. A CD with all the necessary files for installation will be made available in class. Students enrolled for undergraduate credit are also welcome to do the programming assignments. They offer a small amount of extra credit and some insurance against disappointing exam scores.

Grades: Your course grade will be determined as follows:

- homework, 40 points
- better quiz, 25 points
- worse quiz, 15 points
- class presentations (local) or emailed questions(distance), 10 points
- final exam, 50 points
- programming, up to 39 points added to numerator and 32 to denominator

The total points available are thus 140(without programs) or 172 (with programs). Extra credit could take you over 100% The grading scheme is as follows:

Points	Minimum Grade
92%	A
86%	A-
80%	B+
74%	B
68%	B-
62%	C+
56%	C

This system has led to reasonable grades in the Extension School and is unlikely to be changed.

List of Topics:

Date		Chapter	Topics
June	27	0, 1	Probability, Intuition, and Axioms
	29	1	Probability by counting and Inclusion-Exclusion
	4		HOLIDAY
July	6	2	Combinatorics, Bridge, Poker, and Dice
	11	3	Conditional Probability, Independence
	13	2,3	QUIZ 1, Monty Hall Problems
	18	2	Lying Witnesses and Simpson's Paradox
	20	4	Random Variables, Binomial and Poisson
	25	4	Expectation of a Random Variable
	27	3	Infinite Series and Expectation Calculations
August	1	5	QUIZ 2, Simple Random Walk and Gambler's Ruin
	3	5	Ballot theorem, Reflection Principle, Arc Sine Laws
	8	6	Generating Functions
	10	5	Law of Averages and Laws of Large Numbers
	15	-	Final Examination

Chapters 1-4 of Stirzaker will be covered quite thoroughly. Coverage of chapters 5 and 6 will be limited to a few interesting topics.

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