**Math 180 Fall 2014 Professor Murray Gerstenhaber**

***Overview of the course***

Welcome to Math 180, Analytical Methods in Law, Economics and Medicine.

There are no formal mathematical prerequisites for this course. Our text is  *Analytical Methods for Lawyers, second edition*  by Jackson, Kaplow, Shavell, Viscusi, and Cope, published by Foundation Press. (Note: As the text of the second edition is virtually identical with that of the first, if you have been able to obtain a copy of the first edition it will be usable.)

Syllabus

The material is divided into seven units, the first six of which correspond to chapters in the text. The last unit, on Evidence Based Medicine, is not covered in the text. Much of the material for this unit will be drawn from the web. The text was originally written for first-year law students at Harvard. (Note: I have a law degree from Penn and have also taught in the Law School.) It omits some mathematical ideas essential for a fuller understanding of the topics in the chapters we will cover; these will be introduced in class. You will not need to buy any additional texts since there are many references on the web. Here is a list of the units together with a brief mention of some of the materials that will be added.

1. Decision Theory (Chapter 1) In addition to the material in the text we will discuss and prove Bayes’ theorem and “flipping” the decision tree
2. Game Theory (Chapter 2) We will begin by discussing the theory of zero-sum two-person games (not covered in the text), and will include Braes’ paradox.
3. Finance (Chapter 5) The readings here on the Theory of the Firm should be interesting to those of you interested in economics, but we will spend little time there and more on the mathematics of the time value of money. There are many fascinating issues here, some of which may be useful for projects (see below), for example the Black-Scholes theory of options pricing (which involves deep mathematics and for which its developers were awarded the Nobel Prize in Economics) and the near-failure of Long Term Capital Management (which these Nobel laureates helped found) and the issue of “too big to fail”. A more recent issue is “inversions” and their effect on stockholders who may be forced immediately to pay capital gains tax. Who really benefits? (This relates to the Theory of the Firm.)
4. Microeconomics (Chapter 6) In this unit we will include a discussion of Linear Programming and in particular, of the Transportation Problem.
5. Basic Statistics (Chapter 8) The basic Gaussian or “bell-shaped” distribution is in the text, but it omits many other important distributions and statistical tests. We will discuss the binomial and Poisson distributions, the t-test and F-test, the chi-square distribution, and some non-parametric tests.
6. Multivariate Statistics (Chapter 9) If time permits we will also discuss ANOVA (Analysis of Variance).
7. Evidence Based Medicine. The topics will include Abbe plots and NNT (Number Needed to Treat).

Teams and Projects

The class will divide into teams of generally no more than four members who will be expected to work together on homework and take-home exams. However, *every student must submit his own individual homework paper or exam and show on the front not only his or her name, but those of all other team members* (written legibly). Teams should choose a captain who must be able to communicate readily with all team members. Each student will submit a form with his or her name and listing all team members as well as the captain. Teams may adopt nicknames, which they can list on the form; if they do not then I will assign a short name to each team. (If any teams reorganize during the semester, exchanging member or changing captains, they must inform me.) A main responsibility of each team will be to choose some topic to research, submit it to me for approval, and report on it at the end of the semester. The report will consist of two parts, a paper of between 10 to 15 pages on standard letter paper, double spaced (copies of tables or graphs do not count as a page) and a presentation to the entire class in which each team member must participate. The written reports must be submitted in advance of the presentations, which will take place on the last two class days, Thursday, December 4, and Tuesday, December 9. *Every student must submit his or her own paper indicating his or her contribution to the project.* Each team will get 15 minutes, including discussion time. *The research project and presentation are in place of a final exam* and will count for 40% of your grade. In view of this I should like to be able to give more time to each presentation, but the only way to make it possible would be to meet on one of the reading days, Wednesday, December 10 or Thursday, December 11, preferably the latter during the 1:30 – 3 pm usual class time. (I will poll the class to see if this is feasible, but it seem a reasonable trade-off for not having a final.)

Examinations and Grading

I am planning for one in-class exam on Tuesday, September 23, which will be graded and returned by Tuesday, September 30. It will count for 15% of your grade. (The drop period ends on Friday, October 3.) However, if we run behind schedule, then in order to allow for one more lecture it may be replaced by a take-home exam, which will then be distributed Thursday, September 18 and collected on Tuesday, September 23. There will then be one

additional exam, a take-home, which will count for 25% of your grade. The remaining 20% will come from homework and possible spot quizzes.

Religious Holidays

You will not see me in class on any day when I have an important religious obligation, and I do not expect to see you on any day that is similarly important to you. However, you must tell me at the start of the semester of the days on which you will absent yourself so that we can arrange for you to keep up with the work*.* I observe the major Jewish holidays, so *there will no class on Thursday, September 25 (First day of Rosh Hashanah) and no class on Thursday. October 16 (Shemini Atzeret, Yizkor).* (I will try to arrange for review sessions on one or both of these days.)