

MATHEMATICAL STATISTICS (MATH 36B)

Planned syllabus for Mathematical Statistics course (Math 36b) to be taught in Spring 2007.

Emphasis of course. This course will place heavy emphasis on theoretical and conceptual aspects of Mathematical Statistics. Lectures will explain the theoretical origins and practical implications of statistical formulae. For the most part computations will not be done in class since they are best done by computer.

The course will begin with the theory of estimators, in particular the *Maximum Likelihood estimate*. The derivation of the MLE's of various distributions will be used to both review those distributions which the student should have learned in Math 36a (Probability) and will also be used to set the tone and pace of the course. [Math 36a is a prerequisite so I don't want to waste a lot of time reviewing it.]

Topics. We will cover Chapters 5-14 of *An Introduction to Mathematical Statistics and Its Applications* 4th ed. by Larsen and Marx.

- (1) *Estimation/Review of special distributions:* Theory and derivation of estimators. Proof of the information inequality. Examples such as estimating the number of NAZI tanks in WWII. Review/MLE of: Poisson, normal, gamma distributions, order statistics. Finite population correction.
- (2) *Hypothesis testing:* Type I and Type II errors, power and significance, Generalized Maximum Likelihood Estimates.
- (3) *Sampling distributions:* χ^2 , F and t -distributions, their density functions and applications.
- (4) *Two sample tests:* t -test and F -test.
- (5) *Goodness of fit:* χ^2 for multinomial distributions.
- (6) *Regression:* Derivation of linear regression is a MLE. Applications.
- (7) *Analysis of Variance.* F -test, ANOVA table. Subhypotheses, contrasts. Comparison with paired t -test.
- (8) *Nonparametric statistics:* Wilcoxon signed rank and other topics as time permits.

Homework. There will be two types of homework:

- (1) Mathematical assignments: computations with brief conclusions which would be graded for mathematical content only. About 5 problems per week. Students are encouraged to work together on homework but each student hands in his own homework.
- (2) Written assignments: One project each two or three weeks. These should go into particular examples in more depth and should be understandable to someone who knows nothing about statistics.
 - (a) The first project should be handed in several times until it is perfect. (So, you should all get A's on this one.)

- (b) The second project will be handed in twice. For subsequent projects (2 or three more) you only get one shot.
- (c) Projects can be done in teams of 2 or 3 students (handing in one project signed by all team members). All members of a team get the same grade for the project unless you explain to me why you should get more credit than the others on the team.

There will also be quizzes but no final exam. All work needs to be handed in on the last day of class or at most two days later.

There will be 4 or 5 projects. Each project should have at least three written parts:

- (1) An *introduction* written for the layman without computations explaining the purpose of the project, where the data came from and which methods will be used to study the data. This is basically a repetition of the assignment and can be written before the project is done.
- (2) A *technical middle report* explaining how computations are done and what each number represents.
- (3) A *conclusion* which not only states the outcome but discusses its validity by explaining why the method used was appropriate for the specific project and addresses possible shortcoming such as explanations for outliers (data which doesn't fit) and reliability of the randomness or validity of sampling method.

Grades. Grades will be computed as follows:

- 1/3 Projects.
- 1/3 Math Homework.
- 1/6 Quizzes and tests.
- 1/6 Class participation.

Students with disability. If you are a student with a documented disability at Brandeis University and if you wish to request a reasonable accommodation for this class, please see the instructor immediately.

Academic integrity. All members of the Brandeis academic community are expected to maintain the highest standard of academic integrity as outlined in "Rights and Responsibilities." Any violations will be treated seriously.