

## DEPARTMENT OF MATHEMATICS, NORTHEASTERN UNIVERSITY

### MTH U581: Statistics and Stochastic Processes.

Summer 1 2005

**Class:** M,Tu.,W and Th. 8.00–9.40 a.m. in 325 SH

**Instructor:** Prof. Mike Malioutov

**Office:** 545 Lake; phone 373-5650; email: m.malioutov@neu.edu

**Office hours:** M,W 12:30 pm – 1:30 p.m.

This course continues MTH U481 by introducing more advanced topics of Statistics and more general relation between successive trials, namely Markov Chains and Hidden Markov Models.

**Text:** “Introduction to Probability”, (GNU) C.M. Grinstead and J. L. Snell, second edition (published by American Mathematical Society). Chapters 10-12 cover the first part of our course. It can be downloaded free (by the authors’ permission) from

<http://www.dartmouth.edu/~chance/>. Click on ‘A GNU book’ in the left column of the title page and follow the signs. Chapters 10-12 correspond to pages 375-507 of the pdf-output (pages 365-497 of the paper version). Next, we shall cover some elementary material on inference for Hidden Markov Models (HMM) following (probably) Durbin et al “Biological Sequence Analysis”, Cambridge University Press, 1998 (BSA). The last part of the course will be (depending on students’ choice) either an Intro to Multiple Regression and Optimal Experimental Design, using the instructor’s lecture notes, or a sketch of Statistical ideas of Information Theory and its applications (equipartition, compression, transmission capacity of communication channels, hypotheses testing and gambling) from “Elements of the Information Theory” by Cover and Thomas, Wiley, 1991 (CT), parts of chapters 3,5,8 and 12, stopping when appropriate. Printouts will be provided for all parts of the course.

### **Grading:**

There will be regular (almost daily) short end-of-class quizzes, one in-class midterm test, and the two-hour departmental final test.

Homework problems will be assigned and graded each week.

In addition there will be an option of computer lab on HMM based on MATLAB or a short test worth 10 % grade. You are encouraged to work together in small groups (no more than three) on these labs. Volunteers for projects involving reading and presenting talks in class will be awarded by 10 % of the grade.

Your grade will consist of:

Final: 40%    MidTerm: 20%    Homework: 20%, quizzes: 10 %, Computer lab or a short test: 10 %

**Grades:** A: 85% – 100%    B: 70% – 85%    C: 55% – 70%

### **Preliminary Syllabus (subject to possible corrections):**

week 1. Brief review of Probability. Moment generating functions: Ch. 10 of GNU book.  
week 2-4. Random Walks and Markov Chains, Chapter 11-12 of GNU book.

week 5. Hidden Markov Models (HMM). Most probable path and estimation of parameters (BSA).

weeks 6 (IT option). Equipartition, compression and information transmission (CT).

weeks 7 (IT option). Method of types, gambling and hypotheses testing (CT).

### **IMPORTANT:**

1. The best way to learn this material is to do the homework problems every week. Please ask me questions about things you don't understand, either in class or at my office.

**DON'T** wait until you feel completely lost!

2. It is your responsibility to be aware of any changes the instructor may make to the syllabus as they are announced in class. Students are responsible for all information given when they are absent.

3. The grade I (Incomplete) will be given only if you have a good attendance record, have missed the Final for a good reason, and otherwise you are doing passing work. Makeup exams are not given unless you have missed the exam for a valid reason and can prove it. Both makeups and incomplete are given at discretion of instructor.

4. If you have a concern about the course or the instructor that is not or cannot be resolved by speaking with the instructor, please contact Professor D. King (the vice chair), 447 LA, x5679, donking@neu.edu.

5. It is University policy that no grade, including an incomplete, can be changed after one year. Exceptions must be authorized by the Academic Standing Committee.

**6. All students without legitimate conflicts (approved by the instructor) will take the final exam at the scheduled time. Do not make travel plans that conflict with the final exam.**

### **Assignment 1**

**Due date:** Wednesday, May 11.

**Reading:** Ch. 10 of GNU book

**Problems (full grade is given for more than 85 %):**

1. p. 375 of GNU book: #1(a-c), #2(a-c), #3, #5, #6, #7, #8, #11.

2. p. 393 of GNU book: #1, #4, #5

3. p.402 of GNU book: #1(a-c), #2, #3(a,b), #7, #9.