

September 13, 2011

**POL 602, Applied Data Analysis I: Probability Theory**

Fall 2011

Mondays &amp; Wednesdays, 10:30-12:00, SBS N-705

Tutorial: Fridays, 2-3 pm, SBS N-705

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**Purpose**

This course offers an introduction to the theory and practice of quantitative data analysis. It provides the foundation for POL 603 and POL 604, and focuses mainly on probability theory and mathematical statistics. In addition, it introduces first elements of the statistical programming language *R*.

**Course Requirements**

- Problem sets – 33%
- Midterm exam – 33%
- Final exam – 33%

**Problem Sets**

There will be weekly to bi-weekly problem sets. Analytical work will form between 2/3 and 3/4 of the assignments, and computational work the rest. I strongly encourage you to cooperate on the problem sets. *However*, each student is required to hand in their own original work (also see Stony Brook's Academic Integrity policy at the end of the syllabus). Hands-on practice is an integral part of succeeding in this class. I therefore strongly encourage you to use the tutorial and office hours for questions about class work and problem sets.

## Tutorial

The weekly tutorial represents your first line of defense if your own studies leave you with unanswered questions. Attendance is *mandatory*. However, the tutorial only can be effective if you come prepared with questions. It is not intended as secondary lecture.

## Books & Software

The course does not follow a specific textbook. However, I require that you choose at *at least two books* at different levels of exposition to follow the course material. Even though there is no single required text, readings are not optional. Coming to class prepared is a prerequisite for success in this class.

For teaching  $R$ , I rely on **Baclawski, *Introduction to Probability with R*, 2008**. I will occasionally assign  $R$  problems from the book, so I recommend you purchase it.

For the textbook, I recommend the following:

- **Ashenfelter, Levine & Zimmerman, *Statistics and Econometric*, 2006**. This is at a lower mathematical level than the other books. The text can serve as a useful first read for new concepts, even though the course will aim for a higher mathematical level than presented here.
- **Wackerly, Mendenhall & Scheaffer, *Mathematical Statistics*, 7th Edition, 2008**. Fairly high mathematical level. The text uses many examples. This sometimes feels cluttered, but the examples can help to illustrate abstract concepts.
- **Casella & Berger, *Statistical Inference*, Second Edition, 2002**. Older editions are ok as well. This presents the material at a quite high mathematical level. The exposition can be terse, but concepts are dealt with in great clarity. It is a great book for future reference.

The software  **$R$**  is open-source. It can be downloaded from the  $R$  Project website: <http://www.r-project.org>.  $R$  code can be generated using any text editor. A good choice for Windows users is WinEdt. This is share-ware that can be tested for free: <http://www.winedt.com>. WinEdt ties directly into  $R$  and provides a graphical user interface (GUI).

## Other Information

Please find other information (academic integrity notice, disability notice) at the end of the syllabus.

## Course Outline

This course outline is subject to change if individual sections take longer or shorter than expected.

### *Week 1, August 29*

- Introduction

*August 31, No Class, Away for APSA*

*September 5, No Class, Labor Day*

### *Week 2, September 7*

- Set Theory

### *Week 3, September 12 & 14*

- Probability Theory
- Conditional Probability and Independence

### *Week 4, September 19 & 21*

- Random Variables
- Distribution Functions
- Density and Mass Functions

### *Week 5, September 26*

- Expected Values and Moments

*September 28, No Class, Friday Schedule*

### *Week 6, October 3 & 5*

- Transformations
- Common Distributions

***Week 7, October 10 & 12***

- Joint, Marginal & Conditional Distributions
- Covariance & Correlation

***Week 8, October 17 & 19***

- Multivariate Distributions
- The Sampling Distribution

***Week 9, October 24 & 26***

- Convergence of Random Variables
- **Midterm Exam** in class on 10/26/2011

***Week 10, October 31 & November 2***

- Hypothesis Testing
- Power of a Test

***Week 11, November 7 & 9***

- Finding Point Estimates
- Likelihood Ratio Tests

***Week 12, November 14 & 16***

- Non-parametric Tests
- Simulation methods: The Bootstrap

***Week 13, November 21***

- Bayesian Estimation

***Week 14, November 28 & November 30,***

- Applied Bayesian estimation

- MCMC: Gibbs sampling

***Week 15, December 5 & 7,***

- Properties of Estimators in Finite & Infinite Samples

***Week 16, December 12, WEDNESDAY SCHEDULE***

- **Final Exam** in class on 12/12/2011

### **Americans with Disabilities Act**

If you have a physical, psychological, medical or learning disability that may impact your course work, please contact Disability Support Services, ECC (Educational Communications Center) Building, room 128, (631) 632-6748. They will determine with you what accommodations, if any, are necessary and appropriate. All information and documentation is confidential.

### **Academic Integrity**

Each student must pursue his or her academic goals honestly and be personally accountable for all submitted work. Representing another person's work as your own is always wrong. Faculty are required to report any suspected instances of academic dishonesty to the Academic Judiciary. Faculty in the Health Sciences Center (School of Health Technology & Management, Nursing, Social Welfare, Dental Medicine) and School of Medicine are required to follow their school-specific procedures. For more comprehensive information on academic integrity, including categories of academic dishonesty, please refer to the academic judiciary website at <http://www.stonybrook.edu/uaa/academicjudiciary>.

### **Critical Incident Management**

Stony Brook University expects students to respect the rights, privileges, and property of other people. Faculty are required to report to the Office of Judicial Affairs any disruptive behavior that interrupts their ability to teach, compromises the safety of the learning environment, or inhibits students' ability to learn. Faculty in the HSC Schools and the School of Medicine are required to follow their school-specific procedures.