STAT 421 **Probability Theory** **Autumn 2019**

Syllabus

Instructor: Brian Steele Office: Math 314
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Course Format: 3 lectures/week: MWF 11:00-11:50 (section 1: Math 108).

In Stat 421, we develop the probabilistic tools and language of mathematical statistics. The course cover standard probabilistic models and properties of common random variables and vectors, their moments, and common probability distributions. The structure of statistical inference is studied in Stat 422. In particular, the theory of estimation, confidence sets and hypothesis testing for common parametric models are investigated.

Students taking the course must have completed a year long course in calculus and had some exposure to basic probability and statistics. Stat 421-422 is a required sequence for Master's and PhD students majoring in mathematics with statistics emphasis.

Learning Goals:

1. To understand the axiomatic approach to probability, counting and combinatorial methods, and Bayes' Theorem.
2. To understand random variables and their properties, including marginal and conditional distributions, expectation, conditional expectation, covariance and correlation, moment generating functions, and distributions of functions of one or more random variables.
3. To recognize and learn the properties of important probability distributions.
4. To gain the ability to prove results in probability.
5. To use statistical software to simulate random phenomena and to carry out probability computations for standard distributions.

Course Content: In Stat 421, we shall cover most, but not all of the material in chapters 1 through 7 of the textbook. The topics listed on the textbook author's webpage are:

1. Basic concepts such as random experiments, probability axioms, conditional probability, and counting methods
2. Single and multiple random variables (discrete, continuous, and mixed), as well as moment-generating functions, characteristic functions, random vectors, and inequalities
3. Limit theorems and convergence

Prerequisites: : Math 251 (multivariable calculus), Math 305, and Stat 341 (Introduction to Probability and Statistics) or consent of the instructor

Textbook: H. Pishro-Nik, *Introduction to probability, statistics, and random processes*, available at https://www.probabilitycourse.com, Kappa Research LLC, 2014.

1. Hogg, McKean and Craig, *Introduction to Mathematical Statistics*, Sixth Edition, Prentice Hall 2005.

2. Mood, Graybill and Boes, *Introduction to the Theory of Statistics*, Third Edition, McGraw-Hill 1974. (available online : `http://www.e-booksdirectory.com/details.php?ebook=3627`).

Homework: Homework assignments are comprised of a set of problems that are assigned weekly. Solutions to *some* of the problems are in the textbook and the author's webpage. There will be a quiz most Wednesdays that is either one of the homework problems or a modification of one.

Attendance: It's best to attend class regularly (you've paid for it, after all).

Incomplete (I) Grades: Incompletes (I's) are given at the discretion of the instructor. See the 2009-2010 UM catalog for the conditions under which an incomplete may be given. Incompletes will not be given under any other circumstances.

Grading: Your final grade for this course will be given according to the +/- grading system and based on the weights shown to the right. The final exam will be cumulative.

Quizzes	25%
Exams (2)	50%
Final Exam	25%

There is no strict grading scale for this course; however, the table below shows a possible scenario for the letter grade breakdown in this course.

Grade	A- to A+	B- to B+	C- to C+	D- to D+	F	CR (Credit)
Percentage	90-100%	80-89%	68-79%	57-67%	Less than 57%	57-100%

Exams: There will be 2 exams during the semester during the weeks shown below. If you cannot make it to an exam, please let me know before the exam. No make-up exams will be given without a documented reason.

Exam	Date
I	First week of October
II	Third week of November

Final exam: The final exam will be on the material since Exam II. The scheduled time is Friday, December 13 from 10:10-12:00.

Academic Misconduct: All students must practice academic honesty. Academic misconduct is subject to an academic penalty by the course instructor and/or a disciplinary sanction by the University. All students need to be familiar with the Student Conduct Code.