DALHOUSIE UNIVERSITY

Faculty of Science Course Syllabus
Department of Mathematics and Statistics

STAT 5067
Advanced Statistical Theory II

Winter, 2024

Dalhousie University is located in Mi'kma'ki, the ancestral and unceded territory of the Mi'kmaq. We are all Treaty people.

We acknowledge the histories, contributions, and legacies of the African Nova Scotian people and communities who have been here for over 400 years.

Instructor: Bruce Smith bruce.smith@dal.ca

Lectures: MW 2:05-3:25, Chase 107

Course delivery: In person.

Course Description: This course builds upon the material of Statistics 4066/5066. After a review of probability theory, statistical theory for the major methods of estimation will be rigorously developed. Topics include statistical consistency, limiting distributions of estimators, limiting distributions for testing in likelihood settings and transformations of confidence regions. Asymptotic optimality for point estimation, testing and confidence regions will be defined, and optimality results will be established for likelihood methods.

Course Prerequisites: STAT 4066/5066

Course Objectives/Learning Outcomes: The student will be able to derive and apply the delta-method for obtaining the standard error of an estimator. The student will be able to establish the statistical consistency of estimators and know under what conditions consistency does not hold for major methods of estimation. The student will be able to derive higher order asymptotic approximations. The student will understand how to transform confidence regions so that they have good properties. The student will learn the techniques required to derive limiting distributions of estimators for a number of classes of estimation. They will be able to recognize the types of regularity condition violations that cause standard theory not to apply. The student will learn how to determine the efficiency of an estimator. M-estimation will be introduced, and students will learn that ML estimation is the most efficient form of M-estimation. The limiting distributions of the major statistical testing approaches for likelihood methods will be derived and the student will learn that they are often locally most powerful tests. The student will learn that there is a duality between testing and confidence interval estimation and use that duality to determine locally optimal confidence regions.

Course Materials: Mathematical Statistics: Basic Ideas and Selected Topics (2nd Edition). Peter J. Bickel and Kjell A. Doksum.

Course Assessment:

Component	Weight (% of final grade)	Date
Take home exams	*4 - each totalling 25%,*	roughly every three weeks.

Conversion of numerical grades to Final Letter Grades follows the Dalhousie Common Grade Scale:

A+ (90-100)	**B+** (77-79)	**C+** (65-69)	**D** (50-54)
A (85-89)	**B** (73-76)	**C** (60-64)	**F** (<50)
A- (80-84)	**B-** (70-72)	**C-** (55-59)	

Course Policies: It is expected that each student will write up their take home exams independently.

Course Content: The course will focus on material in Chapters 5 and 6 and the appendices of the Bickel and Doksum book, including:

- *Review of Probability Theory*
- *Statistical Consistency*
- *Higher-Order Asymptotic Approximations and Transformation of Confidence Regions*
- *Limiting Distributions of Estimators and Test Statistics*
- *Locally Most Powerful Testing and Locally Optimal Confidence Regions*
- *Bayesian Inference*
- *Additional Topics*

Link to University Policies and Statements

Link to Student Resources