

MATH 556: MATHEMATICAL STATISTICS I

Instructor:	David A. Stephens, Burnside Hall 1225 david.stephens@mcgill.ca
Lectures:	Tuesday, Thursday; 1:05 pm – 2:25 pm
Website:	www.math.mcgill.ca/dstephens/556/ and myCourses
Office hours:	Monday, Thursday; 4:00pm – 5:30 pm (to be confirmed)
Recommended Texts:	<i>Elements of Distribution Theory</i> , T. Severini <i>Statistical Inference (2nd Ed)</i> , G. Casella and R. L. Berger.
Prerequisites:	MATH 323, MATH 356 or equivalent.

This is primarily a course on distribution theory for univariate and multivariate distributions.

TARGET SYLLABUS

1. Preliminaries

- 1.1 Basics of Probability and Random Variables
- 1.2 Univariate Distributions
- 1.3 Transformations
- 1.4 Expectations and Moments
- 1.5 Some Inequalities: Concentration inequalities; Markov's inequality; Chebyshev's inequality; Chernoff bounds; Cauchy-Schwarz Inequality; Jensen's Inequality
- 1.6 Generating Functions and The Characteristic Function
- 1.7 Numerical methods, simulation and Monte Carlo

2. Multivariate distributions

- 2.1 Joint, marginal and conditional distributions
- 2.2 Dependence, covariance and correlation
- 2.3 Exchangeability

3. Families of distributions

- 3.1 Parametric Families
- 3.2 Location-Scale Families
- 3.3 Exponential and Exponential Dispersion Families
- 3.4 Convolution Families and Sums of Random Variables
- 3.5 Hierarchical Models

4. Sampling Distributions

- 4.1 Definitions
- 4.2 Sampling from a Location-Scale Family
- 4.3 Sampling from an Exponential Family
- 4.4 Sampling from a Normal Family
- 4.5 Order and Rank statistics

5. Convergence concepts & Asymptotic Theory

- 5.1 Convergence in Probability: The Weak Law of Large Numbers
- 5.2 Convergence Almost Surely: The Strong Law of Large Numbers
- 5.3 Convergence in Distribution & Large Sample Approximations
- 5.4 A Central Limit Theorem
- 5.5 The Delta Method

EVALUATION

The final mark for the course will be calculated **on the following basis only**: as the larger of
20% assignments + 20% midterm + 60% final exam
and

20% assignments + 80% final exam

In the event of extraordinary circumstances beyond the University's control, the content or evaluation scheme in this course is subject to change.

- Coursework:** Four in-term assignments (5 % each)
Submitted electronically via myCourses.
- Midterm exam:** In class, Thursday 6th October.
- Final exam:** 3 hours, to be held in the final exam period.
Date and venue to be confirmed by the University.

Policy for in-term assignments:

- (i) You may discuss assessment questions with any other person, but the document submitted for assessment must be entirely produced by yourself.
- (ii) Reasonable requests for extension will be considered if made in a timely fashion.
- (iii) Late submission without an extension being granted may result in up to 100% penalty.

If you need special examination arrangements or accommodations, please contact the **Office for Students with Disabilities** at 514-398-6009.

MCGILL UNIVERSITY POLICY STATEMENTS

The following statements are included in this course outline in keeping with Senate resolutions:

- 1 *McGill University values academic integrity. Therefore, all students must understand the meaning and consequences of cheating, plagiarism and other academic offences under the **Code of Student Conduct and Disciplinary Procedures**. For more information, see*

www.mcgill.ca/students/srr/honest/

[Approved by Senate on 29 January 2003]

- 2 *In accord with McGill University's Charter of Students' Rights, students in this course have the right to submit in English or in French any written work that is to be graded.*

[Approved by Senate on 21 January 2009]

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David A. Stephens.
1st September, 2022.