**STAT 3559 A: MATHEMATICAL STATISTICS**

**COURSE OUTLINE**

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|---|---|
| **Term** | Winter 2021 |
| **Instructor Email** | Dr. M. Ould Haye |
| **Website Office** | mohamedouhaye@cunet.carleton.ca |
| **Office hour** | On zoom by appointment only |

**Important note: all classes are live on zoom. No recordings!**
**You will receive invitations prior to lectures**

**Timetable** The course involves 3 hours of lectures and one-hour tutorial per week. Tutorials will start on the week of **January 18, 2020.**

**Lectures** Mondays and Fridays, 10:05 am – 11:25 am (ET),
**Tutorials** Fridays, 1:35-2:25pm On culearn
**TA** Joshua Miller; email: joshuamiller@cmail.carleton.ca

**Assignments** There will be **four** assignments with specific due dates. All assignments count towards the term mark. Late assignments will not be accepted. Due dates for assignments are tentatively scheduled for February 5, 26, March 19, and April 9, 2020.

**Calculators** Only non-programmable calculators may be used for the midterm test and final exam.

**Midterm, final exam and assignments policies** There will be **one** 2-hour midterm test written (via culearn). The test is scheduled for **March 5, 2021**. There will be no make-up tests. If you miss the midterm test you will receive a zero unless you provide your instructor with a proper documented reason (e.g., medical), in which case the weight of the midterm test will be shifted to the final exam. The same rule applies to each assignment. **Final exam:** 3 hours**.** Time, date TBA by Carleton University.

**Grading** Final exam: 55% Midterm Test: 25% Assignments: 20%

**Textbook** Probability and Statistics, 4th edition, by M. H. DeGroot and M. J. Schervish. Student Solutions Manual (SSM), by M. H. DeGroot and M. J. Schervish.

**Notes** 1. Assignments and their solutions, problem sets for tutorials, some practice problems, and announcements will be posted on cuLearn. Students should check the course web page on cuLearn on a regular basis.
2. You must obtain at least 50% of total AND at least 50% of the final exam mark to pass the course.

**Academic Accommodation**

You may need special arrangements to meet your academic obligations during the term.

For an accommodation request the processes are as follows:
**Pregnancy obligation:** write to me with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details visit the Equity Services website http://www2.carleton.ca/equity/accommodation/.

**Religious obligation:** write to me with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details visit the Equity Services website http://www2.carleton.ca/equity/accommodation/.

**Academic Accommodations for Students with Disabilities:** The Paul Menton Centre for Students with Disabilities (PMC) provides services to students with Learning Disabilities (LD), psychiatric/mental health disabilities, Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorders (ASD), chronic medical conditions, and impairments in mobility, hearing, and vision. If you have a disability requiring academic accommodations in this course, please contact PMC at 613-520-6608 or pmc@carleton.ca for a formal evaluation. If you are already registered with the PMC, contact your PMC coordinator to send me your Letter of Accommodation at the beginning of the term, and no later than two weeks before the first in-class scheduled test or exam requiring accommodation (if applicable). After requesting accommodation from PMC, meet with me to ensure accommodation arrangements are made. Please consult the PMC website for the deadline to request accommodations for the formally-scheduled exam (if applicable) at http://www2.carleton.ca/pmc/new-and-current-students/dates-and-deadlines/. You can visit the Equity Services website to view the policies and to obtain more detailed information on academic accommodation at http://www2.carleton.ca/equity/.

**Academic Integrity:** The University states unequivocally that it demands academic integrity from all its members. Academic dishonesty, in whatever form, is ultimately destructive to the values of the University. Students who violate the principles of academic integrity through dishonest practices undermine the value of the Carleton degree. Dishonesty in scholarly activity cannot be tolerated. Any student who violates the standards of academic integrity will be subject to appropriate sanctions.

**Important dates:**

- January 11, 2021: Winter term classes begin.
- January 25, 2021: Last day for registration. Last day to change courses or sections for winter and fall term courses.
- January 31, 2021: Last day to withdraw from winter term courses with a full fee adjustment.
- February 12, 2021: April examination schedule available online.
- February 15, 2021: Statutory holiday. University closed.
- February 15-19, 2021: Winter break, no classes.
- March 19, 2021: Last day to request formal exam accommodations for December examinations to the Paul Menton Centre for Students with Disabilities.
- April 14, 2021: Last day of winter term classes. Last day for academic withdrawal from winter term courses.
- April 2, 2021: Statutory holiday. University closed.

- April 16-27, 2021: Final examinations in winter term courses will be held.

**STAT 3559 A** **Approximate weekly outline** **Winter 2021**

| Week | Topics | Text sections |
|---|---|---|
| 1 | Parametric statistical models. Concept of an estimator. Basic criteria for selecting an estimator: unbiasedness, minimum variance, consistency, and asymptotic normality. | 7.1, 8.7, |
| 2 | Consistency and unbiasedness of the sample mean and the sample variance. Empirical substitution principle as a method of parameter estimation. | 8.7 (Cont) |
| 3 | Fisher's lemma. Confidence intervals: general definition; confidence intervals for the mean and variance of a normal distribution; approximate confidence intervals. | 8.3, 8.5, |
| 4 | Gamma distribution: definition and properties. Beta distribution: definition and properties. | 5.7, 5.8 |
| 5 | Notions of statistical model, parameter space, loss function, and decision rule, and Bayes estimators (prior and posterior distributions, conjugate families of distributions, explicit form of a Bayes estimator with respect to the quadratic loss function). | 7.4 |
| 6 | Sufficient statistics: definition, Neyman-Fisher factorization theorem, Rao-Blackwell theorem (improving an estimator by conditioning it on a sufficient statistic); Lehmann-Scheffé uniqueness theorem; UMVU estimators. | 7.7-7.9, |
| 7 | Method of moments. Regular families of distributions. Fisher information. Cramér-Rao inequality. Equality in the Cramér-Rao inequality: one-parameter exponential families, efficient estimators. | 8.8 |
| 8 | Method of maximum likelihood: definition of a MLE, invariance property of a MLE, asymptotic properties of a MLE (consistency, asymptotic normality, asymptotic efficiency). | 7.5, 8.8, |
| 9 | Basic concepts of the Neyman-Pearson approach to hypothesis testing: statistical hypothesis; null and alternative hypotheses; simple and composite hypotheses; acceptance and rejection regions; test procedures; test function; type I and type II errors; level of significance; size of a test; p-value; power of a test; power function of a test. | 9.1, |
| 10 | Most powerful tests. Families of distributions with a monotone likelihood ratio; uniformly most powerful tests. Generalized likelihood ratio tests for two-sided alternatives. | 9.2-9.3 |
| 11 | Chi-square test of goodness-of-fit for a simple hypothesis. Chi-square test of goodness-of-fit for a composite hypothesis. Chi-square test of independence. Chi-square test of homogeneity. | 10.1-10.4 |
| 12 | Kolmogorov-Smirnov one-sample tests of goodness-of-fit. Kolmogorov-Smirnov two-sample tests of homogeneity. Sign test for testing hypothesis of no treatment effects and for comparing two different methods of treatment. | 10.6, 10.8, |

**Warning:** The above weekly schedule is subject to change. Make sure you keep up to date with any changes in order of presentation, etc.