Department of Mathematics & Statistics
Concordia University

> **STAT 347**
> Introduction to Non-Parametric Statistics
> *Fall 2023*

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Class Schedule: Wednesdays and Fridays, 13:15-14:30.

Office hours: Wednesdays, 11:00-12:30.

Text: *Nonparametric Statistical Inference*, 5th Edition, by J. D. Gibbons and S. Chakraborti.

Reference: *Introduction to the Theory of Nonparametric Statistics*, by R. H. Randles and D.A.Wolfe (Wiley, 1979).

Objective: This course is an introduction to the basic techniques of nonparametric inference – mainly tests of hypotheses. We shall study the classical methods, exact as well as approximate (i.e., large sample), in this field – theoretically and numerically.

Assignments: There will be 5 assignments. Assignments are compulsory. Students are expected to submit assignments in class. **Late assignments will not be accepted.** Assignments contribute 15% to your final grade. Working regularly on the assignments is essential for success in this course.

Calculators: Only calculators approved by the Department (with a sticker attached as proof of approval) are permitted for the class test and final examination.
For a list of Approved calculators see
http://www.concordia.ca/artsci/math-stats/services.html #calculators.

Midterm Test: There will be one **midterm test,** based on the material of lectures 1-5, which will contribute up to 20% to your final grade (see the **Grading Scheme** below). The midterm test will be held Wednesday, October 18, 2023, <u>in class.</u> This exam, as well as the final, will be closed-book exams.

    NOTE: It is the Department's policy that tests missed for any reason, **including illness,** cannot be made up. Students who are unable to write the midterm test for a valid reason must write to their instructor to request

a 85% final exam. Such a request will not be granted unless it is made in writing (by email), the reason is valid, and is supported by documentation or other evidence. Valid reasons for missing a midterm test include: conflicts with other exams or religious observances (must be reported to the instructor in advance); illness (Short-Term Absence form or valid medical note required); bereavement. Students who miss the midterm test but do not request a 85% final, as described above, will forfeit the marks for the midterm test.

Final Exam: The final examination will be three hours long and will cover all the material in the course. In order to obtain a good grade, the student **MUST** show that she/he has a THOROUGH understanding of the subject and is good at problem-solving.

NOTE: Students are responsible for finding out the date and time of the final exams once the schedule is posted by the Examinations Office. Conflicts or problems with the scheduling of the final exam must be reported directly to **the Examinations Office**, **not to your instructor**. It is the Department's policy and the Examinations Office's policy that **students are to be available until the end of the final exam period. Conflicts due to travel plans will not be accommodated.**

Final Grade: a) Assignments (15%)
b) Mid-term test (20%)
c) Final examination (65%)

 If the grading scheme for this course includes graded assignments, a reasonable and representative subset of each assignment may be graded. Students will not be told in advance which   subset of   the   assigned problems will   be marked   and   should therefore attempt all assigned problems.

IMPORTANT: **PLEASE NOTE THAT THERE IS NO '100% FINAL EXAM' OPTION IN THIS COURSE.**

Weeks	Sections	Topics to be covered
1	2.1, 2.2, 2.3, 2.4	Order Statistics; The Quantile Function; The Empirical Distribution Function; Statistical Properties of Order Statistics.
2	2.5, 2.6, 2.7	Probability-Integral Transformation; Joint Distribution of Order Statistics; Distributions of the Median and Range.
3	2.8, 2.9, 2.10, 2.11	Exact Moments of Order Statistics; Large-Sample Approximations to the Moments of Order Statistics; Asymptotic Distribution of Order Statistics; Tolerance Limits for Distributions and Coverages.
4	3.1, 3.2, 3.3, 3.4	Introduction to Tests of Randomness; Tests Based on the Total Number of Runs; Tests Based on the Length of the Longest Run; Runs Up and Down.
5	3.5, 4.1, 4.2, 4.3, 4.4	A Test Based on Ranks; Introduction to tests of Goodness of Fit; The Chi-Square Goodness-of-Fit Test; The Kolmogorov-Smirnov One-Sample Statistic; Applications of the Kolmogorov-Smirnov One-Sample Statistics.

6	**MID-TERM** 4.5, 4.6, 4.7	Mid Term exam will cover material up to Weeks 5 contents. Lilliefors's Test for Normality; Lilliefors's Test for the Exponential Distribution; Visual Analysis of Goodness of Fit.
7	5.1, 5.2, 5.3, 5.4	Confidence Interval for a Population Quantile; Hypothesis Testing for a Population Quantile; The Sign Test and Confidence Interval for the Median.
8	5.5, 5.6, 5.7, 5.8	Rank-Order Statistics; Treatment of Ties in Rank Tests; The Wilcoxon Signed-Rank Test and Confidence Interval & Summary.
9	6.1, 6.2, 6.3, 6.4	The Wald-Wolfowitz Runs Test; The Kolmogorov-Smirnov Two-Sample Test; The Median Test.
10	6.6, 8.2, 9.3, 9.4	The Mann-Whitney U Test; The Wilcoxon Rank-Sum Test, The Freund-Ansari-Bradley-David-Barton Tests; The Siegel-Tukey Test.
11	10.2,10.4, 10.6, 10.8	Extension of the Median Test; The Kruskal-Wallis One-Way ANOVA Test and Multiple Comparisons; Tests Against Ordered Alternatives; The Chi-Square Test for k Proportions.
12	11.1, 11.2, 11.3 & **Review**	Definition of Measures of Association in a Bivariate Population; Kendall's Tau Coefficient; Spearman's Coefficient of Rank Correlation.

Academic Integrity and the Academic Code of Conduct

This course is governed by Concordia University's policies on Academic Integrity and the Academic Code of Conduct as set forth in the Undergraduate Calendar and the Graduate Calendar. Students are expected to familiarize themselves with these policies and conduct themselves accordingly. "Concordia University has several resources available to students to better understand and uphold academic integrity. Concordia's website on academic integrity can be found at the following address, which also includes links to each Faculty and the School of Graduate Studies: https://www.concordia.ca/conduct/academic-integrity.html" *[Undergraduate Calendar, Sec 17.10.2]*

Behaviour

All individuals participating in courses are expected to be professional and constructive throughout the course, including in their communications.

Concordia students are subject to the Code of Rights and Responsibilities which applies both when students are physically and virtually engaged in any University activity, including classes, seminars, meetings, etc. Students engaged in University activities must respect this Code when engaging with any members of the Concordia community, including faculty, staff, and students, whether such interactions are verbal or in writing, face to face or online/virtual. Failing to comply with the Code may result in charges and sanctions, as outlined in the Code.

Intellectual Property

Content belonging to instructors shared in online courses, including, but not limited to, online lectures, course notes, and video recordings of classes remain the intellectual property of the faculty member. It may not be distributed, published or broadcast, in whole or in part, without the express permission of the faculty member. Students are also forbidden to use their own means of recording any elements of an online class or lecture without express permission of the instructor. Any unauthorized sharing of course content may constitute a breach of the Academic Code of Conduct and/or the Code of Rights and Responsibilities. As specified in the Policy on Intellectual Property, the University does not claim any ownership of or interest in any student IP. All university members retain copyright over their work.

Extraordinary circumstances

In the event of extraordinary circumstances and pursuant to the Academic Regulations the University may modify the delivery, content, structure, forum, location and/or evaluation scheme. In the event of such extraordinary circumstances, students will be informed of the change.