

McGILL UNIVERSITY

Department of Economics Economics 227D2 Section 2: Economic Statistics

TERM 2 COURSE OUTLINE AND SYLLABUS

John W. Galbraith

This course is the second part of a two-semester sequence. You must register for both semesters to receive credit. If you have any doubts about administrative matters related to your program, be sure to see an advisor *who is specialized in your particular program—Major, Minor, Honours, etc.*

Course description and objectives

Some of us will be doing statistical analyses professionally, but virtually all of us will be seeing statistical evidence presented (not only professionally, but in personal contexts such as evaluating medical or health information). Therefore, while we will learn how to do the relevant computations, it is especially important to understand the interpretation of statistical procedures, what they do and do not imply, and to be able to judge validity and avoid pitfalls that will lead to false conclusions.

Last term, the general objectives of the course were stated as follows, and these remain relevant; we will be doing some review of this before we move on:

“The course is aimed at providing students with the statistical tools necessary for analyzing and interpreting economic data. The course introduces fundamental statistical concepts, including descriptive statistics, probability theory, and inferential statistics, with an emphasis on their application in economics. Throughout the semester, students will learn to describe and summarize data using numerical measures and graphical techniques. The course also covers probability rules, random variables, and probability distributions—both discrete and continuous—that are crucial for understanding economic outcomes. In the latter part of the course, students will delve into statistical inference, focusing on estimation, hypothesis testing, and comparing population parameters. Special attention will be given to experimental design and the analysis of categorical data. Students will also gain hands-on experience using the statistical software Stata to apply these methods to real-world datasets, preparing them for more advanced econometric analysis in subsequent courses.

By the end of the course, students should be able to:

- Apply descriptive and inferential statistical techniques to economic data.
- Use probability theory to model random events and understand the implications for decision-making.

- Conduct basic data analysis using Stata, including generating descriptive statistics, probability plots, confidence intervals, and hypothesis tests.”

Additional objectives of the second term of the course:

- First, we want to review, consolidate and extend some knowledge that you acquired in first term, concerning data description, probability distributions, expectations and moments and core statistical principles.
- With respect to statistical inference and confidence intervals, we will develop our understanding of the interpretation of tests and their validity in circumstances that we will commonly meet, and relate this to core principles such as the central limit theorem. We will also look at some simple cases of nonparametric tests.
- We will extend the previous study of point estimation to the widely applied technique of linear regression, emphasizing the ability to estimate the parameters of these models and also to read, interpret and critique studies using this method, and recognize its uses and limitations.
- As time permits, we will give brief overviews of some more advanced methods that you will meet in further reading and study, including time series and forecasting, probability forecasting models and machine learning methods.
- Throughout, we will be paying attention to pitfalls that can lead to false conclusions or misunderstanding of statistical analyses.

Administration

3 credits.

- This is section 2: two lectures per week: Monday and Wednesday, 8:35am-9:55am

Restrictions:

- No credit is given for this course unless both ECON 227D1 is completed successfully in Fall 2024 and ECON 227D2 is completed successfully in Winter 2025.
- You might not be able to receive credit for both this course and other statistics courses. See an advisor if you have questions.

Office hours and questions:

- My office is Leacock 321A (third floor of the Leacock building). Hours will be announced after I survey the class to find times when most people are able to come (likely Monday and Wednesday, but at different hours on those two days). Our teaching assistants will

hold some tutorial or office hours as well, to be determined. I might hold some office hours by zoom, especially near the end of term when more people want to come; we'll see.

I also usually am able to stay around after class (somewhere outside the classroom so as not to interfere with the next class) in order to answer any further questions that you might have that we didn't get to in class.

- Please do not email me unless it's an emergency (an emergency is when you're sick the day of the exam and you, or a friend if you can't get to your laptop, let/lets me know this in advance of the exam). For questions about the course or general advising, speak to me after class or in my office hours, and we can talk instead of typing.

Texts and other tools:

- Various texts cover the same essential material. The default textbook for this section will be Newbold et al., *Statistics for Business and Economics*. Any edition of this is fine, although chapters and material might be in a different order in different editions. You can often pick up used copies of this book (ie, on actual paper) for a very low price. Early editions of the book are just by P. Newbold, without co-authors. These are just as good. My personal favourite is the 4th edition, but any one is approximately as good as any other. I will update this syllabus with an instructor code for the online version, when I have it.
- Another possible choice is the book used last term, *Statistics for Business and Economics* (12th Edition) by McClave, Benson and Sincich, published by Pearson Education Canada.
- Either of these comes with online resources if you get the online version. None of these online editions is essential. I will post assignments separately on MyCourses.
- I will also post an evolving set of general notes ('Economic Statistics') which will give you an alternative set of things to read to help develop your understanding. These have more mathematics than is strictly required for this course, but you can take from them whatever is useful to you. These notes attempt to explain important points of theory which will help you to understand what is behind the statistical methods that you will see.
- There are numerous other good books available. For those who have a strong background or interest in mathematics, one of the very best is the classic **Introduction to the Theory of Statistics**, by Mood, Graybill and Boes, McGraw-Hill, 1974. (The original edition is earlier than '74 but this edition is relatively widely available.) Copies of this can sometimes be picked up for ridiculously low prices online or in used bookstores, and it's worth keeping on your shelf indefinitely.

Statistical Software: The course requires the use of the statistical program **Stata**. Stata is used by many economists who work with data, although there are alternatives that you may wish to learn later that offer more flexibility. Prior knowledge of Stata is not a prerequisite for this course. A document concerning use of Stata at McGill was posted on MyCourses last term.

See <https://www.stata.com/links/resources-for-learning-stata/> for some Stata-related materials.

Python and R are other programs widely used in applied statistics, and can be downloaded free of charge, along with user interfaces that you might find helpful (eg., R Studio). I will be using Matlab in class demonstrations. Python is now widely used in the sophisticated end of the financial industry, so familiarity with it may be a benefit to some of you.

TA support: TAs will hold weekly office hours. In these sessions, they will be available to answer your questions, help you to review the course material, and help you solve problems and exercises. Times and location will be posted on MyCourses.

Evaluation: Note that this is the second semester of a two-semester course. A numerical grade will be computed for each term and you will ultimately receive a single grade for the combination of the two semesters. This full-year grade will be the equally-weighted average of the two individual term grades. A final letter grade will be obtained from the overall numerical grade. Any letter grades assigned at intermediate stages are for information only; computations will be based on the underlying numerical quantities.

Evaluation is planned as follows (percentages are of the grade for the term, which forms one half of the full-year grade).

Assignments 5%, mid-term exam 25%, April exam 70%.

Following our class vote, the midterm will be held on Wednesday 19 February, in class.

Assignments: Assignments will be graded on making a serious attempt, not on whether the answers are correct or not. The reason for this is that if evaluation is based on having the correct answer, people will research the question via friends, online groups, AI programs etc, with the result that little is learned. Instead, I want you to try the assignments and identify the point at which you get stuck, and think about how to proceed in the future. In this way, you can expect to feel better prepared and more confident on exams.

All assignments in which the student makes a real attempt at the questions will receive 100%.

Midterms: If someone is unable to write the midterm for a legitimate (possibly documented) reason, the weight will be added to that of the April exam.

You will not be allowed to present additional work to increase your grade in the course.

You should regularly check the **myCourses** page for announcements, up-to-date information, additional readings, assignments, and other items to assist you in the course.

Deferred and supplemental examinations:

If you miss or are unable to write the final exam, you must request a **deferred exam** according to the process described here: www.mcgill.ca/exams/dates/supdefer. Please note that exam accommodations are rarely approved for reasons related to personal vacation, travel, or family events. Unlike a supplemental exam, the deferred exam will cover material from ECON 227D2 only.

In addition to what is stated in this syllabus, please familiarize yourself with the University rules on deferred and supplemental examinations. A deferred exam is one which replaces an exam that was missed; a supplemental exam is a second exam in a course which a student has failed, and becomes a second (not replacement) grade for the course. There are University rules governing the circumstances in which you have the right to take one or the other of these exams.

The deferred or supplemental examination for this course, which in accordance with University rules will be held in August following the end of the course, covers in principle the entire course. It may be a deferred exam for some students (those who missed the April exam) and a supplemental for others (those who did not pass the course and want to try again to pass and then receive the credits). A supplemental examination mark is not combined with other evaluation during the year, for those who take it; that is, the supplemental examination is 100% of the supplemental grade. However if a student writes the August examination as a deferred exam because the April exam was missed, then it counts only for the weight of the exam that was missed.

A deferral requires a reason which is compatible with the University's policies, usually an illness. This may require documentation. If you are booking travel, it is your responsibility to be sure that you will be here for the examinations. That means either waiting until the examination schedule is available, or booking travel for the day following the last day of examinations in April.

In case of absence at the final exam for medical reasons, please refer to the University Regulations Concerning Final Examinations. Note: According to Senate regulations, instructors are not permitted to make special arrangements for final exams. Please consult the Calendar, section 4.7.2.1, General University Information and Regulations at www.mcgill.ca.

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

Transfers from Honours to Major program

Transfers from Honours to Major are routine, although this is an unusual feature within the University: these can be done after the first-term add/drop period. There are two time windows when transfers are permitted. The January add/drop period is the second and last of these. If you transfer into 227 in January, the grade will be based entirely on work in this course. Your Winter-term grade from 227 will be your full-year grade. For those who transferred in November, the first-term grade will already have incorporated Prof. El Attar-Vilalta's method of dealing with the transfer, and I will average that grade with the second-term grade as for those who were in this course from the beginning.

Note also that the coverage of Econ 227 and 257 is not identical; students who transfer must check carefully to be sure that they are familiar with all of the material covered in 227 before the transfer. This may of course be a bit challenging for students who transfer in January, and requires attention.

In the event that you decided to transfer, or are considering a transfer, be sure to speak with advisors in the Economics department. Lists of advisors for different programs are posted near the fourth-floor office in Leacock.

Official University statements

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 (see <http://www.mcgill.ca/students/srr/honest/> for more information).

L'université McGill attache une haute importance à l'honnêteté académique. Il incombe par conséquent à tous les étudiants de comprendre ce que l'on entend par tricherie, plagiat et autres infractions académiques, ainsi que les conséquences que peuvent avoir de telles actions, selon le Code de conduite de l'étudiant et des procédures disciplinaires (pour de plus amples renseignements, veuillez consulter le site <http://www.mcgill.ca/students/srr/honest/>).

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.

Conformément à la Charte des droits de l'étudiant de l'Université McGill, chaque étudiant a le droit de soumettre en français ou en anglais tout travail écrit devant être noté.

Under no circumstances will you be allowed to present additional work to increase your grade in the course.

No audio or video recording of any kind is allowed in class without the explicit permission of the instructor. The use of Mobile Computing and Communications Devices devices must, in all cases, respect policies and regulations of the University, including in particular the Code of Student Conduct and Disciplinary Procedures; the Policy Concerning the Rights of Students with Disabilities; and the Policy on the Responsible Use of McGill IT Resources.

Instructor-generated course materials (e.g., handouts, notes, summaries, exam questions, lecture and class recordings etc.) are protected by law and may not be copied or distributed in any form or in any medium without explicit permission of the instructor. Note that infringements of copyright can be subject to follow up by the University under the Code of Student Conduct and Disciplinary Procedures.

End-of-course evaluations are one of the ways that McGill works towards maintaining and improving the quality of courses and the student's learning experience. You will be notified by e-mail when the evaluations are available. Please note that a minimum number of responses must be received for results to be available to students.

The reading list is subject to change during the semester. In the event of extraordinary circumstances beyond the University's control, the content and/or evaluation scheme in this course is subject to change.

Course Outline

Given the time constraints, it is possible that some topics will not be covered or some topics added. We maintain discretion regarding changes in this outline. Any changes will be announced in class and/or on *mycourses*.

The list of topics below is non-exhaustive. References to the Newbold et al. book are to the 8th edition but others are similar, although chapter numbers might differ. **Note that while the references below contain the main body of material, not everything we do is contained in the Newbold book and we will also refer to some parts of it that are not listed below. Your class notes are part of the course material.**

Section 1: Review of fundamentals from first term

- Descriptive statistics and interpretation of higher-order moments.
- Probability functions, density and distribution
- Core statistical principles: WLLN, CLT (more time if this is new)
- Real-time simulations to gain intuition and check understanding
- Newbold et al: Chapter 6 (Sampling) esp. 6.2; Economic Statistics notes Chapter 3.

Section 2: Review of core principles of inference

- Principles of classical hypothesis testing and argument behind classical statistical inference
- Confidence intervals and relationship with hypothesis testing
- Examples of confidence intervals and tests for some standard problems
- Sampling distributions and test interpretation
- Data mining and hypotheses influenced by data
- Newbold et al: Chapter 7 esp. 7.2-7.4. Economic Statistics, Chapters 4, 10 (apart from distribution of estimated variance at the end-not covered), 11.

Section 3: Principles of estimation

- estimator, bias, loss functions including the mean squared error (MSE); decomposition of the MSE;
- Interval estimation and asymptotic confidence intervals based on a CLT
- Brief overview of non-parametric estimation and inference, in contrast with parametric methods

Section 4: Linear regression models

- Introduction to linear regression models in simple settings (IID, exogeneity)
- Derivation of linear parametric estimators. Supplement: matrix forms
- Estimation and parametric inference on parameters
- Interpretation of the regression model
- Data mining again
- Overview of some common pitfalls and misconceptions

Section 5: Overviews of some additional topics (if time)

- Time series methods and statistical forecasting
- Binary choice models and probability estimation
- ‘big data’ and machine learning methods