

**Faculty of Science Course Syllabus
Department of Economics
Time Series in Economics, ECON 4440
Winter 2019**

Instructor:

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Timetable:

Lecture Hours:

- Monday and Wednesday, 13.05-14.25 , LSC- Common Area 212

Office Hours:

- Thursday, 09.00-11.30 (or by appointment)

Course Description:

This is a course in econometrics that focuses on time series models. The topics cover estimation and inference procedures for univariate and multivariate time series models with stationary and nonstationary data, including stationary univariate time series models (ARMA), unit-root testing, vector autoregressive and vector error correction models, autoregressive heteroscedasticity (ARCH/GARCH), and Markov switching models.

Course Prerequisites:

ECON 3338 (grade of C or higher), ECON 3339 (grade of B or higher)

Course Objectives:

This course introduces the econometric analysis of time series. The emphasis is on the development of standard time series models, the study of their properties, and their application to economic and financial data, using practical examples.

Learning Outcomes and competences:

After having followed the course the students should be able:

- to estimate and perform hypothesis testing on the parameters of all the discussed models using standard econometric software packages
- to associate the different models with relevant economic and financial applications

In terms of the econometric models presented in the course, the students should be able:

- to identify the dependence and stationarity properties of time series data,
- to describe and relate the features and linkages between different kinds of ARMA processes, and to do calculus for specific processes using difference equation and lag operator techniques including the purpose of forecasting
- to identify and compare different types of non-stationary processes, and to analyze their relative features
- to describe and apply the testing procedure for unit root processes (Dickey-Fuller test)
- to formulate the VAR, and to derive the properties of VAR models including the calculation of impulse response functions

- to discuss the notion of spurious regression for integrated processes
- to define and analyze the co integrated VAR model, and the VECM model
- to interpret the output of the VAR estimation procedure for cointegrated variables, and to discuss the hypothesis testing approach for the cointegration rank
- to introduce approaches in modeling heteroskedasticity in time series using the GARCH family of models
- introduce Regime Switching Models, and discuss estimation procedures and inference about the number of regimes

Material:

- Instructor notes
- James H. Stock and Mark W. Watson "Introduction to Econometrics", 3rd Edition, Updated version, Chapters 14-16.
- Hamilton (1994), Time Series Analysis (reference textbook, not required)
- Mills, and Markellos (2008), The Econometric Modeling of Financial Time Series (simpler than Hamilton, not required)
 - + Hamilton (1994) and Mills and Markellos (2008) are on a 2-hr reserve on Killam Library.

Software:

- **Gretl**
 - + Gretl is freeware econometric software, which can be downloaded in <http://gretl.sourceforge.net/>.
- **R**
 - + R is freeware software used by many researchers for econometrics and statistics. It is available in: <http://www.r-project.org/>
- **STATA**
 - + STATA is available in McCain Bldg computer labs. You can also purchase an individual licence at a student rate: <http://www.stata.com/order/new/edu/gradplans/campus-gradplan/>
Note that although a cheaper student version is available, it can only handle a limited number of variables and observations.

A short discussion about the above packages and other statistical software will take place during the first class. Although students are free to choose the statistical package of their preference, demonstration of concepts will be based on Gretl.

Data Sources:

The course focuses on economic and financial time series data. The following sources provide macroeconomic and financial data for United States, Canada, and other countries:

1. Federal Reserve Economic Data- FRED-St. Louis FED:
 - <https://research.stlouisfed.org/fred2/>
 - One of the most comprehensive data sources regarding macroeconomic data for United States. It includes data for other countries as well.
 - Examples: Real Gross Domestic Product, 10-year Treasury Constant Maturity Rate
 - Bonus: Free App that you can access the site via your mobile device, and an excellent Excel add-in for downloading and manipulating data.

2. Statistics Canada- Key socioeconomic Database-CANSIM:
 - <https://www150.statcan.gc.ca/n1/en/type/data>
 - The equivalent of FRED for all things Canadian. It includes a host of data for Canada and the individual provinces organized in tables.
 - Example: Consumer Price Indices exist in Table 18-10-0004-01. The table contains Price Indices for a variety of goods and services categories, for Canada and provinces (access to the individual components by Add/Remove Data). Data can be exported into MS Excel.
3. IMF World Economic Outlook Database:
 - <https://www.imf.org/external/pubs/ft/weo/2018/02/weodata/index.aspx>
 - It contains selected macroeconomic data series from the statistical appendix of the World Economic Outlook report, which presents the IMF staff's analysis and projections of economic developments at the global level, in major country groups and in many individual countries.
4. International Monetary Fund (IMF) International Financial Statistics (IFS):
 - <http://dal.ca.libguides.com/economics>, click on "International Financial Statistics."
 - (<http://data.imf.org/?sk=5dabaff2-c5ad-4d27-a175-1253419c02d1>)
 - Primarily financial statistics for countries members of IMF; exchange rates, monetary statistics, prices, interest rates.
 - Access via Data Tables, when you can select the country or series of interest, and ability to export to Excel.
5. World Bank World Development Indicators:
 - <http://data.worldbank.org/data-catalog/world-development-indicators>
 - Most current and accurate global development data available, and includes national, regional and global estimates.
 - Access via Data Tables, when you can select the country or series of interest, and ability to export to Excel.
6. Organisation for Economic Co-operation and Development (OECD)
 - <https://data.oecd.org/>
 - A variety of data for OECD countries.
7. Canadian Housing Market Outlook & Statistics
 - <https://www.cmhc-schl.gc.ca/en/data-and-research/data-tables>
 - <https://www03.cmhc-schl.gc.ca/hmip-pimh/en#Profile/1/1/Canada>
 - Teranet-National Bank House Price Index: <http://www.housepriceindex.ca/Default.aspx>

Format:

- Lectures
- Computer Exercises

Assessment:

- Empirical Projects: 25% (individual)
 - + 12.5%: Project no 1; Midterm
 - + 12.5%: Project no 2: Final
 - Detailed instructions to be provided in separate documents.
- Midterm Exam: 25%
- Final Exam :50%

- Notes:
 - Projects
 - + Details about the project deliverables and instructions will be provided in separate documents.
 - + The projects are primarily empirical in nature. The content will depend on the material covered in class. The first project will be based on material covered in class up to the midterm (approximately Weeks 1 to 6), whereas the second project will be based on the material covered till the end of the course.
 - Exams
 - + In the event that you are unable to attend the midterm exam, the student must contact the instructor by email prior to the date and time of the exam, and submit a completed Student Declaration of Absence via Brightspace (no medical note is required). The weight of the midterm exam will be added to the final exam.
 - + If a student misses the final exam for a valid reason, (Section 16.8 of the University Calendar), she/he must notify the instructor immediately. The student will have the opportunity to write up a make-up exam within the next week after the end of the class.
 - + Examinations are “closed book” and materials other than those mentioned should not be used. There is no supplemental privilege in this course.
 - To pass the course, a student must achieve an overall passing grade and a minimum grade of 50% on the final examination, which covers material drawn from the entire course.

Grading scheme:

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

Important Dates (midterm date is tentative):

- Last Day to Change and Add Classes for registered students: January 18th
- Last Day to Drop without “W”: February 4th
- Last Day to Drop with “W”: March 11th
- Winter study break: February 18th-22nd
- **Project no 1:** February 25th
- **Project no 2:** April 1st
- **Midterm Exam:** February 11th (**in class**)
- **Final Exam:** Regular exam period (April 10th- April 26th)

Course Policies:

Email Policy:

- Weekdays: emails received by 18.00 would be responded by the end of the day. Anything after that hour would be responded in the following day.
- Weekends: emails are to be checked sporadically, thus you should not expect a response within the same day.
- Lengthy questions are easier and preferable to be answered during office hours.
- **Make sure that you have checked the course outline and all material available in Brightspace prior to asking a question.**

Course contents:

| Week 1 | |
|---|--|
| January 7 th | <ul style="list-style-type: none"> • Administrative Issues/ Software/Data Sources & Transformation • Review of Probability and Statistical Concepts-Maximum Likelihood |
| Week 2 | |
| January 14 th | <ul style="list-style-type: none"> • Time Series Models and Ordinary Least Squares |
| Week 3 | |
| January 21 st | <ul style="list-style-type: none"> • ARMA Models: Description -Properties |
| Week 4 | |
| January 28 th | <ul style="list-style-type: none"> • ARMA Models: Estimation and Forecasting |
| Week 5 | |
| February 4 th | <ul style="list-style-type: none"> • ARIMA Models |
| Week 6 | |
| February 11 th February 13 th | <ul style="list-style-type: none"> • Midterm Exam • Unit Root Testing |
| WINTER STUDY BREAK (February 18th to 22nd) | |
| Week 7 | |
| February 25 th | <ul style="list-style-type: none"> • Unit Root Testing (cont.) • Spurious Regressions- Cointegration |
| Week 8 | |
| March 4 th | <ul style="list-style-type: none"> • VAR Models: Estimation- Forecasting- Impulse Response Functions |
| Week 9 | |
| March 11 th | <ul style="list-style-type: none"> • VEC Models |
| Week 10 | |
| March 18 th | <ul style="list-style-type: none"> • Conditional Variance Models: ARCH/GARCH and variants |
| Week 11 | |
| March 25 th | <ul style="list-style-type: none"> • Regime Switching Models- KALMAN Filter |
| Week 12 | |
| April 1 st April 3 rd | <ul style="list-style-type: none"> • Graduate Student Presentations/Special Topics |

University Policies and Statements

This course is governed by the academic rules and regulations set forth in the University Calendar and by Senate

Academic Integrity

At Dalhousie University, we are guided in all of our work by the values of academic integrity: honesty, trust, fairness, responsibility and respect (The Center for Academic Integrity, Duke University, 1999). As a student, you are required to demonstrate these values in all of the work you do. The University provides policies and procedures that every member of the university community is required to follow to ensure academic integrity.

Information: https://www.dal.ca/dept/university_secretariat/academic-integrity.html

Accessibility

The Advising and Access Services Centre is Dalhousie's centre of expertise for student accessibility and accommodation. The advising team works with students who request accommodation as a result of a disability, religious obligation, or any barrier related to any other characteristic protected under Human Rights legislation (Canada and Nova Scotia).

Information: https://www.dal.ca/campus_life/academic-support/accessibility.html

Student Code of Conduct

Everyone at Dalhousie is expected to treat others with dignity and respect. The Code of Student Conduct allows Dalhousie to take disciplinary action if students don't follow this community expectation. When appropriate, violations of the code can be resolved in a reasonable and informal manner—perhaps through a restorative justice process. If an informal resolution can't be reached, or would be inappropriate, procedures exist for formal dispute resolution.

Code: https://www.dal.ca/dept/university_secretariat/policies/student-life/code-of-student-conduct.html

Diversity and Inclusion – Culture of Respect

Every person at Dalhousie has a right to be respected and safe. We believe inclusiveness is fundamental to education. We stand for equality. Dalhousie is strengthened in our diversity. We are a respectful and inclusive community. We are committed to being a place where everyone feels welcome and supported, which is why our Strategic Direction prioritizes fostering a culture of diversity and inclusiveness

Statement: <http://www.dal.ca/cultureofrespect.html>

Recognition of Mi'kmaq Territory

Dalhousie University would like to acknowledge that the University is on Traditional Mi'kmaq Territory. The Elders in Residence program provides students with access to First Nations elders for guidance, counsel and support. Visit or e-mail the Indigenous Student Centre (1321 Edward St) (elders@dal.ca).

Information: https://www.dal.ca/campus_life/communities/indigenous.html

Important Dates in the Academic Year (including add/drop dates)

https://www.dal.ca/academics/important_dates.html

University Grading Practices

https://www.dal.ca/dept/university_secretariat/policies/academic/grading-practices-policy.html

Missed or Late Academic Requirements due to Student Absence (policy)

https://www.dal.ca/dept/university_secretariat/policies/academic/missed-or-late-academic-requirements-due-to-student-absence.html

Student Resources and Support

Advising

General Advising: https://www.dal.ca/campus_life/academic-support/advising.html

Science Program Advisors: <https://www.dal.ca/faculty/science/current-students/academic-advising.html>

Indigenous Student Centre: https://www.dal.ca/campus_life/communities/indigenous.html

Black Advising Centre: https://www.dal.ca/campus_life/communities/black-student-advising.html

International Centre: https://www.dal.ca/campus_life/international-centre/current-students.html

Academic supports

Library: <https://libraries.dal.ca/>

Writing Centre: https://www.dal.ca/campus_life/academic-support/writing-and-study-skills.html

Studying for Success: https://www.dal.ca/campus_life/academic-support/study-skills-and-tutoring.html

Copyright Office: <https://libraries.dal.ca/services/copyright-office.html>

Fair Dealing Guidelines: <https://libraries.dal.ca/services/copyright-office/fair-dealing.html>

Other supports and services

Student Health & Wellness Centre: https://www.dal.ca/campus_life/health-and-wellness/services-support/student-health-and-wellness.html

Student Advocacy: <https://dsu.ca/dsas>

Ombudsperson: https://www.dal.ca/campus_life/safety-respect/student-rights-and-responsibilities/where-to-get-help/ombudsperson.html

Safety

Research Lab Safety

https://www.dal.ca/content/dam/dalhousie/pdf/dept/safety/lab_policy_manual_2007.pdf

Biosafety: <https://www.dal.ca/dept/safety/programs-services/biosafety.html>

Chemical Safety: <https://www.dal.ca/dept/safety/programs-services/chemical-safety.html>

Radiation Safety: <https://www.dal.ca/dept/safety/programs-services/radiation-safety.html>

Scent-Free Program: <https://www.dal.ca/dept/safety/programs-services/occupational-safety/scent-free.html>

DEPARTMENT OF ECONOMICS STATEMENT ON ACADEMIC INTEGRITY

At Dalhousie University, we respect the values of academic integrity: honesty, trust, fairness, responsibility, and respect. As a student, adherence to the values of academic integrity and related policies is a requirement of being part of the academic community at Dalhousie University.

What does academic integrity mean?

Academic integrity means being honest in the fulfillment of your academic responsibilities, thus establishing mutual trust. Fairness is essential to the interactions of the academic community and is achieved through respect for the opinions and ideas of others. “Violations of intellectual honesty are offensive to the entire academic community, not just to the individual faculty member and students in whose class an offence occurs.”

(<http://academiccalendar.dal.ca/Catalog/ViewCatalog.aspx?pageid=viewcatalog&catalogid=1&chapterid=89&topicgroupid=381&loadusercredits=False>)

How can you achieve academic integrity?

- Make sure you understand Dalhousie’s policies on academic integrity.
- While discussion with your fellow students is valuable, do not submit an assignment or essay that is essentially identical to an assignment or essay submitted by another individual or group.
- In assignments or essays, use an approved method of citation for any material taken directly from an existing source or any material that is a paraphrase of an existing source.
- Do not download the work of another from the Internet and submit it as your own.
- Do not submit work that has been completed through collaboration or previously submitted for another assignment without permission from your instructor.
- Do not have someone else write a test for you, or write a test for someone else.
- During a test, do not talk with other students and do not try to copy the work of another student.

What will happen if an allegation of an academic offence is made against you?

Instructors are required to report any suspected offence. The full process is outlined in the Discipline flow chart (found at <http://academicintegrity.dal.ca>) and includes the following:

- Each Faculty has an Academic Integrity Officer (AIO) who receives allegations from instructors.
- The AIO decides whether to proceed with the allegation and you will be notified of the process.
- If the case proceeds, you will receive a PENDING grade until the matter is resolved.
- If you are found guilty of an academic offence, a penalty will be assigned ranging from a warning to suspension or expulsion from the University and can include a notation on your transcript, failure of the assignment, or failure of the course. All penalties are academic in nature.

Where can you turn for help?

- If you are ever unsure about ANYTHING, contact your instructor.
- See <http://academicintegrity.dal.ca> for links to policies, definitions, online tutorials, and tips on citing and paraphrasing.
- See <http://writingcentre.dal.ca> for assistance with proofreading, writing styles, and citations.
- See <http://libraries.dal.ca/research.html> for a set of research tools including Subject Guides,



Assignment Calculator, and RefWorks.

- See <http://studentservices.dal.ca> for assistance with appeals and discipline procedures.
- See <http://senate.dal.ca> for a list of Academic Integrity Officers, a discipline flow chart, and the Senate Discipline Committee.

The [Policy on Student Submission of Assignments & Use of Originality Checking Software](#) states that “any instructor may require student assignments to be submitted in both written and electronic (computer-readable) form, e.g., a text file or as an email attachment, as defined by the instructor. Use of third-party originality checking software does not preclude instructor use of alternate means to identify lapses in originality and attribution. The results of such assessment may be used as evidence in any disciplinary action taken by the Senate.”