

University of Waterloo
Department of Economics
Econ 623 / 723
Course Outline
(Winter 2021)

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Course Description

The main goal of this course is to provide students with an econometric (statistical) foundation for pursuing applied and theoretical research in economics. This course covers some of the most important concepts, models and methods used in the empirical Time Series analysis. This course has a pre-requisite of Econ 621. The topics for this class are listed below.

The course slides and study materials will be uploaded on Learn for each topic. Some video lectures will also be uploaded on Learn. I strongly encourage students to read the corresponding chapters in the textbook for better understanding the course materials.

Recommended References:

Time Series Analysis (TSA), by J. D. Hamilton, Princeton University Press

Econometrics Analysis (EA), by W. H. Greene, 6th Edition, NY, Macmillan

Related Useful References

Statistics and Finance: An Introduction by D. Ruppert

Journals:

Econometrica, Journal of Econometrics, Journal of Time Series Analysis, Journal of Business and Economic Statistics, Journal of Applied Econometrics, Journal of Finance, Journal of Financial Econometrics, and etc.

Topics to be covered

Probability and Statistics Foundation [EA: Appendix A, B]

(random variable, probability functions, moments, multivariate concepts, distribution theory)

Preliminary Time Series Concepts [TSA: Chp. 2, Chp. 3]

(Deterministic and stochastic processes, basic concepts of Stationarity, Autocorrelation Function (ACF), Partial ACF (PACF), Ergodicity, Lag-Operator; Price, Return, Volatility, Portfolio Optimization Introduction)

Topics in Estimation Methods

(OLS, MLE, MoM/GMM, WLS, GLS, IV/2SLS)

Linear Stationary Time Series Models, Estimation and Forecasting [TSA: Chp. 3; EA: Chp. 19, 21]

(White Noise (WN) process, Autoregressive (AR) process), Moving Average (MA) process, mixed Autoregressive Moving Average (ARMA) process, Stationarity and invertibility conditions, Statistical properties and Estimation strategy, Forecasting)

Non-Linear Time Series Modelling with Time-varying Volatility [TSA: Chp. 21; EA: Chp. 19]

(Autoregressive Conditional Heteroskedasticity (ARCH), Generalized ARCH (GARCH), Stochastic Volatility (SV) model, statistical properties, estimation procedures, empirical applications)

Multivariate Time Series [TSA: Chp. 10, Chp. 11]

(Vector Autoregressions (VAR), Vector Moving Average (VMA), Granger Causality, Maximum Likelihood Estimation (MLE) and Statistical Properties)

Additional Topics:

Capital Asset Pricing Model (CAPM) Introduction

Non-Stationary Models for Time Series and Co-integration (Random Walk, Unit Roots, Dickey-Fuller Tests, Co-integration System and Error Correction)

Recent Development in Non-linear Time Series Models (Structure breaks; High Frequency data; Realized Measures)

Value at Risk (VaR) Introduction

Mixture Models in Time Series

Machine Learning Methods

Some related (empirical / theoretical) papers for certain topic might be discussed. If necessary, some introductions of Matlab may be illustrated for applications. The topics may not be covered in the exact order as shown above. The additional topics may not be all covered.

Computing SoftWare

There will be several problem sets which require using statistical software for computation. You also need to use the statistical software for your empirical project. Feel free to use any computing package you prefer. But I would suggest Stata or Matlab or R.

Office Hours

I will hold a weekly “office hour” (Friday 14:00 – 15:00) in an email format. I will be on line to respond your questions during the time. Please feel free to communicate with me via email during the office hours. Of course, you could also feel free to ask questions any other time via email. But, there might be a bit delay in responding outside the office hour time. (Please use your UWaterloo email account. And please specify “**Econ 623+Student Name+ ID**” in your email subject.)

Course Requirements

- Homework (30%)
- Presentation (Slides with Audio) (20%)
- Empirical Project – Stage 1 (Literature Review) (10%)
- Empirical Project – Stage 2 (Model Construction and Empirical Analysis) (15%)
- Empirical Project – Stage 3 (Final Project) (25%)

Econ 623: Students are expected to do a 15-20 minutes presentation based on the term research projects. Only two formats of the slides are acceptable: pdf or ppt. The presentation should focus on your motivations and contributions of the project (either in empirical data analysis or theoretical model development) with a brief literature review. Regarding the term paper, there is no restriction on the number of pages. However, it should include the following components: Introduction, Model, Data analysis and Conclusion.

Econ 723: Similar requirements as in Econ 623 are also applied to Econ 723. Students are expected to do a 30-40 minutes presentation based on the term research project. The term paper will be evaluated with a higher standard. A thorough and comprehensive literature review is expected. The term paper should also present some theoretical results with Monte Carlo or empirical data analysis supports.

Important Notes:

- (1) I will use Learn to communicate with you. So all the class announcements, assignments, and all other course related materials will be posted on Learn. Please make sure checking Learn regularly.
- (2) There will be three monthly assignments (10% each). The due day for the first assignment is Jan. 29 (23:59). The due day for the second assignment is Feb. 26 (23:59). The due day for the third assignment is Mar. 31 (23:59).
- (3) You need to do a presentation for your empirical project. The format will be slides with an audio component. More details on this will be provided.
- (4) Empirical Project is divided into three stages. (a) Stage 1: Literature Review; (b) Stage 2: Model Construction and Empirical Analysis; (c) Stage 3: Final Project. More detailed instructions will be provided.
- (5) You need to make your submission via Learn Dropbox.
- (6) The due day for the Presentation Slides (with audio) and Final Version of Empirical Project is Apr. 16, 2021 (23:59).
- (7) The penalty for late submission (for assignment, presentation and empirical project) is 50% per day. Therefore, your submission will NOT be accepted two days after the due day.

Economics Department Deferred Final Exam Policy

Cross-listed course

Please note that a cross-listed course will count in all respective averages no matter under which rubric it has been taken. For example, a PHIL/PSCI cross-list will count in a Philosophy major average, even if the course was taken under the Political Science rubric.

Academic Integrity

Academic Integrity: In order to maintain a culture of academic integrity, members of the University of Waterloo are expected to promote honesty, trust, fairness, respect and responsibility. See the [UWaterloo Academic Integrity](#) webpage and the [Arts Academic Integrity](#) webpage for more information.

Discipline: A student is expected to know what constitutes academic integrity, to avoid committing academic offences, and to take responsibility for his/her actions. A student who is

unsure whether an action constitutes an offence, or who needs help in learning how to avoid offences (e.g., plagiarism, cheating) or about “rules” for group work/collaboration should seek guidance from the course professor, academic advisor, or the Undergraduate Associate Dean. When misconduct has been found to have occurred, disciplinary penalties will be imposed under Policy 71 – Student Discipline. For information on categories of offenses and types of penalties, students should refer to [Policy 71 - Student Discipline](#). For typical penalties check [Guidelines for the Assessment of Penalties](#).

Grievance: A student who believes that a decision affecting some aspect of his/her university life has been unfair or unreasonable may have grounds for initiating a grievance. [Read Policy 70 - Student Petitions and Grievances](#), Section 4. When in doubt, please be certain to contact the department’s administrative assistant who will provide further assistance.

Appeals: A decision made or penalty imposed under Policy 70 - Student Petitions and Grievances (other than a petition) or Policy 71 - Student Discipline may be appealed if there is a ground. A student who believes he/she has a ground for an appeal should refer to [Policy 72 - Student Appeals](#).

Accommodation for Students with Disabilities

Note for students with disabilities: [The AccessAbility Services office](#), located on the first floor of the Needles Hall extension (1401), collaborates with all academic departments to arrange appropriate accommodations for students with disabilities without compromising the academic integrity of the curriculum. If you require academic accommodations to lessen the impact of your disability, please register with the AS office at the beginning of each academic term.

If you are using Turnitin® in your course

Turnitin.com: Text matching software (Turnitin®) will be used to screen assignments in this course. This is being done to verify that use of all material and sources in assignments is documented. Students will be given an option if they do not want to have their assignment screened by Turnitin®. In the first week of the term, details will be provided about arrangements and alternatives for the use of Turnitin® in this course.

Note: students must be given a reasonable option if they do not want to have their assignment screened by Turnitin®. See [guidelines for instructors](#) for more information.