University of Waterloo
Department of Economics
Econ 623 / 723

Course Outline

(Winter 2023)

Instructor: Xu, Dinghai

Office: HH 201   **Email**: dhxu@uwaterloo.ca
Lecture Time: M. & W. 11:30 – 12:50   **Lecture Location**: HH 138
Office Hours: Weds. 16:00 to 17:00 or by appointment

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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.

Recommended References:

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

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

Related Useful References
[1] **Time Series Analysis: Forecasting and Control** by Box, Jenkins and Reinsel
[2] **Statistics and Finance: An Introduction** by Ruppert

Journals:

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

+ Papers…. (To be determined)…

Topics to be covered

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)

Linear Stationary Time Series Models [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 Autoregrssions (VAR), Vector Moving Average (VMA), Granger Causality, Maximum Likelihood Estimation (MLE) and Statistical Properties)

Non-Stationary Models for Time Series and Co-integration [TSA: Chp. 15, Chp. 16, Chp. 17, Chp 18, Chp. 19; EA: Chp. 22]
(Random Walk, Unit Roots, Dickey-Fuller Tests, Co-integration System and error correction)

*Recent Development in Non-linear Time Series Models [Journal Papers]
(Structure breaks; High Frequency data; Realized Measures)

*Mixture Models in Time Series [Journal Papers]
(Mixture models theory and applications; Mixture models in Machine Learning)

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

Computing SoftWare

The problem sets and term paper require using a statistical software for computation. Feel free to use any computing package you prefer. But I would suggest Matlab or R. Some popular computing software packages have been installed in the computers in the computer Lab or in Arts' public computing labs. For more information, please consult the Information Systems and Technology (IST) office.

Course Requirements

- Homework (15%)
- Midterm Exam (30%)
  (*There will be one in-class mid-term for this course. The exam date is Mar. 15, 2023*)
- In-class Presentation (15%) [Schedule: TBA]
- Term Paper (40%)

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 projects. 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 (5% each) with due day at the end of each month throughout the term. You need to make your submission via Learn Dropbox.
(3) The penalty for late submission is 50% per day. Therefore, your submission will NOT be accepted two days after the due day.
(4) If you miss your midterm due to illness, with a valid medical record (subject to verification), please follow our deferred final exam policy.

Economics Department Deferred Final Exam Policy
Deferred Final Exam Policy found at https://uwaterloo.ca/economics/current-undergraduates/policies-and-resources/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 Integritity Webpage (https://uwaterloo.ca/academic-integrity/)](https://uwaterloo.ca/academic-integrity/) and the [Arts Academic Integrity Office Webpage (http://arts.uwaterloo.ca/current-undergraduates/academic-responsibility)](http://arts.uwaterloo.ca/current-undergraduates/academic-responsibility) for more information.

Discipline: A student is expected to know what constitutes academic integrity, to avoid committing academic offenses, and to take responsibility for his/her actions. A student who is unsure whether an action constitutes an offense, or who needs help in learning how to avoid offenses (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, **including writing exams in a section that you are not registered in,** 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 found at http://www.adm.uwaterloo.ca/infosec/guidelines/penaltyguidelines.htm.

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.]() In addition, read [the Student Grievance Process]() for the Faculty of Arts found at https://uwaterloo.ca/arts/current-undergraduates/student-support/student-grievances-faculty-arts-processes.

Appeals: A student may appeal the finding and/or penalty in a decision made under

Policy 70 - Student Petitions and Grievances (other than regarding a petition) or Policy 71 - Student Discipline if a ground for an appeal can be established. Read [Policy 72 - Student Appeals.]()

Other sources of information for students
[Academic integrity (Arts) Academic Integrity Office (uWaterloo)]()

<u>Accommodation for Students with Disabilities</u>

Note for students with disabilities: The AccessAbility Services office, located

in Needles Hall Room 1132, 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.