(Applied)Time Series Econometrics
ECO532

Section: **1**
Term: **Spring 2020**
Department: **School of Economics**
Credit: **3 Hours**
Meeting: **Mon, Wed 2:00-3:15 PM Lengyel Hall/Gym 127**
Instructor: **Dr. Thomas F. P. Wiesen**
Office: **Winslow Hall 207C**
Office Hours: **Thursday 2:30-5:00pm or by appointment**
Email: **thomas.wiesen@maine.edu**

Class Details

Textbook and Materials

- Primary textbook: *Applied Econometric Time Series*, 4th edition by Walter Enders
- Reference textbook: *Forecasting: Principles and Practice*, 2nd edition by Rob Hyndman & George Athanasopoulos
- Reference textbook: *Time Series Analysis and Its Applications With R Examples*, 4th edition by Robert Shumway & David Stoffer
- Reference textbook: *Time Series and Panel Data Econometrics*, by Hashem Pesaran

I will draw materials from multiple textbooks. However, the *primary* textbook will be Walter Enders' book. I am obviously not going to require you to purchase 4 rather expensive textbooks. All are optional purchases. However, if you do buy a textbook, then I recommend you buy Enders' book.

We will use R for our computational analysis. Download the software here, then download RStudio as a user friendly interface. This software is free and open source. You should set up R to automatically download packages from the internet when your code requires them.

Course Details according to the UMaine Course Catalog (feel free to ignore this)

This is a graduate course in applied time series econometrics. Theorems and proofs will not be emphasized in this course. Instead, we will work to develop both a significant understanding of the role of time series econometrics in empirical economics and a strong ability to execute applied time series econometrics in the development of economic models and in the analysis of economic policy. Identification, estimation, evaluation, hypothesis testing, forecasting, and simulation will be emphasized. Both univariate and multivariate time series processes will be covered and applications will include both microeconomic and macroeconomic models. Prerequisite: ECO530 or permission.

Course Description

This course is a graduate-level introduction to the statistical analysis of economic time series data, or more generally, data generated from dependent statistical processes across time. The focus is on fundamental models of time series processes, and how these models can be used to forecast and make inferences about economic questions. This will include econometric theory and applications in univariate and multivariate settings. Both reduced form (e.g., forecasting and Granger-causality) and structural (e.g., identification

based on economic theory) techniques will be covered. Most of what we know empirically about the overall economy and much about financial markets and asset prices is based on data that vary over time.

I will cover a health mix of theory and applications. In other words, I will cover the theory and assumptions behind the econometric tools. But I will also cover applications (in macroeconomics, finance, and other fields) and writing computer code in R. Thus, the general goal of this course is for students to be able to USE and UNDERSTAND the tools of applied time series econometricians. Being able to both use the tools and understand the tools are critical; doing only one and not the other is insufficient. If students are only able to use the tools but do not fully understand them, then they do not fully comprehend where the tools came from, or the assumptions behind them, and are more likely to use the tools in inappropriate situations. Using statistical methods as a "black box" is a poor way to perform analysis. On the other hand, it is similarly problematic if students only understand the theory yet are incapable of actually running the analysis and interpreting the results.

I assume students have mastered the basic tools of probability and statistical inference, have a good understanding of linear regression models, and are comfortable with linear algebra.

Tentative Course Content and Outline
The outline below includes chapter and sections from Enders, Hyndman/Athanasopoulo (HA), Shumway/Stoffer (SS), and Pesaran textbooks. This is tentative and may change depending on time constraints and the pace of learning in the class.

- Introduction to time series data and analysis
    - Motivation: Enders 1.1; HA 1; SS 1
    - Time series graphs in R and fundamental concepts: HA 2; SS 2
    - Difference Equations: Enders 1.2, 1.3, 1.9
- Univariate time series models
    - Autoregressive moving average (ARMA) models: Enders 2.1-2.11; HA 8; SS 3
    - Models of time-varying volatility: Enders 3.1-3.3; SS 5.3
    - Non-stationary processes: Enders 4.1-4.3, 4.5; HA 9.4; SS 5.2
- Multivariate time series models
    - Time series regression models: Enders 5.1, 5.2; HA 5, 9
    - Vector autoregression (VAR) models: Enders 5.5-5.13; HA 11.2; SS 5.6; Pesaran 24
    - Cointegration and vector-error-correction models (VECM): Enders 6.1-6.6

Grades
Grades will be determined by homework, a journal article presentation, a project paper/presentation, a midterm exam, and a final exam with the following weights:

Homework	20%
Journal Article Presentation	15%
Project Paper/Presentation	25%
Midterm Exam	15%
Final Exam	25%

The midterm and final exams will mostly cover econometric theory. The homework will cover both econometric theory and applications. The project paper & presentation will emphasize using multiple tools to analyze an economic dataset and answer an economic question.

The table below gives the grade distributions. These are minimum scores and if need be, I will introduce a "curve." The curve will consist of lowering the minimum percentages required for a particular grade. For instance, a typical curve may consist of making the minimum score for an "A" 92% instead of 93.3%. However, you should in no way depend on the curve since the curve is NOT guaranteed, and if I do implement it, it may be very small. All students should do all assignments. I will not drop any grades of any assessments. All questions regarding grades will be directed to this section in the syllabus.

Total Points	Letter Grade	Transcript GPA points
100-93.3%	A	4.00
93.2-90.0%	A-	3.67
89.9-86.7%	B+	3.33
86.6-83.3%	B	3.00
83.2-80.0%	B-	2.67
79.9-76.7%	C+	2.33
76.6-73.3%	C	2.00
73.2-70.0%	C-	1.67
69.9-66.7%	D+	1.33
66.6-63.3%	D	1.00
63.2-60.0%	D-	0.67
59.9-0%	F	0.00

Homework
Twenty percent of your grade will be based on out-of-class homework. The homework will cover both econometric theory and applications using R. Students are encouraged to work together. However, students should think for themselves; do not simply copy what your peers are doing. Each students should submit their own homework individually.

Journal Article Presentation
Fifteen percent of your grade will be based on a journal article presentation. Students will pick a scholarly journal article to read and present to the class. Students should either pick a paper from the list below or find a paper on a time series topic that they are interested in. If a student wished to find their own paper to present from the literature, they must get the paper approved by the professor. These presentations should last approximately 20-25 minutes and should be accompanied by presentation slides (emailed to the professor beforehand). Students will be graded on the accuracy and clarity of the article content as well as the delivery of the presentation. A good way to tell if you understand something is if you are able to explain it to someone else in your own words.

- Bernanke, Boivin, and Eliasz (2005) Measuring the Effects of Monetary Policy: A Factor-Augmented Vector Autoregressive (FAVAR) Approach
- Blanchard and Quah (1989) The Dynamic Effects of Aggregate Demand and Supply Disturbances
- Coibion and Gorodnichenko (2015) Information Rigidity and the Expectations Formation Process: A Simple Framework and New Facts

- Diebold and Yilmaz (2014) On the network topology of variance decompositions: Measuring the connectedness of financial firms
- Engle (1982) Autoregressive Conditional Heteroscedasticity with Estimates of the Variance of United Kingdom Inflation
- Engle, Ito, and Lin (1990) Meteor Showers or Heat Waves? Heteroskedastic Intra-Daily Volatility in the Foreign Exchange Market
- Faust (1998) The robustness of identified VAR conclusions about money
- Forni and Gambetti (2014) Sufficient information in structural VARs
- Francis, Owyang, Roush, and DiCecio (2012) A Flexible Finite-Horizon Alternative To Long-run Restrictions With An Application To Technology Shocks
- Fry and Pagan (2011) Sign Restrictions in Structural Vector Autoregressions: A Critical Review
- Gali (1999) Technology, Employment, and the Business Cycle: Do Technology Shocks Explain Aggregate Fluctuations?
- Gonzalo and Ng (2001) A systematic framework for analyzing the dynamic effects of permanent and transitory shocks
- Granger (1969) Investigating Causal Relations by Econometric Models and Cross-spectral Methods
- Jorda (2005) Estimation and Inference of Impulse Responses by Local Projections
- King, Plosser, Stock, and Watson (1991) Stochastic Trends and Economic Fluctuations
- Koop, Pesaran, and Potter (1996) Impulse response analysis in nonlinear multivariate models
- Lamoureux and Lastrapes (1990) Heteroskedasticity in Stock Return Data: Volume versus GARCH Effects
- Lamoureux and Lastrapes (1993) Forecasting Stock-Return Variance: Toward an Understanding of Stochastic Implied Volatilities
- Lastrapes (1992) Sources of Fluctuations in Real and Nominal Exchange Rates
- Pesaran and Shin (1998) Generalized impulse response analysis in linear multivariate models
- Rigobon (2003) Identification through Heteroskedasticity
- Rubio-Ramírez, Sargent, and Watson (2007) ABCs (and Ds) of Understanding VARs
- Sims (1980) Macroeconomics and Reality
- Sims (1986) Are Forecasting Models Usable for Policy Analysis?
- Sims and Zha (1999) Error Bands for Impulse Responses
- Stock and Watson (1988) Variable Trends in Economic Time Series
- Stock and Watson (2005) Implications of Dynamic Factor Models for VAR Analysis
- Stock and Watson (2005) Vector Autoregressions
- Uhlig (2005) What are the effects of monetary policy on output? Results from an agnostic identification procedure

The above links should work on UMaine computers. To access these articles off campus, you may have to sign into the UMaine library and use the "OneSearch" tool. When accessing these articles, I recommend you download the PDF. For some of the older papers, publishers have converted the PDFs into web text, which has sometimes introduced errors into the equations.

Project Paper & Presentation
Twenty-five percent of your grade will be based on a project paper and presentation. Students will research an economic question, find time series data, and analyses that data. Findings and methodology will be presented to the class and reported in a paper. Replication studies are acceptable. Your analysis must contain at least two of the following: a forecast, estimated parameters from an AR model, estimated parameters from a MA model, estimated parameters from an ARMA model, an ARCH model, a GARCH model, an unit root process/hypothesis test, a VAR impulse response function, a VAR forecast error variance decomposition, a cointegration analysis/hypothesis test, a vector-error-correction model.

Presentations should last approximately 20-25 minutes and should be accompanied by presentation slides (emailed to the professor beforehand). Papers should be written with succinctness (5-6 pages in length) and clarity.

Tentative Calendar and Important Dates

Date	Description
Wednesday, January 22	First day of this class
Monday, January 27	Lecture; Add/Drop ends
Wednesday, January 29	Lecture
Monday, February 3	Lecture
Wednesday, February 5	Lecture
Monday, February 10	Lecture
Wednesday, February 12	Lecture
Monday, February 17	No class, President's Day
Wednesday, February 19	Lecture
Thursday, February 20	Last day to drop class & it not appear on transcript (4:30pm)
Monday, February 24	Lecture; email the professor your top two journal articles*
Wednesday, February 26	Lecture
Monday, March 2	Lecture
Wednesday, March 4	Lecture
Monday, March 9	Lecture
Wednesday, March 11	Midterm Exam
Monday, March 16	No class, spring break
Wednesday, March 18	No class, spring break
Monday, March 23	Journal Article Presentations
Wednesday, March 25	Journal Article Presentations
Monday, March 30	Journal Article Presentations
Wednesday, April 1	Lecture
Monday, April 6	Lecture
Wednesday, April 8	Lecture; Last day to withdraw from class and get "W" grade (4:30pm)
Monday, April 13	Lecture
Wednesday, April 15	Lecture
Monday, April 20	Project Presentations
Wednesday, April 22	Project Presentations
Monday, April 27	Project Presentations; Last day of this class
Wednesday, April 29	No class, Maine Day; Project Papers due (6:00pm)
Friday, May 8	Final Exam (8:00am-10:00am)
Friday, May 15	Final grades due

*Two students should not present the same journal article. To prevent this, students must email their ranked top two journal article preferences to the professor by 6pm on Monday, February 24. Journal articles not on the above list need to be approved by the professor.

Class Policies

Attendance

I will not regularly take attendance. In that sense, attendance is not technically mandatory. However, attendance is expected and missing class is highly frowned upon. If you do miss a class, be sure to get the missed notes from a classmate.

If you miss an exam/presentation, then your absence must be documentable. If it is a "of the moment" type absence, such as illness, please let me know at least by the morning before the class. If you are sick enough to miss a test, then you are sick enough to go to the University health services and get a note. If the absence was known in advance, such as jury duty or a family wedding, please let me know at least 3 days in advance. I reserve the right to see the documentation for the absence. If I deem the reason for the absence as excusable, then you will be allowed to make up the exam or presentation.

With the exception of very extreme circumstances, final exam make-ups will not be allowed.

Classroom conduct
You are expected to act professionally in the classroom. This expectation includes, but is not limited to: being quiet, silencing your cellular device, respecting other students, respecting the instructor, and asking questions by raising one's hand. If you are acting disorderly to the point where you are impeding other students' ability to learn, I reserve the right to ask you to leave the classroom.

Laptop computers are allowed in class only if there are used for legitimate class-related tasks, such as taking notes. If I find you using your laptop computer in class for tasks not related to class, then I will ask you to put your laptop away. Note that scrolling through social media on your laptop is extremely distracting to students siting behind you.

Office Hours
My office is located on the second floor of Winslow Hall room 207C. Winslow Hall is just southwest of Fogler Library. My official office hours are listed on the first page of this syllabus. If those times do not work for you, just send me an email and we can set up an appointment. Feel free to use these office hours to come see me and ask questions.

Class Communication
I will periodically use blackboard to communicate announcements and distribute course materials. I strongly recommend you set up your blackboard settings to automatically email you when a new announcement is posted. It is a good habit to periodically check blackboard and your UMaine email.

Syllabus
This syllabus should be considered a contract between me (the professor) and you (the student). However, there may come a time when a change to the syllabus becomes necessary. In such an event, the change will be announced in class and posted online.

University Policies
University Academic Honesty Statement
Academic honesty is very important. It is dishonest to cheat on exams, to copy term papers, to submit papers written by another person, to fake experimental results, or to copy or reword parts of books or articles into your own papers without appropriately citing the source. Students committing or aiding in any of these violations may be given failing grades for an assignment or for an entire course, at the discretion of the instructor. In addition to any academic action taken by an instructor, these violations are also subject to

action under the University of Maine Student Conduct Code. The maximum possible sanction under the student conduct code is dismissal from the University.

University Students Accessibility Services Statement

If you have a disability for which you may be requesting an accommodation, please contact Student Accessibility Services, 121 East Annex, 581-2319, as early as possible in the term. Students who have already been approved for accommodations by SAS and have a current accommodation letter should meet with me, Thomas Wiesen, privately as soon as possible.

Course Schedule Disclaimer (Disruption Clause)

In the event of an extended disruption of normal classroom activities, the format for this course may be modified to enable its completion within its programmed time frame. In that event, you will be provided an addendum to the syllabus that will supersede this version.

Observance of Religious Holidays/Events

The University of Maine recognizes that when students are observing significant religious holidays, some may be unable to attend classes or labs, study, take tests, or work on other assignments. If they provide adequate notice (at least one week and longer if at all possible), these students are allowed to make up course requirements as long as this effort does not create an unreasonable burden upon the instructor, department, or University. At the discretion of the instructor, such coursework could be due before or after the examination or assignment. No adverse or prejudicial effects shall result to a student's grade for the examination, study, or course requirement on the day of religious observance. The student shall not be marked absent from the class due to observing a significant religious holiday. In the case of an internship or clinical, students should refer to the applicable policy in place by the employer or site.

Sexual Discrimination Reporting

The University of Maine is committed to making campus a safe place for students. Because of this commitment, if you tell a teacher about an experience of sexual assault, sexual harassment, stalking, relationship abuse (dating violence and domestic violence), sexual misconduct or any form of gender discrimination involving members of the campus, your teacher is required to report this information to the campus Office of Sexual Assault & Violence Prevention or the Office of Equal Opportunity.

If you want to talk in confidence to someone about an experience of sexual discrimination, please contact these resources:

- For confidential resources on campus: Counseling Center: 207-581-1392 or Cutler Health Center: at 207-581-4000.
- For confidential resources off campus: Rape Response Services: 1-800-871-7741 or Partners for Peace: 1-800-863-9909.
- Other resources: The resources listed below can offer support but may have to report the incident to others who can help:
- For support services on campus: Office of Sexual Assault & Violence Prevention: 207-581-1406, Office of Community Standards: 207-581-1409, University of Maine Police: 207-581-4040 or 911. Or see the OSAVP website for a complete list of services at http://www.umaine.edu/osavp/