ECON 684: Applied Time Series Analysis and Forecasting
Winter 2020-2021 Syllabus

University of Maryland, College Park
Master of Science in Applied Economics Program
Washington, DC location (though all courses for Winter 2020-2021 are completely online)

Because of the Covid-19 pandemic, this course is administered completely online. I will notify students of the Zoom link before December 2, 2020, via an ELMS announcement.

Class times: In total, there are about 2 hours 45 minutes of lecture each week. Most of that will be synchronous, some of it will be asynchronous:
- Wednesdays (synchronous) 7:30pm - 9:30pm with a 30-minute break from 8:15p – 8:45p. (Those sessions will NOT be recorded.)
- On Fridays I will post about 75 minutes of recorded "mini-lectures" that you should watch before class the following Wednesday. (We will spend some time at the beginning of class Wednesdays by reviewing the material covered in the recorded lectures.

The first class is December 2. There is no class December 30.
The midterm exam will be January 13. The final exam is February 24.

Instructor: David Burk, dburk@umd.edu
Office hours: Saturdays from noon-1pm or by appointment.

TA: Scott Abramson, JSAbram@umd.edu
TA Office Hours: Mon 5:30pm - 6:15pm

Course Overview:
This master's-level course covers estimating, testing, and forecasting time series models. It will develop fundamental concepts through the study of univariate time series, and then generalize those concepts to multivariate time series. Specific topics include ARIMA models, volatility models, unit roots, spurious regression, cointegration, VAR models, and Granger causality. There will be an emphasis on macroeconomic applications, such as studying the relationships between unemployment and inflation (i.e., the Phillips curve); unemployment and GDP (i.e., Okun's Law); the macroeconomy and various shocks; and the term structure of interest rates.

Prerequisites
Econ 642 and Econ 645.

Evaluation
Problem Sets: 10% (4 problem sets in total)
Weekly Online Discussion Participation: 5%
Replication Project: 20%
Midterm: 30%
Final: 35%

The course will be graded on a curve. Your score for each component (problem sets, weekly online discussion participation, replication project, and exams) will be normalized and then combined into one "overall course score." I will assign letter grades based on those scores and my professional judgement. Having a score one standard deviation above the mean typically results in an A. Students with an unsatisfactory understanding of the course material—who fail to grasp the major concepts of time series analysis and are unable to conduct a reasonable empirical analysis of time series data—will receive a grade of B- or below.

Problem Sets: Students may work in groups; if they do so a group should submit one set of answers for the whole group.

Weekly Online Discussion: There will be weekly online discussions which students are required to contribute to. Those discussions will typically deal with course reading. I will provide initial prompts for each week's discussion and facilitate discussion to make sure it is instructive and worthwhile. The discussion will be open for at least two days, but will never be open on the day of class.

Replication Project: Students will replicate the primary results of a research paper of their choosing that uses some of the methods discussed in class. Students are responsible for producing a short (less than 3 pages of single-spaced text, plus tables and figures) but highly polished paper that includes a summary of the central argument of the paper, their replication results, and an evaluation of the paper. (This paper could be a useful writing sample for any job applications). If time and class size permits, students also will give a brief but focused presentation of their work to their classmates. To facilitate the production of high quality output, there are several intermediate assignments related to the replication paper: selecting an appropriate paper (I will help!); drafting a summary of the paper's argument and an outline of the proposed replication paper; obtaining the necessary data; and completing the replication analysis.

Reading Materials and Software
The main text which the course follows closely is *Applied Econometric Time Series*, Fourth Edition, by Walter Enders, 2015. Earlier editions are acceptable substitutes.

In addition, we will also study several articles and book chapters, all of which are available online to UMD students and will be posted on ELMS/Canvas:
- Bernanke, Ben S. and A. Blinder, "Credit, Money and Aggregate Demand," *The American Economic Review*, vol. 82, no. 4, 1992, pp. 901-921.
- Hansen, B., "The New Econometrics of Structural Change: Dating Breaks in U.S. Labor Productivity," *The Journal of Economic Perspectives*, Vol. 15, No. 4. (Autumn, 2001), pp. 117-128.
- Hamilton, J. "What is an Oil Shock?," *Journal of Econometrics*, April 2003, vol. 113, pp. 363-398.

For empirical analysis, you may use whatever software you like. I will use Stata in class however if you want to use (or learn to use) R, I can help with that as well—just let me know!

Tentative Schedule of Topics and Due Dates
This may change as the course proceeds. Keep an eye on ELMS/Canvas announcements.
The date listed is for the synchronous online classes on Wednesdays.

Date	Topic	Reading
Dec. 2	What Time Series is Good For; Statistics, Econometrics, and Math Review; Difference Equations	Enders, Chapter 1
Dec. 9	ARMA Processes: Introduction, and Moving Averages	Enders, Ch. 2
Dec. 16	ARMA Processes: Autoregressions and ARMA; **PS1 DUE**	
Dec. 23	MLE Estimation Theory; Intro to Forecasting	section on MLE from your econometrics text book
Dec. 30	NO CLASS – WINTER BREAK	
Jan. 6	Modeling Volatility: ARCH and GARCH processes; **PS2 due; select paper to replicate**	Enders, Ch. 3
Jan. 13	**Midterm**; Non-stationary Processes: Trends and Unit Roots; Cointegration; Structural Breaks; **submit draft of summary of paper**	Enders, Ch. 4
Jan. 20	Non-stationary Processes and Structural Breaks (continued)	
Jan. 27	Intro to Vector Auto-Regression; **PS3 due**	Enders, Ch. 5
Feb. 3	Structural VARs; **obtain data needed for replication**	
Feb. 10	Applications of VARs; **PS4 due**	Bernanke and Blinder 1992
Feb. 17	Applications of VARs; **replication paper due**	Hamilton 2003
Feb. 24	**FINAL**	

Course Objectives
Our program has 7 general learning outcomes for students:

1. Ability to understand, evaluate and analyze economic data
2: Ability to understand and interpret statistical evidence from economic data
3: Ability to apply empirical evidence to assessing economic arguments
4: Ability to apply macroeconomic theories to policy discussions
5: Ability to apply microeconomic theories to policy discussions
6: Ability to communicate economic ideas to a broader audience
7: Ability to evaluate the effectiveness of policy programs using sound economic techniques

The learning outcomes that pertain to this course primarily are 1, 2, 3, 4, and 6.

Course Website: Copies of the course syllabus, your grades, and other relevant links and documents will be posted on the course's ELMS/Canvas website. You can access the site via www.elms.umd.edu. You will need to use your University of Maryland "directory ID" and password.

Email: The University has adopted email as the primary means of communication outside the classroom, and I will use it to inform you of important announcements. Students are responsible for updating their current email address via http://www.registrar.umd.edu/current/ (Under the first major heading of "Online Transactions" there is a link to "Update Contact Information".)

Contact Hours: Three credit master's-level courses at the University of Maryland require a minimum amount of contact between instructors and students. Our courses' 12 weekly meetings only satisfy 80% of the university's contact requirement. The other 20% is satisfied by weekly mandatory and graded online contact. In principle, the contact hours requirement could be satisfied by scheduling 3 additional 150-minute meetings per term, or 6 additional 75-minute meetings, or 10 additional 45-minute meetings. But in practice the contact hours requirement is satisfied by the weekly online discussions. The weekly online discussions are a more flexible way to ensure that our program's courses in DC provide the same level of student-instructor contact as the traditional 15-week face-to-face version of the same course when it is taught on campus in College Park.

Workload: Mastering the material covered in this course requires a significant amount of work outside of class. Students should expect to spend more time outside of class than in class – typically at least twice as much time. The courses in our DC program are 12-week courses that cover all the same material as a traditional semester-long 3-credit course (15 weeks). The compressed schedule makes it possible to complete our degree in just 15 months if you take 2 courses each term. But the compressed schedule also implies an accelerated pace with an average of 25% more work per week in a given course ($15/12 = 1.25$). The normal full-time load in a master's program is 3 courses per semester, or 6 courses per year. The weekly work load when taking 2 of our DC courses per term is equivalent to the load from 2.5 "normal" 15-week courses - so $2.5/3.0 = 83\%$ of a full-time load. Students who take 2 courses per quarter in our program complete 8 courses per year. So over the course of a year, taking 2 courses per quarter in our DC program is equivalent to 133% of a full-time load ($8/6 = 1.33$).

Academic Integrity: The University of Maryland has a nationally recognized Code of Academic Integrity, administered by the Student Honor Council. This Code sets standards applicable to all undergraduate and graduate students, and you are responsible for upholding these standards as you complete assignments and take exams in this course. Please make yourself aware of the consequences of cheating, fabrication, facilitation, and plagiarism. For more information see www.studenthonorcouncil.umd.edu.

Student Conduct: Students are expected to treat each other with respect. Disruptive behavior of any kind will not be tolerated. Students who are unable to show civility to one another or myself will be referred to the Office of Student Conduct. You are expected to adhere to the Code of Student Conduct.

Excused Absences: The University of Maryland's policy on excused absences is posted here: http://www.president.umd.edu/administration/policies/section-v-student-affairs/v-100g

Please note:

If you miss any class meetings for any reason, you are still responsible for all material covered during the meeting you missed. It is your responsibility – not the instructor's – to get yourself caught up in the course. Instructors routinely facilitate things by posting lecture notes, etc.

If you need to miss an exam or other graded course requirement because of illness, injury, or some other emergency: Follow doctor's orders and get documentation. Get in touch with the instructor as soon as you're able – preferably prior to missing the exam or deadline. Communicate with the instructor to make up the course requirement as soon as possible. You are entitled to recover before you make up the course requirement, but you are not entitled to extra days to study beyond the time the doctor's note says you're incapacitated. If you are incapacitated for more than a week or so beyond the end of the term, your grade in the course will be an "Incomplete". In such cases you must negotiate a plan with your instructor for completing the course requirements. Once you make up the course requirement the instructor will change your "I" to the appropriate letter grade.

School Closings and Delays: Information regarding official University closing and delays can be found on the campus website and the snow phone line: (301) 405-SNOW (405-7669). Since our program is an evening program in downtown Washington, DC, rather than a day program in College Park, we do not always cancel classes on the same days as the College Park campus. The program director will always announce cancellation information to the program as an announcement on the program's ELMS/Canvas site. This will generally be done by 1:00 p.m. on days when weather or other factors are an issue.

UMD Counseling Center: Sometimes students experience academic, personal and/or emotional distress. The UMD Counseling Center in Shoemaker Hall provides comprehensive support services that promote personal, social, and academic success. The cost of these services is covered by the fees you already paid when you registered for classes, and there is no additional charge if you use the services. Proactively explore the range of services available, including the

Counseling Service, Accessibility and Disability Service, Learning Assistance Service, and the Testing Office, all described at http://www.counseling.umd.edu/

Students with Disabilities: The University of Maryland does not discriminate based on differences in age, race, ethnicity, sex, religion, disability, sexual orientation, class, political affiliation, or national origin. Reasonable accommodations will be arranged for students with documented disabilities. Students who have an accommodations letter from the Accessibility and Disability Service (ADS) should meet with me during the first week of the term to discuss and plan for the implementation of your accommodations. If you require reasonable accommodations but have not yet registered with ADS, please contact the Accessibility and Disability Service at 301-314-7682 or adsfrontdesk@umd.edu.

Academic Progress: The UMD Graduate School requires that students maintain a GPA of at least 3.0. Students whose cumulative GPA falls below 3.0 will be placed on academic probation by the graduate school. Students on academic probation must ask the program's director to petition the graduate school if they want to remain enrolled in the program. The petition must include a plan for getting the student's GPA up to at least 3.0. Students who do not live up to their plan can have their enrollment in the program terminated without having earned the degree. Note: a grade of "B" corresponds to a GPA of 3.0. A grade of "B-" corresponds to a GPA of 2.7.