The George Washington University  
MA in Applied Economics  

COURSE AND CONTACT INFORMATION  
Course: ECON 6376.10 Time Series Analysis  
CRN: 17435  
Semester: Fall 2016  
Time: Thursdays, 6:10 PM – 8:40 PM  
Location Funger Hall 223  

INSTRUCTOR  
Name: James Outen  
E-mail: jouten@cftc.gov  
Office hours: By appointment  

COURSE DESCRIPTION  
The objective of this course is to give students the tools required to understand and implement models commonly used in time series econometrics. Emphasis is placed on intuition and application. The course will both help students understand how to use time series data to test hypotheses and serve as an introduction to the ideas and techniques of forecasting. Topics covered include time series properties of data (unit roots, near unit roots, stationarity), difference equations, stationary models (autoregressive and moving-average models), models with trends (deterministic and stochastic), multi-equation models (reduced-form and structural VARs), cointegration and error-correction models, models with time-varying coefficients, forecasting models, and basic forecast evaluation. Students will become proficient with performing basic time series analysis and forecasting using time series statistical software such as R. We will review examples of time series techniques applied to problems in macroeconomics, finance, and energy economics.  

COURSE PREREQUISITES  
Applied Macroeconomic Theory, ECON 6305  
Econometrics, ECON 6375  
Students are expected to be familiar with basic statistical and econometric concepts.  

TEXTS  
The primary text is Applied Econometric Time Series (Wiley) by Walter Enders. You may use any of the 2nd, 3rd, or 4th edition as they are substantially the same.  

We will also use Introductory Time Series with R (Springer) by Paul Cowpertwait and Andrew Metcalfe as a supplementary practical text. This text presents R programming for time series analysis. Some of the applications we will study come from this text.  

For additional reference texts, please consult:  

Preliminary – Subject to Revision
LEARNING OUTCOMES:
As a result of completing this course, students will be able to:
1. Understand time series data, test for stationarity or trends.
2. Perform and evaluate hypothesis tests and other statistical methods for time series analysis including VARs, and regression analysis of time series data.
3. Utilize econometric software for time series analysis and economic forecasting.
4. Evaluate forecasts and test different forecast models.

GRADING
- Problem Sets                 25%
- Research Paper              35%
- Research Paper Presentation 15%
- Midterm Exam                25%

Problem Sets: Please see the schedule for problem set due dates. Please type all solutions to assignments. For problems that require computation, please provide annotated code as well as results.

Research Paper and Presentation: Graduate-level economics study is designed to prepare you to not just be a more advanced consumer, but also a producer of research and analysis. To that end it is important to practice the research process: identifying a problem, gathering and analyzing data, and communicating your results. Students will write a short original research paper to be presented in class. Students will be graded on the research proposal, the final version of the paper, the presentation of the research paper, and on how well you answer questions posed by your classmates and instructor. Students are encouraged to ask thoughtful questions during paper presentations.

The goal of the paper and presentation is for you to apply the tools you have developed in this class to address an economic question involving time series data. You likely have a topic from your professional or personal life that lends itself to time series analysis, and I encourage you to choose a topic that is familiar and of interest to you. Papers should be well-written and be no longer than 10 pages excluding references. You must provide your written research proposal to me no later than meeting 10. The research proposal is a few paragraphs that poses the research question and answers the who/what/where/when/why of the research project. I am very happy to advise you on your research question. Presentations will take place in class on the 14th meeting and possibly during the scheduled final exam time (15th meeting) if needed. Please employ a consistent and professional format for your paper (the guidelines in The Journal of Economic Perspectives for preparing your tables, charts, and references is a good reference). Additional details regarding the paper and presentation are forthcoming in class.

Midterm exam: The midterm exam is take home and covers material from the first nine lectures. I will be in the classroom during meeting 10 and available to answer any questions you have.
CLASS POLICIES
Attendance is not required or graded but is strongly recommended; there is a strong applied component to this course and students are therefore encouraged to engage closely with the material. Late work is not accepted under normal circumstances; if you have an extraordinary circumstance please contact me in advance for consideration.

BEFORE THE FIRST CLASS
You will often be asked to perform computations as part of the problem sets. Please install R on your personal computer prior to the first class. You may also want to install RStudio. R and RStudio are free and open-source software for computation, statistics, data manipulation, and graphing. R (along with Python) is quickly becoming one of the most desired programming languages in finance, data analysis, and academia. You are free to use any other computational software you are familiar with but I will not provide support for any language other than R.

UNIVERSITY POLICY ON RELIGIOUS HOLIDAYS
1. Students should notify faculty during the first week of the semester of their intention to be absent from class on their day(s) of religious observance;
2. Faculty should extend to these students the courtesy of absence without penalty on such occasions, including permission to make up examinations;
3. Faculty who intend to observe a religious holiday should arrange at the beginning of the semester to reschedule missed classes or to make other provisions for their course-related activities

For GW’s teaching policies, see http://www.gwu.edu/~academic/Teaching/main.htm

ACADEMIC INTEGRITY
I personally support the GW Code of Academic Integrity. It states: “Academic dishonesty is defined as cheating of any kind, including misrepresenting one's own work, taking credit for the work of others without crediting them and without appropriate authorization, and the fabrication of information.” Please note that allowing another student to copy your work is defined as cheating under the Academic Integrity code.

For the remainder of the code, see: http://www.gwu.edu/~ntegrity/code.html

SUPPORT FOR STUDENTS OUTSIDE THE CLASSROOM
DISABILITY SUPPORT SERVICES (DSS)
Any student who may need an accommodation based on the potential impact of a disability should contact the Disability Support Services office at 202-994-8250 in the Marvin Center, Suite 242, to establish eligibility and to coordinate reasonable accommodations. For additional information please refer to: http://gwired.gwu.edu/dss/

UNIVERSITY COUNSELING CENTER (UCC) 202-994-5300
The University Counseling Center (UCC) offers 24/7 assistance and referral to address students' personal, social, career, and study skills problems. Services for students include:
- crisis and emergency mental health consultations
- confidential assessment, counseling services (individual and small group), and referrals

Preliminary – Subject to Revision
SECURITY
In the case of an emergency, if at all possible, the class should shelter in place. If the building that the class is in is affected, follow the evacuation procedures for the building. After evacuation, seek shelter at a predetermined rendezvous location.
CLASS SCHEDULE
The class schedule is designed to cover the fundamental topics and techniques in time series analysis in the first nine meetings. This will give you a good idea as to the breadth of the subject and allow you to formulate a topic for your research paper. The consequence is that we will move quickly through the Enders text and will cover a lot of material. Then in the second part of the class we revisit some topics in greater detail and rigor as well as review additional papers and examples which use those topics. Please refer to the assigned sections of the Cowpertwait and Metcalfe text for programming assistance on the problem sets.

<table>
<thead>
<tr>
<th>Meeting</th>
<th>Date</th>
<th>Topic</th>
<th>Reading-Enders</th>
<th>Reading-Cowpertwait &amp; Metcalfe</th>
<th>Additional Readings (see below)</th>
<th>Problem Set Assigned</th>
<th>Problem Set Due</th>
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<tr>
<td>1</td>
<td>2016.09.01</td>
<td>Prerequisite Review, Difference Equations</td>
<td>Ch. 1</td>
<td>Ch. 1, 2</td>
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<td>1</td>
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<td>2</td>
<td>2016.09.08</td>
<td>Stationary Models</td>
<td>Ch. 2</td>
<td>Ch. 6</td>
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<td>3</td>
<td>2016.09.15</td>
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<td>Ch. 3</td>
<td>Ch. 4,7</td>
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<td>4</td>
<td>2016.09.22</td>
<td>Non-Stationary Models</td>
<td>Ch. 4</td>
<td>Ch. 4,7</td>
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<td>5</td>
<td>2016.09.29</td>
<td>Multi-equation Models</td>
<td>Ch. 5</td>
<td>Ch. 11</td>
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<td>6</td>
<td>2016.10.06</td>
<td>Cointegration</td>
<td>Ch. 6</td>
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<td>2016.10.13</td>
<td>Non-linear Models</td>
<td>Ch. 7</td>
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<td>Ch. 3, 5</td>
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<td>9</td>
<td>2016.10.27</td>
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<td>Ch. 3, 5</td>
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<td>Midterm Exam</td>
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<td>11</td>
<td>2016.11.10</td>
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<td>12</td>
<td>2016.11.17</td>
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<td>14</td>
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<td>15</td>
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<td>Research Paper Presentations (if necessary)</td>
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READING ASSIGNMENTS
Students should read the listed articles and text below before the respective class. The scheduled reading load is variable; the first part of the class is focused on technique via the texts and the second part focused on application via articles. Please do not wait until the last minute; instead, establish a reading schedule so you can cover the materials in time. You are likely to not understand everything in the assigned articles, and that is okay. Please try to follow the logic of the article and understand the question at hand, the methods employed, and the conclusions of the article. You may access the articles through JSTOR or similar university journal databases. We will discuss the assigned articles during the lectures.
Meeting 6: Cointegration


Meeting 8: Forecasting


Meeting 11: Topical Focus: Energy Economics


Meeting 12: Topical Focus: Macroeconomics


Meeting 13: Topical Focus: Finance (TBD)