

**Department of Economics**

**The George Washington University**

**MA in Applied Economics**

**Time Series Analysis Syllabus**

**COURSE DETAILS**

Title: ECON 6376 Time Series Analysis

Section: Section 10 (CRN 25043)

Semester: Fall 2018

Time: Thursday, 6:10 PM – 8:40 PM

Location Funger Hall 223

**INSTRUCTOR**

Name: James Outen

Campus Address: Monroe Hall rm. 340 (Economics Department Office)

E-mail: [jouten@gwu.edu](mailto:jouten@gwu.edu)

Telephone: 202.994.6150 (Economics Department Office)

Office hours: By appointment

**GRADUATE ASSISTANTS**

Name: Mr. Feng Zhang (Discussion section)

Email: [zhangfeng@gwmail.gwu.edu](mailto:zhangfeng@gwmail.gwu.edu)

Discussion Section: Monday and Thursday from 3:00 to 4:30 in Monroe Hall rm. 324

Name: Ms. Shuang Wu (Computer lab)

Email: [swu2@gwmail.gwu.edu](mailto:swu2@gwmail.gwu.edu)

Computer Lab Monday and Thursday from 4:30 to 6:00 in Monroe Hall rm. 324

**COURSE DESCRIPTION**

The objective of this course is to give students the tools required to understand, implement, and interpret common models 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 are: 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. Restricted to students in the applied economics MA program.

**COURSE PREREQUISITES**

Applied Macroeconomic Theory, ECON 6305

Probability and Statistics for Economics, ECON 6374

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. Page references to Enders correspond to the 4th edition of the text.

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. This text is available electronically through the GW Library at no additional fee.

The course textbooks are usually available on amazon.com, and [gettextbooks.com](http://gettextbooks.com/), as well as through the University bookstore.

For additional reference texts, please consult:

*Time Series Analysis*, James Hamilton, Cambridge, MA: The MIT Press.

*Introductory Econometrics: A Modern Approach*, Jeffery Wooldridge.

**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.

**AVERAGE MINIMUM AMOUNT OF INDEPENDENT, OUT-OF-CLASS, LEARNING EXPECTED PER WEEK:**

In a 15-week semester, including exam week, you should expect to spend a minimum of 4 hours a week for each hour of instruction. For a 2 ½ hour course worth three credits this means that you should expect to study a minimum of 10 hours outside of class each week.

**GRADING**

* Problem Sets 30%
* Research Paper 30%
* Research Paper Presentation 10%
* Midterm Exam 30%

**Problem Sets:** Please see the schedule for problem set due dates. Please type all solutions to assignments. All solutions should have page numbers and your name. Please submit solutions to problem sets as a PDF file to Blackboard. For problems that require computation, please provide annotated code as well as results. Please structure your responses (text, code, and graphics, as applicable) so that it is easy to interpret. You may work in groups on the problem sets but your answers must be your own. Identical or substantially similar answers may be considered to be a violation of the GW Code of Academic Integrity.

**Research Paper:** 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. Students will be graded on the research proposal and the final version of the paper.

The goal of the paper 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 previous classes or 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 and appendices. **You must provide your written research proposal to me no later than meeting 11.** The research proposal is a few paragraphs that poses the research question and answers the who/what/where/when/why of the research project. Failure to provide a written proposal or writing a paper substantially different from the proposal will result in a penalty. **You must submit a final research paper no later than meeting 14, which is the beginning of research paper presentations.**

I am very happy to advise you on your research question. 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 grading of the paper are forthcoming in class.

**Midterm exam**: The exam is take home and comprehensive. I will be in the classroom during meeting 11 and available to answer any questions you have. **You must submit your solutions to the exam no later than meeting 13.**

**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.

**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. Answers to problem sets and the exam must be submitted through Blackboard.

**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.

Common examples of academically dishonest behavior include, but are not limited to

1. Cheating
2. Fabrication
3. Plagiarism
4. Falsification and forgery of University academic documents
5. Facilitating academic dishonesty

Sanctions range from failure of the assignment, to failure of the course, to suspension or expulsion from the University. For the remainder of the code, see: <http://www.gwu.edu/~ntegrity/code.html>

All students need to be familiar with GW's Code of Academic Integrity. Item 3 in Section 1 of Article II of the Code deals with plagiarism.

“Plagiarism - intentionally representing the words, ideas, or sequence of ideas of another as one's own in any academic exercise; failure to attribute any of the following: quotations, paraphrases, or borrowed information.”

For a full set of definitions, see: <http://www.gwu.edu/~ntegrity/code.html#definition>

For the full Code, see: <http://www.gwu.edu/~ntegrity/code.html>

**Plagiarism and How to Avoid It**

Plagiarism is a serious matter both inside and outside academia. Students are responsible for becoming familiar with the different forms that plagiarism can take. Ignorance doesn’t exempt students from being penalized for plagiarism. It is essential to educate yourself about what constitutes plagiarism before writing an essay for a take-home exam, a term paper, a dissertation, or a report in the workplace. Students have failed the course or been expelled because of plagiarism. 

You can find a good overview of plagiarism and how to avoid it at

<http://widstudents.wordpress.com/tag/plagiarism/>  
  
It’s worth reading through the entire web page, including the section titled "Plagiarism Tales at GW."  The following document has good examples of the different forms that plagiarism can take (in Section 4). You should read 1-4 carefully. The document should dispel the possible misconception that plagiarism is committed only when an entire paper, or large parts of a paper, are copied. That is NOT the case. Copying a sentence or even a phrase without properly attributing it constitutes plagiarism.

<http://www.ece.msstate.edu/~fowler/Classes/plagiarism.pdf>  
  
On the important distinctions among quoting, paraphrasing, and summarizing, see

<http://owl.english.purdue.edu/owl/resource/563/01/>  
  
On the proper use of quotations, see

<http://writingcenter.unc.edu/resources/handouts-demos/citation/quotations>

**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 Rome Hall, 801 22nd St., NW, Suite 102, to establish eligibility and to coordinate reasonable accommodations. For additional information, please refer to <https://disabilitysupport.gwu.edu/>

Students must arrange with the DSS office ***well in advance*** of needing the service.

*UNIVERSITY COUNSELING CENTER (UCC)****202-994-5300***

The University’s Mental Health Services 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. For additional information see: <https://healthcenter.gwu.edu/mental-health>

**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 ten 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 texts and will cover a lot of material. Then in the remainder of the class we will 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.

NOTE: In accordance with university policy, the final exam will be given during the final exam period and not the last week of the semester. For details and complete policy, see: [provost.gwu.edu/administration-final-examinations-during-examination-period](https://provost.gwu.edu/administration-final-examinations-during-examination-period)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Meeting** | **Date** | **Topic** | **Reading-Enders** | **Reading-Cowpertwait & Metcalfe** | **Additional Readings (see below)** | **Problem Set Due** |
| 1 | 2018.08.30 | Difference Equations | Ch. 1 | Ch. 1, 2 |  |  |
| 2 | 2018.09.06 | Stationary Models | Ch. 2 | Ch. 4,6 |  |  |
| 3 | 2018.09.13 | Non-stationary Models | Ch. 4 | Ch. 4,7 |  | 1 |
| 4 | 2018.09.20 | Non-stationary Models | Ch. 4 | Ch. 4,7 |  |  |
| 5 | 2018.09.27 | Volatility | Ch. 3 | Ch. 4,7 |  |  |
| 6 | 2018.10.04 | Multi-equation Models | Ch. 5 | Ch. 11 |  | 2 |
| 7 | 2018.10.11 | No Class – Make Up Class TBD | | | | |
| 8 | 2018.10.18 | Cointegration | Ch. 6 | Ch. 11 | Yes |  |
| 9 | 2018.10.25 | Forecasting | Ch. 2 | Ch. 3, 5 | Yes | 3 |
| 10 | 2018.11.01 | Forecasting | Ch. 2 | Ch. 3, 5 | Yes |  |
| 11 | 2018.11.08 | Midterm Exam |  |  |  |  |
| 12 | 2018.11.15 | Time Series Research |  |  | Yes | 4 |
|  | 2018.11.22 | No Class – Thanksgiving Break | | | | |
| 13 | 2018.11.29 | Research Paper Workshop |  |  |  |  |
| 14 | 2018.12.06 | Research Paper Presentations |  |  |  |  |
| 15 | TBD (final exam week) | Research Paper Presentations (if necessary) |  |  |  |  |

**READING ASSIGNMENTS – *Tentative and subject to later revision***

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 some of the assigned articles during lectures.

Cointegration

Granger, C. W. J., and P. Newbold. 1974. “Spurious Regressions in Econometrics.” *Journal of Econometrics* 2 (2): 111–20.

Hendry, David F., and Katarina Juselius. 2000. “Explaining Cointegration Analysis: Part 1.” *The Energy Journal* 21 (1): 1–42.

Hendry, David F., and Katarina Juselius. 2001. “Explaining Cointegration Analysis: Part II.” *The Energy Journal* 22 (1): 75–120.

Forecasting

Elliott, Graham, and Allan Timmermann. 2008. “Economic Forecasting.” *Journal of Economic Literature* 46 (1): 3–56.

Time Series Research

De Vany, Arthur, and W. David Walls. 1996. “The Law of One Price in a Network: Arbitrage and Price Dynamics in Natural Gas City Gate Markets.” *Journal of Regional Science* 36 (4): 555–70.

De Vany, Arthur S., and W. David Walls. 1999. “Cointegration Analysis of Spot Electricity Prices: Insights on Transmission Efficiency in the Western US.” *Energy Economics* 21 (5): 435–48.

Hamilton, James D. 1983. “Oil and the Macroeconomy since World War II.” *Journal of Political Economy* 91 (2): 228–48.

Nelson, Charles R., and Charles R. Plosser. 1982. “Trends and Random Walks in Macroeconomic Time Series: Some Evidence and Implications.” *Journal of Monetary Economics* 10 (2): 139–62.

**Guidelines for Time Series Analysis Presentation and Paper**

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 and appendices. Please provide annotated code in an appendix to the paper. I will grade your papers on how well they are written and how clearly they evaluate the question you are addressing, and I will grade your presentations on how well you answer questions posed from your classmates.

Please employ a consistent and professional format for your paper (the guidelines in *The Journal of Economic Perspectives* for preparing tables, charts, and references is a good template). I strongly suggest that you visit the University Writing Center if you have concerns about your writing. It is also advisable to have friends or colleagues proofread your paper and/or presentation materials.

**You must provide your written research proposal to me no later than the date stated on the syllabus.** The research proposal is a few paragraphs that poses the research question and answers the who/what/where/when/why of the research project. My goal in asking for the research proposal is to make sure you have selected a narrowly defined and feasible project. I am very happy to advise you on your research question. Presentations will take place in class on the last regular class meeting and possibly during the scheduled final exam time (15th meeting) if needed.

**All papers are due, either electronically or hard copy, on the last regular class meeting, as stated in the syllabus.** This due date holds even if you end up presenting your paper during the following meeting during the final exam period.

Your applied research paper should have the following sections:

1. An abstract of no more than five sentences that summarizes the paper. The abstract should be succinct and quickly give the reader an overview of the paper content.
2. An introduction that presents and motivates your question. The question should be explicit and narrowly-focused so that you can address it in the page limit given for this assignment. Many of the applications in the textbook provide examples of such questions.
3. The paper should provide a brief literature review/discussion of previous work of relevant papers on the topic. Discuss how your paper extends this body of knowledge. Don’t go down the rabbit hole on the literature review but try to include some references to place your work in context.
4. The paper should describe the theory and/or analytical technique that will be applied to the question. This section would also identify the data used in the empirical analysis and discuss the variables included in your model. This section could include a few equations that illustrate your theory or model.
5. Your paper should include charts and tables that summarize the data and analytical results as needed.
6. Your results section should discuss the analysis performed and the results in specificity. Make the connection between the numerical values of the results and the concepts you are addressing with your question. If there are deficiencies in your data or confusing results don’t hide them but instead suggest how additional data or tests could resolve the uncertainty.
7. The paper should have a brief conclusion that summarizes what you have learned and areas for future research.

Your presentation should generally include the same sections as the paper. The following are some extra points regarding presentation:

1. Presentations should be no longer than 10 minutes. We’ll likely have a hard limit so practice and make sure you can present in less than 10 minutes to allow time for some questions.
2. Prepare a few slides to accompany your presentation; try not to read slides but instead talk to the audience and refer to the slides when necessary.
3. Start with a title slide which includes your name. Briefly introduce yourself and your topic.
4. Speak loudly enough that someone at the back of the room could hear you easily.

2115 G Street, NW | Suite 340 | Washington, DC 20052

**t** 202-994-6150 | **f** 202-994-6147