COLORADOSCHOOLOFMINES

**Subject: EGBN Number: 594**

**Course Title: Time Series Econometrics**

**Semester/year: Fall 2019**

**This version: 5/3/2019, subject to change**

**Instructor or Coordinator: Ben Gilbert**

**Contact information: EH 319, bgilbert@mines.edu, x2359**

**Office hours: 2:30-3:30, M,W**

**Class meeting days/times: 3:30-4:45, M,W**

**Class meeting location: EH 211**

**Lab session: TBD**

**Web Page/Canvas link: TBD**

**Teaching Assistant: TBD**

**Contact information:**

**Instructional activity:** 3 hours lecture 1 hours lab ___ semester hours

**Course designation:** ___ Common Core ___ Distributed Science or Engineering

___ Major requirement _X_ Elective ___ Other (please describe _____)

**Course description from Bulletin:** Analysis of economic and financial time series of interest to the mineral and energy industries, including but not limited to equity returns, commodity prices, macroeconomic variables and production activity. Tools covered include models for the mean (ARIMA), models for volatility (ARCH/GARCH), multivariate techniques (VAR, VECM), and special topics according to student and instructor interest (e.g., nonlinear models, nonparametric methods, state space models, Bayesian methods, etc.)

**Textbook and/or other requirement materials:**

**Required text:** Analysis of Financial Time Series, 3rd Edition, Ruey S. Tsay, Wiley

I have chosen this book because of its emphasis on financial applications and abundant worked examples in R. The course will use the R statistical package. Computers in the lab on the first floor of Engineering Hall have R installed, but it will be more convenient to install it on your own laptop and bring it to lecture and lab. R and R Studio, a convenient user interface, are free online.

I will assign additional readings from time to time.

**Other supplemental texts that may be helpful:**
This extremely helpful online text is free and written with examples and code in R:
Forecasting: Principles and Practice, Rob J. Hyndman and George Athanasopoulos,
https://www.otexts.org/fpp

This free text covers the basics of dynamic processes, particularly chapters 2.5, 4, 7, and 10.
Applied Intertemporal Optimization, Klaus Waelde
http://www.waelde.com/pdf/AIO.pdf

These texts are not required, but are foundational texts in time series analysis and can help improve your understanding:

Time Series Analysis, James D. Hamilton (1994), Princeton University Press
Applied Econometric Time Series, Walter Enders (2009), Wiley
New Introduction to Multiple Time Series Analysis, Helmut Lutkepohl (2007), Springer

**Student learning outcomes: At the conclusion of the class students will…**

1. Characterize the properties of time series data, including the distribution, dependence, and multivariate relationships.
2. Estimate the parameters of a variety of time series models.
3. Interpret and explain the results of a model in a way that any business professional can understand.
4. Conduct forecasts and characterize the uncertainty in those forecasts.

**Brief list of topics covered:**

1. Autoregressive Integrated Moving Average models (ARIMA)
2. (Generalized) Autoregressive Conditional Heteroskedasticity (ARCH/GARCH)
3. Cointegration
4. Vector Autoregression (VAR)
5. Vector Error Correction Models (VECM)
6. Special topics according to student/instructor interest (e.g., nonlinear/threshold models, nonparametric techniques, Kalman filter and other state space models, Bayesian methods)

**Policy on academic integrity/misconduct:** The Colorado School of Mines affirms the principle that all individuals associated with the Mines academic community have a responsibility for establishing, maintaining an fostering an understanding and appreciation for academic integrity. In broad terms, this implies protecting the environment of mutual trust within which scholarly exchange occurs, supporting the ability of the faculty to fairly and effectively evaluate every student's academic achievements, and giving credence to the university's educational mission, its scholarly objectives and the substance of the degrees it awards. The protection of academic integrity requires there to be clear and consistent standards, as well as confrontation and sanctions when individuals violate those standards. The Colorado School of Mines desires an environment free of any and all forms of academic misconduct and expects students to act with integrity at all times.

Academic misconduct is the intentional act of fraud, in which an individual seeks to claim credit for the work and efforts of another without authorization, or uses unauthorized materials or fabricated information in any academic exercise. Student Academic Misconduct arises when a student violates the principle of academic integrity. Such behavior erodes mutual trust, distorts the fair evaluation of academic achievements, violates the ethical code of behavior upon which education and scholarship rest, and undermines the credibility of the university. Because of the serious institutional and individual ramifications, student misconduct arising from violations of academic integrity is not tolerated at Mines. If a student is found to have engaged in such misconduct sanctions such as change of a grade, loss of institutional privileges, or academic suspension or dismissal may be imposed.

The complete policy is online.

**Grading Procedures:**

| | |
|---|---|
| Presentation 1 | 10% |
| Homework and Participation | 25% |
| Midterm | 15% |
| Presentation 2 | 10% |
| Final Project | 20% |
| Final Exam | 20% |

Presentation 1 will be a consulting-style presentation analyzing a time series variable or variables of interest using the tools learned up to that point. Suppose that the audience (me, and the rest of the class) is a group of executives, directors, clients, or investors. Consulting-style presentations concisely and clearly communicate technical information by distilling a lot of analysis into what is important and actionable for a decision maker. The presentations will be short (5 min) but the slide deck should have a detailed appendix for the interested reader (me) to understand more deeply what you've done. The goal is to demonstrate that you know how to apply the tools and that you can communicate the results in an action-relevant way. Examples of successful consulting-style presentations are here:

https://www.konsus.com/blog/25-powerpoint-presentation-examples-from-consulting-firms-and-what-you-can-learn-from-them/

http://elc-columbia.weebly.com/uploads/3/9/7/2/39724566/how_to_do_consulting_presentations__elc_.pdf

http://www.consultantsmind.com/2017/04/23/30-mckinsey-presentations/

Presentation 2 will be a short (5 min) presentation of the Final Project.

The Final Project can either be an original project that applies the tools you've learned to a research question with time series data, or a critical analysis of a paper or set of papers that use time series methods. The work product for the final project can be either a written paper or a highly detailed and readable appendix to your slide deck. In either case the project should reflect the skills you've learned.

PhD students can (and should) write a research paper in lieu of these assignments; Presentation 1 for PhD students will be a paper proposal, the Final Project will be the full paper, and Presentation 2 will be a short presentation of the full paper. Proposals/papers should clearly summarize the state of the academic literature and indicate how the analysis adds to the academic literature.

Homework and Participation: There will be short weekly or bi-weekly homework assignments. They are intended to keep you on top of the material and will be graded on a check-plus, check, check-minus scale. Homework must be turned in on time so that I can post solutions for the class. We will also work on and discuss problems and examples during class time. Homework must be turned in before it is due to be graded – plan ahead.

Exams: The exams will reflect what was emphasized during class and on homework assignments. If you will be absent during a scheduled exam, you should schedule a make-up time before you leave.

**Statistics software lessons**: Course staff will hold special weekly lab sessions to introduce you to R's capabilities in time series analysis. By the end of the semester you will be able to fit all of the models covered in the course using R. Attendance at these is optional but is highly encouraged if you are not already proficient in R. R is available on computers in the departmental computer lab on the first floor of Engineering Hall.

**Coursework Return Policy:** All material will be handed back within two weeks. I will strive for a one week turnaround on the presentations and exams.

**Absence Policy** (e.g., Sports/Activities Policy): Standard Mines policy for approved excused absences.

**Common Exam Policy** (if applicable): No common exams

**Communication Policy:** Please do not email me with questions about course *material* until you have (1) consulted another student or the TA, and (2) posted your question on the Canvas discussion board. I am more than happy to answer questions online and by email, but only when other students have the opportunity to participate as well. If you do email me with a question, I will most likely post the question and the answer to Canvas. If you ask on Canvas, you are likely to get an answer more quickly. Please also make an effort to answer your classmates' questions if you have an idea and can help. There is no penalty for being wrong, and I will thank you for trying. Please DO email me any time you have a concern about the course or any other issue not related to the material. I will respond within 24 hours.

**Caveats:** All information in this syllabus is subject to change upon the decision of the instructor, with adequate communication to the students in class and electronically.

**Detailed Course Schedule:** This schedule is subject to change depending on student and instructor interests. Should changes occur, announcements will be made in class and electronically and the readings will be updated accordingly. Please read the assigned readings in advance of class meetings.

Week 1 (Aug 19):
- Tsay Chapter 1, Review of Asset Returns and Basic Statistics & Probability
- Wednesday is MEE day. No class – please attend the MEE events.

Week 2 (Aug 26):
- Tsay Chapter 1 continued, Chapter 2.1-2.3, Issues with dependence

Week 3 (Sept. 2):
- Tsay Chapter 2.4-2.6, Stationarity and ARMA Models

Week 4 (Sept. 9):
- Tsay Chapter 2.7-2.11, Nonstationarity, Seasonality, and issues with the errors

Week 5 (Sept. 16):
- Tsay Chapter 3.1-3.5, (Generalized) Autoregressive Conditional Heteroskedasticity

Week 6 (Sept 23):
- Tsay Chapter 3.6-3.16, Extensions to ARCH and GARCH
- Time permitting: some nonlinear methods from Tsay Chapter 4

Week 7 (Sept 30):
- Presentation 1

Week 8 (Oct 7):
- Review, Midterm 1

Week 9 (Oct 14):
- Fall break
- Tsay Chapter 8.1, Introduction to multivariate time series

Week 10 (Oct 21):
- Tsay Chapter 8.2-8.4, More multivariate tools, vector autoregression and vector ARMA

Week 11 (Oct 28):
- Tsay Chapter 8.5-8.6, Cointegration

Week 12 (Nov. 4):
- Chapter 8.7, 8.8, selected readings, extensions to multivariate techniques

Week 13 (Nov. 11):
- Special topics decided by students and instructor TBD

Week 14 (Nov. 18):
- Thanksgiving. Special topics continued.

Week 15 (Nov. 25):
- Special topics continued

Week 16 (Dec. 2):
- Presentation 2