COURSE DESCRIPTION

This course has a broad structure and covers many aspects of modeling and estimating financial/economic time series. In particular, we will be focusing on (i) linear regression models involving variables observed over time and (ii) “pure” univariate and multivariate time-series models. The objective is that participants gain a thorough understanding of the theory underlying time-series econometrics, which is the basis for any empirical time-series analysis of financial/economic market phenomena. The course places a particular emphasis on clearly identifying which econometric methods are appropriate under which scenarios. Estimation techniques covered will be Ordinary Least Squares (OLS) and Generalized Method of Moments (GMM).

COURSE MATERIALS

- **Textbook**
  
  Author: Fumio Hayashi  
  Book title: Econometrics  
  Year: 2000  
  Publisher: Princeton University Press  
  ISBN-10: 0-691-01018-8

- Additional reading material (journal articles) may be introduced during the course

- Check the course website on Blackboard (blackboard.rutgers.edu) and your official Rutgers email account regularly

- Software: Participants can choose their preferred programming language. However, “lower”-level programming will be required using (statistical) programming languages such as Matlab (language used by instructor), R, Gauss, Ox, S-PLUS, or similar; please refrain from using Stata or EViews.

PREREQUISITES

26.223.554: Econometrics - Cross-Sectional (and the prerequisites for that course). Knowledge of calculus, matrix algebra, probability theory and statistics are essential for this course.

ACADEMIC CONDUCT

All students are expected to know, understand and live up to the standards of RU Academic Integrity Policy (http://academicintegrity.rutgers.edu/files/documents/AI_Policy_2013.pdf). Don’t let cheating destroy your hard-earned opportunity to learn. See business.rutgers.edu/ai for more details.

ATTENDANCE AND PARTICIPATION

Attendance is not part of your grade. However, there is a strong relationship between attendance/active participation and grades.
Students will be responsible for all work missed during an absence, no matter what the reason for the absence.

**GRADING POLICY AND EXAMS**

- There are **four** graded items in this course: *Homework Exercises, Empirical Work, Midterm Exam, Final Exam*. You will receive a separate score between 0 and 100 for each of the four items. The final grade will be a weighted average of the four items using the weighting schemes indicated below.

- At the end of each lecture, a set of **Homework Exercises** will be handed out. You are asked to complete these individually and submit them before the following lecture. These homework exercises will be part of the final grade; understanding the problems will substantially assist students in learning the course material and performing well on the exams. Each homework exercise receives an equal weight. Forgiveness policy: the score for the worst homework set is discarded. No make-up exercises are possible. You will receive a score of zero (for the respective homework exercise) if you fail to submit/submit late.

- Two sets of **Empirical Work** projects will be assigned, one in the first half and one in the second half of the course. The projects are designed to introduce the course participants to the use of econometrics in the form of two small empirical studies to support the theoretical part of research. You are asked to complete these in groups of two (groups to be formed during the first lecture) within 7 weeks. The deadline for “Empirical Work I” is October 22, and for “Empirical Work II” is December 10, 2015. Assignments should be submitted in .pdf format and should be uploaded to the appropriate folder (“Assignments” tab) on the Blackboard course website. The output will consist of a description of the results, a documentation of your findings, and a discussion of the implications. The programming code including annotations(!) should be added as an appendix to the text of the project. To assist participants in coding, I will upload programming code corresponding to the material covered in each lecture for reference. My code is written in Matlab. If you prefer to use a different language, necessary adaptations should be minimal. No make-up work is possible. You will receive a score of zero (for the respective assignment) if you fail to submit/submit late.

- The **Midterm Exam** is scheduled for October 29, 2015, during regular class hours. The format of the exam is closed-book. For your reference, last year’s midterm exam is available on the Blackboard course page. Please only bring pencils, pens, erasers, a standard calculators (with the basic functions; not programmable and/or cell phone), and your Rutgers ID card with you to the exam; other items should be placed at the front of the classroom. The material covered in the exam will be the respective chapters from the textbook, journal articles, and the corresponding material from lectures 1 to 8. There will be no make-up midterm exam. You will receive a score of zero if you miss the exam.

- The **Final Exam** will be given sometime between December 15 and December 22, 2015. The format of the exam is closed-book. For your reference, last year’s midterm exam is available on the Blackboard course page. Please only bring pencils, pens, erasers, a standard calculators (with the basic functions; not programmable and/or cell phone), and your Rutgers ID card with you to the exam; other items should be placed at the front of the classroom. All course materials will be relevant for the final exam, with an emphasis on the course content covered in lectures 9 to 13. There will be no make-up final exam. You will receive a score of zero if you miss the exam.

- Grading distribution:
  
<table>
<thead>
<tr>
<th>Item</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homework Exercises</td>
<td>14%</td>
</tr>
<tr>
<td>Empirical Work</td>
<td>22%</td>
</tr>
<tr>
<td>Midterm Exam</td>
<td>32%</td>
</tr>
<tr>
<td>Final Exam</td>
<td>32%</td>
</tr>
</tbody>
</table>

- There are no opportunities for extra credit
• Grade allocation:

<table>
<thead>
<tr>
<th>Weighted average of graded items</th>
<th>Corresponding grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum</td>
<td>Maximum</td>
</tr>
<tr>
<td>86.68</td>
<td>100</td>
</tr>
<tr>
<td>80.01</td>
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<tr>
<td>73.34</td>
<td>80</td>
</tr>
<tr>
<td>66.67</td>
<td>73.33</td>
</tr>
<tr>
<td>60</td>
<td>66.66</td>
</tr>
<tr>
<td>0</td>
<td>59.99</td>
</tr>
</tbody>
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• All (partial) scores received throughout the course will be added to the Grade Center on the Blackboard course website. Please note that the “Total Weighted Average” on Grade Center is a running total; in addition, the system does not properly account for discarding the lowest score of the homework exercises.

• Your partial scores/final grades are not subject to negotiation. If you feel I have made an error, submit your written argument to me within one week of receiving your grade/score. Clarify the precise error I made and provide all supporting documentation. If I have made an error, I will gladly correct it. But I will adjust grades only if I have made an error.

**SCHEDULE AND TOPICS**

Classes will be held every Thursday from 1:00 pm to 3:50 pm in room 226, 1 Washington Park, Newark. We start classes on Thursday, September 3, 2015. Please note that there will be no lecture on November 26, 2015, due to Thanksgiving Recess. The last lecture will be held on December 10, 2015.

The following list of topics will be covered.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Items</th>
</tr>
</thead>
</table>
| **Review of Large-Sample Theory** | - Matrix Algebra  
- Law of Iterated Expectations  
- Convergence in Probability/Distribution  
- Law of Large Numbers  
- Different Central Limit Theorems  
- Stationarity/Ergodicity/Martingales/etc |
| **Large-Sample OLS**      | - Large-Sample Distribution of the OLS Estimator  
- Hypothesis Testing  
- Estimating $E(\varepsilon_t^2x_t^2)$ Consistently  
- Implications of Conditional Homoskedasticity  
- Testing Conditional Homoskedasticity (White’s Test)  
- Estimation with Parameterized Cond. Heteroskedasticity, (F)GLS  
- Testing for Serial Correlation (Box-Pierce Test etc.) |
| **Single-Equation GMM**   | - Failure of Predeterminedness Assumption: Endogeneity Bias  
- The General Formulation  
- Generalized Method of Moments Defined  
- Large-Sample Properties of GMM  
- Testing Overidentifying Restrictions  
- Implications of Conditional Homoskedasticity (2SLS) |
| **Multiple-Equation GMM** | - The Multiple-Equation Model  
- Equation GMM Defined  
- Sample Theory  
- Single-Equation versus Multiple-Equation Estimation  
- Special Cases of Multiple-Equation GMM: FIVE, 3SLS, and SUR  
- Common Coefficients |
|--------------------------|--------------------------------------------------------------------------------------------------------------------------|
| **Serial Correlation**   | - Modeling Serial Correlation: Linear Processes  
- ARMA Processes  
- Vector Processes  
- Estimating Autoregressions |
| **Time-Series Models**   | **of Heteroskedasticity**  
- ARCH  
- GMM estimation of ARCH  
- GARCH  
- IGARCH/EGARCH/GARCH-in-Mean |
| **Serial Correlation in** | **Linear Regressions**  
- Asymptotics for Sample Means of Serially Correlated Processes  
- Incorporating Serial Correlation in GMM (Newey-West Estimation)  
- Estimation under Conditional Heteroskedasticity |
| **Unit-Root Econometrics** | - Time Regressions (trend-stationary variables)  
- Modeling Trends  
- Tools for Unit-Root Econometrics  
- Dickey-Fuller Tests  
- Augmented Dickey-Fuller Tests  
- Which Unit-Root Test to Use? |
| **Cointegration**        | - Cointegrated Systems  
- Alternative Representations of Cointegrated Systems  
- Testing the Null of No Cointegration  
- Inference on Cointegrating Vectors |

Your feedback is always welcome!