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**PSC 405**

**Linear Models**

Spring 2016  
3:25-4:40 T/TH  
Harkness 329

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## **PREREQUISITES**

The prerequisites for this course include a mathematical statistics course at the level of PSC 404 and mathematical modeling at the level of PSC 407.

## **OVERVIEW**

In this course, we examine the linear model, variations of it, and various pathologies one encounters in practice. The linear model has a long history in statistics, econometrics, and political methodology. Understanding the linear model is important for further research in nonlinear and likelihood-based models (e.g., PSC 505). Its simplicity also makes understanding the theory behind it and the pathologies more tractable than when dealing with more complicated, nonlinear models. This course has two goals: (1) provide students with the statistical theory of linear models and (2) provides students with the skills for applied data analysis using the linear model.

## **COURSE REQUIREMENTS**

The requirements consist of problem sets, a midterm, and a final. The problem sets will be divided between analytic and empirical exercises, and all empirical exercises will be performed in R. Students are expected to work alone on homeworks. Students are also responsible for the additional readings. The course grade will be calculated as follows: problem sets 30%, midterm 30%, final 40%.

## **COURSE WEBPAGE**

Dropbox directory to be provided.

## **TEXTS**

The required texts for this course are:

- Hansen, Bruce E. 2014. *Econometrics*.  
Provided in Dropbox folder.
- Faraway, Julian. 2002. *Practical Regression and Anova using R*.  
Provided in Dropbox folder.  
The accompanying source code and data, are free on the web here:  
<http://cran.r-project.org/web/packages/faraway/index.html>
- Achen, Christopher. 1982. *Interpreting and Using Regression*. Sage.

If you want a slightly different version of the section material, take a look at

- Peress, Michael. *Lecture Notes on Linear Models*.  
Provided in Dropbox folder.

The following texts are not required but may be helpful for simpler overviews:

- Gujarati, Damodar N. 2003. *Basic Econometrics*. 4th edition. McGraw-Hill.
- Kennedy, Peter. 2001. *A Guide to Econometrics*. 4th ed.
- Kmenta, Jan. 1986. *Elements of Econometrics*. 2nd ed.
- Wooldridge, Jeffrey. 2003. *Introductory Econometrics: A Modern Approach*.

## COURSE SCHEDULE

### 0. A Light Review of Covariance, Correlation, and Regression

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| 1. <b>Linear Algebra</b>                     | <i>Hansen App A</i>                     |
| 2. <b>The Linear Regression Model</b>        | <i>Achen Ch 2.</i>                      |
| • Conditional expectation                    | <i>Hansen Ch 2.</i>                     |
| • Ordinary least squares (OLS)               | <i>Hansen Ch 3.</i>                     |
| • OLS: Finite sample properties              | <i>Hansen Ch 4 &amp; Achen Ch 3.</i>    |
| • OLS: Asymptotic properties                 | <i>Hansen Chs 5-6 &amp; Achen Ch 4.</i> |
| 3. <b>Specification and Misspecification</b> | <i>Hansen Ch 7.</i>                     |
| • Omitted variable bias                      | <i>Hansen Ch 2.23.</i>                  |
| • Measurement error                          | <i>Hansen Ch 15 Intro.</i>              |
| • Inclusion of irrelevant variables          |   |

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| 4. Hypothesis Testing                              | <i>Hansen Ch 8 &amp; Achen Ch 5-6.</i> |
| 5. Regression extensions                           | <i>Hansen Ch 9.</i>                    |
| • Nonlinearity                                     |  |
| • Heteroskedasticity and generalized least squares |  |
| 6. Generalized Method of Moments                   | <i>Hansen ch 13.</i>                   |
| 7. Endogeneity and Instrumental Variables          | <i>Hansen Ch 15.</i>                   |
| 8. Bayesian Methods                                |  |
| 9. Univariate Time Series Models                   | <i>Hansen Ch 16.</i>                   |
| 10. Panel Data Models                              | <i>Hansen Ch 19.</i>                   |
| 11. Nonparametric and Semiparametric Methods       |  |

### Additional reading

- Achen, C. 1977. "Measuring Representation: Perils of the Correlation Coefficient." *American Journal of Political Science* 21:805-815.
- Freedman, D. 1991. "Statistical Models and Shoe Leather." *Sociological Methodology* 21:291-313.
- Rosenbaum, P. 1999. "Choice as Alternative to Control in Observational Studies." *Statistical Science* 14:259-304.
- Achen, C. 1990. "What Does 'Explained Variance' Explain?: Reply." *Political Analysis* 2:173-184.
- King, G. 1986. "How Not to Lie with Statistics," *American Journal of Political Science* 30:666-687.
- Belsley, Kuh, and Welsch. 1980. *Regression Diagnostics*, Ch. 2.
- Farrar & Glauber. 1967. "Multicollinearity in Regression Analysis: the Problem Revisited." *Review of Economics and Statistics* 49: 92-107.
- Lemieux, P. 1978. "A Note on the Detection of Multicollinearity." *American Journal of Political Science* 22: 183-186.
- Clarke, K. 2005. "The Phantom Menace: Omitted Variable Bias in Econometric Research." *Journal of Conflict Management and Peace Science* 22: 341-352.
- Friedrich, R. 1982. "In Defense of Multiplicative Terms in Multiple Regression Equations." *American Journal of Political Science* 26: 797-833.

- Braumoeller, B. 2005. "Hypothesis Testing and Multiplicative Interaction Terms." *International Organization* 58: 807-820. (And the "author's checklist": [www.people.fas.harvard.edu](http://www.people.fas.harvard.edu)).
- Bartels, L. 1991. "Instrumental and 'Quasi-Instrumental' Variables." *American Journal of American Politics* 35: 777-800.
- Achen, C. 1985. "Proxy Variables and Incorrect Signs on Regression Coefficients." *Political Methodology* 11: 299-316.
- Mundlak, Y. 1978. "On the Pooling of Time Series and Cross Section Data." *Econometrica* 46: 69-85.
- Beck & Katz. 1995. "What to do (and not to do) with Time-Series Cross-Section Data." *American Political Science Review* 89: 634-647.

NOTE: Instructor reserves the right to modify this syllabus at any time.