

14BP99

Mathematics, Statistics and Computational Brush-up Courses for the Competition and Market Regulation and the Economics of Public Policy Master Programs

Instructors

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Course Objective

The aim of this courses is to refresh your memory of the tools in Mathematics and Statistics, which you are going to use in the courses throughout the master.

Schedule

The review classes are going to take place between Sept. 6 and Sept. 20, 2018.

References

For those of you who would like to prepare before the classes start, here there are some useful references. Anyway, the material we are going to cover is standard. If you have used some other book in your undergraduate studies, most likely it will work as well.

Mathematics Review

References and details about how to prepare the material for this review course are included in the summer readings file.

Probability and Statistics Review

There are many books that cover similar material. For example:

Elliot A. Tanis and Robert V. Hogg, A Brief Course in Mathematical Statistics, Prentice Hall.

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<http://www.amazon.com/books/dp/0131751395>

The following is an excellent freely available source:

Jeremy Orloff, and Jonathan Bloom. *18.05 Introduction to Probability and Statistics, Spring 2014*. (Massachusetts Institute of Technology: MIT OpenCourseWare), <http://ocw.mit.edu> (Accessed 2 Sep, 2015). License: [Creative Commons BY-NC-SA](https://creativecommons.org/licenses/by-nc-sa/4.0/)

Course Outline

1. MATHEMATICS (18h)

1.1. Basic Concepts. Sets. Basic Algebra. Mathematical Notation.

1.2. Elements of Linear Algebra. Matrix Operations.

1.3. Calculus

- Limits and Continuity
- Differentiation
- Taylor's Rule
- Integration
- Partial derivatives
- Implicit Function Theorem
- Concave and Convex Functions

1.4. Optimization

- Unconstrained Maximization
- Necessary Conditions for an Interior Extrema
- Sufficient Conditions for a Local Extrema
- Equality Constraints and Lagrange Multiplier Method
- Envelope Theorem
- Inequality Constraints and Kuhn-Tucker Method

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2. COMPUTATION (10h)

2.1. Introduction to STATA

- Working with Stata: menu vs. command line vs. do files
- Help files, online PDF documentation since Stata 11
- Creating empty datasets and copy/pasting data
- Data import: different ways of importing data
- Describing the data
 - Describe
 - Sum
 - Tabulate

2.2. Data sources

- Import data from main public data sources, e.g. Eurostat, World Bank, ...
- Missing values

2.3. Data manipulation

- Generating new variables. "Generate" vs. "Egen".
- Dropping variables
- Sorting
- Recode, group
- Labeling variables and values
- Logical expressions

2.4. Programming in do files

- If condition
- Loops
- Commenting

2.5. Graphing (here menu can be useful)

- Line plot. Legend, labels, shapes, colors, ...
- Scatter plot
- Combining graphs: "twoway", e.g. scatter with regression line
- Histogram

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- Kernel density, intuitive discussion of bandwidth
- Step function for cdf

2.6. Presenting results

3. STATISTICS (14h)

3.1. Review of Probability (4h)

- Random Variables and Probability Distributions
- Expected Values, Mean and Variance
- Two Random Variables
 - Joint and Marginal Distributions
 - Conditional Distributions
 - Bayes' Theorem
 - The Law of Iterated Expectations
 - Independence
 - Covariance and Correlation
 - The Mean and Variance of Sums of Random Variables
- The Normal, Chi-squared, Student t and F Distributions
- Random Sampling
- Large-Sample Approximations
 - Convergence in Probability and Convergence in Distribution
 - Law of Large Numbers
 - Central Limit Theorem

3.2. Review of Statistics (4h)

- Properties of Estimators
 - Un-biasedness, Consistency and Efficiency
- Hypothesis Testing
- The t-statistic and the p-value
- Confidence Intervals
- Linear regression

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3.3. Statistics with Stata (6h)

- Basis statistical routines
 - Mean, standard deviation, correlation
 - Percentiles
 - (t-)Test on mean difference. Compare groups within one variable, compare two variables.
 - Cross-tabulation of two binary variables and corresponding tests (Pearson)
 - Cross-tabulation of two discrete variables and corresponding tests (Pearson)
 - OLS with one explanatory variable
 - Internal variables: `_coef`, `_se`
 - More stored information: “Ereturn list”, “matrix list e(vce)”
 - Post estimation commands
- Panel data
 - Data structure: Wide vs. long
 - Reshape
 - Xtset
 - Xtdes
- Time Series data
 - Tsset
 - Lag and forward operator
 - First difference and dlog

Exam

At the end of the courses, there will be a short exam.