barcelona gse
graduate school of economics

MATHS AND STATISTICS BRUSH UP COURSE
for MASTERS IN COMPETITION AND PUBLIC POLICY

2014-2015 Academic Year

Instructors
Joan de Martí – Mathematics
Sarolta Laczó – Statistics
Inés Black - Computation

Course Objective

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

There will be an exam for this course.

Schedule

The review classes are going to take place between Sept. 8 and Sept. 22, 2014.

Brush-Up Courses Schedule – 2014-2015:

Schedule	Monday 8	Tuesday 9	Wednesday 10	Thursday 11	Friday 12
9:30h – 11:30h	Mathematics	Mathematics	Mathematics	La Diada Catalan Holiday	Mathematics
12h – 14h	Mathematics	Mathematics	Mathematics		Mathematics
15h – 17h	Stata Group A		Stata Group A		Stata Group A
12h – 14h	Stata Group B		Stata Group B		Stata Group B
Schedule	**Monday 15**	**Tuesday 16**	**Thursday 17**	**Friday 18**	**Monday 19**
9:30h – 11:30h	--	Statistics	Statistics	Statistics	Statistics
12h – 14h	Mathematics	Statistics	Statistics	Statistics	Statistics
15h – 17h	Stata Group A		Stata Group A		Stata Group A
12h – 14h	Stata Group B		Stata Group B		Stata Group B
Schedule	**Monday 22**				
9:30h – 11:30h	--				
12h – 14h	Statistics				
15h – 17h	Stata Group A				
12h – 14h	Stata Group B				

References

Osborne's Math Tutorial is the reference we are going to follow more closely for the Analysis Review. We are going to follow "A Brief Course in Mathematical Statistics" by Tanis & Hogg for the Probability and Statistics Review. For those of you who would like to prepare before the classes start, here are the references:

Analysis Review:

*Martin J. Osborne, *Mathematical methods for economic theory: a tutorial* (2007), http://www.economics.utoronto.ca/osborne/MathTutorial/index.html

Lawrence Blume and Carl P. Simon, (1994), Mathematics For Economists, W.W. Norton and Co., New York, London.

Other online references and material from a previous year can be found at http://www.econ.upf.edu/~demarti/mathmaster/

Probability and Statistics Review:

* Elliot A. Tanis and Robert V. Hogg, A Brief Course in Mathematical Statistics, Prentice Hall. http://www.amazon.com/books/dp/0131751395

Course Outline
1. **Review of Analysis (18h)**

1.1. Basics of Analysis (8h)
· Limits
· Continuity
· Differentiation, Taylor's Rule
· Integration
· Total and Partial derivatives
· Implicit Function Theorem
· Concave and Convex Functions of a Single Variable
· Homogenous Functions

1.2. Optimization (10h)
· Unconstrained Maximization
· Necessary Conditions for an Interior Extrema
· Sufficient Conditions for a Local Extrema
· Equality Constraints and Lagrange Multiplier Method
· Envelope Theorem
· Economic Applications
· Inequality Constraints and Kuhn-Tucker Method (if time allows)

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2. **Review of Probability and Statistics (18h)**

2.1. Review of Probability (12h)
· Random Variables and Probability Distributions
· Expected Values, Mean and Variance
· Two Random Variables
        o Joint and Marginal Distributions
        o Conditional Distributions
        o Bayes' Theorem
        o The Law of Iterated Expectations
        o Independence
        o Covariance and Correlation
        o The Mean and Variance of Sums of Random Variables
· The Normal, Chi-squared, Student t and F Distributions
· Random Sampling
· Large-Sample Approximations
        o Convergence in Probability and Convergence in Distribution
        o Law of Large Numbers
        o Central Limit Theorem

2.2 Review of Statistics (6h)
· Properties of Estimators
        o Un-biasedness, Consistency and Efficiency
· Hypothesis Testing
· The t-statistic and the p-value
· Confidence Intervals

3. **Computational Tools**

Exam
At the end of the course, we will give you a short in-class exam and discuss the solutions together.

 Contents STATA
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

        o Describe

- o Sum

- o Tabulate

2. Data sources
- Import data from main public data sources: World Bank (WDI), Penn Tables, Eurostat, ECB, …

- Missing values: "." vs. "99"

3. Data manipulation
- Generating new variables. "Generate" vs. "Egen".

- Dropping variables

- Sorting

- Recode, group

- Labeling variables and values

- Logical expressions

4. 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

5. Programming in do files
- If condition
- Loops
- Commenting

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6. Graphing (here menu can be useful)
- Line plot. Legend, labels, shapes, colors, …

- Scatter plot

- Combining graphs: "twoway", e.g. scatter with regression line

- Histogram

- Kernel density, intuitive discussion of bandwidth

- Step function for cdf

7. Panel data
- Data structure: Wide vs. long

- Reshape

- Xtset

- Xtdes

8. Time Series data
- Tsset

- Lag and forward operator

- First difference and dlog

9. Presenting results