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

2012-2013 Academic Year

Instructors:

- Review Courses in Analysis – Prof. Johannes Gierlinger

- Review Course in Probability and Statistics – Prof. Sarolta Laczó

- Computational Tools (Stata) – Prof. Ezgi Kaya

Course Objective

The aim of this course is to refresh your memory of the tools in mathematics and statistics that you are going to use in the courses throughout the master.

Evaluation Method

There will be an exam at the end of this course to assess your entry level. This grade will not count toward the result of your master courses.

Schedule

The review classes are going to take place between Sept. 7 and Sept. 20th.

Schedule for Review Courses in Analysis (18 hours), Probability and Statistics (18 Hours) and Computational Tools (14 Hours).

Course	Friday 7	Monday 10	Wednesday 12	Thursday 13	Friday 14
9:30-11:30	**Analysis** Johannes Gierlinger	**Probability** &Statistics Sarolta Laczó	**Analysis** Johannes Gierlinger	**Probability** &Statistics Sarolta Laczó	**Analysis** Johannes Gierlinger
12:00-14:00	**Analysis** Johannes Gierlinger	**Probability** &Statistics Sarolta Laczó	**Analysis** Johannes Gierlinger	**Probability** &Statistics Sarolta Laczó	**Analysis** Johannes Gierlinger
16:00-18:00		**Computation** Ezgi Kaya	**Computation** Ezgi Kaya	**Computation** Ezgi Kaya	

Course	Monday 17	Tuesday 18	Wednesday 19	Thursday 20	Friday 21
9:30-11:30	**Probability** &Statistics Sarolta Laczó	**Analysis** Johannes Gierlinger	**Probability** &Statistics Sarolta Laczó	**Analysis** Johannes Gierlinger	
12:00-14:00	**Probability** &Statistics Sarolta Laczó	**Analysis** Johannes Gierlinger	**Probability** &Statistics Sarolta Laczó	**Probability** &Statistics Sarolta Laczó	
16:00-18:00	**Computation** Ezgi Kaya	**Computation** Ezgi Kaya	**Computation** Ezgi Kaya	**Computation** Ezgi Kaya	

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)

   References:

   We are going to follow Osborne's Math Tutorial for the Analysis Review and the first three chapters of Stock and Watson for the Probability and Statistics Review. For those of you who would like to prepare before the classes start, here are the references:

   *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.

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 Unbiasedness, Consistency and Efficiency
- · Hypothesis Testing
- · The t-statistic and the p-value
- · Confidence Intervals

References:
*James H. Stock and Mark W. Watson, Introduction to Econometrics – 3rd Edition (2011), Prentice Hall. (Chapters 1-3)

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

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
   - Labelling 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)"
   - Postestimation commands

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

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