

# Refresher Course in Basic Mathematics and Statistics

## Course Outline

**Instructor:** Rebecca Stuart

**Place:** R.110, building A.-L. Breguet 2

### Daily schedule:

09:15-10:00 Lecture and discussion exercises

10:15-11:00 Lecture and discussion exercises

11:15-12:00 Lecture and discussion exercises

Lunch

13:15-14:15 Lecture and discussion exercises

### Topics

#### *Day 1: Single-variable calculus*

- Function forms
  - Geometric properties of functions (increasing or decreasing, concave or convex)
  - Exponential and logarithmic functions
- Differentiation rules and applications
  - Definition and rules
  - High-order derivatives
  - Composite functions and chain rule
- Extension to multi-variable functions
  - Partial derivatives
- Integration concepts and rules
  - Areas and definite integrals

#### *Day 2: Optimization*

- Unconstrained optimization
  - First and second order conditions
- Constrained optimization
  - Lagrange functions
  - Examples and interpretation of the results

### *Day 3: Probability*

- Basic definitions
  - Union, intersection, complement, and conditional probability
- Random variables
  - Probability mass and density functions
  - Cumulative distribution function
- Moments of a single random variable distribution
  - Mean
  - Variance and standard deviation
- Some common distributions
  - Normal distribution, student t-distribution, Chi-square distribution, F-distribution
- Distribution of several random variables
  - Joint probability
  - Conditional probability density function
  - Conditional mean and variance
  - Covariance and correlation

### *Day 4: Statistics*

- Population and random sampling
  - Sampling method
- Estimation of population mean and variance
  - Population mean
  - Population variance
- Confidence interval and p-value
  - Test statistic
  - Confidence interval
  - p-value
- Hypothesis testing
  - One-tail test
  - Two-tail test

### *Day 5: Introductory linear algebra and linear regression*

- Vector and matrix notation
- Basic operations
  - addition, subtraction, product
  - transpose
  - inverse
- Linear regression (OLS with one independent variable)

## References

- [BWA] Boslaugh, S. and Watters, P.A. (2008): Statistics in a Nutshell, 1st edition, O'Reilly.
- [CAR] Carter, Michael (2001): Foundations of Mathematical Economics, 1st edition, The MIT Press.
- [CIA] Chiang, Alpha C. (1984): Fundamental Methods of Mathematical Economics, 3rd edition, McGraw-Hill.
- [DOW] Dowling, Edward T. (2001): Introduction to Mathematical Economics, 3rd edition, Schaum's Outline Series, McGraw Hill.
- [HGL] Hill, R.C., Griffiths, W.E. and Lim, G.C. (2008): Principles of Econometrics, 3rd edition, John Wiley & Sons.
- [SBL] Simon, K. and Blume, L. (1994): Mathematics for Economists, 1st edition, W.W. Norton & Company.
- [SWA] Stock, J. and Watson, M. (2007): Introduction to Econometrics, 2nd edition, Pearson International Edition.
- [SH1] Sydsaeter, K. and Hammond, P. (2008): Essential Mathematics for Economic Analysis, 3rd edition, Prentice Hall.
- [SH2] Sydsaeter, K., Hammond, P., Seierstad, A. and Strom, A. (2008): Further Mathematics for Economic Analysis, 2nd edition, Prentice Hall.