# Syllabus for *Math Review and Computer Programming*

Fall 2018

(The material is subject to future changes.)

## Instructor:

Bowen Chen

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Office hours: MWF 1:00 – 2:00 pm at Waters Hall 331H

## Class Information

Time: 4:00 – 6:00 pm at weekdays from August $20^{th}$ to August $31^{th}$; MWF 4:00 – 6:00 pm from September $3^{rd}$ to September $14^{th}$ (tentative).

Location: Water's Annex 104 (tentative)

## Course Description:

The first part of the course aims to prepare the incoming graduate students with necessary knowledge in mathematics before they dive into the graduate-level economics courses. This part is, by design, a review of what you have learnt. Since both PhD and master's students are attending the course, the review would cover materials up to master's levels. Yet, much weight is placed on undergraduate levels of mathematics.

The second part of the course focuses on computer programming. This part aims to help the students with limited programming experience improve their programming skills that are very important to the graduate studies. We will cover three popular softwares: R, STATA and SAS. I will teach R and our guest lecturers, Tebilla Nakelse and James Mitchell, will teach STATA and SAS, respectively.

The course lasts for four weeks with 19 sessions in total. The course is **not** graded; and there will

no exam or homework assignment. Attendance is also not required, but it is strongly encouraged unless you are confident about your mathematical backgrounds or programming skills.

## Recommended Readings:

### 1. For Mathematics

(1) Introduction to Mathematical Economics, by Edward T. Dowling, 2012;

(2) Mathematics for Economists, by Carl P. Simon and Lawrence Blume, 1994.

### 2. For R

(1) An Introductory Note on R, by Bowen Chen (to be distributed before the class begins);

(2) R for Data Science, by Hadley Wickham and Garrett Grolemund, 2017 (available online);

(3) Advanced R, by Hadley Wickham, 2018 (available online).

### 3. For STATA

(1) Data Management Using Stata: A Practical Handbook, by Michael Mitchell, 2010;

(2) Introduction to STATA. UCLA: Statistical Consulting Group (online source: `https://stats.idre.ucla.edu/stata/`) .

## Course Outline:

### PART I. Mathematics

1. Warming up

Course review

2. Elementary algebra

Exponents and laws of exponents; Polynomials; Logarithm; Rules of algebra; Inequality; Fractions; Summation and product; Function; Graph

3. Calculus I

First-order derivatives; Rules for computing derivatives; Increasing and decreasing function; Differentiability and continuity; Linear approximation; Higher-order derivatives; Taylor expansion theorem.

4. Calculus II

Composite function and chain rule; Inverse function theorem; Convexity and concavity; Unconstrained optimization I

5. Calculus III

Partial derivatives; Partial and total differentials; Euler's theorem; Implicit function theorem; Gradient vector and Hessian matrix; Unconstrained optimization II

6. Calculus IV

Constrained optimization; Langrange multiplier.

7. Calculus V

Integrals; First-order differential equations

8. Linear Algebra I

System of equations; Matrix operations; Matrix inverse; Determinant; Rank

9. Linear Algebra II

Linear dependence; Hessian matrix and sign definiteness; Eigenvalues and eigenvectors

10. Linear Algebra III

Eigendecomposition; Trace; Matrix derivatives

## PART II. Computer Programming

11. Using R I

R basics – "Hello world"

12. Using R II

Data management – dplyr and tidyr

13. Using R III

Data visualization – plot and ggplot2

14. Using STATA I

Basics

15. Using STATA II

Statistics, Data management and visualization

16. Using STATA III

Regressions