

Nonparametric Econometrics*

Chandra Kiran Krishnamurthy

Department of Economics

Umeå University

chandra.kiran@econ.umu.se

Magnus Ekström

Department of Statistics

Umeå University

Magnus.Ekstrom@slu.se

Bengt Kriström

Dept. of Forest Economics

SLU Umeå

Yuri Belyaev

Mathematics and Mathematical Statistics

Umeå University

This is a graduate-level *first course* covering certain basic topics in non-parametric econometrics and resampling (bootstrap), suitable for students and researchers in a wide variety of fields (including economics, statistics/Bio-statistics/mathematical statistics, forest management, engineering). This course is designed primarily for *users* of non-parametric methods i.e. for researchers and students who plan to use these methods in their *applied* work. This is therefore a course aimed at individuals interested in using and understanding

1. non- and semi-parametric statistical methods, such as regression and density-, distribution- or quantile-estimation and nearest neighbour methods.
2. resampling methods and in, particular, the bootstrap, in the context of both parametric and non-parametric methods.

An added benefit for applied users is the focus on accommodating the practically important case of non-parametric estimation with mixed discrete-and-continuous data. Given

*Please email chandra.kiran@econ.umu.se and Magnus.Ekstrom@slu.se if you have any questions regarding the prerequisites or any other questions/concerns regarding the course.

the focus on *developing theory from an applications perspective*, this is a course designed to be useful for students and researchers who would like to learn methods for solving a problem they are currently working on.

The course aims at providing a broad theoretical understanding of the need for, and basic properties of, a few non-parametric statistical methods. In addition, some **basic** ideas regarding implementation (in the **R** programming environment) of a few methods will be illustrated. In this course, kernel-based methods will be the primary tool for exposition. However, some discussion will be provided of a few alternative methods (especially nearest neighbour methods) and many optional readings will be provided on these alternatives. Most of the material covered is standard material from non-parametric statistics, and the only “Econometrics” aspect of the course is the choice of the topics covered and the orientation of the course.

This course will proceed like many Econometrics courses, with theoretical developments discussed first before a basic application or two are discussed briefly. Depending on audience interests, we will cover a few non-econometric applications (for instance, applications in forest resources and bio-statistics, among other fields)¹. In keeping with the Econometrics orientation, we will also discuss derivative estimation, the non-parametric analogue of the “regression coefficient”.

This being a graduate methods course, for the main methods developed we will study some asymptotic properties, although **not** in great detail. Inference in the non-parametric context will also be covered, with resampling (in particular, the bootstrap) being the main method studied. A somewhat thorough treatment of the bootstrap will be given; the use of the bootstrap in a variety of parametric regression settings will also be covered.

Course main content

1. Basic notions in probability, statistics and statistical data
2. Non-parametric density estimation
3. Non-parametric regression
4. Derivative estimation
5. Density and regression with mixed data
6. Nearest neighbour methods
7. Semi-parametric regression
8. Resampling and bootstrap inference

¹Please also note that, for the computer application/project, you are encouraged to use your own data to solve *your own* research problems. This course can, therefore, help you move ahead with your own research.

Learning Outcomes

On completion of the course, the students shall:

- have developed a basic understanding of the set up and language of non-parametric econometric methods, with particular focus on density estimation and regression
- have developed an understanding of the basic mechanics of asymptotic properties of certain non-parametric econometric methods (with particular focus on density estimation and regression)
- have acquired an ability to understand the basic numerical issues involved and to solve (estimate) basic non-parametric methods in any software package (preferably in the R package)
- have developed an ability to understand the need for, benefits of, resampling methods, in particular, the bootstrap
- have acquired some idea about the validity of the bootstrap and its use and implementation, in certain regression settings

Prerequisites

It is *desirable* that the prospective students have knowledge corresponding to basic (at the Master's level) university courses in Probability and Statistical Inference/Mathematical Statistics; some familiarity with Generalized Linear Models and with Maximum Likelihood methods would be still more useful. As an illustration, graduate-level courses in Econometrics (corresponding to Econometrics I and II) are necessary for students from the Economics departments. Familiarity with the R package (or a willingness to learn the basics of R rather speedily) is also desirable.

Since it is not possible to enumerate the list of courses which can be said to satisfy the prerequisites, prospective students are invited to e-mail the instructors if they are uncertain about the needed background. In any case, prospective students should feel free to email the instructors regarding any course-related questions.

Literature

The full course literature will be announced later, but the important reference books are likely to be the two below. Please note that, for certain topics, lecture notes will be provided which elaborate and simplify the material in the text book. Only a few chapters each of the following two books will be covered:

1. Li, Q., & Racine, J. S. (2011). Nonparametric econometrics: Theory and practice. Princeton University Press.

2. Pagan, A., & Ullah, A. (1999). Nonparametric econometrics. Cambridge University Press.

Schedule and Grading

Although the exact start and end dates will be announced later, the course is tentatively scheduled for 10 weeks (approx. 18 lectures, meeting twice a week), starting in September. The course will count for 15 HP.

Tentatively, grading will be based on three exams; a theoretical exam at the end of 3-4 weeks, covering the basics; an applied exam (including a computer assignment) or a small research project and a final exam/project at the end of the course. The precise details of the third (final) exam will be announced after discussion with the students but the intention will be to accommodate participants who wish to work on their own research project. Some of the exams (especially exams 2 and 3) *may be* of the take-home variety (i.e. participants will have a few days to finish the exam, and can do it at home); the details will also be announced after a discussion with the participants. The total grade will be based on the (weighted) average grade of the three exams.

Please E-mail [Chandra](#) And [Magnus](#) If You Are Interested In Enrolling For The Course Or Require Any Information Regarding The Course.