An introduction to Stein's Method

7 1/2 hp

Course period:

1st reading period,

Last day for application: None specified

Course leader / Address for applications:
Kaspar Stucki / stucki@chalmers.se

Course description (Advertisment for Ph.D. students)

Stein's method goes back to the sixties when Charles Stein found a clever way to provide errors in the approximation by the normal distribution of the distribution of the sum of dependent random variables of a certain structure. However, his ideas are sufficiently abstract and powerful to be able to work well beyond that intended purpose, applying to approximation of more general random variables by distributions other than the normal (such as the Poisson, exponential, etc). Since then Stein's method has evolved a lot and has been recently used in many hot research areas, such like random matrices, random graphs or point process theory.

Basically Stein's method can be used in every field of probability theory where one wants to proof a limit theorem. The aim of this course is to give a introduction to this powerful method and provide examples how Stein's method can be applied to various problems.

In the first part we cover classical normal and Poisson approximation and proof a Berry-Esseen type central limit theorem. Then we will introduce the so-called "generator approach" which allows basically to approximate any given random variable or even any random object.

A second part is about Poisson point process approximation. We will start with some baisc point process theory and then apply the generator approach to this specific problem. Basically we provide error bounds for replacing a given point process with a Poisson process.

If there is time left, we can cover other topics according to the wishes of the students.

During the course there will be home work assignments. At the end of the course there will be an oral exam.

Will meet once a week for two hours.

Mathematics Department

Teachers:
Kaspar Stucki

Examiner: Kaspar Stucki

Faculty of Science; Department of Mathematical Sciences

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1. Confirmation

The syllabus was confirmed by the Head of the Department of Mathematical Sciences 2015-08-28.

Disciplinary domain: Science
Department in charge: Department of Mathematical Sciences

2. Position in the educational system

Elective course.

3. Entry requirements

None.

4. Course content

Normal approximation, Berry-Esseen type central limit theorems, Poisson apporximation, generator approach to Stein's method, application of Stein's method to spatial statistics (Poisson point process approximation, central limit theorem for Poisson functionals)

5. Outcomes

After completion of the course the Ph.D. student is expected to be able to,

- Understand the concept of Stein's method.
- Be able to proof limit theorems for possibly dependent random variables.
- Know some basics of point process theory and understand how Poisson point process approximation works.

6. Required reading

The main source will be the book " *An Introduction to Stein's Method*. Singapore Univ. Press, Singapore. (2005)" by BARBOUR, A. D. and CHEN, L. H. Y., and the lecture notes "Fundamentals of Stein's method" by Nathon Ross (http://arxiv.org/pdf/1109.1880v1.pdf).

7. Assessment

Passing grade requires a passing grade on the homeworks and the final oral exam as well as class attendance. The final oral exam is individual. It will be jointly scheduled so there is no absense issue.

A Ph.D. student who has failed a test twice has the right to change examiners, if it is possible. A written application should be sent to the Department.

In cases where a course has been discontinued or major changes have been made a Ph.D. should be guaranteed at least three examination occasions (including the ordinary examination occasion) during a time of at least one year from the last time the course was given.

8. Grading scale

The grading scale comprises Fail, (U), Pass (G)

9. Course Evaluation

The course evaluation is carried out together with the Ph.D. students at the end of the course, and is followed by an individual, anonymous survey. The results and possible changes in the course will be shared with the students who participated in the evaluation and to those who are beginning the course.

10. Language of instruction

The language of instruction is English.