FSF3940 Probability 7.5 credits

Sannolikhetsteori

This is a translation of the Swedish, legally binding, course syllabus.

Establishment

Course syllabus for FSF3940 valid from Spring 2014

Grading scale

G

Education cycle

Third cycle

Specific prerequisites

A Master's degree in mathematics, applied mathematics or related field including at least 30 ECTS in mathematics. Recommended courses are SF2940 Probability theory and SF2743 Advanced real analysis I.

Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

Intended learning outcomes

After completing the course students are expected to

- explain the foundations of probability in the language of measure theory,

- state the strong law of large numbers and give an outline of its proof
- have a basic knowledge of other 0-1 laws in probability
- have a working knowledge of weak convergence, characteristic functions, and the central limit theorem,
- give examples and applications of the strong law of large numbers and the central limit theorem,
- explain the concepts of recurrence and transience of random walks,
- explain the content of the Radon-Nikodym theorem and give an outline of its proof,
- explain the concept of conditional expectation, its properties and applications
- give an introduction to discrete time martingales and the martingale convergence theorem
- give examples and applications of martingales
- be able to solve basic problems related to the theory

Course contents

Probability is the mathematical theory for studying randomness and is one of the fundamental subjects in applied mathematics.For a rigorous treatment of probability, the measure theoretic approach is a vast improvement over the arguments usually presented in undergraduate courses. This course gives an introduction to measure theoretic probability and covers topics such as the strong law of large numbers, the central limit theorem, conditional expectations, and martingales. It is expected, but not required, that students have had some exposure to measure theory prior to taking this course. Students will practice by studying applications and solving problems related to the theory.

Disposition

The course will consist of roughly bi-weekly discussion meetings (not standard lectures) where students present and discuss the material as well as some weekly exercises. The topic for each meeting is given below. Any of the books mentioned above can be used. The last two books are quite technical and perhaps not as accessible as the first six.

1. Measur and Integration (sigma-field, measure, integration)
2. Random variables, Expected Value, Independence
3. The Law of Large Numbers (Borel-Cantelli, 0-1 Laws, Applications)
4. The Central Limit Theorem (Generating Functions, Weak Convergence, Applications)
5. Random Walks (Recurrence, Transience)
6. Conditional Expectation (Radon-Nikodym Theorem, existence, properties)
7. Martingales (Martingale Convergence, Applications)

Course literature

1. Rick Durrett, Probability: Theory and Examples, 4th Edition, Cambridge Series in Statistical and Probabilistic Mathematics, 2010. ISBN 9780521765398

2. Jean Jacod and Philip Protter: Probability Essentials, Corrected Second Printing, Springer Verlag, 2004. ISBN 3-540-43871-8
3. Sid Resnick, A Probability Path, Birkhäuser Boston, 5th printing, 2005.
4. Allan Gut, Probability: A Graduate Course, Springer, 2005.
5. David Pollard, A User's Guide to Measure Theoretic Probability, Cambridge University Press, 2002.
6. Patrick Billingsley, Probability and Measure, 3rd Edition, Wiley.
7. Daniel Stroock, Probability: An Analytic View, 2nd Edition, Cambridge University Press, 2011.
8. Olav Kallenberg, Foundations of Modern Probability, 2nd Edition, Springer, 2002.

Examination

Based on recommendation from KTH's coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

If the course is discontinued, students may request to be examined during the following two academic years.

The examination will be done as a combination of homework and oral exam.

Other requirements for final grade

Hemwork and oral exam

Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.
- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.