READING PROJECTS

WRITTEN REPORTS AND TALKS

1. Aim of the projects

We will further explore some aspects of martingales, ergodic theory and Brownian motion, by reading and explaining some classical textbooks or articles. Here is the outline of the proposed work:

(1) Choose among the topics below, and read about the chosen subject in one of the references of the bibliography (or any good book on stochastic calculus).
(2) Explain your topic, giving some details for the proofs, in Latex format. This should yield a document between 5 and 10 pages long. Attention should be paid to redaction.
(3) Prepare a Beamer presentation of your topic. Those presentations should fulfill the following criterions:
   - The exposition should be 30mn long.
   - No more than 20 slides are allowed.
   - Be able to read everything written on your slides, including formulas.
   - Give an overview of your topic before getting into technical details.

The projects will be realized in groups of 2 or 3 persons.

2. Topics list

Here is a possible choice of questions which can be raised:

2.1. **Martingales.**

- Discrete models in finance.
- Polya's urn models.
- Branching processes.

2.2. **Ergodic theorems.**

- Breuer-Major for Gaussian stationary sequences.
- Expand Khoshnevisan's paper *Normal numbers are normal*, including a couple of proofs.
- Subadditive ergodic theorem and application to a discrete model (increasing subsequence, first passage percolation).
- Shuffling cards and random walks on groups.

2.3. **Brownian motion.**

- Brownian motion and its maximum.
- Nowhere differentiability of Brownian motion.
- Modulus of continuity of Brownian motion.
- Hausdorff dimension of the Brownian curve.

2.4. **Itô's formula.**

- Martingale moment inequalities.
- Girsanov's theorem.
- Local time and Tanaka's formula.

Bibliography:

(1) R. Durrett: Stochastic calculus. A practical introduction. Probability and Stochastics Series. CRC Press, 1996.
(2) I. Karatzas, S. Shreve: Brownian motion and stochastic calculus. Second edition. Graduate Texts in Mathematics, 113. Springer-Verlag, 1991.
(3) D. Revuz, M. Yor: Continuous martingales and Brownian motion. Third edition. Springer-Verlag, 1999.