

READING PROJECTS

WRITTEN REPORTS AND TALKS

1. AIM OF THE PROJECTS

We will further explore some aspects of Brownian motion, stochastic differential equations and applications to machine learning, 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 about 10 pages long. Attention should be paid to redaction. Keep AI input to a minimum.
- (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. Slides should not be overloaded.
 - 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 4 persons.

2. TOPICS LIST ON FUNDAMENTAL TOOLS IN STOCHASTIC CALCULUS

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

2.1. Brownian motion.

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

2.2. Itô's formula.

- Martingale moment inequalities.
- Girsanov's theorem.
- Local time and Tanaka's formula.
- Recurrence and transience of Brownian motion.

2.3. Stochastic differential equations.

- Black-Sholes formula and related topics in mathematical finance.
- Weak solutions.
- One dimensional diffusions.
- Linear equations.

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) Lamberton, Damien, and Bernard Lapeyre. Introduction to stochastic calculus applied to finance. CRC press, 1996.
- (4) D. Revuz, M. Yor: Continuous martingales and Brownian motion. Third edition. Springer-Verlag, 1999.