Probabilistics methods in finance (cours en anglais)

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Objectifs: Option pricing in discrete and continuous time, with martingales use and first steps of stochastic calculus.

Chapter I. Preliminaries

1. Derivative products, description and use: Forward/Future contracts, Options
2. Rates and discounting
3. Arbitrage methods

Chapter II. Forward contracts pricing (reminder, in tutorial)

Chapter III. Mathematical tools

Conditional expectation, martingale.

Chapter IV. Option pricing in discrete time

General N periods model, with d risky assets: self-financing strategies, No arbitrage opportunity property and Equivalent Martingale Measures, complete markets and option pricing.

N periods Binomial model (Cox-Ross-Rubinstein, risk-neutral probability, option pricing, delta hedging.

Chapter V. Option pricing in continuous time: Black-Scholes model

1. Brownian motion and Ito processes. Quadratic variation of the Brownian motion, Ito integral for a simple process, extension to the computation of BtdBt, Ito lemma (heuristic proof).
2. Black-Scholes model
Partial differential equation approach, hedging from that equation.
Probabilistic approach for European options, Girsanov theorem (particular case), Black Scholes formula, delta computation, use.

Références:

 J. Hull, *Options, futures, and other derivative securities*, Prentice-Hall (2018: 10th ed).

Baxter, M. and Rennie, A., Cambridge University Press, 1996.

Kwok, Y.K., *Mathematical models of financial derivatives*, Springer, 2nd edition, 2008 (3 first chapters).

Jacod, J., Protter, P. (2000) *Probability Essentials*. Springer.