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Introduction to pricing and hedging of contingent claims

This syllabus is subject to change based on the needs of the class

Course Description

This course is an introduction to the valuation of financial derivatives. We start from a discreet setting and define important notion such as the absence of arbitrage opportunity and self financing portfolio. Simultaneously, we will introduce vanilla contracts: forward, futures European vanilla option and motivate their existence as risk mitigating tools. In this framework, we will study a fundamental family of pricing algorithm: the multinomial tree. Next we will focus to continuous time model. We first introduce the notion of continuous time stochastic process, martingales and Markov Chains. We will illustrate those notion with the rudimentary example of the Brownian motion. This will help us in defining the notion of stochastic integration underlying Ito's calculus. With those tools in hand we will be able to tackle the Black Scholes model thus defining the notion of Greeks and motivating their use in risk management. The last part of this course will focus on practical aspect of Black and Scholes formula: its robustness with respect to the volatility parameter, how it can be used to calculate a hedging strategy and measure implied volatility.

Prerequisites

Bachelor level in probability, analysis and linear algebra. No a priory knowledge in finance is needed.

Recommended reading

Hull J. C. (2018), Options, Futures, and Other Derivatives. Lamberton D., Lapeyre B. (1996) Introduction to Stochastic Calculus Applied to Finance, Second Edition. Ben Tahar I., Trashorras J., Turinici G., (2016) Élements de Calcul Stochastique pour l'Évaluation et la Couverture des Actifs Dérivés.

Course Objectives

At the completion of this course, students will be able to:

1. have a comprehensive understanding of simple financial derivatives: forward, futures, European vanilla option.
2. be able to implement binomial tree for derivative pricing.
3. have a comprehensive understanding of continuous time stochastic processes: continuous time Markov chains and martingales.
4. be able to derivate the Black Scholes formula from simple hedging argument and use it as risk management tool.
5. implement PDE and Monte carlo methods in the Black and Scholes framework.