



FRE-GY 6141

Static and Dynamic Hedging

Fall 2024

Mondays, 2:00 pm to 4:40 pm
6 MetroTech, Room 214

Instructors

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Course Overview

This elective course was designed by our beloved colleague Prof. Peter Carr. He made profound research contributions in this area (and in many other important domains of quantitative finance) and always shared his expertise with enthusiasm and dedication. It is an honor to teach this class as an expression of our deep affection and respect for Peter.

In the Black-Scholes framework (asset-price returns are normally distributed with constant variance per unit time), pricing European-style derivatives follows from the (risk-adjusted) distribution at expiry of the underlying asset price. Pricing a derivative with an exotic payoff

(for instance, the contract paying the delivered variance of daily returns) invokes the same distribution as a derivative with a “plain-vanilla” payoff: the density just gets integrated against a different function of the at-expiry asset price. This suggests that, for valuation purposes, plain-vanilla derivative prices “frame” the prices of exotics. And again, within the confines of the Black-Scholes assumptions, the exotic’s “Greeks” can be extracted (sometimes semi-analytically).

Naturally arising questions:

- Even if plain vanillas can be used to price out the exotic, to what extent do we have a replication that’s statically achievable? Thankfully (for the development of intuition) many of the exotic structures we examine for the implications (and complexity) of dynamic vs. static replication are derivatives that materialize from actual end-user trading/hedging activity.
- Suppose that the pricing information given “by the market” (prices of the plain-vanillas) does not align with the Black-Scholes assumptions. For example, say we observe, for some expiry, a skew in the implied volatility profile across strikes. Do we revisit the parametric set-up and choose a different SDE for the asset price?
- Suppose we settle on a different underlying process. Are there “tricks of the trade” in understanding the updated sensitivities, such as delta and vega? Can we explain in “ground-level” terms why the sensitivities get changed?
- Can we get traction just from the market information (without selecting a different stochastic process)?
- Which exotics are most sensitive to the “internal dynamics” of the price process? For which exotics can two models (say “local vol” and “stochastic vol”) that “line up the same” for all plain vanillas produce significantly different prices, or similar prices but different delta?

We will take a hands-on, somewhat intuitive, approach in this class. We will try to keep an ongoing connection to actual market situations and spend some time in motivating some of the product types.

Prerequisites

Course in derivatives pricing (such as FRE-GY 6073).

Toolkit of stochastic calculus; intuition for its use.

Homework

Two homework assignments. Collaboration is encouraged.

Review Sessions

We will hold weekly review sessions (via Zoom).

Inclusion Statement

The NYU Tandon School and the Department of Finance and Risk Engineering value an inclusive and equitable environment for all our students. We hope to foster a sense of community in this class and consider it a place where individuals of all backgrounds, beliefs, ethnicities, national origins, gender identities, sexual orientations, religious and political affiliations, and abilities will be treated with respect.

It is our intent that all students' learning needs be addressed both in and out of class, and that the diversity that students bring to this class be viewed as a resource, strength, and benefit. If this standard is not being upheld, please feel free to speak with us at any time.