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Options Markets

FIN 890, Fall 2021 (Wednesdays, 2-4pm)

• Overview

- This class will provide an overview of the stock market and the bond market before going into the options market. The discussions will take the perspective of a quantitative investor who strives to identify above-average investment opportunities from each market through quantitative systematic analysis of security valuation and risk-return factor structures. The discussions of different security valuation frameworks serve the purpose of identifying mispricing opportunities. The discussions of researches on the risk-return factor structures serve the purpose of constructing robust covariance matrix and identifying average factor risk premiums for portfolio construction.

Before I get into the discussion of option valuation models and option investment return risk structures in the second half of this semester, I will use the overview of the stock market to fix ideas on the general systematic investment perspective, and use the overview of the bond market to introduce some mathematical background that will prove useful for the subsequent option valuation.

• Class formats and requirements

- Each student is required to write two short term papers. The term papers can start with a literature review, but ideally end with some critique, synthesis, and some proposals for new ideas or enhancements. At least one of the term paper needs to have empirical analysis with real data. To facilitate collaboration but to avoid free riding, each term paper can be jointly written by two students.
- Potential perspectives/topics for the term papers:
 - Review the literature on valuation model or return risk structure for a particular market, propose a new valuation model or return structure (some innovation in theory, estimation, or implementation details). Highlight its advantage relative to the literature benchmark via a backtest and comparison of investment performance.

• Class outline

- [An overview of investment considerations](#)
 - Grinold and Kahn: *Active Portfolio Management*
- [Stock valuation](#)
 - Penman: *Accounting for Value*
 - Structural models: [Ye \(2009\)](#), [Penman & Sougiannis \(1998\)](#), [Gebhardt, Lee, Swaminathan \(2001\)](#).
 - Multiples: [Liu, Nissim, Thomas \(2002\)](#), [Schneider \(2007\)](#).
 - Statistical: [Hu, Sy, Wu \(2021\)](#).
- [Stock return analysis](#)
 - Pricing models that link expected returns to risk exposures: CAPM, APT, ...
 - Fama-French style empirical analysis
 - Risk models: [Barra](#)
- [Bond pricing: Dynamic term structure models](#)
 - Tuckman & Serrat, *Fixed Income Securities*

- Theory ([Duffie&Kan\(1996\)](#)), statical arbitrage trading ([Bali,Heidari,Wu \(2009\)](#), [Duarte,Longstaff,Yu \(2007\)](#))
- [Bond return analysis](#)
 - A decentralized pricing theory: [Carr&Wu\(2021\): Decomposing long bond returns](#)
 - Empirical bond return predictions: Yield curve slope (Fama&Bliss (1987), Campbell&Shiller(1991)); yield curve shape (Cochrane&Piazzesi (2005)); Macroeconomic variables (Cooper&Priestley(2009), Ludvigson&Ng(2009), Cieslak&Povala(2015), Greenwood&Vayanos(2014)); Econometric challenge (Gargano,Pettenuzzo,Timmermann (2017)); Machine learning (Bianchi,Buchner,Tamoni(2021))
- [Options valuation](#)
 - Hull: *Options, Futures, and Other Derivatives*
 - Stock return variance prediction
- [Options return analysis](#)
 - Return factor structures: [Meng&Wu\(2021\): Limits of arbitrage and primary risk taken in derivative securities](#)
 - Variance risk premium: [Carr&Wu\(2009\)](#)
- [Corporate bond](#)
 - Structural valuation models: Merton (74), Leland&Toft (1996). Implementation: KMV, Bharath&Shumway (2008), Duan,Sun&Wang (2012)
 - Statistical valuation: [Bai&Wu\(2016\)](#)
 - Corporate bond return risk structures: [Ning](#)
- [Second-generation option pricing models](#)
 - Technical background: [From characteristic functions and Fourier transforms to densities and option prices](#)
 - Zemanian: *Distribution Theory and Transform Analysis*
 - Sample code for [fft](#) and [Fourier-cosine series expansion](#)
 - Carr and Madan, 1999, [Option Valuation Using the Fast Fourier Transform](#), *Journal of Computational Finance*, 2(4), 61--73.
 - Chourdakis, 2005, [Option pricing using fractional FFT](#), *Journal of Computational Finance*, 8(2), 1--18.
 - Fang and Oosterlee, 2008, [A novel pricing method for European options based on Fourier-cosine series expansions](#), *SIAM Journal on Scientific Computing*, 31 (2), 826-848.
 - [Levy process to model security returns](#)
 - Bertoin: *Levy Processes*
 - Sato: *Levy Processes and Infinitely Divisible Distributions*
 - Merton, 1976, [Option Pricing When Underlying Stock Returns Are Discontinuous](#), *Journal of Financial Economics*, 3(1),125-144.
 - Carr, Geman, Madan, Yor, 2002, [The Fine Structure of Asset Returns: An Empirical Investigation](#), *Journal of Business*, 75(2), 305--332.
 - Madan, Carr, Chang, 1998, [The Variance Gamma Process and Option Pricing](#), *European Finance Review*, 2(1), 79--105.
 - Carr and Wu, 2003, [Finite Moment Log Stable Process and Option Pricing](#), *Journal of Finance*, 58(2), 753--777.
 - Wu, 2006, [Dampened Power Law: Reconciling the Tail Behavior of Financial Security Returns](#), *Journal of Business*, 79(3), 1445--1474.
 - [Stochastic time changes to capture stochastic volatilities and skews](#)
 - Jacod and Shiryaev: *Limit Theorems for Stochastic Processes*
 - Kuchler and Sorensen: *Exponential Families of Stochastic Processes*
 - Carr and Wu, 2004, [Time-Changed Levy Processes and Option Pricing](#), *Journal of Financial Economics*, 17(1), 113--141.
 - Heston, 1993, [A Closed-Form Solution for Options with Stochastic Volatility, with Application to Bond and Currency Options](#), *Review of Financial Studies*,

- 6(2), 327--343.
- Bates, 1996, Jumps and Stochastic Volatility: Exchange Rate Processes Implicit in Deutsche Mark Options, *Review of Financial Studies*, 1996, 9(1), 69--107.
 - Huang and Wu, 2004, [Specification Analysis of Option Pricing Models Based on Time-Changed Levy Processes](#), *Journal of Finance*, 59(3), 1405--1439.
 - Carr and Wu, 2007, [Stochastic Skew in Currency Options](#), *Journal of Financial Economics*, 86(1), 213--247.
 - Bakshi, Carr, and Wu, 2008, [Stochastic Risk Premiums, Stochastic Skewness in Currency Options, and Stochastic Discount Factors in International Economies](#), *Journal of Financial Economics*, 87(1), 132-156.
 - [Model estimation and statistical arbitrage trading](#)
 - Simon: *Optimal State Estimation: Kalman, H Infinity, and Nonlinear Approaches*
 - Decentralized option pricing
 - [Carr&Wu \(2020\): Option P&L attribution](#)
 - [Carr&Wu \(2016\): Option breakeven variance](#)

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