**Spring 2017**

**Fixed Income Quantitative Trading (FRE-GY-6971, half-semester, 7 lectures)**

**Instructor**: Prof. Edith Mandel (edith.mandel@nyu.edu)

**Outline**:

The objective of this course is to introduce term structure modeling as an important toolkit for quantitative trading in fixed income. This course will offer a thorough presentation of how state space models are used in quantitative trading applications in liquid fixed income markets.

We will derive and implement dynamic models with corresponding valuation analytics, estimate model parameters with actual historical and intra-day data, formulate and test alpha signals and apply appropriate risk measures. Students will learn to translate theoretical knowledge into a tangible output via programming assignments and a final project.

**Prerequisites**:

FRE-GY-6411

Working knowledge of statistics, data analysis, Python & Jupyter Notebooks is recommended

**Course Grading:**

* Homework Assignments: 50%
* Class Participation 10%
* Final Project: 40%

**L1 Introduction & Definitions, 3/28/17**

* Liquid interest rate markets: bonds, Eurodollars, bond futures, interest rate swaps, swap futures
* Trading platforms: exchanges, interdealer platforms, RFQ venues, SEFs
* Market specifics: central clearing, economic data releases, initial and variation margin, sparse trading activity, order matching engines (FIFO & Pro-rata)
* Introduction to Fixed Income Quant Trading
  + Modeling relationships in the market

**L2 Historical Factor Models (HFM), 4/3/17**

* Introduction to state space modeling & HFM
* Canonical correlation analysis (CCA) in quantitative trading
* Estimating coinegrated relationships
* Constructing small cointegrated portfolios

**L3 HFM & Mean-Reversion Strategies, 4/10/17**

* HFM (PCA&CCA) & factor-based risk-management approach
* Detecting structural breaks & model parameters changes
* EMA, regime-switching models & instability testing

**L4 Term Structure Models (TSM), 4/17/17**

* Risk neutral and physical probability measures
* Equilibrium & arbitrage-free specifications
* General Affine Model (GAM)
  + Pricing capabilities for liquid interest rate products
* Link between HFM & TSM
* Link between Nelson-Siegel & TSM

**L5 Estimation of state space models with historical and intra-day data, 4/24/17**

* Dynamic properties of models suitable for quantitative trading
  + What makes a good model?
  + State vector specifications
* Estimation approaches
  + Quasi maximum likelihood
  + Non-linear iterative LSQ
  + TSM & Kalman filter
* Collinearity & high-frequency noise

**L6 Quantitative Trading in the Eurodollar futures market, 5/1/17**

* Market overview
* Order matching: Pro-rata with ‘Top’
  + Optimal order sizing & risk-management
* Implied & hidden liquidity
  + Solving for additional liquidity to improve execution

**L7 Signal analysis & trading strategies when your data is not ‘Big’, 5/8/17**

* Model-based forecasting & signals
* Signal research framework
  + Definitions & implementations
  + Commonly used metrics of signal quality
  + Testing & validation
* Portfolio construction
* Building a backtest