**ISyE8900 Project Proposal**

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**Introduction**

In this project, we implement a nonparametric approach for modeling curves in the FICC market using various manifold learning methods. The main focus will be the following three original curves and two spread curves derived from the former: US Treasury Zero (Forward) Rate Curve, 3-month US LIBOR Zero (Forward) Rate Curve, 3-month SOFR Zero (Forward) Rate Curve; Swap Spread (LIBOR - Treasury), Basis Spread (LIBOR - SOFR). If time permits, will explore more interesting term structures in the FX markets.

**Literature Review**

**Problem formulation and Application**

Fetching or bootstrapping curves:

From the FEDNY website, we get the functional parameters of the Nelson-Siegel-Svensson structural models for Treasury instantaneous forward rates. Then, by simple bond math, we could construct the zero rate curves for any maturities by plugging the maturity index into the zero rate expression.

The data format should be daily data with continuous maturity spectrum from 1m to 30y (360 dimensions). To make it consistent with the following two curves, we re-sample it to get a weekly dataset with discrete maturity spectrum from 3m to 30y (120 dimensions).

For the LIBOR and SOFR curves, we directly download them from Bloomberg terminal by manually changing “As of Date” variable. If time permits, we will replicate the whole curve bootstrapping pipeline to get these curves using market instruments prices (deposits, futures/forwards, swaps).

Dimension deduction:

Start from baseline classical methods (PCA), then move to advanced methods according to the survey presentation published by Dr. Huo in 2004: semi-classical methods (MDS), manifold searching methods (LLE).

Time series forecasting for each univariate low dimensional coordinate:

Start from ARIMA family models, then add Kalman filter or more general state space models to refine and finalize this AR type forecasting engine.

**Results**

**Discussion**

**References**

[1] Ametrano F M, Bianchetti M. Everything you always wanted to know about multiple interest rate curve bootstrapping but were afraid to ask[J]. Available at SSRN 2219548, 2013.

[2] Chen J, Deng S J, Huo X. Electricity price curve modeling and forecasting by manifold learning[J]. IEEE Transactions on Power Systems, 2008, 23(3): 877-888.

[3] Huo X, Ni X S, Smith A K. A survey of manifold-based learning methods[J]. Recent advances in data mining of enterprise data, 2007: 691-745.