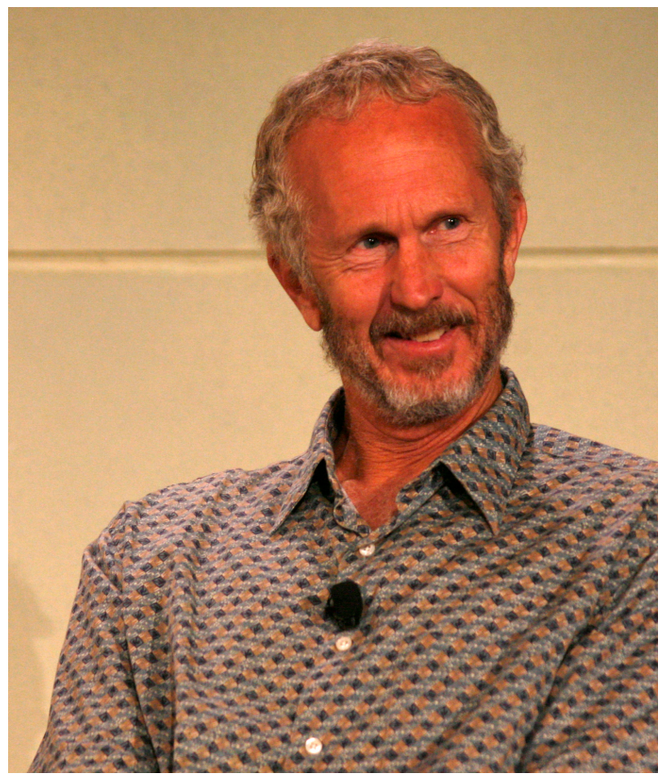
# Using AI to Interpret Financial Data for FinTech Apps

Jonathan Mostovoy
University of Toronto



Left: Beating the Casino - before the Prediction Company
Top right: Norman Packard, bottom right: J. Doyne Farmer

# The Prediction Company

Mathematics
UNIVERSITY OF TORONTO

- 15 years spent working on chaos theory

- Therefore understood how complex systems work, how to use computers for analysis, and at ease with fat-tailed distributions

- Strategy: extract small amounts of information from a great deal of noise

- In particular: Black boxes used to discover how the performances of different industries are intertwined.

- Risk-adjusted return 100x better than S&P 500 from 1991-2016

# RiskLab Toronto

Mathematics
UNIVERSITY OF TORONTO

- RiskLab is a research laboratory at the University of Toronto

- Est. 1996 by Professor Luis Seco

- Pioneer advances in risk & asset management, create spin-off companies, and grown to RiskLab Global

- Originating in Mathematics, now multiple-disciplinary

- Central theme for 50% of projects today: Uncover & interpret unusual financial inter-dependencies

# Mathematical Theory of Exotic, Volatile, & Fragmented Markets

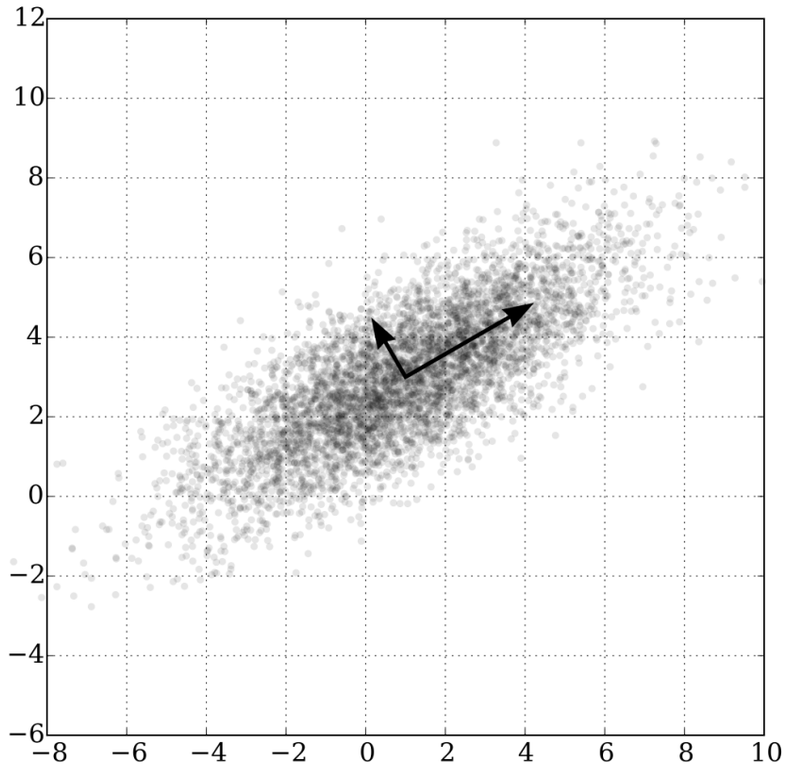
Mathematics
UNIVERSITY OF TORONTO

- A follow up to a 2018 RiskLab paper which achieved pairwise pricing in numeraire-free markets last year.

- Now: investigate properties of “asset-classes”.

- Use Principal Component Analysis, KPCA, & Spectral Clustering to create stable big-data measures on market cohesion.

- Able to define empirically if group of assets is “an asset class”.



# Optimal Allocation Strategy I

Mathematics
UNIVERSITY OF TORONTO

- In a 2013 paper, Prof Seco et. al. studied different asset allocation methodologies and found a link between market conditions and comparative performance.

- First Idea: Use stochastic cohesion-metric spaces for asset representations at any given time

- Compare relative performance of 1/N allocation, minimum variance, and equal risk contribution portfolios

- Found direct link using ML models between current market representation in metric spaces and optimal allocation strategy.

- Directly applicable for institutional investors

# Optimal Allocation Strategy II

Mathematics
UNIVERSITY OF TORONTO

- Second Idea: Use neural-networks to create “financial embeddings” (and induce a metric space) for assets.

- Then proceed as before: train second ML model to understand connection between financial embedding & optimal allocation at a given time

- Again, found significant connection between market representation & optimal allocation

- Conclusion: Comparative performance of allocation strategy is a function of market representation

# Optimal Currency Hedging

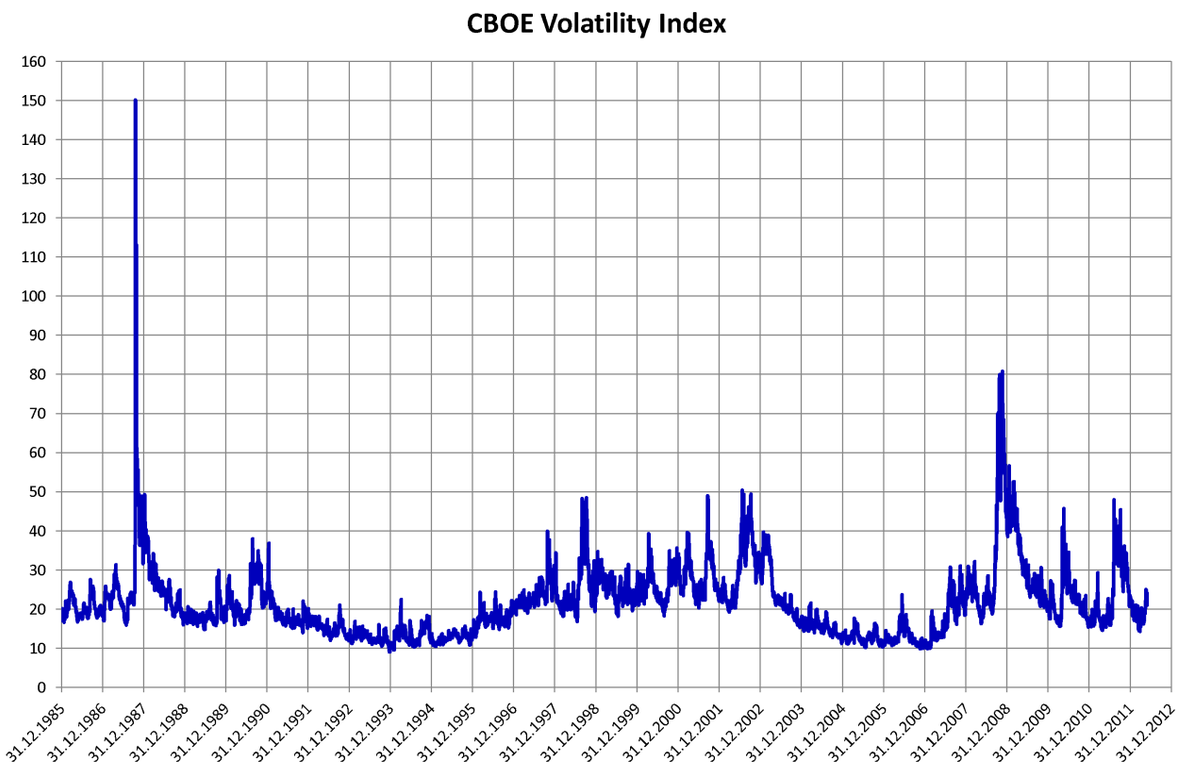
Mathematics
UNIVERSITY OF TORONTO

- Another application:
- To hedge FX risk, one buys an FX swap for the notional at risk.
- However, non-optimal performance if assets are correlated with FX.
- Idea: understand different types of dependencies, and separate time series into two - one not to hedge.
- Classical: GARCH, weak-GARCH, & Markov-switching
- New: random forests

# ML VIX Carry Trades

Mathematics
UNIVERSITY OF TORONTO

- Model the term structure of the VIX with the same tools
- Understand dependencies of VIX term structure on other factors and assets in data-set training fashion
- Define trades via the features extracted using this analysis
- Black box trades



# Further Projects

Mathematics
UNIVERSITY OF TORONTO

- Environmental, social, & governance (ESG) Scores via natural language processing on twitter data

- Reverse engineering ML models - studying the effectiveness of replicating models available via API to generate additional data-sets & the economic impact.

- Pricing asian options on jump diffusion processes - to insure against manipulation for exotic, fragmented, and volatile markets