

# Machine Learning in Quantitative Finance



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Quantitative finance comprises the use of (mostly) mathematical and statistical models and algorithms to solve problems in finance like

- derivatives pricing and hedging
- portfolio allocation
- risk management

# Why machine learning in quantitative finance?

- Financial industry is rich in data
- ML can help solve problems where explicit modelling is too hard
- ML can help speed up processes that are too slow

## Examples of machine learning tasks in finance

- Supervised Learning
  - Regression (e.g. forecast returns, pricing);
  - Classification (e.g. predict the direction of returns).
- Unsupervised Learning
  - Clustering (e.g. identify the most common signs of market stress).
- Reinforcement Learning (e.g. learning trading strategy)

## Industrial Applications in Financial Markets

- Fintech
  - AI Advisor for Personal Customer;
- Factor Investments
  - Digging New Factors (e.g. genetic programming algorithm);
  - Predict Stock Returns (e.g. neural network, ensemble models);
  - Alternative Data (e.g. news data and NLP).
- Timing Strategy
  - High Frequency Data.
- Risk measurement and stress tests (e.g. adversarial training)
- ...

# Characteristic and Challenges of Financial data

## Challenges of Financial Data

- Low signal-noise ratio;
- Limited data availability;
- Heterogeneity;
- Unstructured data;

## Challenges of ML models in Finance

- Interpretability;
- Robustness.

<b>Challenges</b>	<b>Machine Learning Solutions</b>
Noisy Data	Model Ensemble, Data Augmentation, Filtering, Cross Validation...
Limited data availability	Synthetic data generation
Heterogeneity	Change-point Detection ...
New Data type	ML models to handle unstructured data, e.g. word2vec for representing text data.
Interpretability	Combine local and global interpretability strategies e.g. Shapley values, LIME, TCAV, etc.
Robustness	Regularization, adversarial training.

**Table:** Machine Learning Solutions to address Financial Data Challenges.



Thanks for your attention!



# References I