

# DeepStock

stock price prediction with deep learning

---

Siyang Jing, Jiacheng Tian, Jiyu Xu, Yuhui Huang

University of North Carolina, Chapel Hill  
Oct 10th, 2017



- **Stock price prediction:** Previous studies have mostly focused on low frequency [1]. **Machine Learning + Big Data = High Frequency.**
- **Goal:** Predict stock price solely based on price and volume data (of its own and other stocks), without fundamental analysis.
- **Data:**
  - Minute-level US equity pricing and volume data since 2002. Five minute window.
  - 50 largest stocks as ranked by market capitalization.
  - Stocks are correlated, so we will use 600 dimensional lagged stock returns (50 stocks and 12 lagged returns) as raw level input data.
  - 2002-2017 as training set, 2017-2018 as test set.

Following the practice in the research of Chong et al.[2], our model takes the form of

$$\mathbf{r}_t = [r_1, r_2, \dots, r_{50}]$$

$$\mathbf{R}_t = [\mathbf{r}_t, \mathbf{r}_{t-1}, \dots, \mathbf{r}_{t-12}]^T$$

$$\mathbf{r}_{t+1} = f \circ \phi(\mathbf{R}_t)$$

$\phi$ :

- Data  $\rightarrow$  Features, e.g. mean, variance, etc.
- PCA, autoencoder, RBM, and other unsupervised learning techniques.

$f$ :

- Predictor function.
- Recurrent Neural Network (RNN), state of the art for financial time series data analysis [3].



- **Measurements:** normalized mean squared error, mean absolute error, root mean squared error, and mutual information.
- **Bootstrap analysis:** will be performed on assessment of the accuracy of the estimator by random resampling with replacement from the original dataset.
- **Sensitivity:** of the result with respect to each feature and each stock will also be analyzed.

We believe an accurate prediction for stock price will lay a solid ground for a successful trading strategy. It will also shed light on the research of economics, finance, behavioral science, and mathematics.



These slides are modified from maminian's template[4].

- [1] M. Kearns and Y. Nevmyvaka, "Machine learning for market microstructure and high frequency trading," 2013.
- [2] E. Chong, C. Han, and F. C. Park, "Deep learning networks for stock market analysis and prediction: Methodology, data representations, and case studies," *Expert Systems with Applications*, vol. 83, pp. 187 – 205, 2017.
- [3] M. Abe and H. Nakayama, "Deep Learning for Forecasting Stock Returns in the Cross-Section," *ArXiv e-prints*, Jan. 2018.
- [4] maminian, "uncmathbeamer." <https://github.com/maminian/uncmathbeamer>, 2017.

