Stock Prediction Using Random Decision Forests

Ensemble Methods

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Introduction

The Idea

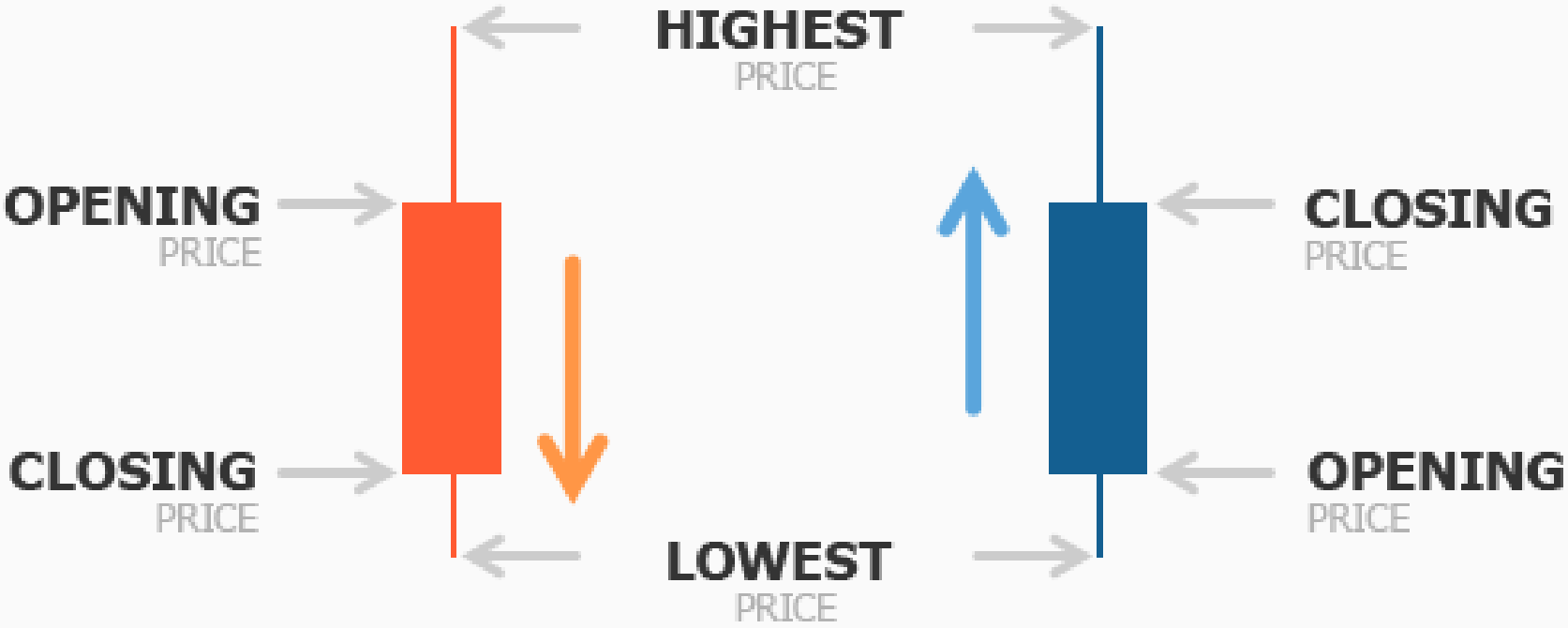
Goal: Predict whether a stock will go up or down over a certain time period.

Method: Collect a number of technical analysis indicators of our data, then train a *Random Forest* on examples consisting of indicators and target values.

The Data

- Scraps data from Google Finance for a list of S&P500 stocks
    1. Example stocks: AAPL, CAT, BA, SBUX
- Contains the following datapoints:
    1. Date (daily data)
    2. Open
    3. High
    4. Low
    5. Close
    6. Volume

OHLC Example



Indicators

Relative Strength Index (RSI)

RSI is a momentum indicator used to identify overbought/oversold stocks.

$$RSI = 100 - \frac{100}{1 + RS}$$

RS = Average gain of up- / loss of downperiods during the specified time frame
Interval: [0,100]

Price Rate of Change (PROC)

PROC (also known as ROC) is also a momentum indicator, measuring the percent change between the current price and the price n periods ago.

$$PROC = 100 * \frac{Close_t - Close_{t-n}}{Close_{t-n}}$$

Interval: [-100,100]

Stochastic Oscillator (SO)

The **SO** compares the closing price of a stock to the range of its fluctuation over a certain time period.

$$\%K = 100\frac{C - L14}{H14 - L14}$$

C = current Closing price

L14, **H14** = 14 day Low, High of the stock

Interval: [0,100]

Williams%R (WR)

Williams%R is also used to identify overbought/oversold stocks.

$$\%R = \frac{H - C}{H - L} * (-100)$$

H, L = Highest, Lowest price of last n days
C = current Closing price
Interval: [0,-100]

On Balance Volume (OBV)

On Balance Volume is an accumulation of the volume since some time period t.
OBV_t is computed by adding or subtracting OBV_{t-1} depending on the *Closing* price.

$$OBV_t = OBV_{t-1} + \begin{cases} Volume & \text{if } Closing_t > Closing_{t-1} \\ 0 & \text{if } Closing_t = Closing_{t-1} \\ -Volume & \text{if } Closing_t < Closing_{t-1} \end{cases}$$

Exponential Weighted Moving Average

The exponential weighted moving average (EWMA) is just a moving average over the prices where the latest prices are weighted more than previous prices, exponentially

Training

Preprocessing

- We stepped through the entire dataset and calculated the indicators and target(1/30 days) values for each stock
- We then removed stocks with erroneous or missing data

The Random Forest Classifier

- Number of trees in forest: 65
- Number of features: 6
- OOB Score and Bootstrapping used

Future plans are to do a hyperparameter search on the forests in order to maximize performance

Experiments

1. Train a random forest for each stock and test their accuracy on the same stock (Stock-Same)
2. Train a random forest on the entire market and test its accuracy on the market (Market-Same)
3. Train a random forest on the entire market and test its accuracy on a single stock (Market-Stock)
4. Train a random forest for a single stock and test it on another stock (Stock-Stock)

Results

Results of Tests

Stock-Same Accuracy:

- AAPL:
  - 1 Period: 49.05%
  - 30 Period: 79.67%
- CAT:
  - 1 Period: 50.28%
  - 30 Period: 70.54%
- BA:
  - 1 Period: 54.98%
  - 30 Period: 69.13%
- SBUX:
  - 1 Period: 47.89%
  - 30 Period: 77.36%

Market-Same Accuracy:

- 1 Period: 60.00%
- 30 Period: 58.96%

Market-Same Accuracy

Stock	Market-Stock (1)	Market-Stock (30)
AAPL	89.29%	94.67%
CAT	89.35%	89.13%
BA	90.12%	91.71%
SBUX	89.73%	93.30%

Stock-Stock Accuracy

Stock / *Model*	AAPL	CAT	BA	SBUX
AAPL(1)	49.05%	50.85%	51.61%	49.28%
AAPL(30)	79.67%	56.11%	54.69%	64.32%
CAT(1)	50.93%	50.28%	47.28%	51.64%
CAT(30)	57.57%	70.54%	50.52%	65.69%
BA(1)	51.15%	48.76%	54.98%	49.34%
BA(30)	62.01%	54.52%	69.13%	65.75%
SBUX(1)	48.07%	51.34%	48.43%	47.89%
SBUX(30	44.95%	45.25%	40.97%	77.36%

Questions?

- Khaidem, L., Saha, S., & Dey, S. R. (2016). Predicting the direction of stock market prices using random forest. arXiv preprint arXiv:1605.00003.
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