



# Quantitative cryptocurrency trading: exploring the use of machine learning techniques

5th SmartData@PoliTO Workshop

Hotel Barolo

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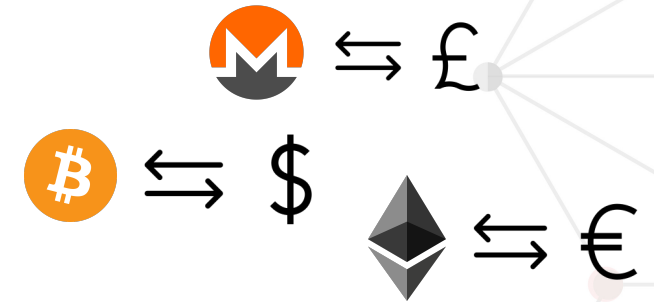
# Cryptocurrencies



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- Medium of exchange in a decentralized currency system
- Obtained via services and cryptographic computation
- Tradable digital assets with renowned currencies
- Many influence factors, high volatility
- Huge difference in capitalization/risk factor
- Heterogenous, informative data



# Quantitative trading systems



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- Mathematical and statistical modeling of financial markets
- Exploit numerical features to summarize the market



Credit: Yahoo Finance

# Our approach



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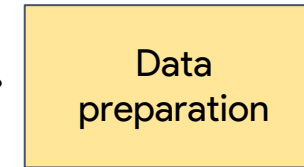
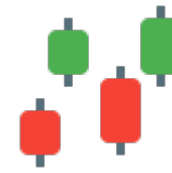


- Forecast one-day ahead price variations
- Adopt both supervised classifiers and statistical regression techniques
  - The former requires a data preparation stage
- Generate trading signals from predictions
- Implement a multi-currency trading strategy using such signals

# Data preparation stage



- Store cryptocurrencies in relational datasets
- One dataset per cryptocurrency



ID	V1	V2	...	Vn	Class

- Each record is associated with a day

- 20 features built upon technical indicators
- A target feature computed as:

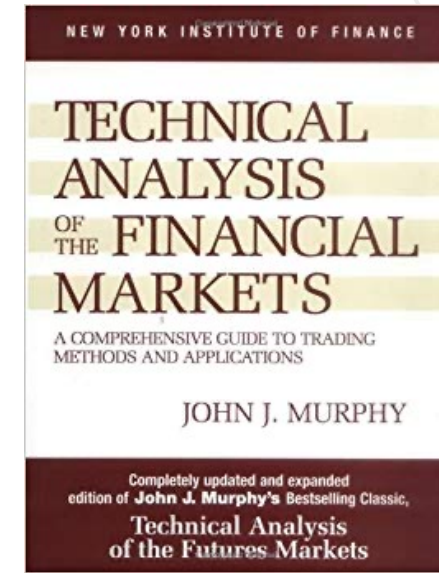
$$L_t = 100 \frac{C_{t+1} - C_t}{C_t}$$

- Fit and predict  $C_t$  only with statistical models

# Data preparation stage: discretization






- Split the domains of predictive features through technical analysis theory. E.g.:
  - $RSI(14)$  was split into  $[0, 30), [30, 70), [70, 100)$
  - $SO(14)$  was split into  $(-\infty, 20), [20, 80), [80, +\infty)$
- The target feature was split into three bins
  - "Decrease" if  $L_t \in (-\infty, -1)$
  - "Stationary" if  $L_t \in [-1, 1]$
  - "Increase" if  $L_t \in (1, +\infty)$



# Trading signals generation



- Use expanding window for the classification process
- One-way mapping of the next-day predictions
  - “Decrease” is “BUY” 
  - “Stationary” is “SELL” 
  - “Increase” is “HOLD” 



*Possible sequence of a down-trending price*

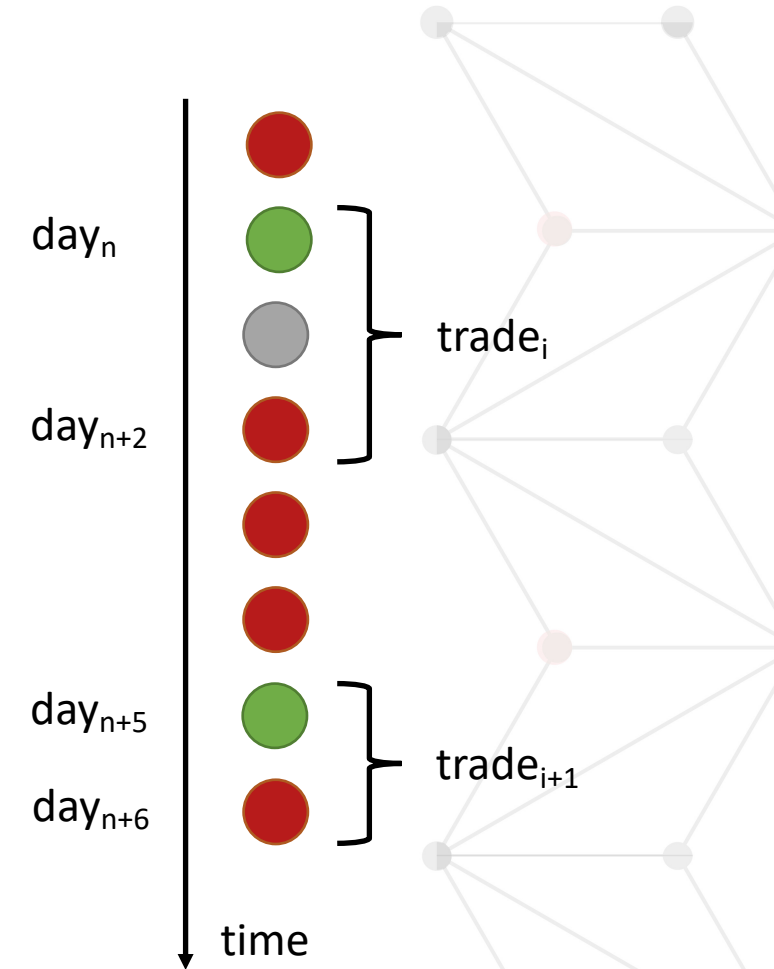
# Trade and money management



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- Operate only long-selling trades
  - “*buy low, sell high*”
  - One open trade at a time, per crypto
  - Multiple cryptos
  - Invest a fixed amount of the capital
- Sell crypto with “*SELL*” signals (if any)
- Preserve equity with stop-loss strategy





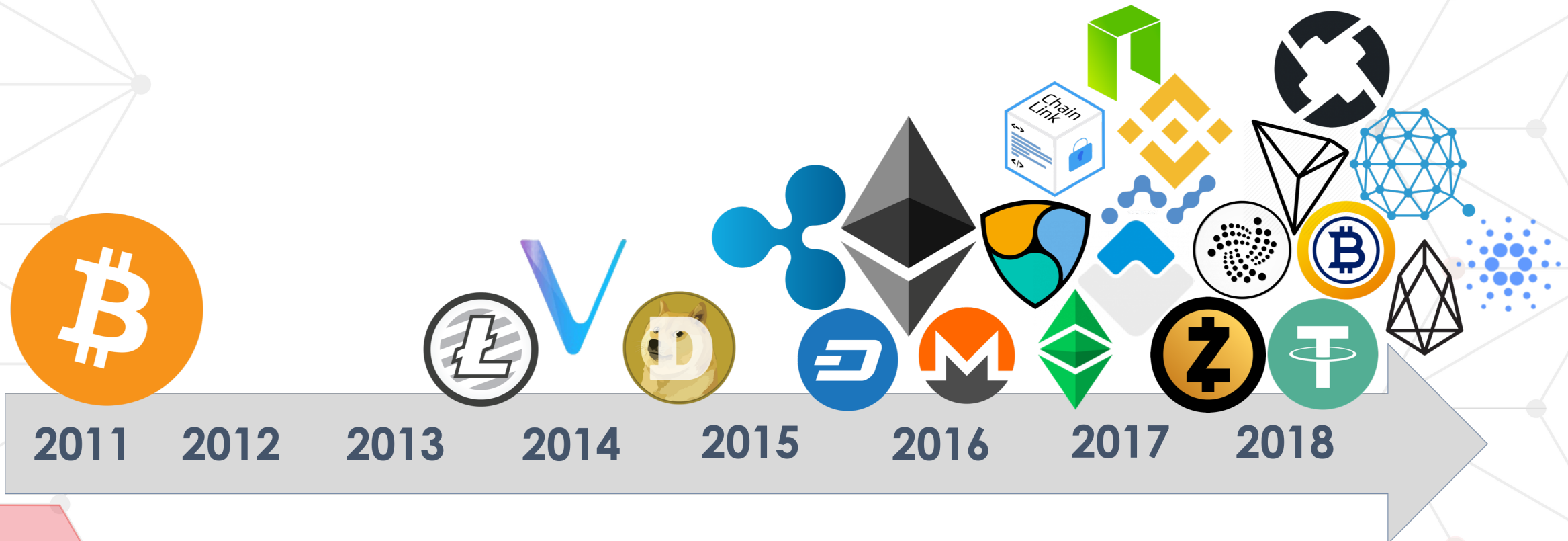
# Experimental setup



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- Eight-years time span [11,18], multiple cryptocurrencies



# Experimental setup

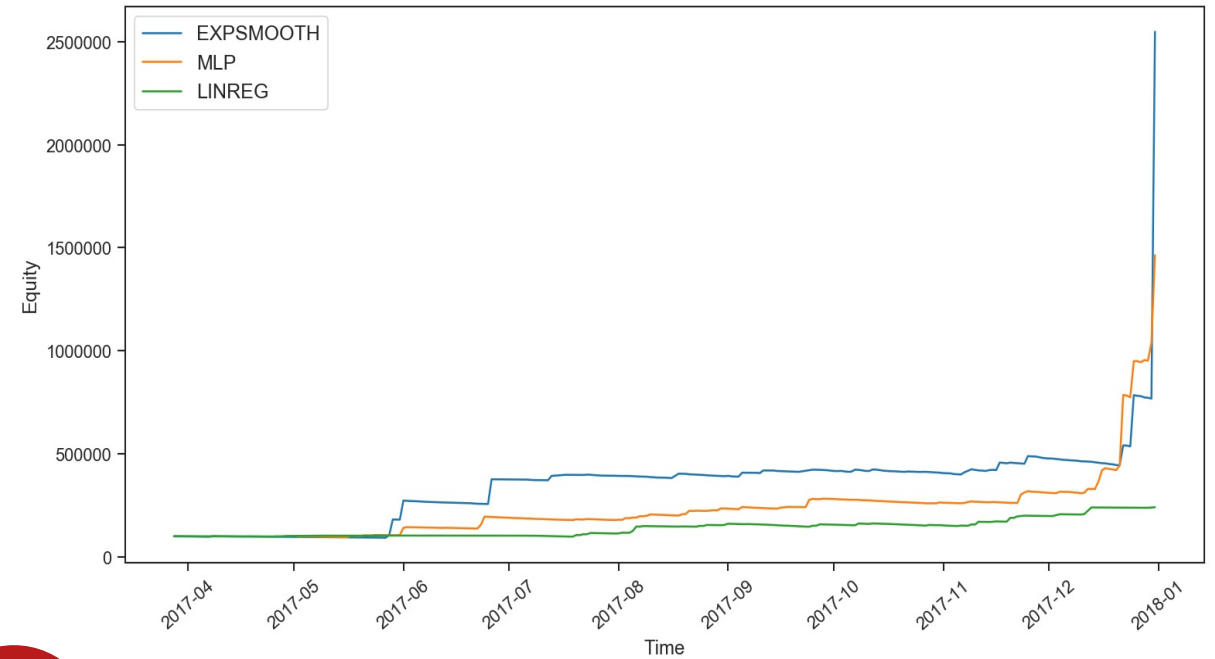
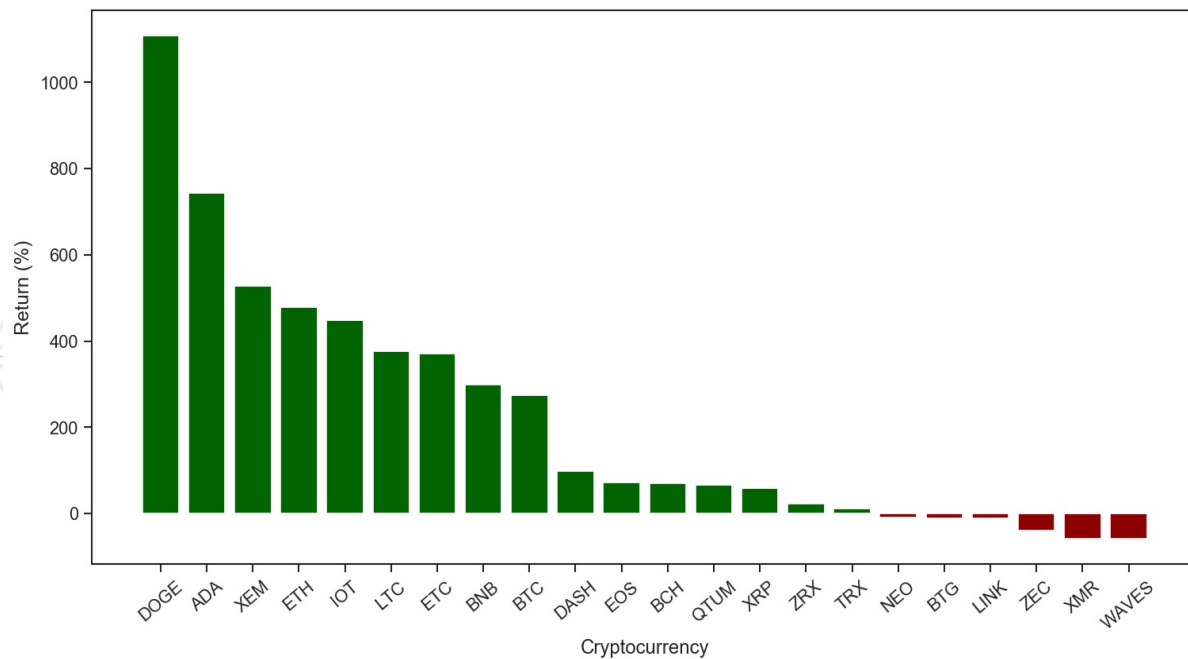


- Eight-years time span [11,18], multiple cryptocurrencies
- Supervised classifiers
  - SVM
  - Multi-Layer Perceptron
  - Random Forest
  - Naïve Bayes
- Autoregressive models
  - ARIMA
  - Exponential Smoothing
  - *Linear regression*
  - Holt-Winter's model
- Initial budget: 100k
- Investment: 10% of the current budget, evenly distributed

# Results



- The overall return comes from many cryptocurrencies

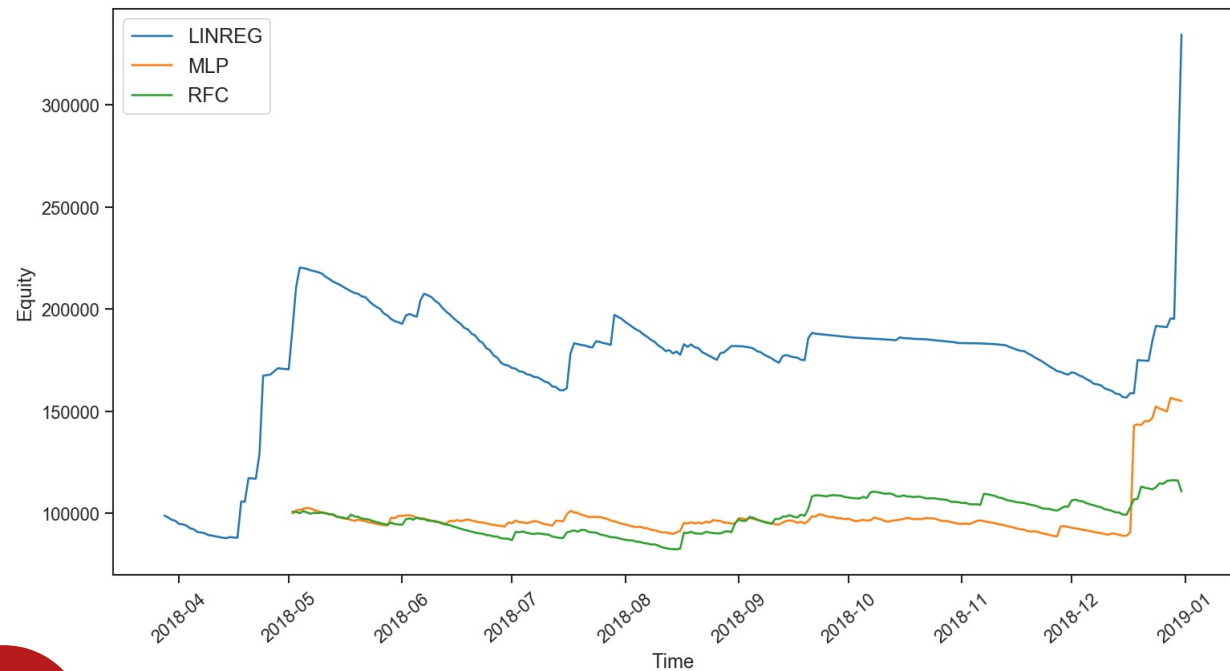
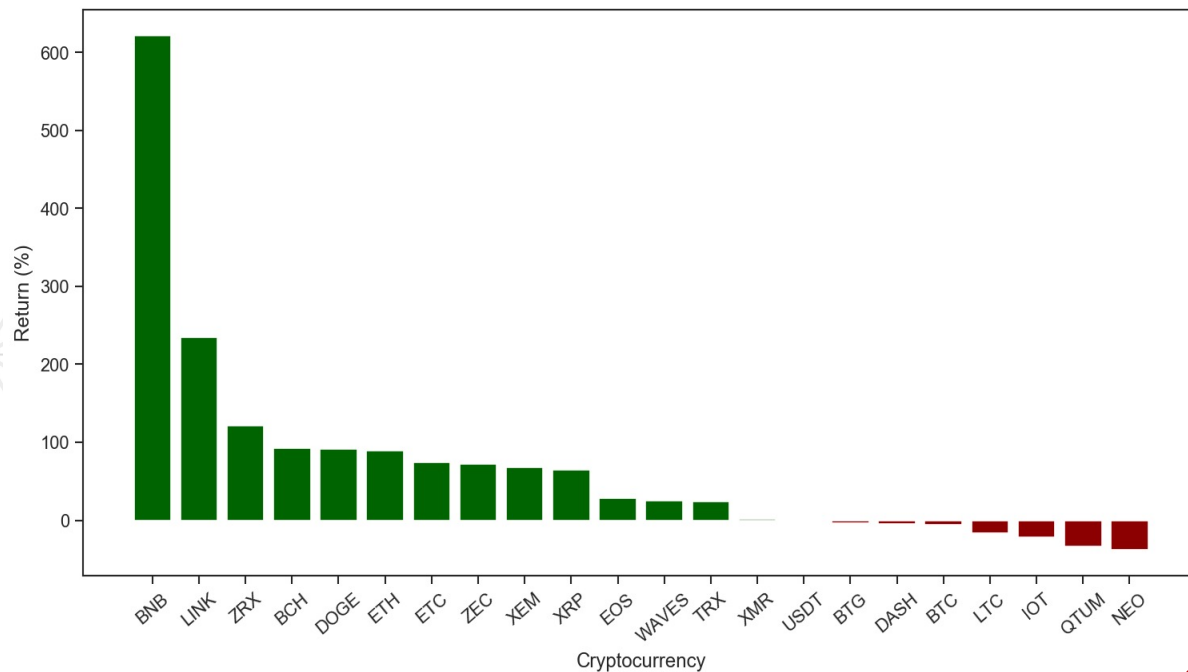


2017

# Results



- A linear regressor (ordinary least squares) is still valuable



2018

# Conclusions



- Quantitative description of cryptocurrencies historical series, plus an automatic trading strategy
- Cryptocurrencies volatility make short-term past information more relevant
- Possible extensions
  - Design an ensemble of time series models and supervised classifiers
  - Improve the classification with transversal information
  - Improve the trading strategy to enhance stability



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# Thank you for your attention!