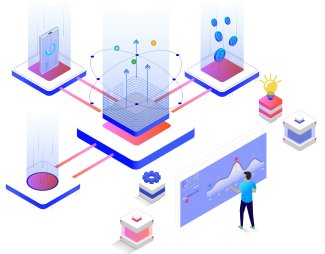
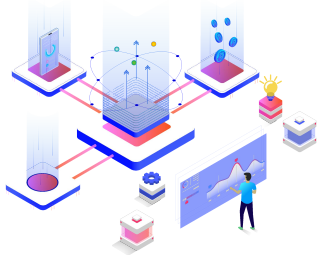
Causes of volatility in cryptocurrencies



Volatility is very important for

- Investment analysis
- Risk management
- Decision making and Portfolio optimization

Understanding the factors which drive the fluctuations of cryptocurrencies and to what extent the volatility is predictable is a practical problem



Coins

- Bitcoin
  - The largest market capitalization
- Ethereum
  - Software platform
- XRP
  - Decentralized
- IOTA
  - Transactions between Internet of Things
- Binance Coin
  - Coin Used for fees on Binance Exchange

Historical data

	Number of observations	Start date	End date
Binance Coin	1313	2017-07-26	2021-02-27
Bitcoin	2862	2013-04-29	2021-02-27
Ethereum	2031	2015-08-08	2021-02-27
IOTA	1355	2017-06-14	2021-02-27
XRP	2764	2013-08-05	2021-02-27

Features

Date	bitcoin	High	Low	Open	Marketcap	sentiment_10_day	volatility_10_day
<date>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>
2016-04-01	0.002953928	-0.0004684475	0.001382289	0.003619497	0.003203401	1.39765234	-0.007419956
2016-04-04	0.008335747	0.0099719084	0.009066230	0.010891164	0.009068220	0.09418116	0.037469320
2016-04-05	0.006136043	0.0045318652	0.002414199	-0.000669389	0.006389305	0.77736947	0.305019922
2016-04-06	-0.001455096	0.0006364528	0.005028340	0.007759778	-0.001203801	-0.52826923	-0.015898241
2016-04-07	-0.001577654	-0.0020493281	-0.005230298	-0.001564993	-0.001349154	0.55816859	0.121335282
2016-04-08	-0.005667710	0.0040220731	-0.002099781	-0.001683070	-0.005435364	0.67660232	-0.078760220

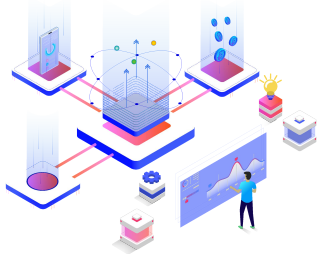
- In addition to features related to Bitcoin price, we use the average past 10-day sentiment for Bitcoin-related news on Coindesk
- Target is the future 10-day volatility

Data preprocessing

- Calculating percentage changes
  - Replacing infinite values with zeros
- Min-max scaling
- Changing dimensions

Sentiment data

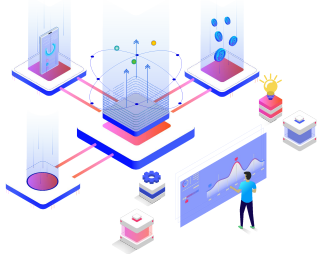
- Coindesk as the data source
- Preprocessing text is one of the most important steps
- Steps:
  - Remove punctuation, stop words, and numbers
  - Convert to lower case
  - Converted to document term matrix
  - Use stemming
  - Limit word lengths to between 5 and 20
- Library SentimentAnalysis
- Sentiment for each news was calculated
  - Loughran-McDonald dictionary for financial data
- Average daily sentiment was calculate per coin



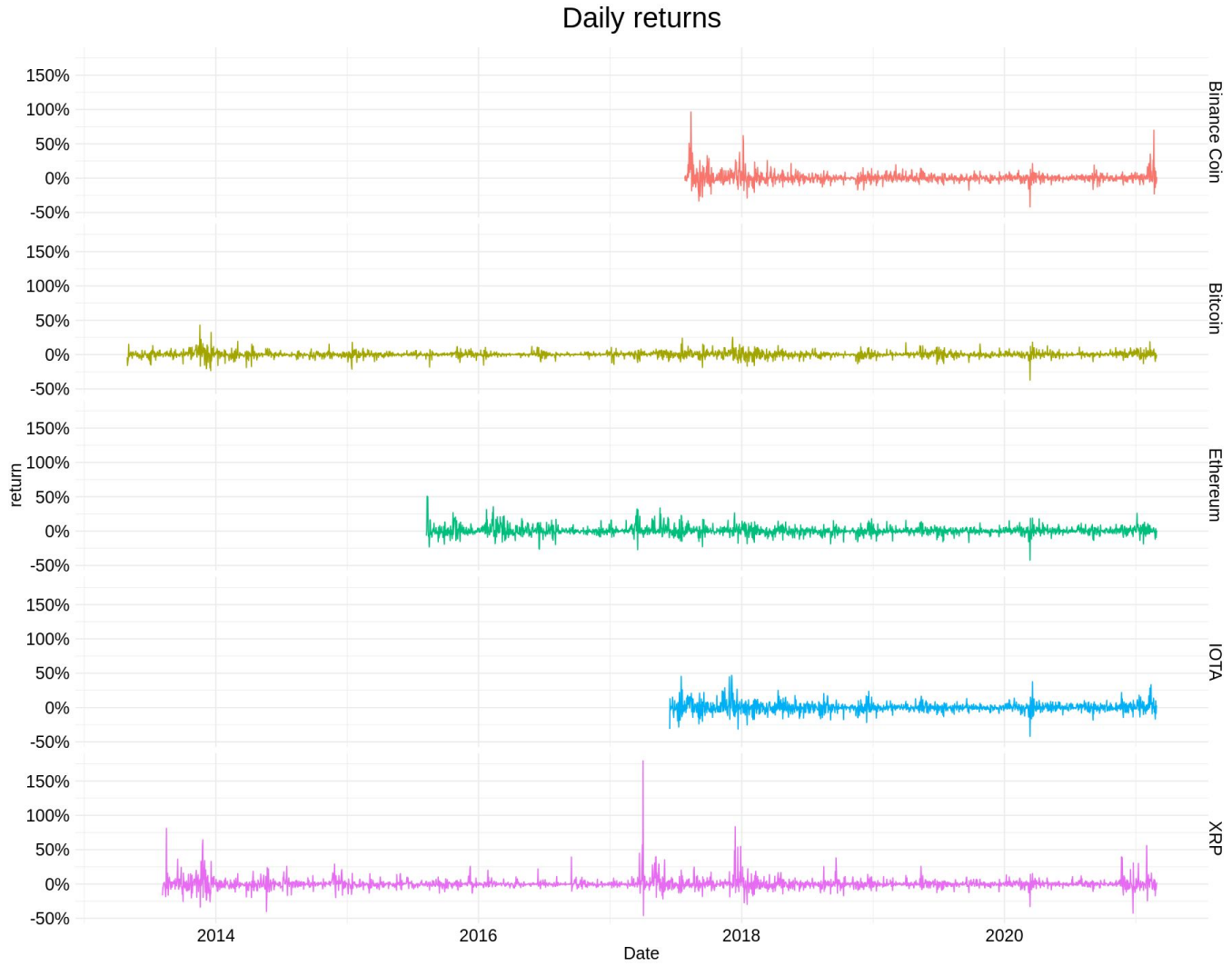
Accumulated Local Effects

ALE plot illustrates how features affect the prediction of a model on average

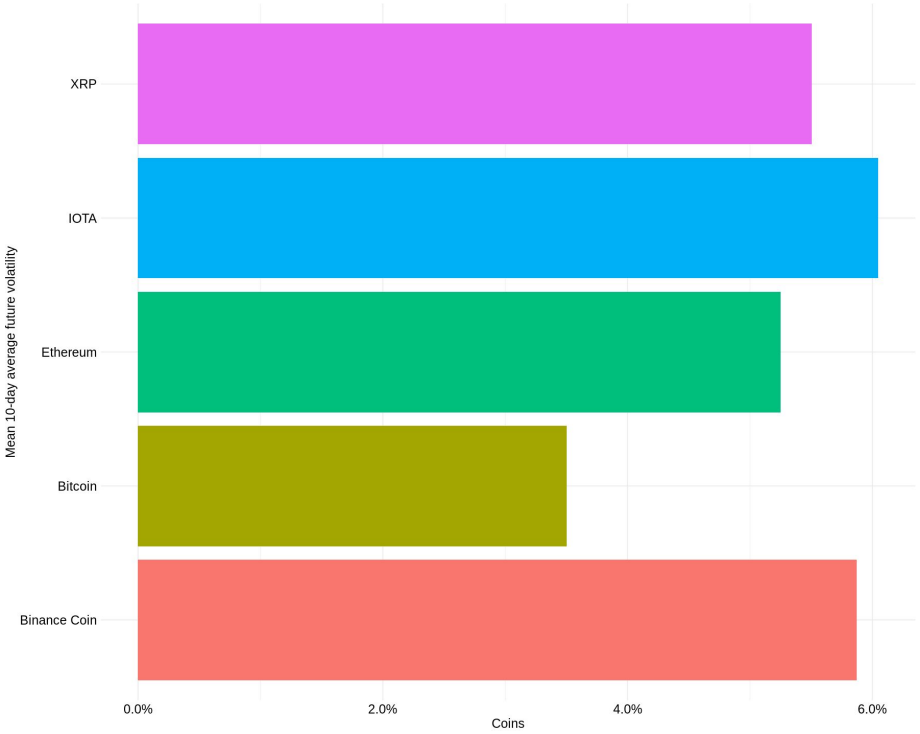
- Works by changing values of one feature at the time
- ALE plots describe how the prediction would change in response to the change of the feature
- Isolates the effect of the feature and excludes the effect of correlated features
- We chose it over PDP, since ALE works better with correlated features

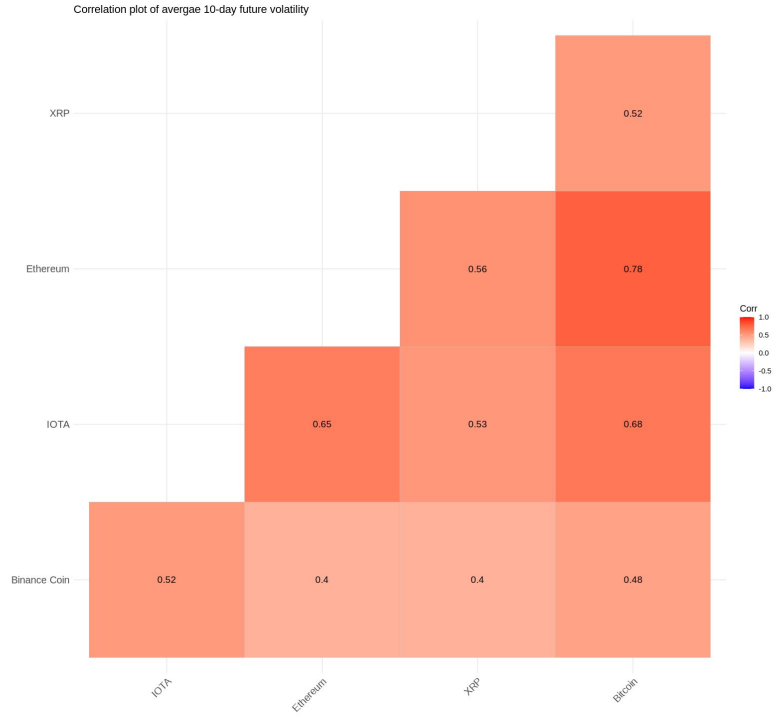


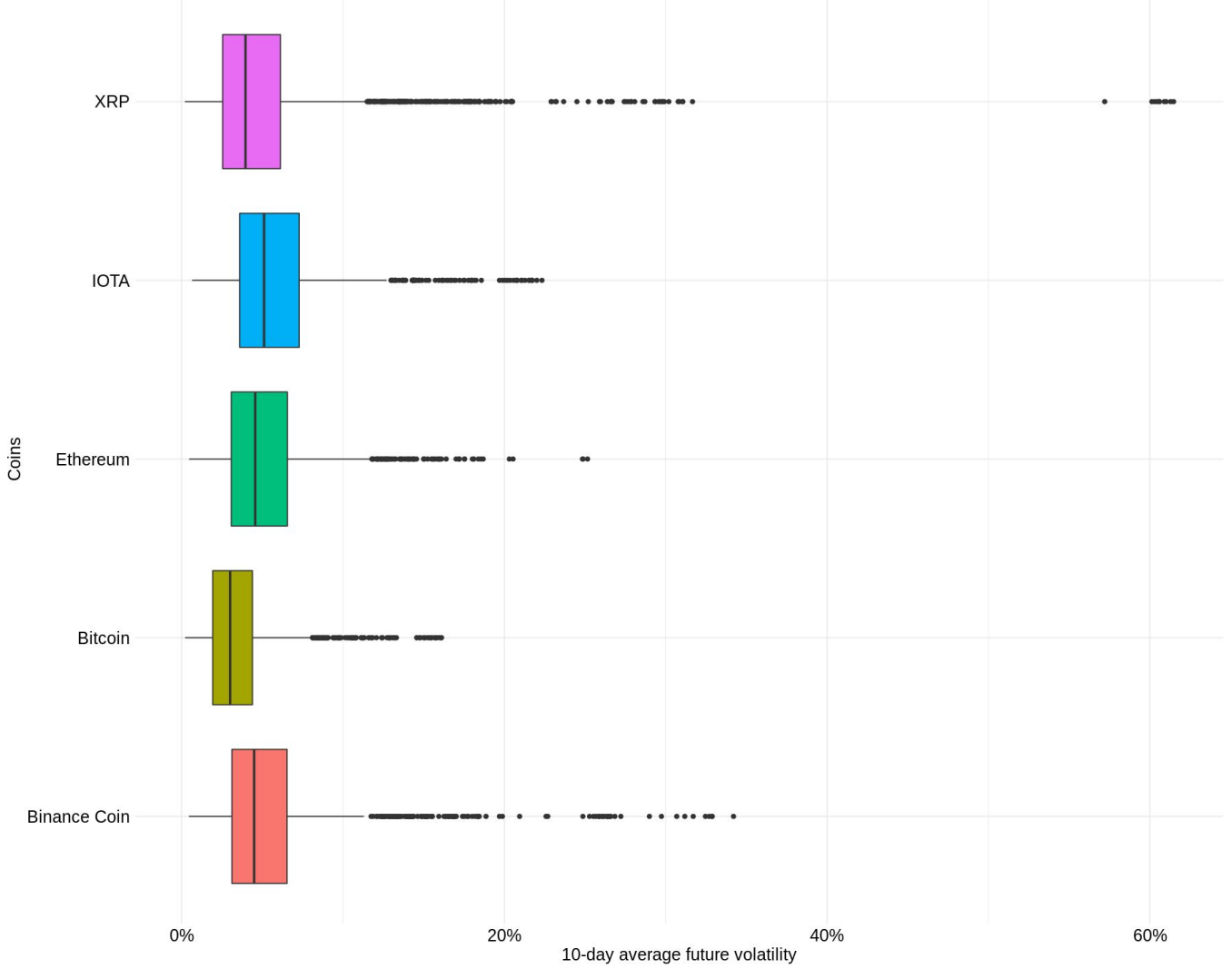
Binance Coin
Bitcoin
Ethereum
IOTA
Other
XRP
SentimentLM
0.05
0.00
-0.05
-0.10
2016
2017
2018
2019
2020
2021
date


Daily returns
150%
100%
50%
0%
-50%
Binance Coin
Bitcoin
Ethereum
IOTA
XRP
return
2014
2016
2018
2020
Date

Average 10-day future volatility
volatility_10_day
60%
40%
20%
0%
Binance Coin
Bitcoin
Ethereum
IOTA
XRP
2014
2016
2018
2020
Date


XRP
IOTA
Ethereum
Bitcoin
Binance Coin
Mean 10-day average future volatility
0.0%
2.0%
4.0%
6.0%
Coins


Correlation plot of avergae 10-day future volatility
XRP
Ethereum
IOTA
Binance Coin
0.52
0.56
0.78
0.65
0.53
0.68
0.52
0.4
0.4
0.48
IOTA
Ethereum
XRP
Bitcoin
Corr
1.0
0.5
0.0
-0.5
-1.0


XRP
IOTA
Ethereum
Bitcoin
Binance Coin
Coins
0%
20%
40%
60%
10-day average future volatility

The model

Hidden layers: 1 (LSTM)

Units: 5

Activation function: Tanh

Epochs: 4,000

Batch size: 64

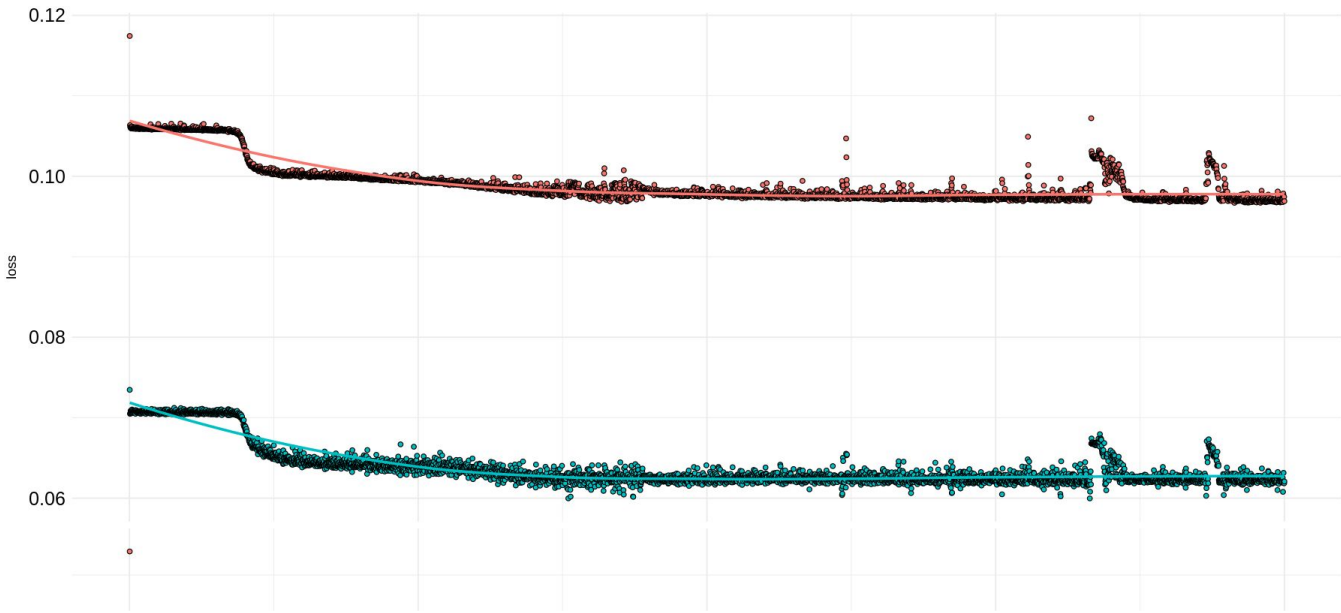
Loss function: MSE

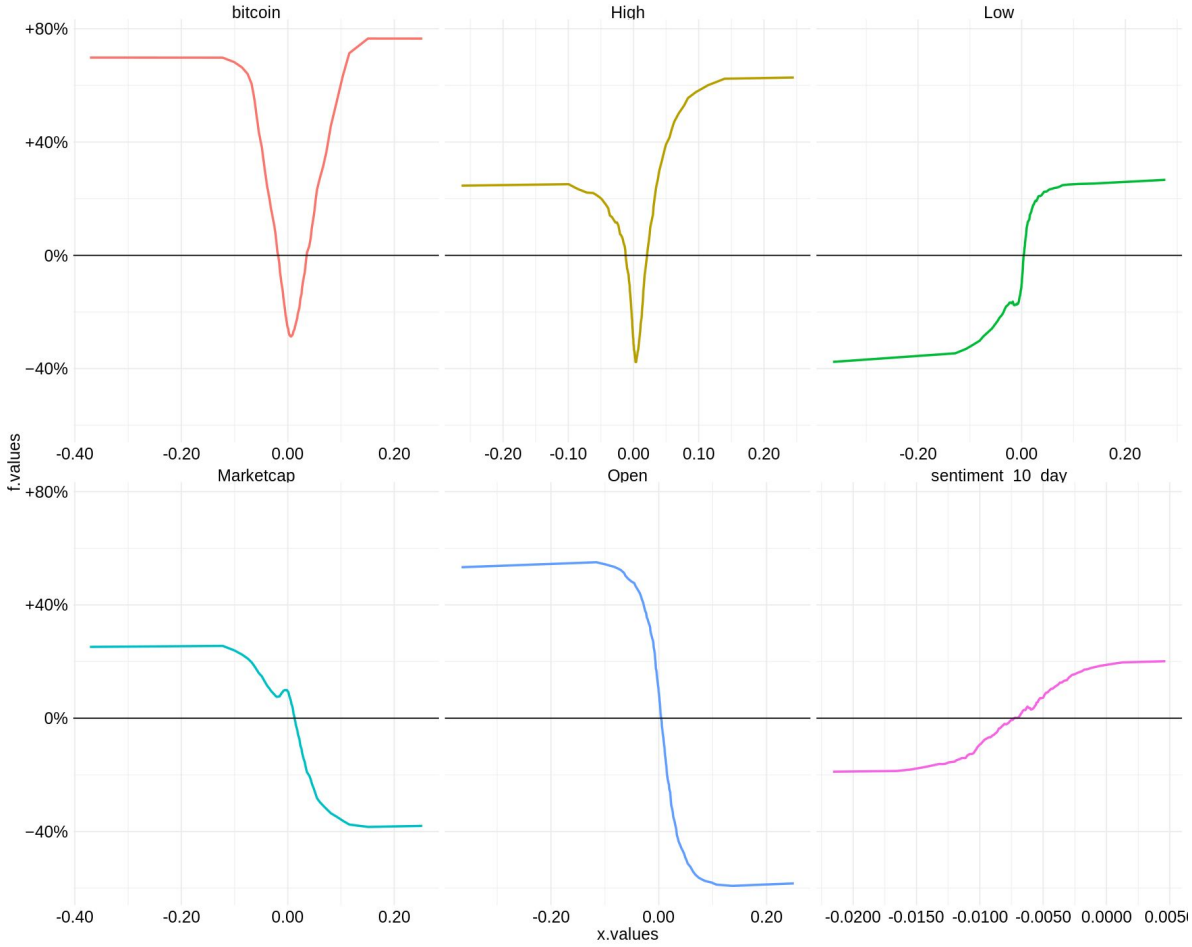
Optimizer: ADAM

Fit

Loss: 0.097

Val loss: 0.062



ALE results

- X-axis indicates the daily changes, except for sentiment data
- Y-axis indicates the effect on future 10-day volatility