Does Elon Musk's tweets influence Bitcoin market value? : A sentiment anaylsis approach

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Abstract

When Elon Musk speaks, bitcoin investors listen. The Tesla chief executive's often-cryptic messages have sent bitcoin's price on a roller-coaster during past years. Prices soared nearly 20% one January morning when he added "#bitcoin" to his Twitter biography. They jumped 16% in a single day the following month after Tesla Inc. revealed it bought $1.5 billion worth of the cryptocurrency. We present a textual analysis that explains how Elon Musk's sentiments in his Twitter content correlates with price and volatility in the Bitcoin market using sentiment analysis and Augmented Dickey–Fuller (ADF) t-statistic test, allowing us to understand the (non-)stationarity of the bitcoin trends. After examining 4787 tweets containing 68676 words, posted from December 2011 to January 2021, and rigorously controlling other determinants, we found that the tone of the world's wealthiest person can drive the Bitcoin market. In addition, Musk is likely to use positive words in his tweets, with great "trust" and "anticipation" as the most frequent sentiments expressed. However, we did not find evidence to support linkage between Musk's sentiments and Bitcoin volatility.

Literature review

Introduction

On January 29, 2021, Elon Musk, at that time the richest person in the world (Klebnikov, 2021), unexpectedly changed the bio1 of his Twitter account to #bitcoin. The price of Bitcoin rose from about 32,000$ to over 38,000$ in a matter of hours, increasing the asset's market capitalization by 111 billion $ The relevance of Musk's tweets for financial markets has already become apparent in other contexts. Musk's endorsement of the encrypted messaging service Signal (Musk, 2021a) led to investors purchasing the unrelated Signal Advance stock, increasing the latter's market valuation from 55$ million to over 3$ billion (DeCambre, 2021). These events clearly show the impact that leadership in social networks can have on financial markets and the decision-making behavior of (individual) investors. While the market may read Musk's tweets on Tesla as "true news," his tweets regarding cryptocurrency reflect moods or personal sentiment, which have been shown to influence financial market pricing (Bollen et al., 2011; Gabrovek et al., 2017; Schumaker and Chen, 2009). Musk declared that Bitcoin is "on the threshold of gaining broad acceptability" in a talk on social media site Clubhouse, and admitted that he is "late to the party but[…] a fan of Bitcoin." He also said in the event that his tweets about the cryptocurrency Dogecoin are just jokes (Krishnan et al., 2021). This is consistent with Musk's tweet from May 2020, in which he stated that he "only own[ed] 0.25 Bitcoins" (Musk, 2020). Tesla, on the other hand, spent $1.5 billion in Bitcoin between January and March 2021 (US Securities and Exchange Commission, 2021), implying that the Bitcoin-related tweets were more than "just jokes." Musk's tweets appear to effect the cryptocurrency market, regardless of whether they are meant in fun or in earnest, which is our incentive to look into the topic further and analyse its consequences. While Musk is far from the only public figure to speak out on social media regarding cryptocurrency or

financial markets, he is undoubtedly one of the most influential. In strategic contacts between prominent individuals such as managers, journalists, or financial analysts and stakeholder groups, social media plays a key role (Heavey et al., 2020; Pfarrer et al., 2010). By communicating directly with customers (Alghawi et al., 2014), controlling the timing of disclosure (Jung et al., 2017), or establishing trust with investors or communities, these individuals can use their social networks to shape their own reputation and identity, or that of a related company (Deephouse, 2000; Zavyalova et al., 2012). (Elliott et al., 2018; Grant et al., 2018). Strategic leaders' social media activities, on the other hand, can generate a lot of ambiguity. For example, it may be difficult to tell whether a message is simply expressing a mood or conveying specific company-related information. It could be hard to ascertain whether a message is merely expressing a mood or conveying specific company-related information. Furthermore, stakeholders may be overwhelmed with irrelevant information that diverts their attention away from the main concerns (Huang and Yeo, 2018). A person's or a company's reputation might be harmed as a result of critical behaviour. Because of the extremely quickly nature of social media, any such harm can occur in an instant (Wang et al., 2019). Several research have looked into the relationship between cryptocurrency markets and social media activity, particularly on Twitter. Short-term Bitcoin liquidity is increased by an increase in the number of Bitcoin-related tweets (Choi, 2020), the number of Bitcoin-related tweets can explain Bitcoin trading volume and returns (Philippas et al., 2019; Shen et al., 2019), and Twitter sentiment can predict cryptocurrency returns (Philippas et al., 2019). (Kraaijeveld and De Smedt, 2020; Naeem et al., 2020; Steinert and Herff, 2018). According to Mai et al. (2018), social media users with less prior cryptocurrency-related involvement drive cryptocurrency effects, which makes sense because their actions are uncommon or unexpected. If Elon Musk tweeted about cryptocurrencies multiple times a day, the market would most certainly treat it as noise. While several studies have looked into the impact of individual tweets on stock market returns (Brans and Scholtens, 2020; Ge et al., 2019—both relating to stock market-related tweets by Donald Trump), to our knowledge, very few researchers have examined into the impact of individual tweets on cryptocurrency returns and trading volume.

This research seeks to determine how one of the world's most powerful persons' social media activities affects cryptocurrency price levels. We take Elon Musk's cryptocurrency-related tweets and categorise them as unanticipated happenings. It is conceivable to evaluate the amount of any effect Musk's tweets had on the market by comparing past cryptocurrency market data to data surrounding these occurrences. The research looks at how leadership, engagement, and information via social media, particularly Twitter, influence investor attention and behaviour in cryptocurrency markets. Of course, Elon Musk is an outlier, which is why our approach might almost be termed a case study. In an ideal world, the findings and implications could be applied to other people and markets, allowing us to better understand the likelihood of social media personalities influencing cryptocurrency markets and whether or not this is a problem.

Conceptual background: Financial market efficiency

"Prices fully represent all available information," according to the efficient market hypothesis (EMH) (Fama, 1970). The price of an item is determined by the intersection of a supply and demand curve, which satisfies both consumers (such as Bitcoin investors) and producers (e.g. Bitcoin miners). As additional relevant information becomes available, the curves adjust. A tweet from Elon Musk could be considered such new knowledge, and is priced appropriately if it is deemed important. However, the EMH's validity has been questioned because it is primarily reliant on market players' preferences and conduct. The adaptive markets hypothesis (AMH), a variant of the EMH, claims that the degree to which information is represented in prices is determined by market conditions as well as the quantity and characteristics of market participants: market effiency is context-dependent. The quality of the information provided is a critical part of the impact of individuals on financial markets. According to signalling theory, an actor can employ high-quality signals to reduce market information uncertainty (Spence, 1973). While such signals are typically used in an agent's own interest, such as when applying for a job (Spence, 1973) or seeking entrepreneurial financing (Ante et al., 2018), it appears possible that a tweet from a very influential or reputable person is interpreted by a significant number of market participants as a signal of the quality of the object of the tweet, even without an ulterior motive or even unintentionally. Every tweet is motivated by something, even if it's just a passing mood. In this situation, having faith in the signal and its quality is critical. A signal must usually be coupled

with direct or indirect expenses in order to be trustworthy or credible (Connelly et al., 2011). The costs in the instance of Elon Musk's tweets are indirect, and they include the potential damage to his reputation as a technological innovator and successful entrepreneur (i.e. his influencer status) or the reputation of the companies with which he is connected (Wang et al., 2019). There's also the possibility of counter-signaling, in which other agents broadcast contradictory or critical messages. If the market discovers, for example, that Musk's tweets are noise rather than quality signals, it should disregard the information as unimportant.

Research questions

We raise the following research questions to address the issue of effciency in cryptocurrency markets and the attention their participants devote to influencers since Elon Musk and other influential individuals are likely to continue publicly commenting on cryptocurrency for the foreseeable future.

RQ1: DO Elon Musk's cryptocurrency-related tweets sentiments have an effect on the pricing and trading volume of cryptocurrency?

The answer to this issue can reveal whether tweets can be considered quality signals in general or whether the market effects seen were purely coincidental. Second, the AMH predicts that a cryptocurrency that is less efficient or liquid will be more affected by Musk's tweets.

RQ2: Do sentiments and polarity of Musk's cryptocurrency-related tweets differs by considering different time-frames?

By answering these two study questions, we will be able to measure and better understand the impact of social media influencers on cryptocurrency markets, as well as draw some implications about how to interpret future events. Market participants will be able to better assess the significance of Musk's tweets and possibly other (social media) influencers in this way. Furthermore, the findings may contribute to broader study on the function of social media leaders in influencing investor behaviour, determining the quality of influencer content in the context of signalling theory, and determining influencer relevance for financial market efficiency.

Data and methods

Popularity analysis

The analysis is based on tweets by Elon Musk (twitter.com/elonmusk) between Jan 2011 to 2022. A data extraction has been conducted via python since some of its functions were more suitable for our purposes. The code used can be seen in the **Annex** section. Our dataframe resulted in total of 4787 tweets containing 68676 words over a time-span of 10 years. As stated in the previous section, popularity and influence are critical factors to be assessed from market participants in order to assign a certain degree of reliability to the information they receive. That's why a first investigation has been conducted in this direction. Elon Musk's influece has been skyrocketing throughout the years, mainly due to the achievements linked to his companies (namely Space X and Tesla) proving wrong many opponents who considered his goals too ambitious to be reached. On top of his professional achievements, his uncommon behavior, his funny character and his inspiring vision and leadership made his influence to grow sistematically. We used three proxies to quantify his popularity: namely, the *numbers of likes*, *number of replies* and *number of retweets* on Musk's tweets. These variables has been grouped by year in order to identify the trend clearly. As expected, his popularity has gained momentum especially after *2016*, when Tesla Model 3 was launched, some companies were renovated and gained momentum (i.e. SolarCity embedded in Tesla itself) and others were founded (i.e. Neuralink).

Bitcoin-related tweets

In a second step, a subset of the total population of tweets was made, in order to extract only tweets containing the word *bitcoin* and *cypto* so to direct our focus to Musk's influence on cryptomarkets Bitcoin-related. Exploiting the embedded time-stamp of these peculiar type of tweets, it could be possible to visualize in time when his tweets (events of interest) were located in respect to the Bitcoin market capitalization trend. At first sight, considerable variations can be highlighted after these events and further considerations will be found in the **Result** section.

Sentiment Analysis

Once obtained these data, they represented the input for our models: Sentiment Analysis and Polarization analysis were conducted, supported by wordclouds (in order to determine which were the most tweeted words). Through score assignment it has been possible to detect which were the most frequent sentiments in Musks's tweets, as well as the duration of these emotions. The results obtained through this first model helped us to understand the gradient of emotions provoked by Tesla CEO's tweets and therefore assessing those as drivers to his popularity and eventually his influence on cryptomarkets.

Testing for stationarity

Finally, we wanted to investigate the presence of linkages between Elon Musk's sentiment and Bitcoin volatility: which means testing for stationarity. First of all, it is utmost important to determine how the series is behaving before applying any model to it: an Augmented Dicky Fuller test was used to evaluate how strongly a time series is defined by a trend. Results showed

Hypothesis

Null Hypothesis (H0) : Null hypothesis of the test is that the time series can be represented by a unit root that is not stationary. *Alternative Hypothesis (H1)*: Alternative Hypothesis of the test is that the time series is stationary.

Why is Stationarity Important?

Stationarity can be defined in precise mathematical terms, but for our purpose we mean a flat looking series, without trend, constant variance over time, a constant autocorrelation structure over time and no periodic fluctuations (seasonality). For data to be stationary, the statistical properties of a system do not change over time. This does not mean that the values for each data point have to be the same, but the overall behavior of the data should remain constant. If the data is non-stationary (meaning it has a trend), we need to remove it in order to proceed with the analysis. Various tecniques can be used to solve the issue of non-stationarity: after some attempts, the most succesful one has been to rely on the *log difference* of time values in Bitcoin price.

[da concludere]

Results

Elon Musk's influence

As can be seen in the summary table below, Elon Musk's influnece has grown widely over the years. In 10 years, **number of replies** per tweet has grown up to more than 3 million, **number of retweets** up to more than 4 million and **number of likes** up to the astonishing numbers of more than 50 million. As of December 31st 2021, Elon Musk's follower amounted to 71.5 mln, which means a very high coverage of $72, 2$.

```
## Loading required package: dplyr


##
## Attaching package: 'dplyr'


## The following objects are masked from 'package:stats':
##
##     filter, lag


## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union


## Loading required package: tidyverse


## -- Attaching packages --------------------------------------- tidyverse 1.3.1 --


## v ggplot2 3.3.5     v purrr   0.3.4
## v tibble  3.1.6     v stringr 1.4.0
## v tidyr   1.2.0     v forcats 0.5.1
## v readr   2.1.2


## -- Conflicts ------------------------------------------ tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()


## Loading required package: readxl


## [1] 4787    39


##   X              id conversation_id   created_at                    date timezone
## 1 0 1.525206e+17    1.525206e+17 1.325199e+12 2011-12-29 17:45:17     -500
## 2 1 1.525170e+17    1.525170e+17 1.325198e+12 2011-12-29 17:31:09     -500
## 3 2 1.523940e+17    1.521644e+17 1.325169e+12 2011-12-29 09:22:15     -500
## 4 3 1.523159e+17    1.523159e+17 1.325150e+12 2011-12-29 04:12:01     -500
## 5 4 1.523120e+17    1.507209e+17 1.325149e+12 2011-12-29 03:56:23     -500
## 6 5 1.521536e+17    1.521518e+17 1.325111e+12 2011-12-28 17:27:08     -500
##   place
## 1   NA
## 2   NA
## 3   NA
## 4   NA
## 5   NA
## 6   NA
##
## 1 Am not saying that is *necessarily* good or bad, but reality will force us to live with the consequ
## 2     Interesting Economist article about how humanity's collective actions have created a fundamenta
## 3      @om Cool personal essay. It really resonated with me, as I felt the same way after coming very
## 4          @richardbranson Liked "Screw Business as Usual" a lot. This approach should be taken to hea
## 5          @kanyewest Just returned from Haiti. For those who want to help, I recommend donating to MS
## 6
```

```
##   language hashtags cashtags   user_id user_id_str username      name day hour
## 1       en       []       [] 44196397    44196397 elonmusk Elon Musk   4   17
## 2       en       []       [] 44196397    44196397 elonmusk Elon Musk   4   17
## 3       en       []       [] 44196397    44196397 elonmusk Elon Musk   4    9
## 4       en       []       [] 44196397    44196397 elonmusk Elon Musk   4    4
## 5       en       []       [] 44196397    44196397 elonmusk Elon Musk   4    3
## 6       en       []       [] 44196397    44196397 elonmusk Elon Musk   3   17
##                                                    link                urls
## 1 https://twitter.com/elonmusk/status/152520590719336448 ['http://j.mp/tDhcer']
## 2 https://twitter.com/elonmusk/status/152517033207136256                   []
## 3 https://twitter.com/elonmusk/status/152394000857448448                   []
## 4 https://twitter.com/elonmusk/status/152315925167742977                   []
## 5 https://twitter.com/elonmusk/status/152311993636892672                   []
## 6 https://twitter.com/elonmusk/status/152153637639028736                   []
##   photos video thumbnail retweet nlikes nreplies nretweets quote_url search
## 1     []     0               False    375       28        36             None
## 2     []     0               False     28        6         9             None
## 3     []     0               False     31        8         9             None
## 4     []     0               False    121        6        15             None
## 5     []     0               False     30        8        12             None
## 6     []     0               False     23        5         3             None
##   near geo source user_rt_id user_rt retweet_id reply_to retweet_date translate
## 1   NA  NA     NA         NA      NA         NA       []           NA        NA
## 2   NA  NA     NA         NA      NA         NA       []           NA        NA
## 3   NA  NA     NA         NA      NA         NA       []           NA        NA
## 4   NA  NA     NA         NA      NA         NA       []           NA        NA
## 5   NA  NA     NA         NA      NA         NA       []           NA        NA
## 6   NA  NA     NA         NA      NA         NA       []           NA        NA
##   trans_src trans_dest
## 1        NA         NA
## 2        NA         NA
## 3        NA         NA
## 4        NA         NA
## 5        NA         NA
## 6        NA         NA


##     Replies           Retweets            Likes
##  Min.   :  1662   Min.   :   8641   Min.   :   39659
##  1st Qu.:  9276   1st Qu.:  38980   1st Qu.:   83556
##  Median :  48520   Median : 296023   Median :  902209
##  Mean   : 420556   Mean   : 959142   Mean   : 9376064
##  3rd Qu.: 280066   3rd Qu.:1358456   3rd Qu.:11328415
##  Max.   :3058376   Max.   :4515907   Max.   :51325802
```

We can visually understand the exponential trend in the growing popularity of Tesla CEO's. It comes as no surprise that when *"Elon Musk speaks, investors listen"*. His influence derives from his large audience, prone to process the majority of the information coming from him as good quality information, influencing their (financial) decision-making process.

```
## Loading required package: hrbrthemes

## NOTE: Either Arial Narrow or Roboto Condensed fonts are required to use these themes.

##       Please use hrbrthemes::import_roboto_condensed() to install Roboto Condensed and
```
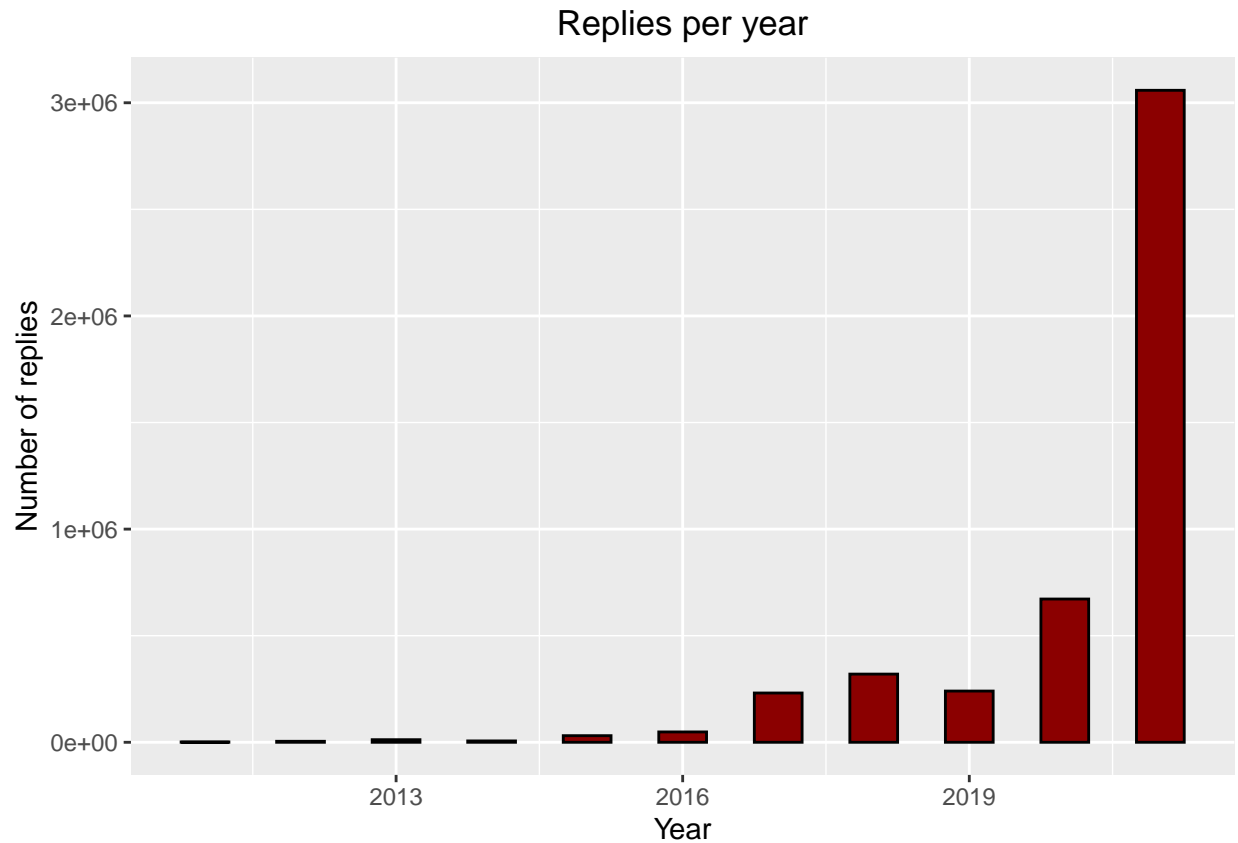
Likes per year

Retweets per year

Replies per year
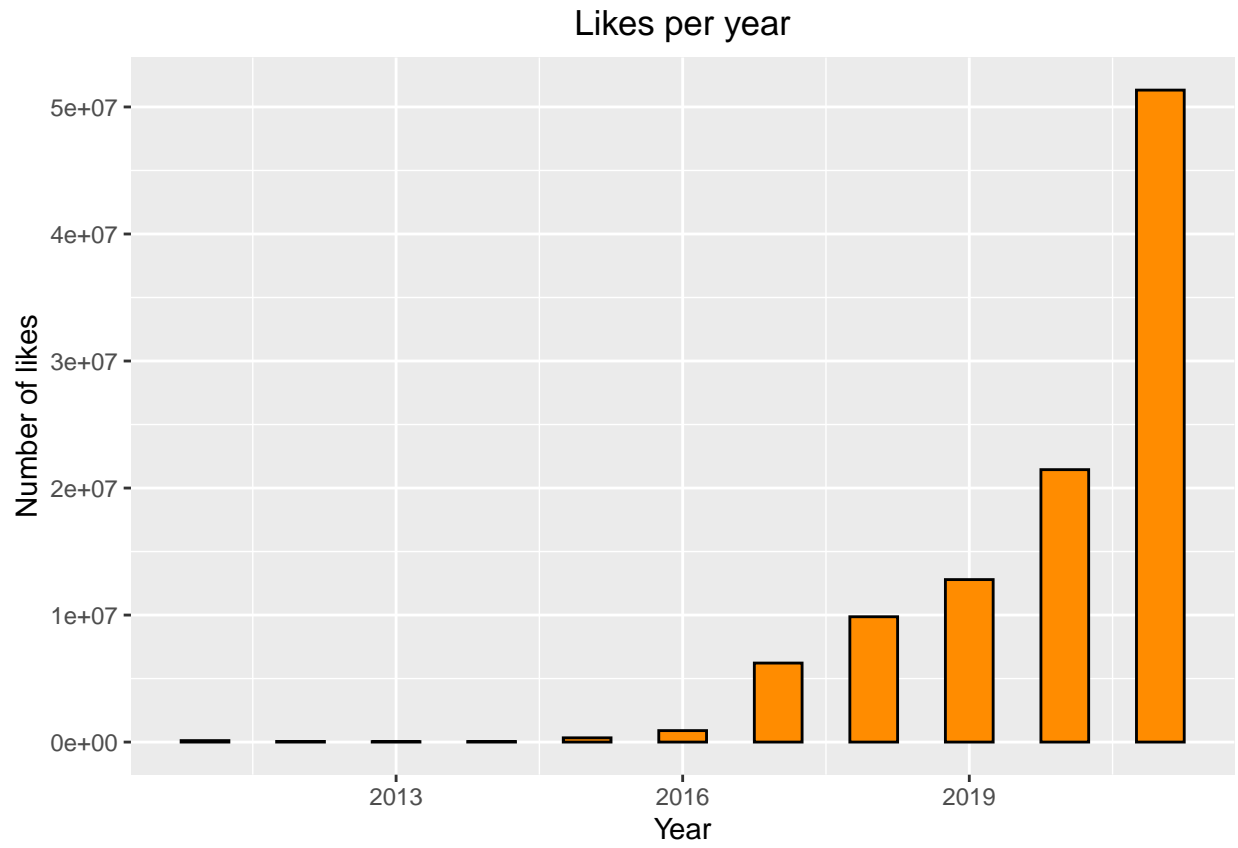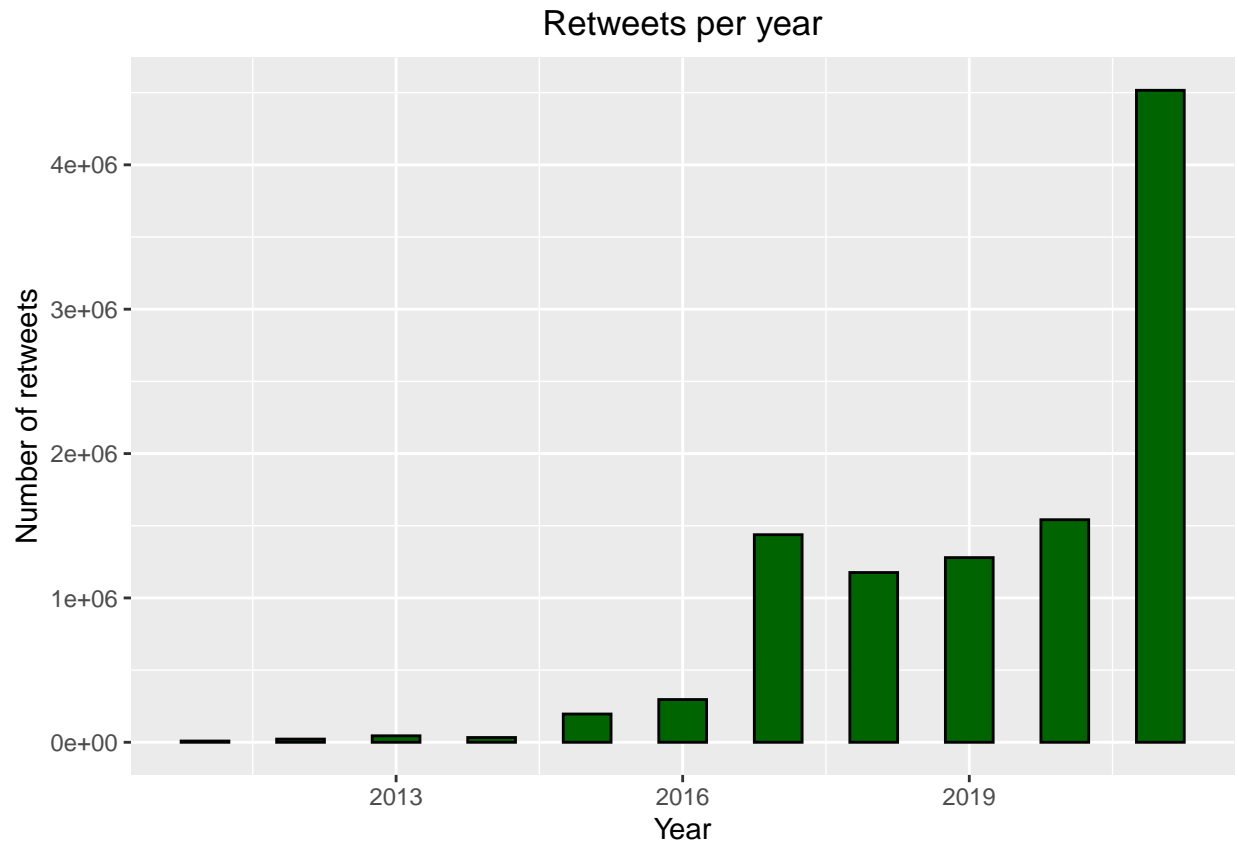
Activty of crypto-related tweets

```
library(ggplot2)

#subsetting in order to undersand tweet share


elondoge = elon[grepl("doge", elon[["tweet"]]),]
elonCryptoOnly = elon[grepl("crypto", elon[["tweet"]]),]
elonBTC = elon[grepl("BTC", elon[["tweet"]]),]

n_doge = length(elondoge$tweet)
n_onlycrypto = length(elonCryptoOnly$tweet)
n_BTC = length(elonCryptoOnly$tweet)
n_totaltweet = n_doge + n_onlycrypto + n_BTC

#vector

vectorshare = c(n_doge, n_onlycrypto, n_BTC)
vectorshare= as.data.frame(vectorshare)
dim(vectorshare)
```

```
## [1] 3 1
```

```r
colnames(vectorshare) = c("tweet number")
rownames(vectorshare) = c("doge", "crypto", "BTC")

# piechart or stackbar




#counting total nlikes, nreplies, nretweet per each keyword to understand where is the maximum activity
## like
n_dogelikes = sum(elondoge$nlikes)/n_doge
n_onlycrptolikes = sum(elonCryptoOnly$nlikes)/n_onlycrypto
n_BTClike = sum(elonBTC$nlikes)/n_BTC
##retweet
n_dogeretweet = sum(elondoge$nretweets)/n_doge
n_onlycrptoretweet = sum(elonCryptoOnly$nretweets)/n_onlycrypto
n_BTCretweet = sum(elonBTC$nretweets)/n_BTC
##reply
n_dogereply = sum(elondoge$nreplies)/n_doge
n_onlycrptoreply = sum(elonCryptoOnly$nreplies)/n_onlycrypto
n_BTClreply= sum(elonBTC$nreplies)/n_BTC




#dataframe activity
vectoractivity_doge= c(n_dogelikes, n_dogereply, n_dogeretweet)
vectoractivity_BTC= c(n_BTClike, n_BTClreply, n_BTCretweet)
vectoractivity_crypto = c(n_onlycrptolikes, n_onlycrptoreply, n_onlycrptoretweet)
dfactivity = cbind(vectoractivity_doge, vectoractivity_crypto, vectoractivity_BTC)
dfactivity= as.data.frame(dfactivity)
rownames(dfactivity) = c("Like", "Replies", "Retweets")
colnames(dfactivity) = c("Activity Doge", "Activity Crypto", "Activity BTC")

#plotting da capire
```

Comment

```
##
## Attaching package: 'lubridate'

## The following objects are masked from 'package:base':
##
##     date, intersect, setdiff, union


##

##
```

GRAFICO CHE CONTA QUANTITTA DI TWEET CHE CONTENGONO DETERMINATE KEYWORD
CRYPTO-RELATED E PERCENTUALE SUL TOTALE DEI TWEET

When Elon Musks tweets, investors listen

Once quantified Elon Musk's influence, it is essential to understand the extent of this influence on the cryptomarket. Which is the width of Bitcoin price volatility once a crypto-related tweets is published? We managed to extract the tweets which only cointained the words *bitcoin* and *crypto* and connected their time-stamp to the Bitcoin market capitalization trend. The pink points on the graphic represent the moment in time when a crpyto-related tweet was published: there is clear evidence suggesting a relationship between the Bitcoin volatility and Musk's trend however, it is still unclear at this stage whether it's Elon Musk's direct influence on Bitcoin price change or the other way round. It cannot be assessed a clear causality relatioship. This issue will be further addressed in this paper.

Elon Musk's Tweets and Bitcoin Volatility
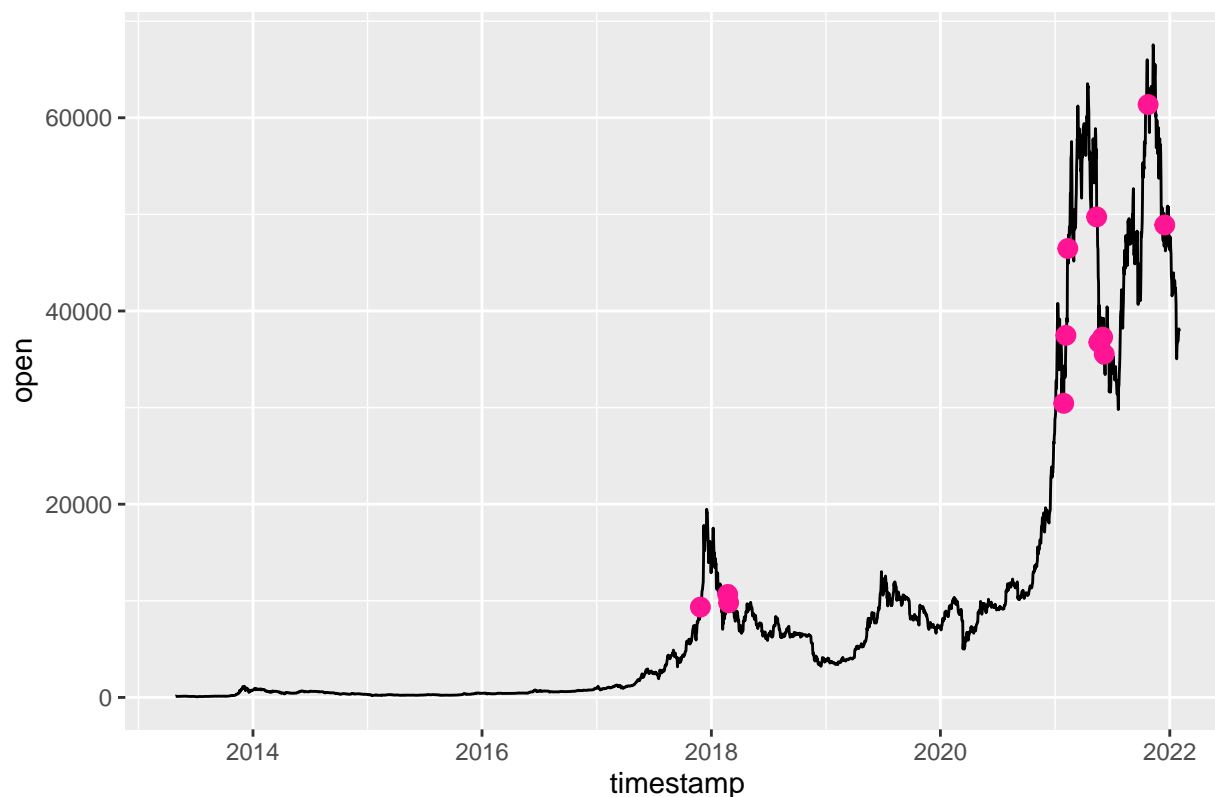
Sentiment Analysis

While the market may interpret Musk's tweets about Tesla as "accurate news", his tweets about cryptocurrency at least to some degree represent moods or personal sentiment. In this section we want to further analyze the nature of this sentiments, the most frequent words and the emotions associated to them.

```
## Loading required package: tm
```

```
## Loading required package: NLP
```

```
##
## Attaching package: 'NLP'
```

```
## The following object is masked from 'package:ggplot2':
##
##     annotate


## Warning in tm_map.SimpleCorpus(corpus, tolower): transformation drops documents


## Warning in tm_map.SimpleCorpus(corpus, removePunctuation): transformation drops
## documents


## Warning in tm_map.SimpleCorpus(corpus, removeNumbers): transformation drops
## documents


## Warning in tm_map.SimpleCorpus(corpus, removeWords, stopwords("english")):
## transformation drops documents


## Warning in tm_map.SimpleCorpus(cleanset, content_transformer(removeURL)):
## transformation drops documents


## Warning in tm_map.SimpleCorpus(cleanset, stripWhitespace): transformation drops
## documents
```

The graphs below shows the most used word and their frequency. It appears that the three most used words are *amp*, *tesla* and *will*. It goes without saying that we expected **tesla** to be one of the most frequent word in Musk's tweet, and our interpretation of the word **will** lies in that this verb shows his strong willingness and decisive, goal-oriented character as well as his inclination towards the future sustained by visionary statements. It can be less clear why **amp** is among the most frequent word, therefore we opted for a further explanation.

```
##               Docs
## Terms          1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
##   actions      1 1 0 0 0 0 0 0 0  0  0  0  0  0  0  0  0  0  0  0
##   bad          1 0 0 0 0 0 0 0 0  0  0  0  0  0  0  0  0  0  0  0
##   consequences 1 0 0 0 0 0 0 0 0  0  0  0  0  0  0  0  0  0  0  0
##   force        1 0 0 0 0 0 0 0 0  0  0  0  0  0  0  0  0  0  0  0
##   good         1 0 0 0 0 0 0 0 0  0  0  0  0  0  0  0  0  0  1  0
##   live         1 0 0 0 0 0 0 0 0  0  0  0  0  0  0  0  0  0  0  0
##   necessarily  1 0 0 0 0 0 0 0 0  0  0  0  0  0  0  0  0  0  0  0
##   reality      1 0 0 0 0 0 0 0 0  0  0  0  0  0  0  0  0  0  0  0
##   saying       1 0 0 0 0 0 0 0 0  0  0  0  0  0  0  0  0  0  0  0
##   will         1 0 0 0 0 0 0 0 0  0  0  0  0  0  0  0  0  0  0  0


## Warning in axis(if (horiz) 2 else 1, at = at.l, labels = names.arg, lty =
## axis.lty, : conversion failure on '…' in 'mbcsToSbcs': dot substituted for <e2>


## Warning in axis(if (horiz) 2 else 1, at = at.l, labels = names.arg, lty =
## axis.lty, : conversion failure on '…' in 'mbcsToSbcs': dot substituted for <80>


## Warning in axis(if (horiz) 2 else 1, at = at.l, labels = names.arg, lty =
## axis.lty, : conversion failure on '…' in 'mbcsToSbcs': dot substituted for <a6>


## Warning in axis(if (horiz) 2 else 1, at = at.l, labels = names.arg, lty =
## axis.lty, : conversion failure on ''s' in 'mbcsToSbcs': dot substituted for <e2>
```

```
## Warning in axis(if (horiz) 2 else 1, at = at.l, labels = names.arg, lty =
## axis.lty, : conversion failure on ''s' in 'mbcsToSbcs': dot substituted for <80>

## Warning in axis(if (horiz) 2 else 1, at = at.l, labels = names.arg, lty =
## axis.lty, : conversion failure on ''s' in 'mbcsToSbcs': dot substituted for <99>
```


AMP

Amp is a universal collateral token designed to facilitate fast and efficient transfers for any real-world application. When using Amp as collateral, transfers of value are guaranteed and can settle instantly. While the underlying asset reaches final settlement, a process that can take anywhere from seconds to days, Amp is held in escrow by a collateral manager. Once the transaction successfully settles, the Amp collateral is released and made available to collateralize another transfer. Amp exists to serve as universal collateral for anyone and any project. (*Source [(https://docs.amptoken.org/)]*). Besides being a collateral for individuals and DeFi platforms, Amp is used as a collateral for payment networks: Flexa uses Amp to enable instant, fraud-free payments to merchants across its digital payment network. Apps that integrate Flexa stake Amp to ensure all payments can be settled in real-time regardless of the asset or protocol used. Since AMP Token was to be integrated with Tesla's payment rail for crypto, it is understandable why it's been one of the most tweeted words by Elon Musk, being this news shocking the crypto-lovers panorama and the future of Tesla. The news of Tesla about the willing to accept crypto as payments and the investment in over 1.5 BLN USD in Bitcoin (February 2021), made the price of Bitcoin to skyrocket. On the other hand, a plethora of enviromental activists opposed this decision due to the high levels of electric energy which are used to mine and sustain the crypto network and highlighted the controversial nature of the Tesla CEO's choice: this led Elon Musk to no longer accept payments in Bitcoin. The impact on the crypto-currency value has been devastating has shown in the following graphic showing once again, how much "investors listen to Elon Musk".
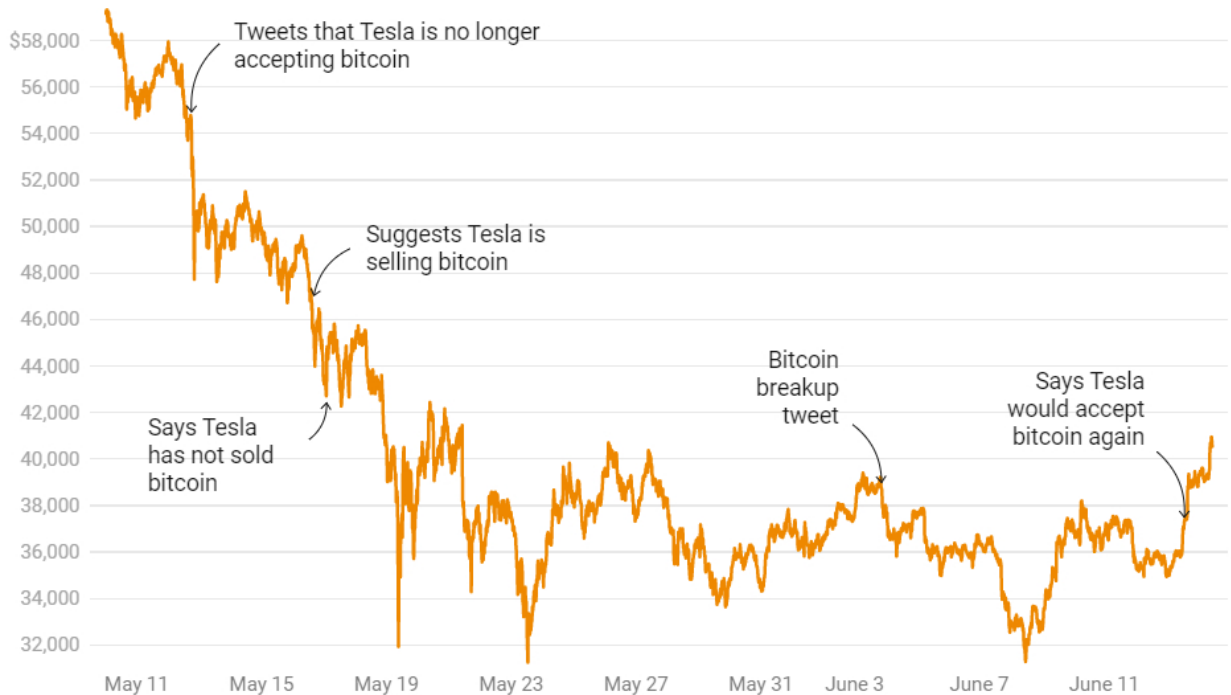
image:

Here follows a wordcloud which helped us to visualize the most frequent words in Elon Musk's tweets. The higher the word's size displayed, the most frequent the word would appear in his tweets.

```
## Warning in strwidth(words[i], cex = size[i], ...): conversion failure on ''s' in
## 'mbcsToSbcs': dot substituted for <e2>

## Warning in strwidth(words[i], cex = size[i], ...): conversion failure on ''s' in
## 'mbcsToSbcs': dot substituted for <80>

## Warning in strwidth(words[i], cex = size[i], ...): conversion failure on ''s' in
## 'mbcsToSbcs': dot substituted for <99>

## Warning in text.default(x1, y1, words[i], cex = size[i], offset = 0, srt =
## rotWord * : conversion failure on ''s' in 'mbcsToSbcs': dot substituted for <e2>

## Warning in text.default(x1, y1, words[i], cex = size[i], offset = 0, srt =
## rotWord * : conversion failure on ''s' in 'mbcsToSbcs': dot substituted for <80>

## Warning in text.default(x1, y1, words[i], cex = size[i], offset = 0, srt =
## rotWord * : conversion failure on ''s' in 'mbcsToSbcs': dot substituted for <99>

## Warning in text.default(x1, y1, words[i], cex = size[i], offset = 0, srt =
## rotWord * : font metrics unknown for Unicode character U+2019

## Warning in strwidth(words[i], cex = size[i], ...): conversion failure on '…' in
## 'mbcsToSbcs': dot substituted for <e2>

## Warning in strwidth(words[i], cex = size[i], ...): conversion failure on '…' in
## 'mbcsToSbcs': dot substituted for <80>
```

```
## Warning in strwidth(words[i], cex = size[i], ...): conversion failure on '…' in
## 'mbcsToSbcs': dot substituted for <a6>

## Warning in text.default(x1, y1, words[i], cex = size[i], offset = 0, srt =
## rotWord * : conversion failure on '…' in 'mbcsToSbcs': dot substituted for <e2>

## Warning in text.default(x1, y1, words[i], cex = size[i], offset = 0, srt =
## rotWord * : conversion failure on '…' in 'mbcsToSbcs': dot substituted for <80>

## Warning in text.default(x1, y1, words[i], cex = size[i], offset = 0, srt =
## rotWord * : conversion failure on '…' in 'mbcsToSbcs': dot substituted for <a6>

## Warning in text.default(x1, y1, words[i], cex = size[i], offset = 0, srt =
## rotWord * : font metrics unknown for Unicode character U+2026

## Warning in strwidth(words[i], cex = size[i], ...): conversion failure on ''re'
## in 'mbcsToSbcs': dot substituted for <e2>

## Warning in strwidth(words[i], cex = size[i], ...): conversion failure on ''re'
## in 'mbcsToSbcs': dot substituted for <80>

## Warning in strwidth(words[i], cex = size[i], ...): conversion failure on ''re'
## in 'mbcsToSbcs': dot substituted for <99>

## Warning in text.default(x1, y1, words[i], cex = size[i], offset = 0, srt =
## rotWord * : conversion failure on ''re' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in text.default(x1, y1, words[i], cex = size[i], offset = 0, srt =
## rotWord * : conversion failure on ''re' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in text.default(x1, y1, words[i], cex = size[i], offset = 0, srt =
## rotWord * : conversion failure on ''re' in 'mbcsToSbcs': dot substituted for
## <99>

## Warning in text.default(x1, y1, words[i], cex = size[i], offset = 0, srt =
## rotWord * : font metrics unknown for Unicode character U+2019

## Warning in strwidth(words[i], cex = size[i], ...): conversion failure on ' '
## in 'mbcsToSbcs': dot substituted for <f0>

## Warning in strwidth(words[i], cex = size[i], ...): conversion failure on ' '
## in 'mbcsToSbcs': dot substituted for <9f>

## Warning in strwidth(words[i], cex = size[i], ...): conversion failure on ' '
## in 'mbcsToSbcs': dot substituted for <a4>

## Warning in strwidth(words[i], cex = size[i], ...): conversion failure on ' '
## in 'mbcsToSbcs': dot substituted for <a3>
```

```
## Warning in strwidth(words[i], cex = size[i], ...): conversion failure on ' '
## in 'mbcsToSbcs': dot substituted for <f0>

## Warning in strwidth(words[i], cex = size[i], ...): conversion failure on ' '
## in 'mbcsToSbcs': dot substituted for <9f>

## Warning in strwidth(words[i], cex = size[i], ...): conversion failure on ' '
## in 'mbcsToSbcs': dot substituted for <a4>

## Warning in strwidth(words[i], cex = size[i], ...): conversion failure on ' '
## in 'mbcsToSbcs': dot substituted for <a3>


## Warning in text.default(x1, y1, words[i], cex = size[i], offset = 0, srt =
## rotWord * : conversion failure on ' ' in 'mbcsToSbcs': dot substituted for
## <f0>

## Warning in text.default(x1, y1, words[i], cex = size[i], offset = 0, srt =
## rotWord * : conversion failure on ' ' in 'mbcsToSbcs': dot substituted for
## <9f>

## Warning in text.default(x1, y1, words[i], cex = size[i], offset = 0, srt =
## rotWord * : conversion failure on ' ' in 'mbcsToSbcs': dot substituted for
## <a4>

## Warning in text.default(x1, y1, words[i], cex = size[i], offset = 0, srt =
## rotWord * : conversion failure on ' ' in 'mbcsToSbcs': dot substituted for
## <a3>

## Warning in text.default(x1, y1, words[i], cex = size[i], offset = 0, srt =
## rotWord * : conversion failure on ' ' in 'mbcsToSbcs': dot substituted for
## <f0>

## Warning in text.default(x1, y1, words[i], cex = size[i], offset = 0, srt =
## rotWord * : conversion failure on ' ' in 'mbcsToSbcs': dot substituted for
## <9f>

## Warning in text.default(x1, y1, words[i], cex = size[i], offset = 0, srt =
## rotWord * : conversion failure on ' ' in 'mbcsToSbcs': dot substituted for
## <a4>

## Warning in text.default(x1, y1, words[i], cex = size[i], offset = 0, srt =
## rotWord * : conversion failure on ' ' in 'mbcsToSbcs': dot substituted for
## <a3>

## Warning in text.default(x1, y1, words[i], cex = size[i], offset = 0, srt =
## rotWord * : font metrics unknown for Unicode character U+1f923

## Warning in text.default(x1, y1, words[i], cex = size[i], offset = 0, srt =
## rotWord * : font metrics unknown for Unicode character U+1f923
```

```
## Warning in strwidth(words[i], cex = size[i], ...): conversion failure on 'don't'
## in 'mbcsToSbcs': dot substituted for <e2>

## Warning in strwidth(words[i], cex = size[i], ...): conversion failure on 'don't'
## in 'mbcsToSbcs': dot substituted for <80>

## Warning in strwidth(words[i], cex = size[i], ...): conversion failure on 'don't'
## in 'mbcsToSbcs': dot substituted for <99>

## Warning in text.default(x1, y1, words[i], cex = size[i], offset = 0, srt =
## rotWord * : conversion failure on 'don't' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in text.default(x1, y1, words[i], cex = size[i], offset = 0, srt =
## rotWord * : conversion failure on 'don't' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in text.default(x1, y1, words[i], cex = size[i], offset = 0, srt =
## rotWord * : conversion failure on 'don't' in 'mbcsToSbcs': dot substituted for
## <99>

## Warning in text.default(x1, y1, words[i], cex = size[i], offset = 0, srt =
## rotWord * : font metrics unknown for Unicode character U+2019
```

```r
if(!require(wordcloud2)) install.packages("wordcloud2")
```

```
## Loading required package: wordcloud2
```

```r
library(wordcloud2)
w <- data.frame(names(w), w)
colnames(w) <- c('word', 'freq')
wordcloud2(w,
           size = 0.7,
           shape = 'rectangle',
           rotateRatio = 0.5,
           minSize = 1)
```

Sentiment scores and density

Based on the following results of the Sentiment Analysis of Elon Musk's tweets, it appears clear that *positive*, *trust* and *anticipation* are the most frequent emotions. This result is perfectly coherent with the visionary Tesla and SpaceX CEO's personality: his hunger for innovative , out-of-the-box solutions; his continuous positive and confident approach towards insurmountable problems such as "taking the human race to Mars", conceiving re-usable rockets disrupting space industry, as well as "changing the world's concept of driving through electric autonomous driven vehicle" and many others clearly embeds those emotions.

```
##
## Attaching package: 'scales'
```

```
## The following object is masked from 'package:syuzhet':
##
##     rescale
```

```
## The following object is masked from 'package:purrr':
##
##     discard
```

```
## The following object is masked from 'package:readr':
##
##     col_factor
```

```
##
## Attaching package: 'reshape2'
```

```
## The following object is masked from 'package:tidyr':
##
##     smiths
```

```
## Warning: `spread_()` was deprecated in tidyr 1.2.0.
## Please use `spread()` instead.
## This warning is displayed once every 8 hours.
## Call `lifecycle::last_lifecycle_warnings()` to see where this warning was generated.
```

```
##   anger anticipation disgust fear joy sadness surprise trust negative positive
## 1     2            1       1    2   1        1        1     1        2        1
## 2     0            0       0    0   0        0        0     0        0        1
## 3     1            1       2    2   0        2        0     1        2        1
## 4     0            0       0    0   0        0        0     1        0        1
## 5     0            1       0    0   1        0        0     3        0        3
## 6     0            0       0    0   0        0        0     0        0        0
```

Sentiment Scores Tweets
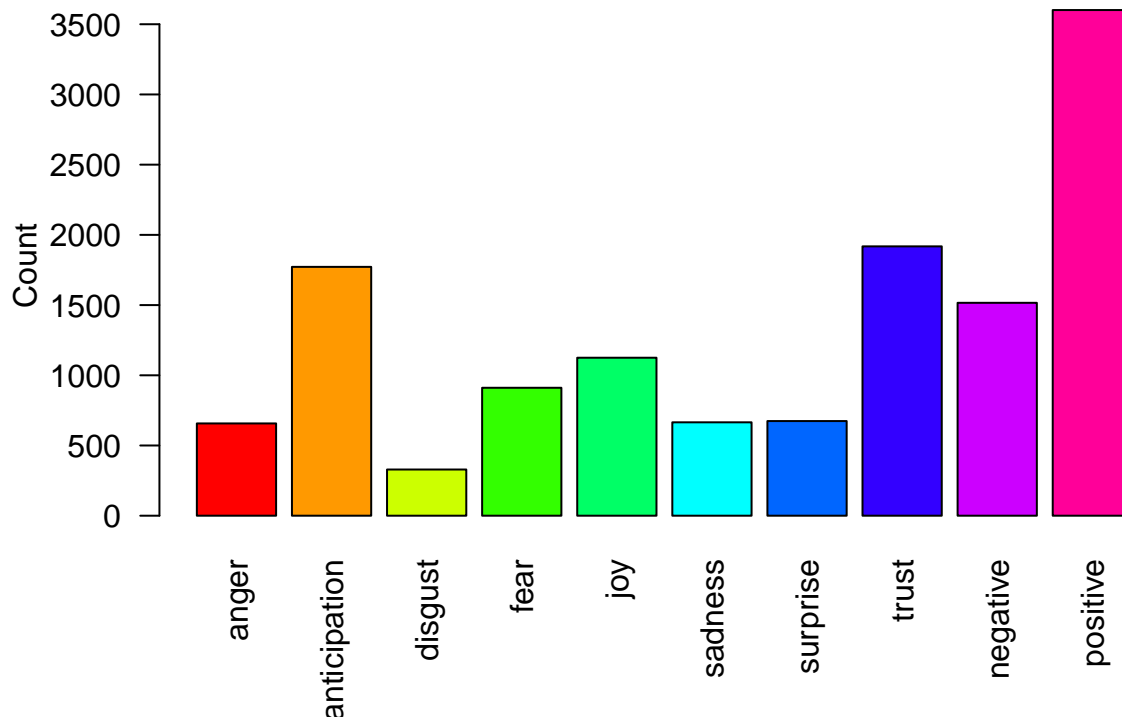

```
## Loading required package: usethis

##
## Attaching package: 'sentimentr'

## The following object is masked from 'package:syuzhet':
##
##     get_sentences

## Warning: Each time `sentiment_by` is run it has to do sentence boundary disambiguation when a
## raw `character` vector is passed to `text.var`. This may be costly of time and
## memory.  It is highly recommended that the user first runs the raw `character`
## vector through the `get_sentences` function.

## Warning: Each time `extract_sentiment` is run it has to do sentence boundary disambiguation when a
## raw `character` vector is passed to `text.var`. This may be costly of time and
## memory.  It is highly recommended that the user first runs the raw `character`
## vector through the `get_sentences` function.
```

Another important result is outlined by the following graphs. It shows the density of sentiment: as it can be noticed it follows a normal-like distribution ($\mu = 0.18$, $ = 0.36$ $), slightly positevely skewed. This result is line with the previous results, highlighting the positive polarity of the sentiments. Here follows a brief statistical summary of the density plot, followed by the plot itself.

```
## [1] 0.182454
```

```
## [1] 0.3592767
```

```
## [1] -0.0477896
```

Density of sentiments

N = 3180   Bandwidth = 0.06145
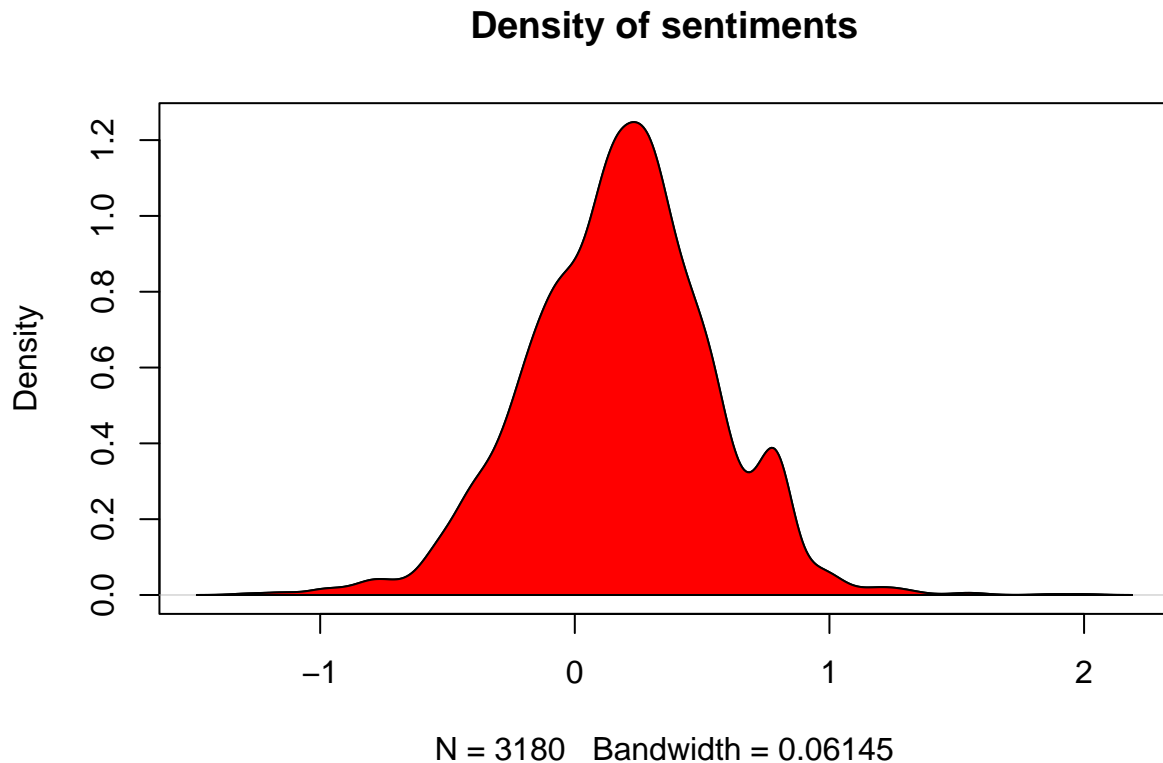
Emotions at the sentence level

The following analysis detects the rate of emotion at the sentence level. This method uses a simple dictionary lookup to find emotion words and then compute the rate per sentence. The emotion score ranges between 0 (no emotion used) and 1 (all words used were emotional). Once again, this result is in line with the previous ones, showing how positive emotions such as joy, trust and anticipation are predominant. Please note that the suffix *_negated* indicates the opposite of the reference emotions, which appears to be consistently absent in relation to any emotion.
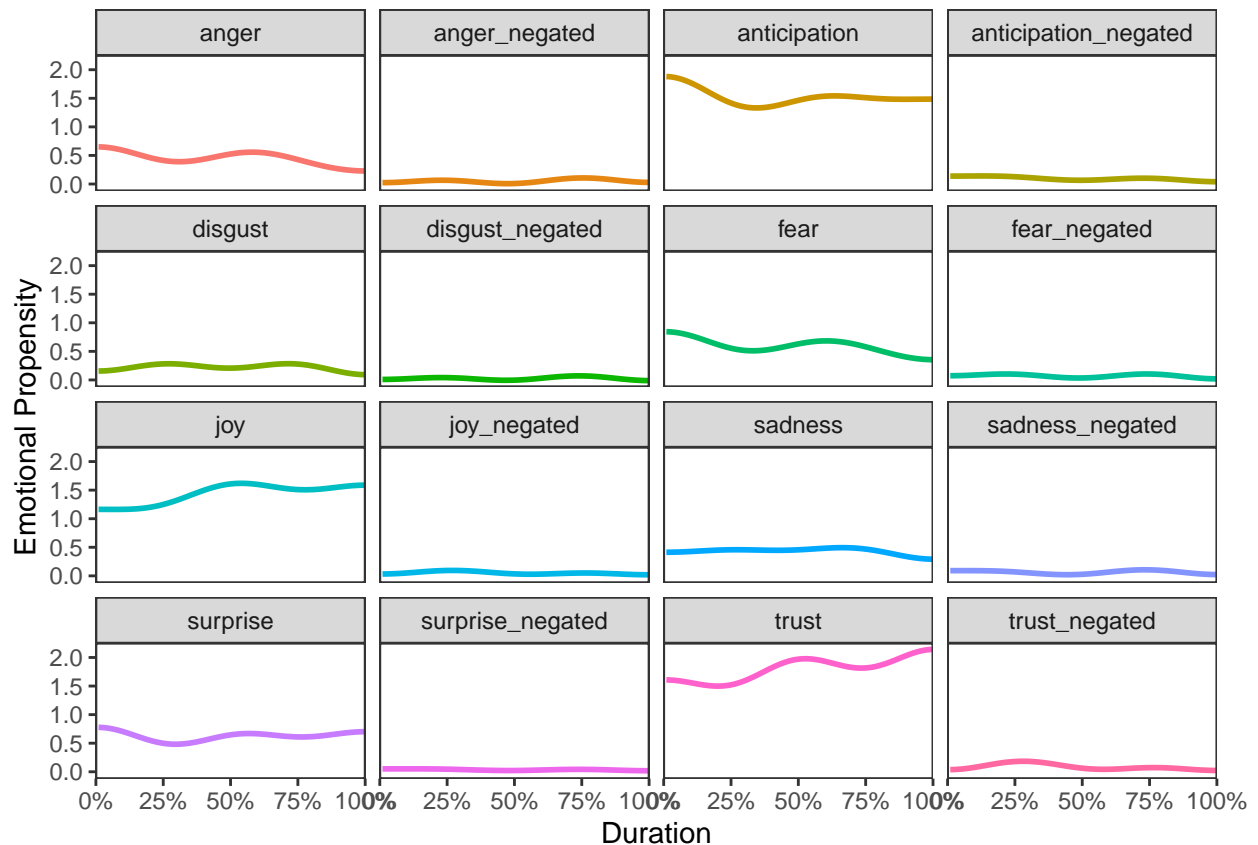
DO THE SAME WITH A SUBSET CONSIDERING ONLY FROM A SPECIFIC POINT ONWARD AND WITHOUT AMP, compare and see if there is any difference.

Subsetting sentiment from Jan 2020 without "AMP" word

```
if(!require(tm)) install.packages("tm")
library(tm)
library(RColorBrewer)
library(wordcloud)

#subset after Jan 2020

tweet2020 = elon
tweet2020 = tweet2020[-c(1:2762),]

#eliminate tweet containing "amp" with grepl
tweet2020 = tweet2020[!grepl("amp", tweet2020[["tweet"]]),]


corpus1 <- iconv(tweet2020$tweet)
corpus1 <- Corpus(VectorSource(corpus1))
inspect(corpus1[1:6])
```

```
## <<SimpleCorpus>>
```

```
## Metadata:  corpus specific: 1, document level (indexed): 0
## Content:  documents: 6
##
## [1] I put the art in fart
## [2] @fvckgerry Haha spectrum af
## [3] @nichegamer King of the Goblins, Master of the Labyrinth
## [4]    Tesla China Team        Such amazing progress!!
## [5] @BnOrdhaug @Erdayastronaut I haven't cross-checked RCS pulses with the MLI dimpling on the video
## [6] @webtekno Nice
```

```r
#clean
corpus1 <- tm_map(corpus1, tolower)
```

```
## Warning in tm_map.SimpleCorpus(corpus1, tolower): transformation drops documents
```

```r
corpus1<- tm_map(corpus1, removePunctuation)
```

```
## Warning in tm_map.SimpleCorpus(corpus1, removePunctuation): transformation drops
## documents
```

```r
corpus1 <- tm_map(corpus1, removeNumbers)
```

```
## Warning in tm_map.SimpleCorpus(corpus1, removeNumbers): transformation drops
## documents
```

```r
cleanset1 <- tm_map(corpus1, removeWords, stopwords('english'))
```

```
## Warning in tm_map.SimpleCorpus(corpus1, removeWords, stopwords("english")):
## transformation drops documents
```

```r
removeURL1 <- function(x) gsub('http[[:alnum:]]*', '', x)
cleanset1 <- tm_map(cleanset1, content_transformer(removeURL1))
```

```
## Warning in tm_map.SimpleCorpus(cleanset1, content_transformer(removeURL1)):
## transformation drops documents
```

```r
inspect(cleanset1[1:10])
```

```
## <<SimpleCorpus>>
## Metadata:  corpus specific: 1, document level (indexed): 0
## Content:  documents: 10
##
##  [1]  put  art  fart
##  [2] fvckgerry haha spectrum af
##  [3] nichegamer king   goblins master   labyrinth
##  [4]    tesla china team        amazing progress
##  [5] bnordhaug erdayastronaut  haven't crosschecked rcs pulses   mli dimpling   video   's  likely ca
##  [6] webtekno nice
##  [7] erdayastronaut since 's  one main engine  gives pitch  yaw control roll control  provided   nit
##  [8] annerajb waitbutwhy looks like  thin flat round ufo   stick starlink terminal  motors  selfadju
##  [9] renatakonkoly rationaletienne just tryin  grow  follower count  pornhub …
## [10] rationaletienne
```

```r
#stemming = reduce to root form
cleanset1 <- tm_map(cleanset1, stripWhitespace)
```

```
## Warning in tm_map.SimpleCorpus(cleanset1, stripWhitespace): transformation drops
## documents
```

```r
inspect(cleanset1[1:5])
```

```
## <<SimpleCorpus>>
## Metadata:  corpus specific: 1, document level (indexed): 0
## Content:   documents: 5
##
## [1]  put art fart
## [2] fvckgerry haha spectrum af
## [3] nichegamer king goblins master labyrinth
## [4]   tesla china team   amazing progress
## [5] bnordhaug erdayastronaut haven't crosschecked rcs pulses mli dimpling video 's likely cause
```

```r
tdm1 <- TermDocumentMatrix(cleanset1)
tdm1 <- as.matrix(tdm1)
tdm1[1:10, 1:20]
```

```
##           Docs
## Terms      1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
##   art      1 0 0 0 0 0 0 0 0  0  0  0  0  0  0  1  0  0  0  0
##   fart     1 0 0 0 0 0 0 0 0  0  0  0  0  0  0  0  0  0  0  0
##   put      1 0 0 0 0 0 0 0 0  0  0  0  0  0  0  0  0  0  0  0
##   fvckgerry 0 1 0 0 0 0 0 0 0  0  0  0  0  0  0  0  0  0  0  0
##   haha     0 1 0 0 0 0 0 0 0  0  0  0  0  0  0  0  1  0  0  0
##   spectrum 0 1 0 0 0 0 0 0 0  0  0  0  0  0  0  0  0  0  0  0
##            0 1 0 0 0 0 0 0 0  0  0  0  0  0  0  0  0  0  0  0
##   goblins  0 0 1 0 0 0 0 0 0  0  0  0  0  0  0  0  0  0  0  0
##   king     0 0 1 0 0 0 0 0 0  0  0  0  0  0  0  0  0  0  0  0
##   labyrinth 0 0 1 0 0 0 0 0 0  0  0  0  0  0  0  0  0  0  0  0
```

```r
words1 <- rowSums(tdm1)
words1 <- subset(words1, words1>=60)
barplot(words1,
        las = 2,
        col = rainbow(50))
```

```
## Warning in axis(if (horiz) 2 else 1, at = at.l, labels = names.arg, lty =
## axis.lty, : conversion failure on ''s' in 'mbcsToSbcs': dot substituted for <e2>
```

```
## Warning in axis(if (horiz) 2 else 1, at = at.l, labels = names.arg, lty =
## axis.lty, : conversion failure on ''s' in 'mbcsToSbcs': dot substituted for <80>
```

```
## Warning in axis(if (horiz) 2 else 1, at = at.l, labels = names.arg, lty =
## axis.lty, : conversion failure on ''s' in 'mbcsToSbcs': dot substituted for <99>
```

```
## Warning in strwidth(words[i], cex = size[i], ...): conversion failure on ''s' in
## 'mbcsToSbcs': dot substituted for <e2>

## Warning in strwidth(words[i], cex = size[i], ...): conversion failure on ''s' in
## 'mbcsToSbcs': dot substituted for <80>

## Warning in strwidth(words[i], cex = size[i], ...): conversion failure on ''s' in
## 'mbcsToSbcs': dot substituted for <99>

## Warning in text.default(x1, y1, words[i], cex = size[i], offset = 0, srt =
## rotWord * : conversion failure on ''s' in 'mbcsToSbcs': dot substituted for <e2>

## Warning in text.default(x1, y1, words[i], cex = size[i], offset = 0, srt =
## rotWord * : conversion failure on ''s' in 'mbcsToSbcs': dot substituted for <80>

## Warning in text.default(x1, y1, words[i], cex = size[i], offset = 0, srt =
## rotWord * : conversion failure on ''s' in 'mbcsToSbcs': dot substituted for <99>

## Warning in text.default(x1, y1, words[i], cex = size[i], offset = 0, srt =
## rotWord * : font metrics unknown for Unicode character U+2019

## Warning in strwidth(words[i], cex = size[i], ...): conversion failure on ' '
## in 'mbcsToSbcs': dot substituted for <f0>
```

```
## Warning in strwidth(words[i], cex = size[i], ...): conversion failure on ' '
## in 'mbcsToSbcs': dot substituted for <9f>

## Warning in strwidth(words[i], cex = size[i], ...): conversion failure on ' '
## in 'mbcsToSbcs': dot substituted for <a4>

## Warning in strwidth(words[i], cex = size[i], ...): conversion failure on ' '
## in 'mbcsToSbcs': dot substituted for <a3>

## Warning in strwidth(words[i], cex = size[i], ...): conversion failure on ' '
## in 'mbcsToSbcs': dot substituted for <f0>

## Warning in strwidth(words[i], cex = size[i], ...): conversion failure on ' '
## in 'mbcsToSbcs': dot substituted for <9f>

## Warning in strwidth(words[i], cex = size[i], ...): conversion failure on ' '
## in 'mbcsToSbcs': dot substituted for <a4>

## Warning in strwidth(words[i], cex = size[i], ...): conversion failure on ' '
## in 'mbcsToSbcs': dot substituted for <a3>

## Warning in text.default(x1, y1, words[i], cex = size[i], offset = 0, srt =
## rotWord * : conversion failure on ' ' in 'mbcsToSbcs': dot substituted for
## <f0>

## Warning in text.default(x1, y1, words[i], cex = size[i], offset = 0, srt =
## rotWord * : conversion failure on ' ' in 'mbcsToSbcs': dot substituted for
## <9f>

## Warning in text.default(x1, y1, words[i], cex = size[i], offset = 0, srt =
## rotWord * : conversion failure on ' ' in 'mbcsToSbcs': dot substituted for
## <a4>

## Warning in text.default(x1, y1, words[i], cex = size[i], offset = 0, srt =
## rotWord * : conversion failure on ' ' in 'mbcsToSbcs': dot substituted for
## <a3>

## Warning in text.default(x1, y1, words[i], cex = size[i], offset = 0, srt =
## rotWord * : conversion failure on ' ' in 'mbcsToSbcs': dot substituted for
## <f0>

## Warning in text.default(x1, y1, words[i], cex = size[i], offset = 0, srt =
## rotWord * : conversion failure on ' ' in 'mbcsToSbcs': dot substituted for
## <9f>

## Warning in text.default(x1, y1, words[i], cex = size[i], offset = 0, srt =
## rotWord * : conversion failure on ' ' in 'mbcsToSbcs': dot substituted for
## <a4>

## Warning in text.default(x1, y1, words[i], cex = size[i], offset = 0, srt =
## rotWord * : conversion failure on ' ' in 'mbcsToSbcs': dot substituted for
## <a3>
```

```
## Warning in text.default(x1, y1, words[i], cex = size[i], offset = 0, srt =
## rotWord * : font metrics unknown for Unicode character U+1f923

## Warning in text.default(x1, y1, words[i], cex = size[i], offset = 0, srt =
## rotWord * : font metrics unknown for Unicode character U+1f923


## Warning in strwidth(words[i], cex = size[i], ...): conversion failure on '…' in
## 'mbcsToSbcs': dot substituted for <e2>


## Warning in strwidth(words[i], cex = size[i], ...): conversion failure on '…' in
## 'mbcsToSbcs': dot substituted for <80>


## Warning in strwidth(words[i], cex = size[i], ...): conversion failure on '…' in
## 'mbcsToSbcs': dot substituted for <a6>


## Warning in text.default(x1, y1, words[i], cex = size[i], offset = 0, srt =
## rotWord * : conversion failure on '…' in 'mbcsToSbcs': dot substituted for <e2>


## Warning in text.default(x1, y1, words[i], cex = size[i], offset = 0, srt =
## rotWord * : conversion failure on '…' in 'mbcsToSbcs': dot substituted for <80>


## Warning in text.default(x1, y1, words[i], cex = size[i], offset = 0, srt =
## rotWord * : conversion failure on '…' in 'mbcsToSbcs': dot substituted for <a6>


## Warning in text.default(x1, y1, words[i], cex = size[i], offset = 0, srt =
## rotWord * : font metrics unknown for Unicode character U+2026


## Warning in strwidth(words[i], cex = size[i], ...): conversion failure on ''re'
## in 'mbcsToSbcs': dot substituted for <e2>


## Warning in strwidth(words[i], cex = size[i], ...): conversion failure on ''re'
## in 'mbcsToSbcs': dot substituted for <80>


## Warning in strwidth(words[i], cex = size[i], ...): conversion failure on ''re'
## in 'mbcsToSbcs': dot substituted for <99>


## Warning in text.default(x1, y1, words[i], cex = size[i], offset = 0, srt =
## rotWord * : conversion failure on ''re' in 'mbcsToSbcs': dot substituted for
## <e2>


## Warning in text.default(x1, y1, words[i], cex = size[i], offset = 0, srt =
## rotWord * : conversion failure on ''re' in 'mbcsToSbcs': dot substituted for
## <80>


## Warning in text.default(x1, y1, words[i], cex = size[i], offset = 0, srt =
## rotWord * : conversion failure on ''re' in 'mbcsToSbcs': dot substituted for
## <99>


## Warning in text.default(x1, y1, words[i], cex = size[i], offset = 0, srt =
## rotWord * : font metrics unknown for Unicode character U+2019
```

```
## Warning in strwidth(words[i], cex = size[i], ...): conversion failure on '' in
## 'mbcsToSbcs': dot substituted for <f0>

## Warning in strwidth(words[i], cex = size[i], ...): conversion failure on '' in
## 'mbcsToSbcs': dot substituted for <9f>

## Warning in strwidth(words[i], cex = size[i], ...): conversion failure on '' in
## 'mbcsToSbcs': dot substituted for <a4>

## Warning in strwidth(words[i], cex = size[i], ...): conversion failure on '' in
## 'mbcsToSbcs': dot substituted for <a3>

## Warning in text.default(x1, y1, words[i], cex = size[i], offset = 0, srt =
## rotWord * : conversion failure on '' in 'mbcsToSbcs': dot substituted for <f0>

## Warning in text.default(x1, y1, words[i], cex = size[i], offset = 0, srt =
## rotWord * : conversion failure on '' in 'mbcsToSbcs': dot substituted for <9f>

## Warning in text.default(x1, y1, words[i], cex = size[i], offset = 0, srt =
## rotWord * : conversion failure on '' in 'mbcsToSbcs': dot substituted for <a4>

## Warning in text.default(x1, y1, words[i], cex = size[i], offset = 0, srt =
## rotWord * : conversion failure on '' in 'mbcsToSbcs': dot substituted for <a3>

## Warning in text.default(x1, y1, words[i], cex = size[i], offset = 0, srt =
## rotWord * : font metrics unknown for Unicode character U+1f923

## Warning in wordcloud(words = names(w1), freq = w1, max.words = 150, random.order
## = F, : cleantechnica could not be fit on page. It will not be plotted.

## Warning in strwidth(words[i], cex = size[i], ...): conversion failure on 'don't'
## in 'mbcsToSbcs': dot substituted for <e2>

## Warning in strwidth(words[i], cex = size[i], ...): conversion failure on 'don't'
## in 'mbcsToSbcs': dot substituted for <80>

## Warning in strwidth(words[i], cex = size[i], ...): conversion failure on 'don't'
## in 'mbcsToSbcs': dot substituted for <99>

## Warning in text.default(x1, y1, words[i], cex = size[i], offset = 0, srt =
## rotWord * : conversion failure on 'don't' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in text.default(x1, y1, words[i], cex = size[i], offset = 0, srt =
## rotWord * : conversion failure on 'don't' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in text.default(x1, y1, words[i], cex = size[i], offset = 0, srt =
## rotWord * : conversion failure on 'don't' in 'mbcsToSbcs': dot substituted for
## <99>
```
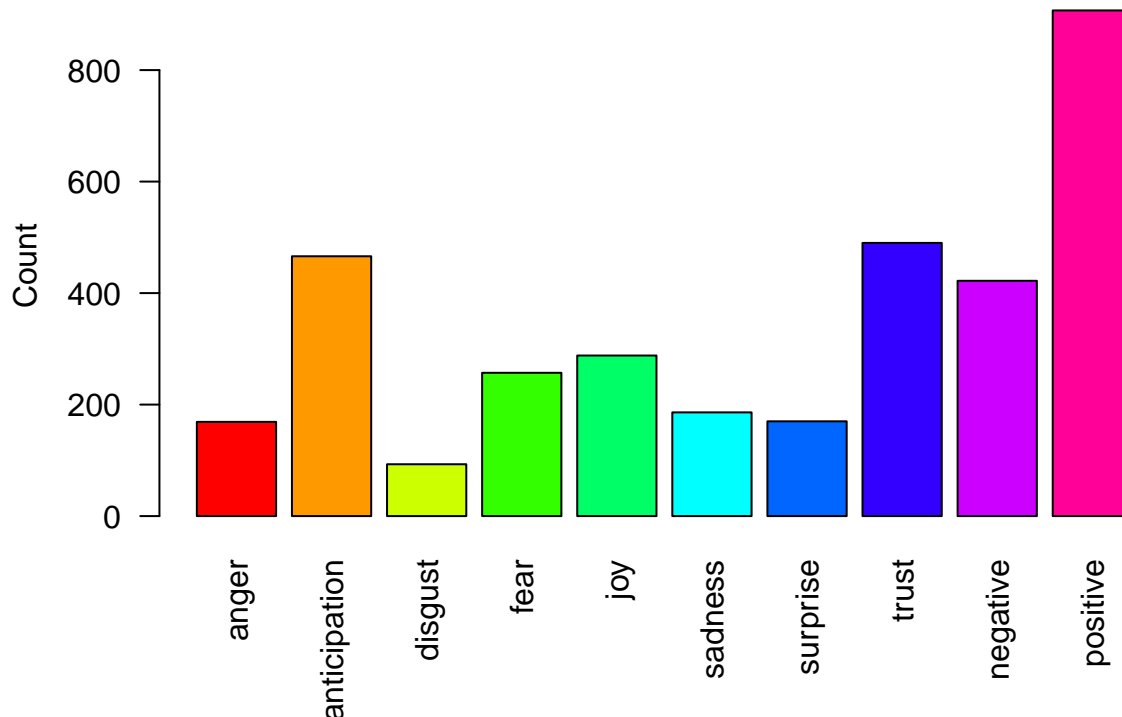
```
## Warning in text.default(x1, y1, words[i], cex = size[i], offset = 0, srt =
## rotWord * : font metrics unknown for Unicode character U+2019

## Warning in wordcloud(words = names(w1), freq = w1, max.words = 150, random.order
## = F, : mass could not be fit on page. It will not be plotted.

## Warning in wordcloud(words = names(w1), freq = w1, max.words = 150, random.order
## = F, : exactly could not be fit on page. It will not be plotted.

## Warning in wordcloud(words = names(w1), freq = w1, max.words = 150, random.order
## = F, : production could not be fit on page. It will not be plotted.

## Warning in strwidth(words[i], cex = size[i], ...): conversion failure on '-' in
## 'mbcsToSbcs': dot substituted for <e2>

## Warning in strwidth(words[i], cex = size[i], ...): conversion failure on '-' in
## 'mbcsToSbcs': dot substituted for <80>

## Warning in strwidth(words[i], cex = size[i], ...): conversion failure on '-' in
## 'mbcsToSbcs': dot substituted for <93>

## Warning in text.default(x1, y1, words[i], cex = size[i], offset = 0, srt =
## rotWord * : conversion failure on '-' in 'mbcsToSbcs': dot substituted for <e2>

## Warning in text.default(x1, y1, words[i], cex = size[i], offset = 0, srt =
## rotWord * : conversion failure on '-' in 'mbcsToSbcs': dot substituted for <80>

## Warning in text.default(x1, y1, words[i], cex = size[i], offset = 0, srt =
## rotWord * : conversion failure on '-' in 'mbcsToSbcs': dot substituted for <93>

## Warning in text.default(x1, y1, words[i], cex = size[i], offset = 0, srt =
## rotWord * : font metrics unknown for Unicode character U+2013

## Warning in wordcloud(words = names(w1), freq = w1, max.words = 150, random.order
## = F, : renatakonkoly could not be fit on page. It will not be plotted.

## Warning in wordcloud(words = names(w1), freq = w1, max.words = 150, random.order
## = F, : energy could not be fit on page. It will not be plotted.

## Warning in wordcloud(words = names(w1), freq = w1, max.words = 150, random.order
## = F, : teslagong could not be fit on page. It will not be plotted.

## Warning in wordcloud(words = names(w1), freq = w1, max.words = 150, random.order
## = F, : times could not be fit on page. It will not be plotted.

## Warning in wordcloud(words = names(w1), freq = w1, max.words = 150, random.order
## = F, : flight could not be fit on page. It will not be plotted.

## Warning in wordcloud(words = names(w1), freq = w1, max.words = 150, random.order
## = F, : important could not be fit on page. It will not be plotted.
```

```
## Warning in wordcloud(words = names(w1), freq = w1, max.words = 150, random.order
## = F, : kimbal could not be fit on page. It will not be plotted.

## Warning in wordcloud(words = names(w1), freq = w1, max.words = 150, random.order
## = F, : almost could not be fit on page. It will not be plotted.

## Warning in wordcloud(words = names(w1), freq = w1, max.words = 150, random.order
## = F, : support could not be fit on page. It will not be plotted.

## Warning in wordcloud(words = names(w1), freq = w1, max.words = 150, random.order
## = F, : thesheetztweetz could not be fit on page. It will not be plotted.

## Warning in wordcloud(words = names(w1), freq = w1, max.words = 150, random.order
## = F, : indeed could not be fit on page. It will not be plotted.

## Warning in wordcloud(words = names(w1), freq = w1, max.words = 150, random.order
## = F, : doo could not be fit on page. It will not be plotted.

## Warning in wordcloud(words = names(w1), freq = w1, max.words = 150, random.order
## = F, : progress could not be fit on page. It will not be plotted.

## Warning in wordcloud(words = names(w1), freq = w1, max.words = 150, random.order
## = F, : booster could not be fit on page. It will not be plotted.

## Warning in wordcloud(words = names(w1), freq = w1, max.words = 150, random.order
## = F, : awesome could not be fit on page. It will not be plotted.

## Warning in wordcloud(words = names(w1), freq = w1, max.words = 150, random.order
## = F, : engines could not be fit on page. It will not be plotted.

## Warning in wordcloud(words = names(w1), freq = w1, max.words = 150, random.order
## = F, : likely could not be fit on page. It will not be plotted.

## Warning in wordcloud(words = names(w1), freq = w1, max.words = 150, random.order
## = F, : every could not be fit on page. It will not be plotted.

## Warning in wordcloud(words = names(w1), freq = w1, max.words = 150, random.order
## = F, : definitely could not be fit on page. It will not be plotted.

## Warning in wordcloud(words = names(w1), freq = w1, max.words = 150, random.order
## = F, : sounds could not be fit on page. It will not be plotted.

## Warning in wordcloud(words = names(w1), freq = w1, max.words = 150, random.order
## = F, : super could not be fit on page. It will not be plotted.

## Warning in wordcloud(words = names(w1), freq = w1, max.words = 150, random.order
## = F, : might could not be fit on page. It will not be plotted.

## Warning in wordcloud(words = names(w1), freq = w1, max.words = 150, random.order
## = F, : needed could not be fit on page. It will not be plotted.
```

```
## Warning in wordcloud(words = names(w1), freq = w1, max.words = 150, random.order
## = F, : release could not be fit on page. It will not be plotted.

## Warning in wordcloud(words = names(w1), freq = w1, max.words = 150, random.order
## = F, : pressure could not be fit on page. It will not be plotted.

## Warning in wordcloud(words = names(w1), freq = w1, max.words = 150, random.order
## = F, : seems could not be fit on page. It will not be plotted.

## Warning in wordcloud(words = names(w1), freq = w1, max.words = 150, random.order
## = F, : ercxspace could not be fit on page. It will not be plotted.

## Warning in wordcloud(words = names(w1), freq = w1, max.words = 150, random.order
## = F, : wow could not be fit on page. It will not be plotted.

## Warning in wordcloud(words = names(w1), freq = w1, max.words = 150, random.order
## = F, : icannotenough could not be fit on page. It will not be plotted.

## Warning in wordcloud(words = names(w1), freq = w1, max.words = 150, random.order
## = F, : hopefully could not be fit on page. It will not be plotted.

## Warning in wordcloud(words = names(w1), freq = w1, max.words = 150, random.order
## = F, : problem could not be fit on page. It will not be plotted.

## Warning in wordcloud(words = names(w1), freq = w1, max.words = 150, random.order
## = F, : months could not be fit on page. It will not be plotted.

## Warning in wordcloud(words = names(w1), freq = w1, max.words = 150, random.order
## = F, : going could not be fit on page. It will not be plotted.

## Warning in wordcloud(words = names(w1), freq = w1, max.words = 150, random.order
## = F, : low could not be fit on page. It will not be plotted.

## Warning in wordcloud(words = names(w1), freq = w1, max.words = 150, random.order
## = F, : gfilche could not be fit on page. It will not be plotted.

## Warning in wordcloud(words = names(w1), freq = w1, max.words = 150, random.order
## = F, : future could not be fit on page. It will not be plotted.

## Warning in wordcloud(words = names(w1), freq = w1, max.words = 150, random.order
## = F, : marcushousegame could not be fit on page. It will not be plotted.

## Warning in wordcloud(words = names(w1), freq = w1, max.words = 150, random.order
## = F, : rainmaker could not be fit on page. It will not be plotted.
```

```r
if(!require(wordcloud2)) install.packages("wordcloud2")
library(wordcloud2)
w1 <- data.frame(names(w1), w1)
colnames(w1) <- c('word', 'freq')
wordcloud2(w1,
           size = 0.7,
           shape = 'rectangle',
           rotateRatio = 0.5,
           minSize = 1)
```

Sentiment scores and density

```
##   anger anticipation disgust fear joy sadness surprise trust negative positive
## 1     0            1       0    0   1       1        1     0        0        1
## 2     0            0       0    0   0       0        0     0        0        0
## 3     0            1       0    0   0       0        0     0        1        2
## 4     0            1       0    0   1       0        0     1        0        1
## 5     1            0       0    1   0       1        0     1        1        1
## 6     0            0       0    0   0       0        0     0        0        0
```

Sentiment Scores Tweets


```
## Warning: Each time `sentiment_by` is run it has to do sentence boundary disambiguation when a
## raw `character` vector is passed to `text.var`. This may be costly of time and
## memory.  It is highly recommended that the user first runs the raw `character`
## vector through the `get_sentences` function.

## Warning: Each time `extract_sentiment` is run it has to do sentence boundary disambiguation when a
## raw `character` vector is passed to `text.var`. This may be costly of time and
## memory.  It is highly recommended that the user first runs the raw `character`
## vector through the `get_sentences` function.
```

```
library(e1071)

txt1 %>%
get_sentences() %>%
sentiment() %>%
filter(sentiment!=0) -> senti1

densitySentiments1 <- density(senti1$sentiment)
mean(senti1$sentiment)
```

```
## [1] 0.1981359
```

```
sd(senti1$sentiment)
```

```
## [1] 0.3859845
```

```
skewness(senti1$sentiment)
```

```
## [1] -0.1307537
```

```
plot(densitySentiments1,main='Density of sentiments')
polygon(densitySentiments1,col='green')
```

Density of sentiments

N = 990   Bandwidth = 0.08501
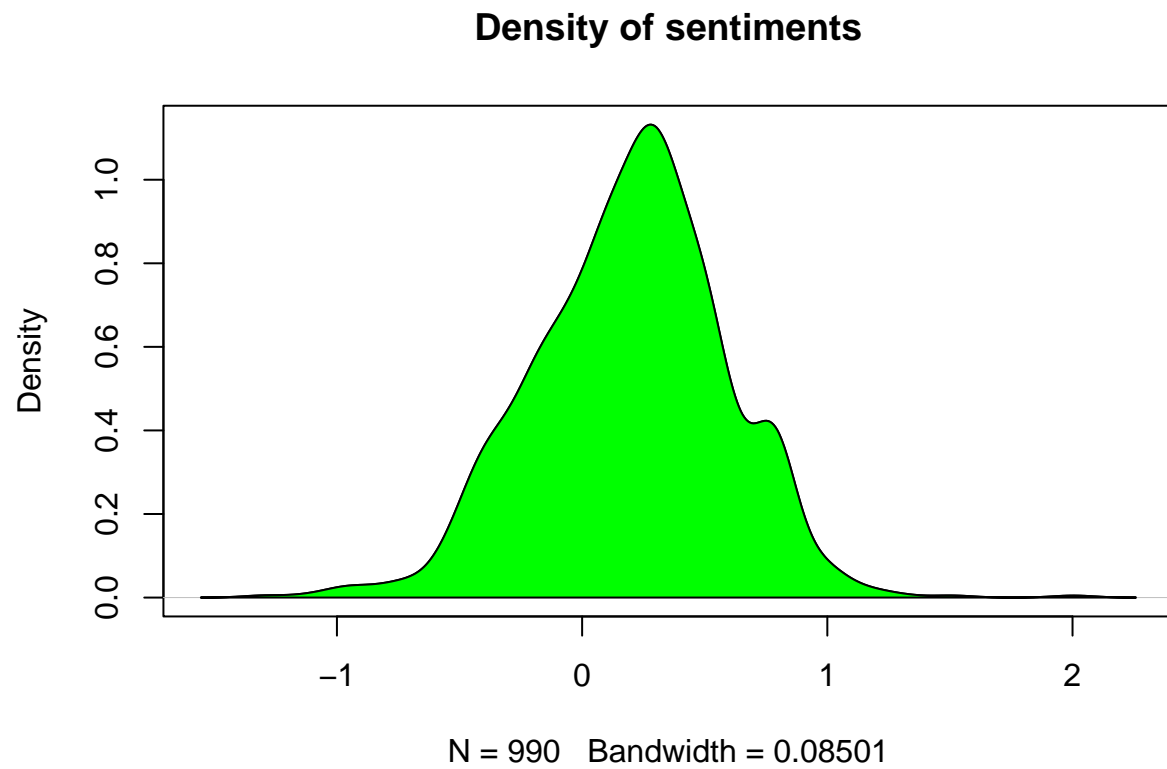
```
e1<-emotion_by(get_sentences(txt1),drop.unused.emotions=TRUE)
plot(e1)
```
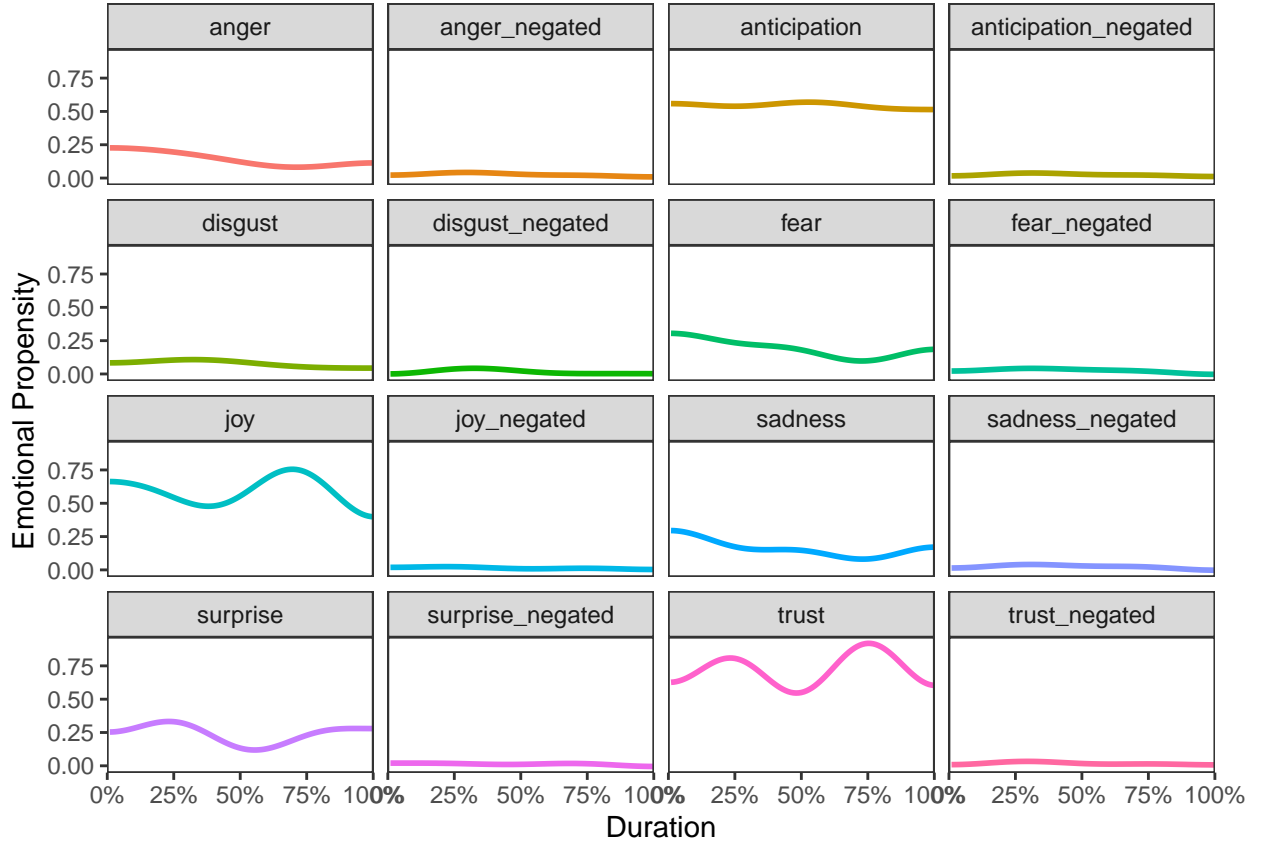
Testing for stationarity

In this section we show the results obtained when testing for Bitcoin trend stationarity. We recall the hypothesis:

Null Hypothesis (H0 : Null hypothesis of the test is that the time series can be represented by a unit root that is not stationary. *Alternative Hypothesis (H1)*: Alternative Hypothesis of the test is that the time series is stationary. The following plot, represent our study focus.

Trend signal
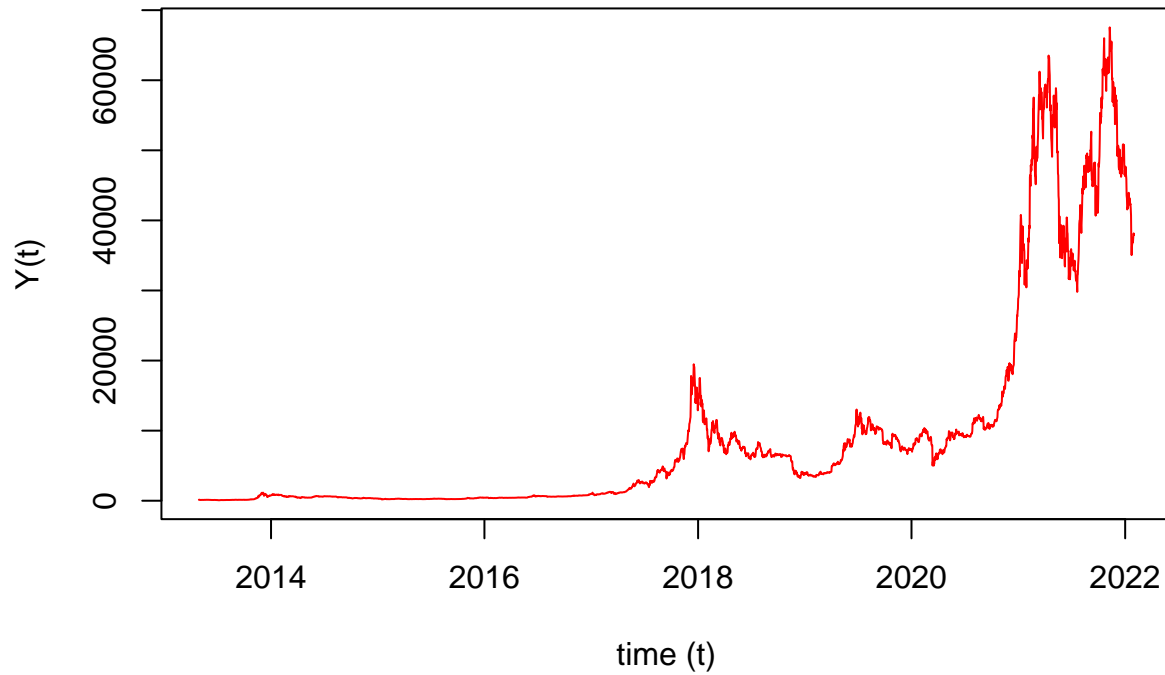
Autocorrelation Function

The autocorrelation function (ACF) defines how data points in a time series are related, on average, to the preceding data points (Box, Jenkins, & Reinsel, 1994). In other words, it measures the self-similarity of the signal over different delay times. An autocorrelation plot shows the value of the autocorrelation function (ACF) on the vertical axis. It can range from –1 to 1. We use autocorrelation plot to assess wether the elements of a time series randomly oscilates around zero.

Our first attempt without any transformation gives the following result, which shows consistent non-

stationarity.
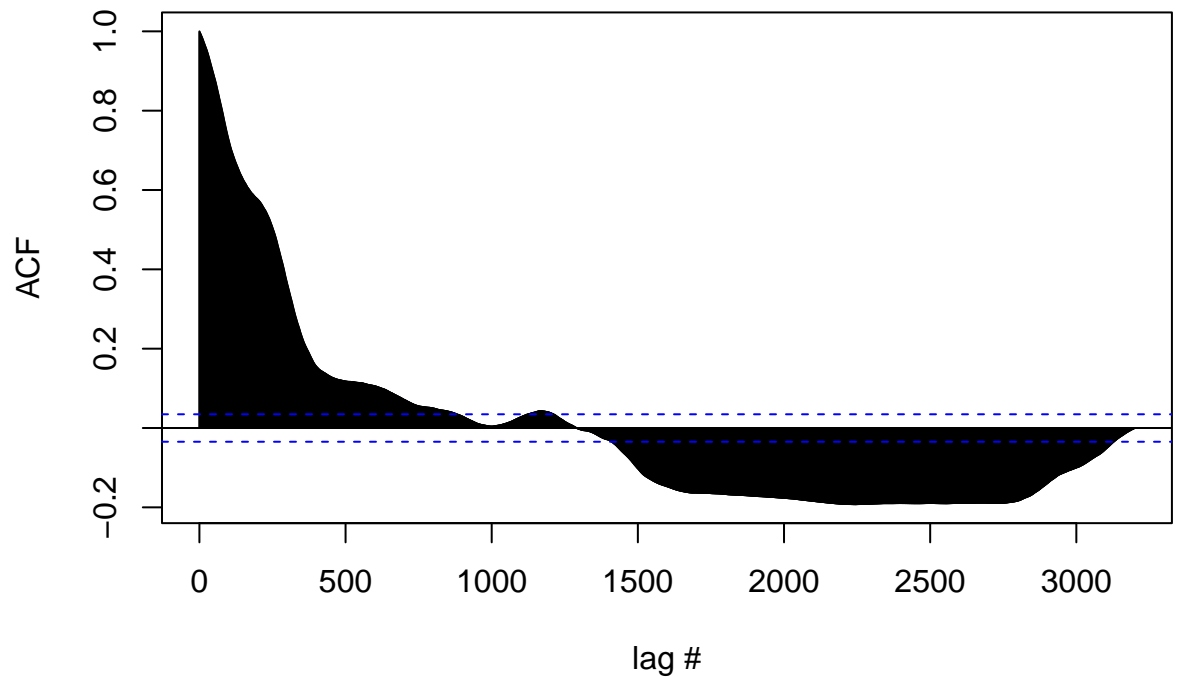
We proceed by applying an Augmented Dickey–Fuller (ADF) t-statistic test for unit root: in statistics and econometrics, an augmented Dickey–Fuller test (ADF) tests the null hypothesis that a unit root is present in a time series sample. The alternative hypothesis is different depending on which version of the test is used, but is usually stationarity or trend-stationarity. It is an augmented version of the Dickey–Fuller test for a larger and more complicated set of time series models. The augmented Dickey–Fuller (ADF) statistic, used in the test, is a negative number. The more negative it is, the stronger the rejection of the hypothesis that there is a unit root at some level of confidence. Our result clearly shows a non-stationarity due to the high p-value (>0.5).

```
## Loading required package: tseries


## Registered S3 method overwritten by 'quantmod':
##    method             from
##    as.zoo.data.frame  zoo


##
##   Augmented Dickey-Fuller Test
##
## data:  btc_hist$open
## Dickey-Fuller = -2.1185, Lag order = 14, p-value = 0.5281
## alternative hypothesis: stationary
```

In order to go from non-stationarity to stationarity different techniques can be used. We first attempt in utilising logaritmic transformation: such transformtion can help to stabilise the variance of a time series. We apply the ADF test, still obtaining a non statistically relevant result, even though the p-value has decreased to 0.46.

Trend signal
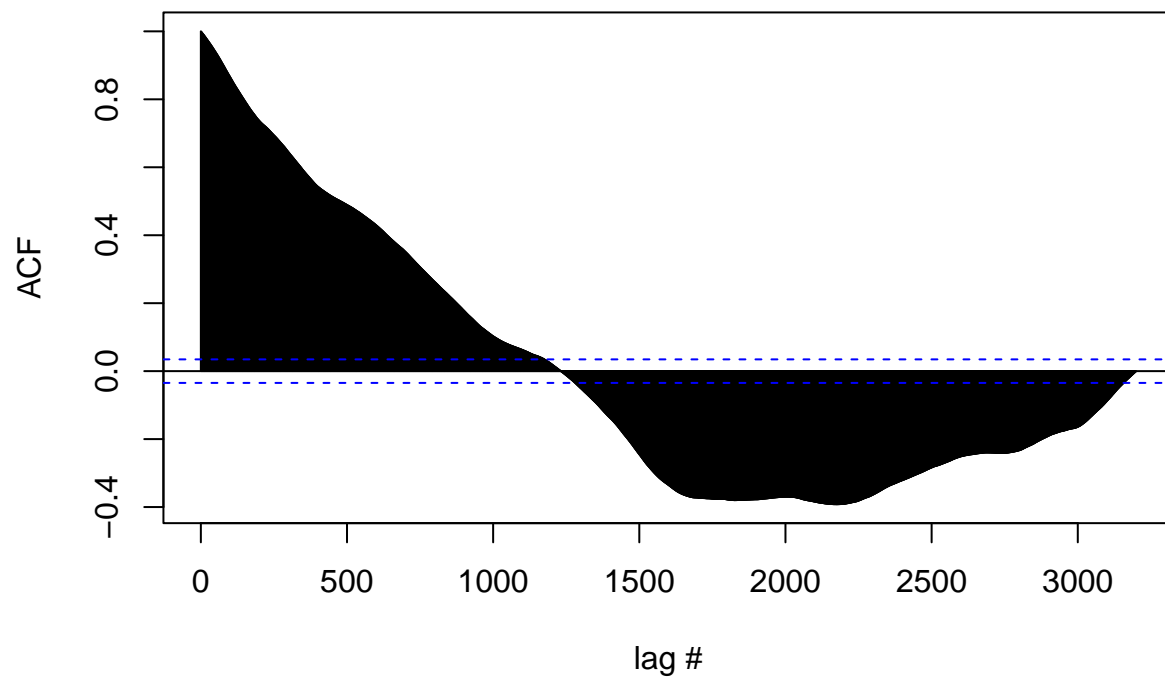
```
## 
##  Augmented Dickey-Fuller Test
## 
## data:  btc_hist$log
## Dickey-Fuller = -2.2737, Lag order = 14, p-value = 0.4624
## alternative hypothesis: stationary
```

Differencing log values can help stabilise the mean of a time series by removing changes in the level of a time series, and therefore eliminating (or reducing) trend and seasonality. We attempt to use this transformation obtaining satisfing results. Indeed, the following plot shows how the trend has been removed and stationarity is obtained.

Trend signal
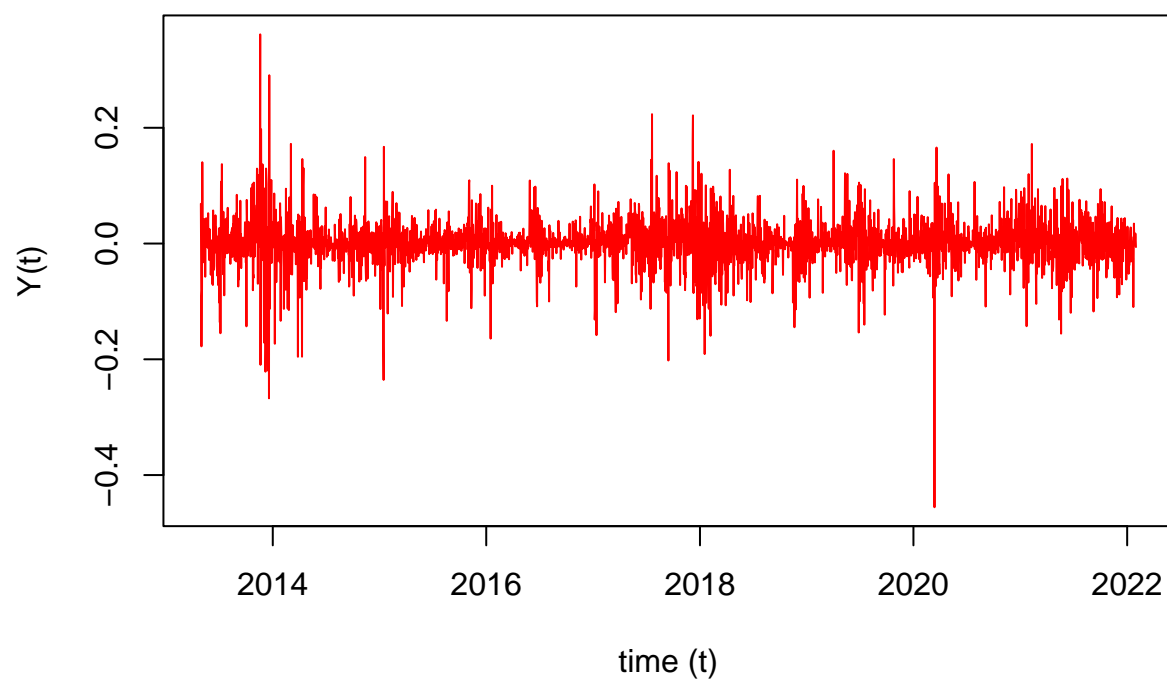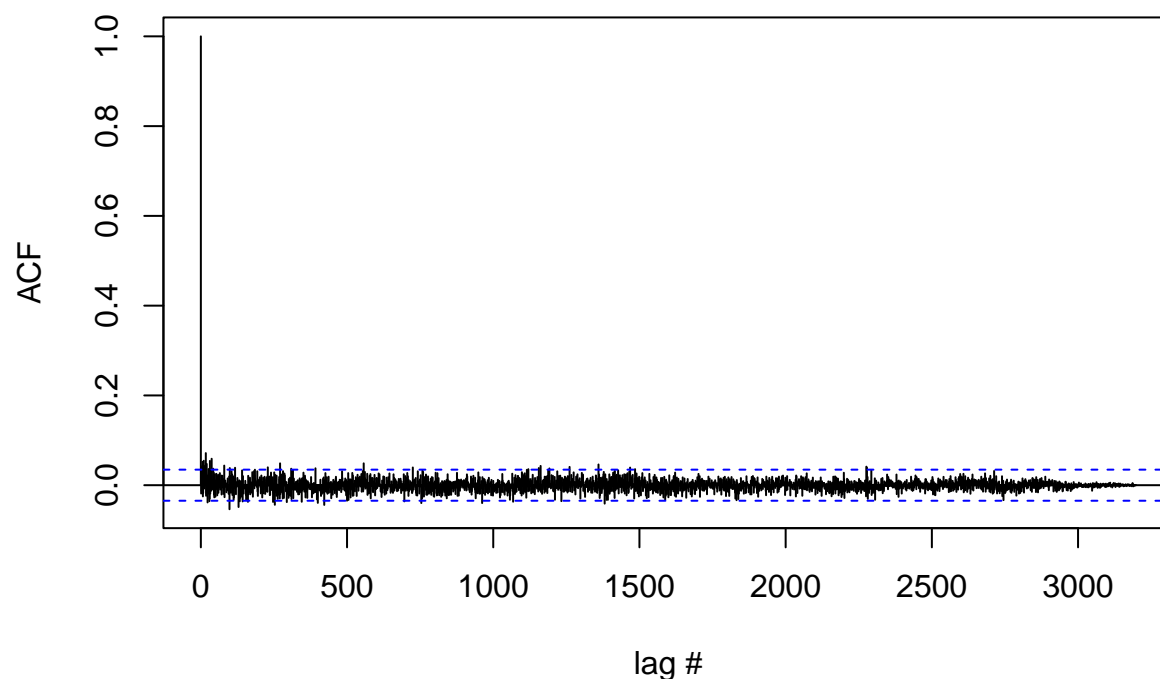
We conduct the ADF test to confirm our results: p-value is now 0.01 (highly significant) and we can assess that the log difference of the elements of the time series result to be non-stationary.

```
##
##  Augmented Dickey-Fuller Test
##
## data:  diff
## Dickey-Fuller = -14.411, Lag order = 14, p-value = 0.01
## alternative hypothesis: stationary


##
##  Augmented Dickey-Fuller Test
##
## data:  logdiff
## Dickey-Fuller = -12.942, Lag order = 14, p-value = 0.01
## alternative hypothesis: stationary
```

This means that bitcoin volatility is random, not influenced by Elon Musk's tweets. This is a core finding of our study.

Da qui in poi fede guarda tu

try to find change points in the data, I use diff for now not sure tho

```
if(!require(changepoint)) install.packages("changepoint")
```

```
## Loading required package: changepoint

## Loading required package: zoo

##
## Attaching package: 'zoo'

## The following objects are masked from 'package:base':
##
##       as.Date, as.Date.numeric

## Successfully loaded changepoint package version 2.2.3
##   See NEWS for details of changes.
```

```
library(changepoint)
library(tidyverse)
library(lubridate)
m_binseg <- cpt.mean(diff, penalty = "BIC", method = "BinSeg", Q = 15)

plot(m_binseg, type = "l", xlab = "Index", cpt.width = 4)
```
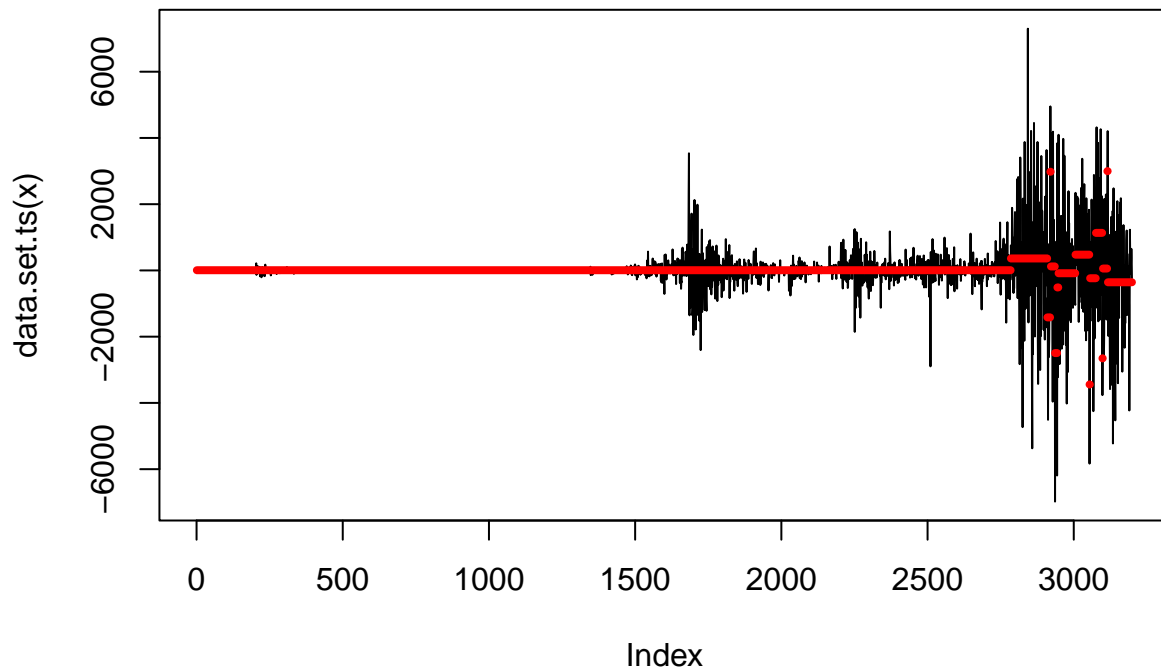
```
cpts(m_binseg)
```

```
##  [1] 2784 2909 2919 2921 2935 2943 2947 3005 3053 3055 3075 3097 3099 3114 3116
```

```
#all the changes happen from 2500 onwards approx, try to subset plot
m_binseg <- cpt.mean(diff[2500:3199], penalty = "BIC", method = "BinSeg", Q = 15)
plot(m_binseg, type = "l", xlab = "Index", cpt.width = 4)
```
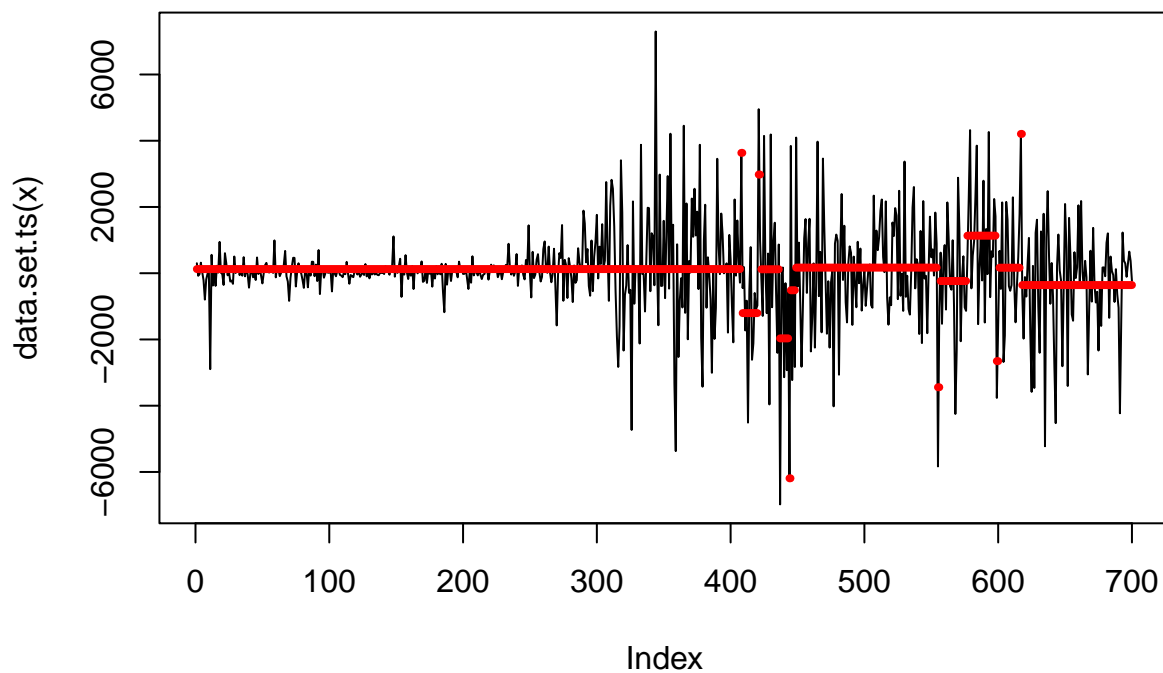

tried with differend methods (segmented neighbour and PELT, but Binseg most effective):

```
cpts(m_binseg)
```

```
##  [1] 407 408 420 422 436 443 444 448 554 556 576 598 600 616 617
```

Those were only taking into consideration the mean, let's see the results for mean and variance all together

```
#transform changepoints in dates
#we just sum it from the first day

cpt_date = btc_hist$timestamp[2499] + cpts(m_binseg)
tweet_date = btc_hist %>% filter(tweet == TRUE) %>% select(timestamp)
```

```r
library(stringr)
sum(str_count(elon$tweet, "\\w+"))
```

```
## [1] 68676
```

```r
eloncrypto <- elon[grepl("crypto", elon[["tweet"]]) | grepl("BTC", elon[["tweet"]]),]
as.data.frame(eloncrypto)
```

```
##         X           id conversation_id   created_at                 date timezone
## 1374 10 9.353294e+17    9.353148e+17 1.511835e+12 2017-11-27 21:08:12     -500
## 1474 12 9.666025e+17    9.662980e+17 1.519291e+12 2018-02-22 04:16:02     -500
## 1489  7 9.677283e+17    9.677053e+17 1.519559e+12 2018-02-25 06:49:40     -500
## 3818  3 1.354921e+18    1.354892e+18 1.611873e+12 2021-01-28 17:33:33     -500
## 3889 14 1.357241e+18    1.357241e+18 1.612427e+12 2021-02-04 03:15:26     -500
## 3937 18 1.359400e+18    1.358702e+18 1.612941e+12 2021-02-10 02:13:58     -500
## 4034  4 1.392951e+18    1.392951e+18 1.620940e+12 2021-05-13 17:11:46     -500
## 4062 12 1.395372e+18    1.395329e+18 1.621517e+12 2021-05-20 09:31:24     -500
## 4091 21 1.399602e+18    1.399472e+18 1.622526e+12 2021-06-01 01:42:40     -500
## 4129 19 1.401663e+18    1.401449e+18 1.623017e+12 2021-06-06 18:11:05     -500
## 4530 55 1.452348e+18    1.451983e+18 1.635102e+12 2021-10-24 14:55:51     -500
## 4532 57 1.452334e+18    1.452313e+18 1.635098e+12 2021-10-24 14:01:32     -500
## 4541 66 1.452186e+18    1.452052e+18 1.635063e+12 2021-10-24 04:11:32     -500
## 4591  5 1.471583e+18    1.471512e+18 1.639688e+12 2021-12-16 15:50:19     -500
##      place
## 1374    NA
## 1474    NA
## 1489    NA
## 3818    NA
## 3889    NA
## 3937    NA
## 4034    NA
## 4062    NA
## 4091    NA
## 4129    NA
## 4530    NA
## 4532    NA
## 4541    NA
## 4591    NA
##
## 1374
## 1474
## 1489                                                                                                @cheresh
## 3818
## 3889
## 3937
## 4034
## 4062 @WhatsupFranks @TeslaGong Currency is already digital! Decentralized crypto is an attempt to wro
## 4091
## 4129
## 4530                                                                        @ProTheDoge Lots of people I tall
## it felt like the people's crypto.
## 4532                    @Filasophical @ShibaInuHodler Out of curiosity, I acquired some ascii hash stri
```

```
## 4541
## 4591
##      language hashtags cashtags   user_id user_id_str username     name day
## 1374       en       []       [] 44196397    44196397 elonmusk Elon Musk   1
## 1474       en       []       [] 44196397    44196397 elonmusk Elon Musk   4
## 1489       en       []       [] 44196397    44196397 elonmusk Elon Musk   7
## 3818       en       []       [] 44196397    44196397 elonmusk Elon Musk   4
## 3889       en       []       [] 44196397    44196397 elonmusk Elon Musk   4
## 3937       en       []       [] 44196397    44196397 elonmusk Elon Musk   3
## 4034       en       []       [] 44196397    44196397 elonmusk Elon Musk   4
## 4062       en       []       [] 44196397    44196397 elonmusk Elon Musk   4
## 4091       en       []       [] 44196397    44196397 elonmusk Elon Musk   2
## 4129       en       []       [] 44196397    44196397 elonmusk Elon Musk   7
## 4530       en       []       [] 44196397    44196397 elonmusk Elon Musk   7
## 4532       en       []       [] 44196397    44196397 elonmusk Elon Musk   7
## 4541       en       []       [] 44196397    44196397 elonmusk Elon Musk   7
## 4591       en       []       [] 44196397    44196397 elonmusk Elon Musk   4
##      hour                                                   link urls photos
## 1374   21 https://twitter.com/elonmusk/status/935329447594541056   []     []
## 1474    4 https://twitter.com/elonmusk/status/966602470431473664   []     []
## 1489    6 https://twitter.com/elonmusk/status/967728299282595840   []     []
## 3818   17 https://twitter.com/elonmusk/status/1354920578482888707  []     []
## 3889    3 https://twitter.com/elonmusk/status/1357241340313141249  []     []
## 3937    2 https://twitter.com/elonmusk/status/1359400199521783809  []     []
## 4034   17 https://twitter.com/elonmusk/status/1392950720979030019  []     []
## 4062    9 https://twitter.com/elonmusk/status/1395371582143430660  []     []
## 4091    1 https://twitter.com/elonmusk/status/1399602277002919937  []     []
## 4129   18 https://twitter.com/elonmusk/status/1401662959923994625  []     []
## 4530   14 https://twitter.com/elonmusk/status/1452348126753349640  []     []
## 4532   14 https://twitter.com/elonmusk/status/1452334458066149377  []     []
## 4541    4 https://twitter.com/elonmusk/status/1452185979431833601  []     []
## 4591   15 https://twitter.com/elonmusk/status/1471583489824808972  []     []
##      video thumbnail retweet nlikes nreplies nretweets quote_url search near
## 1374     0               False   3654      242       442            None   NA
## 1474     0               False   1133      157       118            None   NA
## 1489     0               False   1533       91       156            None   NA
## 3818     0               False  28193      806      2970            None   NA
## 3889     0               False 535291    18505     98378            None   NA
## 3937     0               False  28317     2015      4478            None   NA
## 4034     0               False 362561    56794     33944            None   NA
## 4062     0               False   6471      639      1237            None   NA
## 4091     0               False   8337      338       493            None   NA
## 4129     0               False  23201     2297      3297            None   NA
## 4530     0               False  33363     4089      7198            None   NA
## 4532     0               False  36341     5468      6234            None   NA
## 4541     0               False  17260     2140      1338            None   NA
## 4591     0               False  10378      872       474            None   NA
##      geo source user_rt_id user_rt retweet_id
## 1374  NA     NA         NA      NA         NA
## 1474  NA     NA         NA      NA         NA
## 1489  NA     NA         NA      NA         NA
## 3818  NA     NA         NA      NA         NA
## 3889  NA     NA         NA      NA         NA
## 3937  NA     NA         NA      NA         NA
```

```
## 4034   NA      NA          NA      NA          NA
## 4062   NA      NA          NA      NA          NA
## 4091   NA      NA          NA      NA          NA
## 4129   NA      NA          NA      NA          NA
## 4530   NA      NA          NA      NA          NA
## 4532   NA      NA          NA      NA          NA
## 4541   NA      NA          NA      NA          NA
## 4591   NA      NA          NA      NA          NA
##
## 1374
## 1474                                                  [{'screen_name': 'DeadlyBananas', 'name': 'DeadlyBananas', 'id
## 1489                                                  [{'screen_name': 'cheresh', 'name': 'Evgeny Chereshnev', 'id':
## 3818                                                                                [{'screen_
## 3889
## 3937                                                                                      [{'scre
## 4034
## 4062 [{'screen_name': 'WhatsupFranks', 'name': 'Franks&Beans', 'id': '724771370131824641'}, {'screen_
## 4091                                                                                          [{'screen_
## 4129
## 4530                                                                                                 [{'s
## 4532     [{'screen_name': 'Filasophical', 'name': 'Salif Cybertruck or Bust  ', 'id': '964889226'}, {
## 4541
## 4591                [{'screen_name': 'BTC_Archive', 'name': 'Bitcoin Archive  ', 'id': '970994516357
##       retweet_date translate trans_src trans_dest
## 1374            NA        NA        NA         NA
## 1474            NA        NA        NA         NA
## 1489            NA        NA        NA         NA
## 3818            NA        NA        NA         NA
## 3889            NA        NA        NA         NA
## 3937            NA        NA        NA         NA
## 4034            NA        NA        NA         NA
## 4062            NA        NA        NA         NA
## 4091            NA        NA        NA         NA
## 4129            NA        NA        NA         NA
## 4530            NA        NA        NA         NA
## 4532            NA        NA        NA         NA
## 4541            NA        NA        NA         NA
## 4591            NA        NA        NA         NA
```

```r
cpt_date <- format(as.POSIXct(cpt_date,format="%Y-%m-%d %H:%M:%OS"),format='%m/%d/%Y')
cpt_date <- as.Date(as.character(cpt_date), format='%m/%d/%Y')

btc_hist['breakpoint'] <- btc_hist$timestamp %in% cpt_date


library(ggplot2)
colors <- c("tweets" = "deeppink",  "breaking points" = "blue")
btc_hist[2750:3200,] %>%
ggplot(aes(x = timestamp, y = open)) +
geom_line() +
geom_point(data = . %>% filter(tweet == TRUE), aes(color = "tweets"), size = 3) +
geom_point(data = . %>% filter(breakpoint == TRUE), aes(color = "breaking points"), size = 3) +
ggtitle("Elon Musk's Tweets and Breaking Points") +
theme(plot.title = element_text(hjust = 0.5)) +
```

```
labs(x = "timestamp",
     y = "BTC value",
     color = "Legend") + scale_color_manual(values = colors)
```

Elon Musk's Tweets and Breaking Points
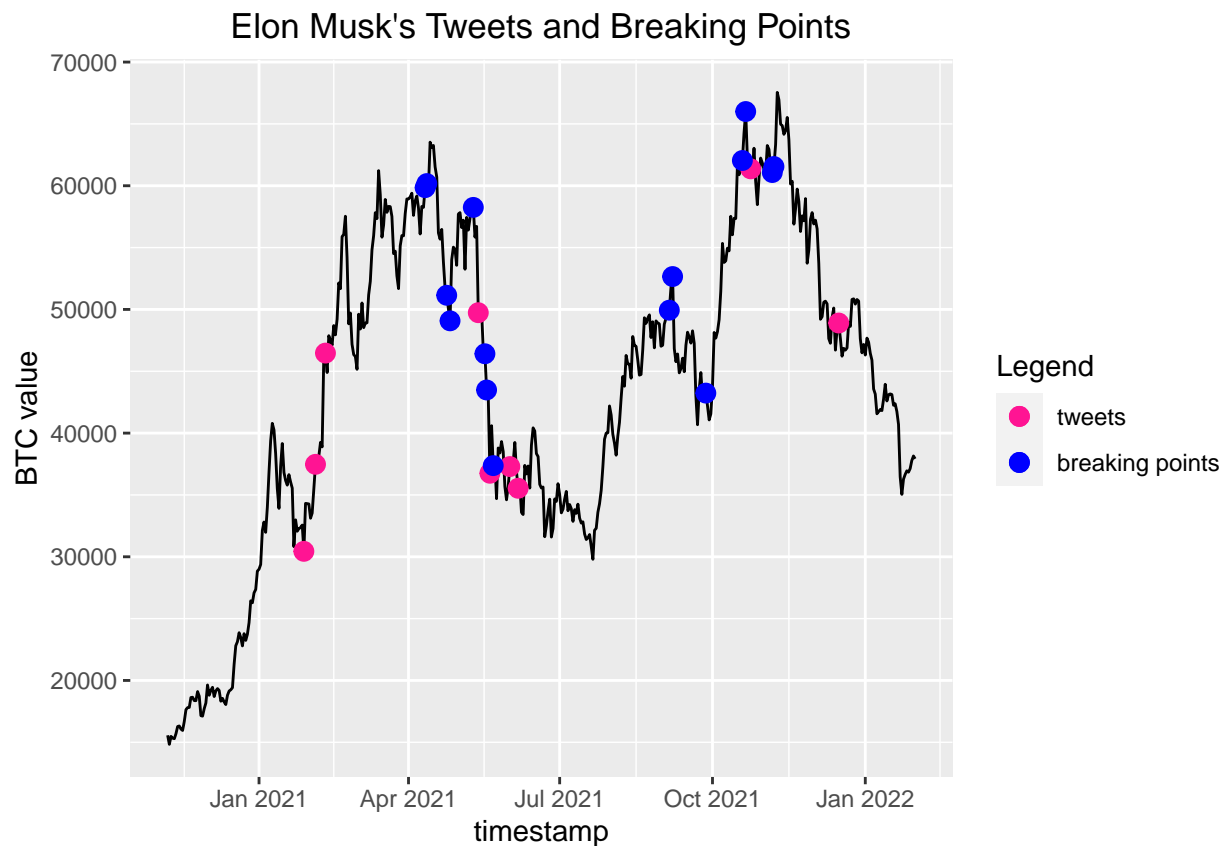
Do the same with Doge

```
doge <- crypto_list(only_active=TRUE)
doge <- subset(doge, doge$slug == "dogecoin")
doge_hist <- crypto_history(doge, limit=1, start_date="20200101", end_date="20220131")
```

```
## > Scraping historical crypto data

##

## > Processing historical crypto data

##

library(stringr)

as.data.frame(doge_hist)

##             timestamp id     slug     name symbol ref_cur      open
## 1  2020-01-02 23:59:59 74 dogecoin Dogecoin   DOGE     USD 0.002034263
```

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```
## 2    2020-01-03 23:59:59 74 dogecoin Dogecoin      DOGE     USD 0.002007977
## 3    2020-01-04 23:59:59 74 dogecoin Dogecoin      DOGE     USD 0.002144226
## 4    2020-01-05 23:59:59 74 dogecoin Dogecoin      DOGE     USD 0.002240008
## 5    2020-01-06 23:59:59 74 dogecoin Dogecoin      DOGE     USD 0.002418308
## 6    2020-01-07 23:59:59 74 dogecoin Dogecoin      DOGE     USD 0.002484822
## 7    2020-01-08 23:59:59 74 dogecoin Dogecoin      DOGE     USD 0.002433075
## 8    2020-01-09 23:59:59 74 dogecoin Dogecoin      DOGE     USD 0.002291321
## 9    2020-01-10 23:59:59 74 dogecoin Dogecoin      DOGE     USD 0.002254530
## 10   2020-01-11 23:59:59 74 dogecoin Dogecoin      DOGE     USD 0.002350604
## 11   2020-01-12 23:59:59 74 dogecoin Dogecoin      DOGE     USD 0.002312906
## 12   2020-01-13 23:59:59 74 dogecoin Dogecoin      DOGE     USD 0.002381060
## 13   2020-01-14 23:59:59 74 dogecoin Dogecoin      DOGE     USD 0.002357932
## 14   2020-01-15 23:59:59 74 dogecoin Dogecoin      DOGE     USD 0.002467566
## 15   2020-01-16 23:59:59 74 dogecoin Dogecoin      DOGE     USD 0.002372113
## 16   2020-01-17 23:59:59 74 dogecoin Dogecoin      DOGE     USD 0.002346193
## 17   2020-01-18 23:59:59 74 dogecoin Dogecoin      DOGE     USD 0.002490170
## 18   2020-01-19 23:59:59 74 dogecoin Dogecoin      DOGE     USD 0.002514212
## 19   2020-01-20 23:59:59 74 dogecoin Dogecoin      DOGE     USD 0.002405322
## 20   2020-01-21 23:59:59 74 dogecoin Dogecoin      DOGE     USD 0.002374483
## 21   2020-01-22 23:59:59 74 dogecoin Dogecoin      DOGE     USD 0.002376046
## 22   2020-01-23 23:59:59 74 dogecoin Dogecoin      DOGE     USD 0.002323335
## 23   2020-01-24 23:59:59 74 dogecoin Dogecoin      DOGE     USD 0.002268044
## 24   2020-01-25 23:59:59 74 dogecoin Dogecoin      DOGE     USD 0.002276085
## 25   2020-01-26 23:59:59 74 dogecoin Dogecoin      DOGE     USD 0.002257507
## 26   2020-01-27 23:59:59 74 dogecoin Dogecoin      DOGE     USD 0.002304434
## 27   2020-01-28 23:59:59 74 dogecoin Dogecoin      DOGE     USD 0.002365289
## 28   2020-01-29 23:59:59 74 dogecoin Dogecoin      DOGE     USD 0.002450594
## 29   2020-01-30 23:59:59 74 dogecoin Dogecoin      DOGE     USD 0.002391217
## 30   2020-01-31 23:59:59 74 dogecoin Dogecoin      DOGE     USD 0.002439877
## 31   2020-02-01 23:59:59 74 dogecoin Dogecoin      DOGE     USD 0.002391252
## 32   2020-02-02 23:59:59 74 dogecoin Dogecoin      DOGE     USD 0.002421095
## 33   2020-02-03 23:59:59 74 dogecoin Dogecoin      DOGE     USD 0.002465532
## 34   2020-02-04 23:59:59 74 dogecoin Dogecoin      DOGE     USD 0.002438452
## 35   2020-02-05 23:59:59 74 dogecoin Dogecoin      DOGE     USD 0.002502805
## 36   2020-02-06 23:59:59 74 dogecoin Dogecoin      DOGE     USD 0.002582951
## 37   2020-02-07 23:59:59 74 dogecoin Dogecoin      DOGE     USD 0.002653770
## 38   2020-02-08 23:59:59 74 dogecoin Dogecoin      DOGE     USD 0.002766879
## 39   2020-02-09 23:59:59 74 dogecoin Dogecoin      DOGE     USD 0.003155727
## 40   2020-02-10 23:59:59 74 dogecoin Dogecoin      DOGE     USD 0.003233898
## 41   2020-02-11 23:59:59 74 dogecoin Dogecoin      DOGE     USD 0.003011425
## 42   2020-02-12 23:59:59 74 dogecoin Dogecoin      DOGE     USD 0.003040672
## 43   2020-02-13 23:59:59 74 dogecoin Dogecoin      DOGE     USD 0.003063552
## 44   2020-02-14 23:59:59 74 dogecoin Dogecoin      DOGE     USD 0.002999218
## 45   2020-02-15 23:59:59 74 dogecoin Dogecoin      DOGE     USD 0.003098151
## 46   2020-02-16 23:59:59 74 dogecoin Dogecoin      DOGE     USD 0.002916936
## 47   2020-02-17 23:59:59 74 dogecoin Dogecoin      DOGE     USD 0.002739679
## 48   2020-02-18 23:59:59 74 dogecoin Dogecoin      DOGE     USD 0.002677453
## 49   2020-02-19 23:59:59 74 dogecoin Dogecoin      DOGE     USD 0.002838629
## 50   2020-02-20 23:59:59 74 dogecoin Dogecoin      DOGE     USD 0.002625253
## 51   2020-02-21 23:59:59 74 dogecoin Dogecoin      DOGE     USD 0.002656138
## 52   2020-02-22 23:59:59 74 dogecoin Dogecoin      DOGE     USD 0.002650497
## 53   2020-02-23 23:59:59 74 dogecoin Dogecoin      DOGE     USD 0.002599788
## 54   2020-02-24 23:59:59 74 dogecoin Dogecoin      DOGE     USD 0.002679338
## 55   2020-02-25 23:59:59 74 dogecoin Dogecoin      DOGE     USD 0.002590142
```

```
## 56  2020-02-26 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002475473
## 57  2020-02-27 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002337142
## 58  2020-02-28 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002323352
## 59  2020-02-29 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002285598
## 60  2020-03-01 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002233246
## 61  2020-03-02 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002278447
## 62  2020-03-03 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002348348
## 63  2020-03-04 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002499746
## 64  2020-03-05 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002399134
## 65  2020-03-06 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002504474
## 66  2020-03-07 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002500657
## 67  2020-03-08 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002406346
## 68  2020-03-09 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002189466
## 69  2020-03-10 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002216847
## 70  2020-03-11 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002207904
## 71  2020-03-12 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002183372
## 72  2020-03-13 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.001540123
## 73  2020-03-14 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.001736776
## 74  2020-03-15 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.001663617
## 75  2020-03-16 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.001683832
## 76  2020-03-17 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.001590881
## 77  2020-03-18 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.001590315
## 78  2020-03-19 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.001566324
## 79  2020-03-20 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.001771461
## 80  2020-03-21 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.001770651
## 81  2020-03-22 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.001784588
## 82  2020-03-23 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.001727475
## 83  2020-03-24 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.001805153
## 84  2020-03-25 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.001851999
## 85  2020-03-26 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.001833002
## 86  2020-03-27 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.001843424
## 87  2020-03-28 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.001805096
## 88  2020-03-29 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.001776904
## 89  2020-03-30 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.001723138
## 90  2020-03-31 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.001850678
## 91  2020-04-01 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.001811804
## 92  2020-04-02 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.001867919
## 93  2020-04-03 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.001883166
## 94  2020-04-04 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.001852890
## 95  2020-04-05 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.001880301
## 96  2020-04-06 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.001865887
## 97  2020-04-07 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.001972083
## 98  2020-04-08 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.001986065
## 99  2020-04-09 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002012907
## 100 2020-04-10 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002021280
## 101 2020-04-11 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.001968032
## 102 2020-04-12 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.001989476
## 103 2020-04-13 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.001989536
## 104 2020-04-14 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.001957915
## 105 2020-04-15 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.001963468
## 106 2020-04-16 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.001940552
## 107 2020-04-17 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002027930
## 108 2020-04-18 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002012803
## 109 2020-04-19 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002059680
```

```
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## 111 2020-04-21 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.001982269
## 112 2020-04-22 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.001970635
## 113 2020-04-23 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002010501
## 114 2020-04-24 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002047133
## 115 2020-04-25 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002101882
## 116 2020-04-26 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002140525
## 117 2020-04-27 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002410472
## 118 2020-04-28 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002353859
## 119 2020-04-29 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002339022
## 120 2020-04-30 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002516712
## 121 2020-05-01 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002444389
## 122 2020-05-02 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002495304
## 123 2020-05-03 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002547752
## 124 2020-05-04 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002510893
## 125 2020-05-05 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002481259
## 126 2020-05-06 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002482979
## 127 2020-05-07 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002518016
## 128 2020-05-08 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002659400
## 129 2020-05-09 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002621858
## 130 2020-05-10 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002611463
## 131 2020-05-11 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002457310
## 132 2020-05-12 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002413291
## 133 2020-05-13 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002463506
## 134 2020-05-14 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002517923
## 135 2020-05-15 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002573520
## 136 2020-05-16 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002506560
## 137 2020-05-17 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002512356
## 138 2020-05-18 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002536538
## 139 2020-05-19 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002543716
## 140 2020-05-20 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002538958
## 141 2020-05-21 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002510130
## 142 2020-05-22 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002485975
## 143 2020-05-23 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002532559
## 144 2020-05-24 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002544249
## 145 2020-05-25 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002455520
## 146 2020-05-26 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002539272
## 147 2020-05-27 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002485560
## 148 2020-05-28 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002511623
## 149 2020-05-29 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002523509
## 150 2020-05-30 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002531371
## 151 2020-05-31 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002615359
## 152 2020-06-01 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002555153
## 153 2020-06-02 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002647410
## 154 2020-06-03 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002561514
## 155 2020-06-04 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002582648
## 156 2020-06-05 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002631602
## 157 2020-06-06 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002595371
## 158 2020-06-07 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002587178
## 159 2020-06-08 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002605565
## 160 2020-06-09 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002583625
## 161 2020-06-10 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002568505
## 162 2020-06-11 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002584234
## 163 2020-06-12 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002454963
```

```
## 164 2020-06-13 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002520444
## 165 2020-06-14 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002532632
## 166 2020-06-15 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002509589
## 167 2020-06-16 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002479308
## 168 2020-06-17 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002489954
## 169 2020-06-18 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002484965
## 170 2020-06-19 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002471191
## 171 2020-06-20 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002434795
## 172 2020-06-21 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002446580
## 173 2020-06-22 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002446692
## 174 2020-06-23 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002473654
## 175 2020-06-24 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002483416
## 176 2020-06-25 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002430249
## 177 2020-06-26 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002416608
## 178 2020-06-27 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002358864
## 179 2020-06-28 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002312919
## 180 2020-06-29 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002325754
## 181 2020-06-30 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002310636
## 182 2020-07-01 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002319677
## 183 2020-07-02 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002330046
## 184 2020-07-03 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002361122
## 185 2020-07-04 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002314868
## 186 2020-07-05 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002306855
## 187 2020-07-06 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002308978
## 188 2020-07-07 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002614165
## 189 2020-07-08 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.003097099
## 190 2020-07-09 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.004731926
## 191 2020-07-10 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.004393899
## 192 2020-07-11 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.003528393
## 193 2020-07-12 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.003810612
## 194 2020-07-13 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.003629614
## 195 2020-07-14 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.003169305
## 196 2020-07-15 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.003286853
## 197 2020-07-16 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.003085843
## 198 2020-07-17 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002991475
## 199 2020-07-18 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.003060122
## 200 2020-07-19 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.003463700
## 201 2020-07-20 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.003382553
## 202 2020-07-21 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.003231541
## 203 2020-07-22 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.003301520
## 204 2020-07-23 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.003283085
## 205 2020-07-24 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.003294785
## 206 2020-07-25 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.003219421
## 207 2020-07-26 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.003238232
## 208 2020-07-27 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.003234254
## 209 2020-07-28 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.003154565
## 210 2020-07-29 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.003197941
## 211 2020-07-30 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.003192409
## 212 2020-07-31 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.003229316
## 213 2020-08-01 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.003225361
## 214 2020-08-02 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.003695958
## 215 2020-08-03 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.003336113
## 216 2020-08-04 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.003388506
## 217 2020-08-05 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.003543337
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## 218 2020-08-06 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.003517355
## 219 2020-08-07 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.003563314
## 220 2020-08-08 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.003533725
## 221 2020-08-09 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.003508148
## 222 2020-08-10 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.003468256
## 223 2020-08-11 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.003494873
## 224 2020-08-12 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.003396899
## 225 2020-08-13 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.003483332
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## 227 2020-08-15 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.003562623
## 228 2020-08-16 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.003540441
## 229 2020-08-17 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.003523562
## 230 2020-08-18 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.003592522
## 231 2020-08-19 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.003508151
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## 234 2020-08-22 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.003392407
## 235 2020-08-23 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.003437853
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## 255 2020-09-12 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002802326
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## 268 2020-09-25 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002628130
## 269 2020-09-26 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002698720
## 270 2020-09-27 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002696840
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## 273 2020-09-30 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002682870
## 274 2020-10-01 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002630530
## 275 2020-10-02 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002614420
## 276 2020-10-03 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002583050
## 277 2020-10-04 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002605920
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## 280 2020-10-07 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002592510
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## 284 2020-10-11 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002667100
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## 289 2020-10-16 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.002594790
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## 466 2021-04-11 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.063749340
## 467 2021-04-12 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.074544430
## 468 2021-04-13 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.070677740
## 469 2021-04-14 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.094255630
## 470 2021-04-15 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.121167010
## 471 2021-04-16 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.181587310
## 472 2021-04-17 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.366098220
## 473 2021-04-18 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.285104920
## 474 2021-04-19 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.320466250
## 475 2021-04-20 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.408434770
## 476 2021-04-21 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.316952810
## 477 2021-04-22 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.305990350
## 478 2021-04-23 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.261022590
## 479 2021-04-24 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.249544190
## 480 2021-04-25 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.269789400
## 481 2021-04-26 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.251240090
## 482 2021-04-27 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.271426570
## 483 2021-04-28 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.272272630
## 484 2021-04-29 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.323232370
## 485 2021-04-30 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.304702320
## 486 2021-05-01 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.337558680
## 487 2021-05-02 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.391087190
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## 488 2021-05-03 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.373631450
## 489 2021-05-04 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.440273940
## 490 2021-05-05 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.537355140
## 491 2021-05-06 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.652842410
## 492 2021-05-07 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.581109700
## 493 2021-05-08 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.687801470
## 494 2021-05-09 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.635820320
## 495 2021-05-10 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.569687080
## 496 2021-05-11 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.450487670
## 497 2021-05-12 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.493742150
## 498 2021-05-13 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.392175990
## 499 2021-05-14 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.487070050
## 500 2021-05-15 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.559668420
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## 502 2021-05-17 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.513413050
## 503 2021-05-18 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.486953510
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## 506 2021-05-21 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.398123710
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## 508 2021-05-23 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.342521790
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## 510 2021-05-25 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.366041280
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## 515 2021-05-30 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.302969430
## 516 2021-05-31 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.301948580
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## 518 2021-06-02 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.370301940
## 519 2021-06-03 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.423739280
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## 533 2021-06-17 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.307749120
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## 538 2021-06-22 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.178682290
## 539 2021-06-23 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.190671430
## 540 2021-06-24 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.234969750
## 541 2021-06-25 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.263480250
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## 542 2021-06-26 23:59:59 74 dogecoin Dogecoin      DOGE      USD 0.237673280
## 543 2021-06-27 23:59:59 74 dogecoin Dogecoin      DOGE      USD 0.246045470
## 544 2021-06-28 23:59:59 74 dogecoin Dogecoin      DOGE      USD 0.264918290
## 545 2021-06-29 23:59:59 74 dogecoin Dogecoin      DOGE      USD 0.257060590
## 546 2021-06-30 23:59:59 74 dogecoin Dogecoin      DOGE      USD 0.263417390
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## 548 2021-07-02 23:59:59 74 dogecoin Dogecoin      DOGE      USD 0.243982170
## 549 2021-07-03 23:59:59 74 dogecoin Dogecoin      DOGE      USD 0.245105580
## 550 2021-07-04 23:59:59 74 dogecoin Dogecoin      DOGE      USD 0.246424780
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## 552 2021-07-06 23:59:59 74 dogecoin Dogecoin      DOGE      USD 0.231216170
## 553 2021-07-07 23:59:59 74 dogecoin Dogecoin      DOGE      USD 0.234301000
## 554 2021-07-08 23:59:59 74 dogecoin Dogecoin      DOGE      USD 0.224383370
## 555 2021-07-09 23:59:59 74 dogecoin Dogecoin      DOGE      USD 0.207073040
## 556 2021-07-10 23:59:59 74 dogecoin Dogecoin      DOGE      USD 0.219845680
## 557 2021-07-11 23:59:59 74 dogecoin Dogecoin      DOGE      USD 0.213887080
## 558 2021-07-12 23:59:59 74 dogecoin Dogecoin      DOGE      USD 0.216010170
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## 560 2021-07-14 23:59:59 74 dogecoin Dogecoin      DOGE      USD 0.199978270
## 561 2021-07-15 23:59:59 74 dogecoin Dogecoin      DOGE      USD 0.197749440
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## 567 2021-07-21 23:59:59 74 dogecoin Dogecoin      DOGE      USD 0.170526870
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## 575 2021-07-29 23:59:59 74 dogecoin Dogecoin      DOGE      USD 0.205590900
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## 584 2021-08-07 23:59:59 74 dogecoin Dogecoin      DOGE      USD 0.204845920
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## 589 2021-08-12 23:59:59 74 dogecoin Dogecoin      DOGE      USD 0.264852890
## 590 2021-08-13 23:59:59 74 dogecoin Dogecoin      DOGE      USD 0.264248980
## 591 2021-08-14 23:59:59 74 dogecoin Dogecoin      DOGE      USD 0.286801470
## 592 2021-08-15 23:59:59 74 dogecoin Dogecoin      DOGE      USD 0.294086150
## 593 2021-08-16 23:59:59 74 dogecoin Dogecoin      DOGE      USD 0.340165410
## 594 2021-08-17 23:59:59 74 dogecoin Dogecoin      DOGE      USD 0.319631380
## 595 2021-08-18 23:59:59 74 dogecoin Dogecoin      DOGE      USD 0.299203300
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## 601 2021-08-24 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.318385570
## 602 2021-08-25 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.289218090
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## 625 2021-09-17 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.242097959
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## 632 2021-09-24 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.224726272
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## 634 2021-09-26 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.208729811
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## 642 2021-10-04 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.221929577
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## 644 2021-10-06 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.252007615
## 645 2021-10-07 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.254340454
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## 647 2021-10-09 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.243495353
## 648 2021-10-10 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.246571995
## 649 2021-10-11 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.229449895
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## 660 2021-10-22 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.242479057
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## 663 2021-10-25 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.275745188
## 664 2021-10-26 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.264782778
## 665 2021-10-27 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.255836251
## 666 2021-10-28 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.237380654
## 667 2021-10-29 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.299964150
## 668 2021-10-30 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.287763678
## 669 2021-10-31 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.269238513
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## 671 2021-11-02 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.271891923
## 672 2021-11-03 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.273504405
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## 676 2021-11-07 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.261970930
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## 678 2021-11-09 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.282539144
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## 682 2021-11-13 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.259618107
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## 684 2021-11-15 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.262870017
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## 687 2021-11-18 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.237556049
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## 691 2021-11-22 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.226160242
## 692 2021-11-23 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.219666010
## 693 2021-11-24 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.226679546
## 694 2021-11-25 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.217132007
## 695 2021-11-26 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.221047340
## 696 2021-11-27 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.201428520
## 697 2021-11-28 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.205295316
## 698 2021-11-29 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.207443571
## 699 2021-11-30 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.215111235
## 700 2021-12-01 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.214486796
## 701 2021-12-02 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.209476252
## 702 2021-12-03 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.209462657
## 703 2021-12-04 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.200355791
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## 704 2021-12-05 23:59:59 74 dogecoin Dogecoin   DOGE     USD 0.178262651
## 705 2021-12-06 23:59:59 74 dogecoin Dogecoin   DOGE     USD 0.171382799
## 706 2021-12-07 23:59:59 74 dogecoin Dogecoin   DOGE     USD 0.178374422
## 707 2021-12-08 23:59:59 74 dogecoin Dogecoin   DOGE     USD 0.176608620
## 708 2021-12-09 23:59:59 74 dogecoin Dogecoin   DOGE     USD 0.178961217
## 709 2021-12-10 23:59:59 74 dogecoin Dogecoin   DOGE     USD 0.169466072
## 710 2021-12-11 23:59:59 74 dogecoin Dogecoin   DOGE     USD 0.164498675
## 711 2021-12-12 23:59:59 74 dogecoin Dogecoin   DOGE     USD 0.168903533
## 712 2021-12-13 23:59:59 74 dogecoin Dogecoin   DOGE     USD 0.169879556
## 713 2021-12-14 23:59:59 74 dogecoin Dogecoin   DOGE     USD 0.157464567
## 714 2021-12-15 23:59:59 74 dogecoin Dogecoin   DOGE     USD 0.191143550
## 715 2021-12-16 23:59:59 74 dogecoin Dogecoin   DOGE     USD 0.181171344
## 716 2021-12-17 23:59:59 74 dogecoin Dogecoin   DOGE     USD 0.173380855
## 717 2021-12-18 23:59:59 74 dogecoin Dogecoin   DOGE     USD 0.169100192
## 718 2021-12-19 23:59:59 74 dogecoin Dogecoin   DOGE     USD 0.172532627
## 719 2021-12-20 23:59:59 74 dogecoin Dogecoin   DOGE     USD 0.169523069
## 720 2021-12-21 23:59:59 74 dogecoin Dogecoin   DOGE     USD 0.167098125
## 721 2021-12-22 23:59:59 74 dogecoin Dogecoin   DOGE     USD 0.171129467
## 722 2021-12-23 23:59:59 74 dogecoin Dogecoin   DOGE     USD 0.173208743
## 723 2021-12-24 23:59:59 74 dogecoin Dogecoin   DOGE     USD 0.184979350
## 724 2021-12-25 23:59:59 74 dogecoin Dogecoin   DOGE     USD 0.186711637
## 725 2021-12-26 23:59:59 74 dogecoin Dogecoin   DOGE     USD 0.190567372
## 726 2021-12-27 23:59:59 74 dogecoin Dogecoin   DOGE     USD 0.189985773
## 727 2021-12-28 23:59:59 74 dogecoin Dogecoin   DOGE     USD 0.187846870
## 728 2021-12-29 23:59:59 74 dogecoin Dogecoin   DOGE     USD 0.174094879
## 729 2021-12-30 23:59:59 74 dogecoin Dogecoin   DOGE     USD 0.168137475
## 730 2021-12-31 23:59:59 74 dogecoin Dogecoin   DOGE     USD 0.171316615
## 731 2022-01-01 23:59:59 74 dogecoin Dogecoin   DOGE     USD 0.170510482
## 732 2022-01-02 23:59:59 74 dogecoin Dogecoin   DOGE     USD 0.173026847
## 733 2022-01-03 23:59:59 74 dogecoin Dogecoin   DOGE     USD 0.174406019
## 734 2022-01-04 23:59:59 74 dogecoin Dogecoin   DOGE     USD 0.170151290
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## 749 2022-01-19 23:59:59 74 dogecoin Dogecoin   DOGE     USD 0.165485057
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## 752 2022-01-22 23:59:59 74 dogecoin Dogecoin   DOGE     USD 0.142650922
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## 754 2022-01-24 23:59:59 74 dogecoin Dogecoin   DOGE     USD 0.141881106
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## 756 2022-01-26 23:59:59 74 dogecoin Dogecoin   DOGE     USD 0.143014159
## 757 2022-01-27 23:59:59 74 dogecoin Dogecoin   DOGE     USD 0.143755860
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## 758 2022-01-28 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.141244080
## 759 2022-01-29 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.141649487
## 760 2022-01-30 23:59:59 74 dogecoin Dogecoin    DOGE    USD 0.143057227
##           high        low       close      volume  market_cap  time_open
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## 2    0.002177209 0.001990922 0.002145376   62619988   263328862 2020-01-03
## 3    0.002489779 0.002049937 0.002241144   94227582   275114093 2020-01-04
## 4    0.002491296 0.002116777 0.002419075   52631740   296989930 2020-01-05
## 5    0.002563552 0.002378505 0.002462966   54562409   302412673 2020-01-06
## 6    0.002496801 0.002353610 0.002432763   52767343   298738083 2020-01-07
## 7    0.002465177 0.002265449 0.002292894   77251526   281594191 2020-01-08
## 8    0.002314182 0.002145303 0.002256095   70690571   277106183 2020-01-09
## 9    0.002360578 0.002199064 0.002355722   87683356   289375371 2020-01-10
## 10   0.002372904 0.002295645 0.002313559   94203409   284228141 2020-01-11
## 11   0.002412745 0.002312906 0.002380681   79426215   292507504 2020-01-12
## 12   0.002406591 0.002327062 0.002357752   83849846   289722805 2020-01-13
## 13   0.002514452 0.002340072 0.002470019  128635383   303552342 2020-01-14
## 14   0.002541363 0.002363101 0.002368673  128940321   291129905 2020-01-15
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## 17   0.002537920 0.002452454 0.002507053  108133943   308242055 2020-01-18
## 18   0.002569967 0.002359251 0.002405036  108085147   295732371 2020-01-19
## 19   0.002423205 0.002358557 0.002374056   92022277   291955767 2020-01-20
## 20   0.002402673 0.002335021 0.002376430   84321565   292280593 2020-01-21
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## 27   0.002449631 0.002362596 0.002449574   91528771   301513933 2020-01-28
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## 574 2021-07-28 23:59:59 2021-07-28 08:12:03 2021-07-28 18:01:03
## 575 2021-07-29 23:59:59 2021-07-29 23:31:03 2021-07-29 19:09:03
## 576 2021-07-30 23:59:59 2021-07-30 02:02:03 2021-07-30 09:29:03
## 577 2021-07-31 23:59:59 2021-07-31 00:33:35 2021-07-31 06:29:07
## 578 2021-08-01 23:59:59 2021-08-01 03:51:48 2021-08-01 23:29:04
## 579 2021-08-02 23:59:59 2021-08-02 07:09:14 2021-08-02 20:07:09
## 580 2021-08-03 23:59:59 2021-08-03 00:40:30 2021-08-03 20:18:27
## 581 2021-08-04 23:59:59 2021-08-04 16:46:08 2021-08-04 08:51:19
## 582 2021-08-05 23:59:59 2021-08-05 00:48:27 2021-08-05 12:46:03
## 583 2021-08-06 23:59:59 2021-08-06 19:41:03 2021-08-06 02:51:03
## 584 2021-08-07 23:59:59 2021-08-07 23:57:03 2021-08-07 00:08:03
## 585 2021-08-08 23:59:59 2021-08-08 00:17:03 2021-08-08 19:18:03
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## 586 2021-08-09 23:59:59 2021-08-09 18:44:03 2021-08-09 00:49:03
## 587 2021-08-10 23:59:59 2021-08-10 22:14:03 2021-08-10 16:53:03
## 588 2021-08-11 23:59:59 2021-08-11 20:38:03 2021-08-11 00:27:03
## 589 2021-08-12 23:59:59 2021-08-12 02:25:03 2021-08-12 16:37:03
## 590 2021-08-13 23:59:59 2021-08-13 23:51:03 2021-08-13 00:19:03
## 591 2021-08-14 23:59:59 2021-08-14 09:47:03 2021-08-14 11:03:03
## 592 2021-08-15 23:59:59 2021-08-15 22:21:03 2021-08-15 07:48:03
## 593 2021-08-16 23:59:59 2021-08-16 11:22:03 2021-08-16 20:07:03
## 594 2021-08-17 23:59:59 2021-08-17 04:53:03 2021-08-17 22:27:03
## 595 2021-08-18 23:59:59 2021-08-18 17:00:03 2021-08-18 01:15:03
## 596 2021-08-19 23:59:59 2021-08-19 20:45:03 2021-08-19 04:19:03
## 597 2021-08-20 23:59:59 2021-08-20 14:48:03 2021-08-20 03:25:03
## 598 2021-08-21 23:59:59 2021-08-21 11:02:03 2021-08-21 11:11:03
## 599 2021-08-22 23:59:59 2021-08-22 10:20:03 2021-08-22 18:11:03
## 600 2021-08-23 23:59:59 2021-08-23 09:00:03 2021-08-23 20:07:03
## 601 2021-08-24 23:59:59 2021-08-24 00:11:03 2021-08-24 16:17:17
## 602 2021-08-25 23:59:59 2021-08-25 06:02:17 2021-08-25 09:50:10
## 603 2021-08-26 23:59:59 2021-08-26 00:55:11 2021-08-26 16:26:21
## 604 2021-08-27 23:59:59 2021-08-27 21:52:18 2021-08-27 00:21:26
## 605 2021-08-28 23:59:59 2021-08-28 00:41:32 2021-08-28 19:24:18
## 606 2021-08-29 23:59:59 2021-08-29 00:57:26 2021-08-29 15:01:33
## 607 2021-08-30 23:59:59 2021-08-30 02:30:21 2021-08-30 23:48:30
## 608 2021-08-31 23:59:59 2021-08-31 16:26:31 2021-08-31 00:32:24
## 609 2021-09-01 23:59:59 2021-09-01 23:52:05 2021-09-01 01:03:51
## 610 2021-09-02 23:59:59 2021-09-02 01:36:12 2021-09-02 00:06:10
## 611 2021-09-03 23:59:59 2021-09-03 15:20:03 2021-09-03 00:43:03
## 612 2021-09-04 23:59:59 2021-09-04 14:35:03 2021-09-04 02:03:03
## 613 2021-09-05 23:59:59 2021-09-05 23:57:03 2021-09-05 06:23:03
## 614 2021-09-06 23:59:59 2021-09-06 10:12:08 2021-09-06 12:04:14
## 615 2021-09-07 23:59:59 2021-09-07 00:09:16 2021-09-07 15:10:03
## 616 2021-09-08 23:59:59 2021-09-08 16:18:03 2021-09-08 08:24:03
## 617 2021-09-09 23:59:59 2021-09-09 00:03:03 2021-09-09 12:42:03
## 618 2021-09-10 23:59:59 2021-09-10 02:33:03 2021-09-10 23:01:03
## 619 2021-09-11 23:59:59 2021-09-11 12:44:03 2021-09-11 08:33:03
## 620 2021-09-12 23:59:59 2021-09-12 23:15:03 2021-09-12 01:25:03
## 621 2021-09-13 23:59:59 2021-09-13 00:19:03 2021-09-13 14:23:03
## 622 2021-09-14 23:59:59 2021-09-14 16:35:03 2021-09-14 00:04:03
## 623 2021-09-15 23:59:59 2021-09-15 23:12:03 2021-09-15 00:59:03
## 624 2021-09-16 23:59:59 2021-09-16 00:03:03 2021-09-16 20:53:03
## 625 2021-09-17 23:59:59 2021-09-17 05:30:03 2021-09-17 23:00:03
## 626 2021-09-18 23:59:59 2021-09-18 10:51:03 2021-09-18 00:09:03
## 627 2021-09-19 23:59:59 2021-09-19 00:02:03 2021-09-19 22:48:03
## 628 2021-09-20 23:59:59 2021-09-20 00:02:03 2021-09-20 12:40:03
## 629 2021-09-21 23:59:59 2021-09-21 12:50:26 2021-09-21 23:45:06
## 630 2021-09-22 23:59:59 2021-09-22 20:53:10 2021-09-22 00:50:25
## 631 2021-09-23 23:59:59 2021-09-23 08:05:20 2021-09-23 11:52:03
## 632 2021-09-24 23:59:59 2021-09-24 00:47:03 2021-09-24 11:19:03
## 633 2021-09-25 23:59:59 2021-09-25 04:23:03 2021-09-25 08:35:03
## 634 2021-09-26 23:59:59 2021-09-26 00:04:03 2021-09-26 08:46:03
## 635 2021-09-27 23:59:59 2021-09-27 02:08:03 2021-09-27 23:58:03
## 636 2021-09-28 23:59:59 2021-09-28 11:24:03 2021-09-28 23:52:03
## 637 2021-09-29 23:59:59 2021-09-29 13:07:03 2021-09-29 00:20:03
## 638 2021-09-30 23:59:59 2021-09-30 19:01:03 2021-09-30 00:07:03
## 639 2021-10-01 23:59:59 2021-10-01 21:56:03 2021-10-01 02:51:03
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## 640 2021-10-02 23:59:59 2021-10-02 19:38:03 2021-10-02 08:54:03
## 641 2021-10-03 23:59:59 2021-10-03 18:45:03 2021-10-03 00:51:03
## 642 2021-10-04 23:59:59 2021-10-04 23:14:03 2021-10-04 04:06:03
## 643 2021-10-05 23:59:59 2021-10-05 15:33:03 2021-10-05 09:20:03
## 644 2021-10-06 23:59:59 2021-10-06 07:17:03 2021-10-06 08:39:03
## 645 2021-10-07 23:59:59 2021-10-07 12:15:03 2021-10-07 03:28:03
## 646 2021-10-08 23:59:59 2021-10-08 09:39:03 2021-10-08 03:43:03
## 647 2021-10-09 23:59:59 2021-10-09 14:50:03 2021-10-09 00:18:03
## 648 2021-10-10 23:59:59 2021-10-10 08:48:03 2021-10-10 23:52:03
## 649 2021-10-11 23:59:59 2021-10-11 08:16:03 2021-10-11 20:12:03
## 650 2021-10-12 23:59:59 2021-10-12 00:04:03 2021-10-12 12:41:03
## 651 2021-10-13 23:59:59 2021-10-13 22:58:03 2021-10-13 07:41:03
## 652 2021-10-14 23:59:59 2021-10-14 00:44:03 2021-10-14 20:43:03
## 653 2021-10-15 23:59:59 2021-10-15 19:13:03 2021-10-15 09:05:03
## 654 2021-10-16 23:59:59 2021-10-16 00:17:03 2021-10-16 00:02:03
## 655 2021-10-17 23:59:59 2021-10-17 22:34:03 2021-10-17 20:22:03
## 656 2021-10-18 23:59:59 2021-10-18 10:19:03 2021-10-18 03:53:03
## 657 2021-10-19 23:59:59 2021-10-19 04:00:03 2021-10-19 19:12:03
## 658 2021-10-20 23:59:59 2021-10-20 19:42:03 2021-10-20 02:59:03
## 659 2021-10-21 23:59:59 2021-10-21 01:31:03 2021-10-21 15:34:03
## 660 2021-10-22 23:59:59 2021-10-22 19:30:03 2021-10-22 16:16:03
## 661 2021-10-23 23:59:59 2021-10-23 17:04:03 2021-10-23 11:03:03
## 662 2021-10-24 23:59:59 2021-10-24 23:40:03 2021-10-24 08:24:03
## 663 2021-10-25 23:59:59 2021-10-25 00:17:03 2021-10-25 18:17:03
## 664 2021-10-26 23:59:59 2021-10-26 09:46:03 2021-10-26 22:57:03
## 665 2021-10-27 23:59:59 2021-10-27 05:13:03 2021-10-27 08:10:03
## 666 2021-10-28 23:59:59 2021-10-28 17:39:03 2021-10-28 03:27:03
## 667 2021-10-29 23:59:59 2021-10-29 00:06:03 2021-10-29 11:38:03
## 668 2021-10-30 23:59:59 2021-10-30 06:00:03 2021-10-30 22:38:03
## 669 2021-10-31 23:59:59 2021-10-31 23:31:03 2021-10-31 13:38:03
## 670 2021-11-01 23:59:59 2021-11-01 00:53:03 2021-11-01 04:03:03
## 671 2021-11-02 23:59:59 2021-11-02 06:10:03 2021-11-02 01:56:03
## 672 2021-11-03 23:59:59 2021-11-03 09:45:03 2021-11-03 14:05:03
## 673 2021-11-04 23:59:59 2021-11-04 00:14:03 2021-11-04 16:09:03
## 674 2021-11-05 23:59:59 2021-11-05 08:52:03 2021-11-05 15:09:03
## 675 2021-11-06 23:59:59 2021-11-06 01:42:03 2021-11-06 11:06:03
## 676 2021-11-07 23:59:59 2021-11-07 16:37:03 2021-11-07 07:14:03
## 677 2021-11-08 23:59:59 2021-11-08 08:52:03 2021-11-08 00:26:03
## 678 2021-11-09 23:59:59 2021-11-09 05:22:03 2021-11-09 11:37:03
## 679 2021-11-10 23:59:59 2021-11-10 14:17:03 2021-11-10 21:25:03
## 680 2021-11-11 23:59:59 2021-11-11 15:16:03 2021-11-11 00:33:03
## 681 2021-11-12 23:59:59 2021-11-12 03:51:03 2021-11-12 16:35:03
## 682 2021-11-13 23:59:59 2021-11-13 22:18:03 2021-11-13 05:38:03
## 683 2021-11-14 23:59:59 2021-11-14 09:21:03 2021-11-14 17:25:03
## 684 2021-11-15 23:59:59 2021-11-15 00:34:03 2021-11-15 21:04:03
## 685 2021-11-16 23:59:59 2021-11-16 00:00:03 2021-11-16 10:10:03
## 686 2021-11-17 23:59:59 2021-11-17 13:05:03 2021-11-17 10:37:03
## 687 2021-11-18 23:59:59 2021-11-18 01:39:03 2021-11-18 17:12:03
## 688 2021-11-19 23:59:59 2021-11-19 15:50:03 2021-11-19 02:59:03
## 689 2021-11-20 23:59:59 2021-11-20 02:21:03 2021-11-20 15:53:03
## 690 2021-11-21 23:59:59 2021-11-21 00:01:03 2021-11-21 23:56:03
## 691 2021-11-22 23:59:59 2021-11-22 13:42:03 2021-11-22 19:41:03
## 692 2021-11-23 23:59:59 2021-11-23 10:20:03 2021-11-23 09:38:03
## 693 2021-11-24 23:59:59 2021-11-24 01:09:03 2021-11-24 14:46:03
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## 694 2021-11-25 23:59:59 2021-11-25 17:26:03 2021-11-25 00:30:03
## 695 2021-11-26 23:59:59 2021-11-26 00:01:03 2021-11-26 08:28:03
## 696 2021-11-27 23:59:59 2021-11-27 04:51:03 2021-11-27 00:06:03
## 697 2021-11-28 23:59:59 2021-11-28 23:59:03 2021-11-28 18:40:03
## 698 2021-11-29 23:59:59 2021-11-29 13:32:03 2021-11-29 09:55:04
## 699 2021-11-30 23:59:59 2021-11-30 04:42:24 2021-11-30 17:09:26
## 700 2021-12-01 23:59:59 2021-12-01 01:23:10 2021-12-01 21:31:26
## 701 2021-12-02 23:59:59 2021-12-02 09:11:03 2021-12-02 03:21:20
## 702 2021-12-03 23:59:59 2021-12-03 13:33:03 2021-12-03 20:20:03
## 703 2021-12-04 23:59:59 2021-12-04 00:22:03 2021-12-04 05:28:03
## 704 2021-12-05 23:59:59 2021-12-05 00:21:03 2021-12-05 15:36:03
## 705 2021-12-06 23:59:59 2021-12-06 22:23:03 2021-12-06 11:14:03
## 706 2021-12-07 23:59:59 2021-12-07 01:20:03 2021-12-07 23:02:03
## 707 2021-12-08 23:59:59 2021-12-08 08:14:03 2021-12-08 12:26:03
## 708 2021-12-09 23:59:59 2021-12-09 00:48:03 2021-12-09 23:59:03
## 709 2021-12-10 23:59:59 2021-12-10 13:37:03 2021-12-10 23:56:03
## 710 2021-12-11 23:59:59 2021-12-11 16:32:03 2021-12-11 00:19:03
## 711 2021-12-12 23:59:59 2021-12-12 20:44:03 2021-12-12 10:14:03
## 712 2021-12-13 23:59:59 2021-12-13 00:16:03 2021-12-13 19:43:03
## 713 2021-12-14 23:59:59 2021-12-14 11:55:03 2021-12-14 06:30:03
## 714 2021-12-15 23:59:59 2021-12-15 00:00:03 2021-12-15 16:00:03
## 715 2021-12-16 23:59:59 2021-12-16 10:08:03 2021-12-16 23:58:03
## 716 2021-12-17 23:59:59 2021-12-17 05:29:03 2021-12-17 14:45:03
## 717 2021-12-18 23:59:59 2021-12-18 10:22:03 2021-12-18 01:32:03
## 718 2021-12-19 23:59:59 2021-12-19 04:27:03 2021-12-19 23:58:03
## 719 2021-12-20 23:59:59 2021-12-20 01:13:03 2021-12-20 14:35:03
## 720 2021-12-21 23:59:59 2021-12-21 12:36:03 2021-12-21 01:30:03
## 721 2021-12-22 23:59:59 2021-12-22 12:08:03 2021-12-22 01:00:03
## 722 2021-12-23 23:59:59 2021-12-23 19:47:03 2021-12-23 00:24:03
## 723 2021-12-24 23:59:59 2021-12-24 19:04:05 2021-12-24 06:22:03
## 724 2021-12-25 23:59:59 2021-12-25 05:41:03 2021-12-25 00:03:03
## 725 2021-12-26 23:59:59 2021-12-26 22:43:04 2021-12-26 04:01:04
## 726 2021-12-27 23:59:59 2021-12-27 17:44:03 2021-12-27 22:48:03
## 727 2021-12-28 23:59:59 2021-12-28 00:02:03 2021-12-28 17:38:03
## 728 2021-12-29 23:59:59 2021-12-29 03:10:06 2021-12-29 23:22:11
## 729 2021-12-30 23:59:59 2021-12-30 12:28:12 2021-12-30 00:19:08
## 730 2021-12-31 23:59:59 2021-12-31 09:13:00 2021-12-31 20:01:00
## 731 2022-01-01 23:59:59 2022-01-01 17:47:00 2022-01-01 05:11:00
## 732 2022-01-02 23:59:59 2022-01-02 17:04:00 2022-01-02 04:55:00
## 733 2022-01-03 23:59:59 2022-01-03 00:00:00 2022-01-03 20:31:00
## 734 2022-01-04 23:59:59 2022-01-04 15:05:00 2022-01-04 19:03:00
## 735 2022-01-05 23:59:59 2022-01-05 10:10:00 2022-01-05 22:37:00
## 736 2022-01-06 23:59:59 2022-01-06 20:10:00 2022-01-06 04:44:00
## 737 2022-01-07 23:59:59 2022-01-07 00:04:00 2022-01-07 04:37:00
## 738 2022-01-08 23:59:59 2022-01-08 07:07:00 2022-01-08 19:25:00
## 739 2022-01-09 23:59:59 2022-01-09 20:02:00 2022-01-09 15:19:00
## 740 2022-01-10 23:59:59 2022-01-10 04:40:00 2022-01-10 14:40:00
## 741 2022-01-11 23:59:59 2022-01-11 11:53:00 2022-01-11 00:10:00
## 742 2022-01-12 23:59:59 2022-01-12 23:59:00 2022-01-12 07:29:00
## 743 2022-01-13 23:59:59 2022-01-13 08:55:00 2022-01-13 00:00:00
## 744 2022-01-14 23:59:59 2022-01-14 07:17:00 2022-01-14 00:04:00
## 745 2022-01-15 23:59:59 2022-01-15 07:22:00 2022-01-15 00:14:00
## 746 2022-01-16 23:59:59 2022-01-16 00:00:00 2022-01-16 20:08:00
## 747 2022-01-17 23:59:59 2022-01-17 00:07:00 2022-01-17 16:16:00
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## 748 2022-01-18 23:59:59 2022-01-18 00:22:00 2022-01-18 18:35:00
## 749 2022-01-19 23:59:59 2022-01-19 03:34:00 2022-01-19 08:37:00
## 750 2022-01-20 23:59:59 2022-01-20 15:12:00 2022-01-20 23:58:00
## 751 2022-01-21 23:59:59 2022-01-21 00:31:00 2022-01-21 22:55:00
## 752 2022-01-22 23:59:59 2022-01-22 00:39:00 2022-01-22 10:19:00
## 753 2022-01-23 23:59:59 2022-01-23 13:58:00 2022-01-23 00:07:00
## 754 2022-01-24 23:59:59 2022-01-24 00:01:00 2022-01-24 13:08:00
## 755 2022-01-25 23:59:59 2022-01-25 19:16:00 2022-01-25 07:20:00
## 756 2022-01-26 23:59:59 2022-01-26 19:10:00 2022-01-26 22:17:00
## 757 2022-01-27 23:59:59 2022-01-27 14:35:00 2022-01-27 21:20:00
## 758 2022-01-28 23:59:59 2022-01-28 00:11:00 2022-01-28 12:52:00
## 759 2022-01-29 23:59:59 2022-01-29 20:46:00 2022-01-29 15:07:00
## 760 2022-01-30 23:59:59 2022-01-30 10:10:00 2022-01-30 21:28:00
```

```r
doge_hist$timestamp <- format(as.POSIXct(doge_hist$timestamp,format="%Y-%m-%d %H:%M:%OS"),format='%m/%d,
doge_hist$timestamp <- as.Date(as.character(doge_hist$timestamp), format='%m/%d/%Y')

plot(doge_hist$timestamp,doge_hist$open,
     type='l',col='red',
     xlab = "time (t)",
     ylab = "Y(t)",
     main = "Trend signal")
```
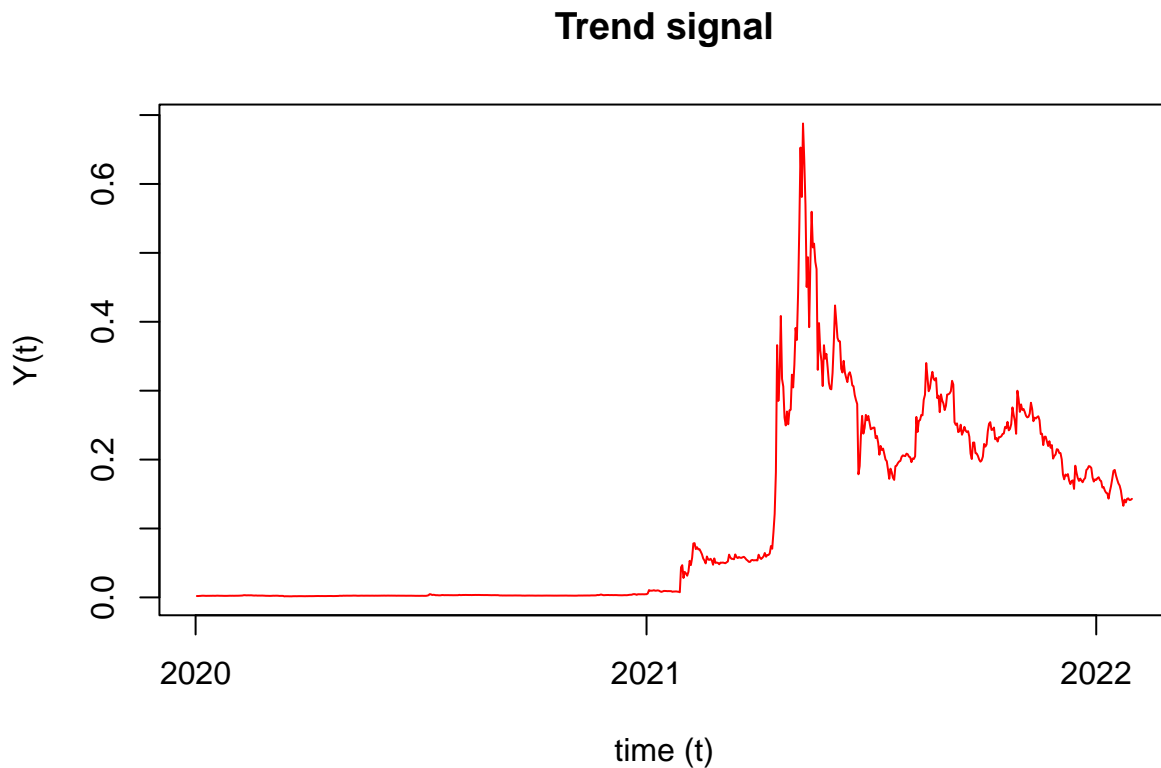
Trend signal


```r
dogelogdiff = diff(log(doge_hist$open))
```

```
plot(doge_hist$timestamp[2:760],dogelogdiff,
     type='l',col='red',
     xlab = "time (t)",
     ylab = "Y(t)",
     main = "Trend signal")
```

Trend signal
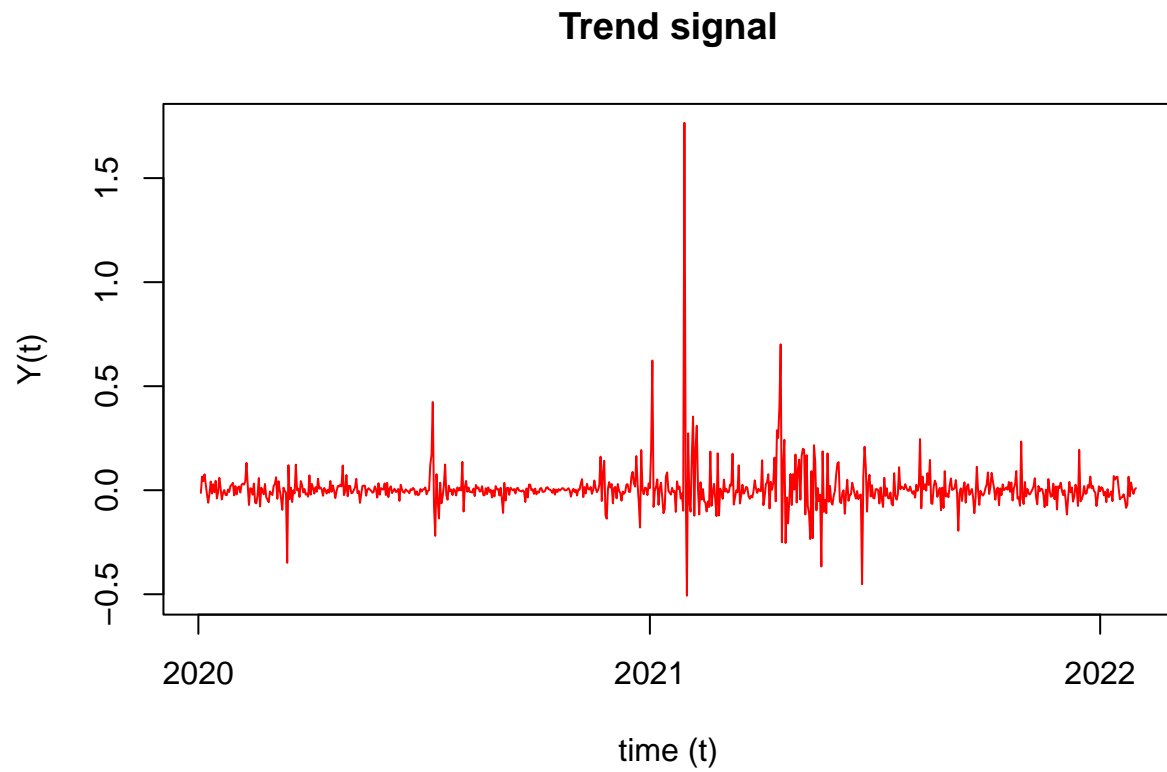

```
acf(dogelogdiff,lag.max = length(doge_hist$timestamp),
        xlab = "lag #", ylab = 'ACF', main=' ')
```
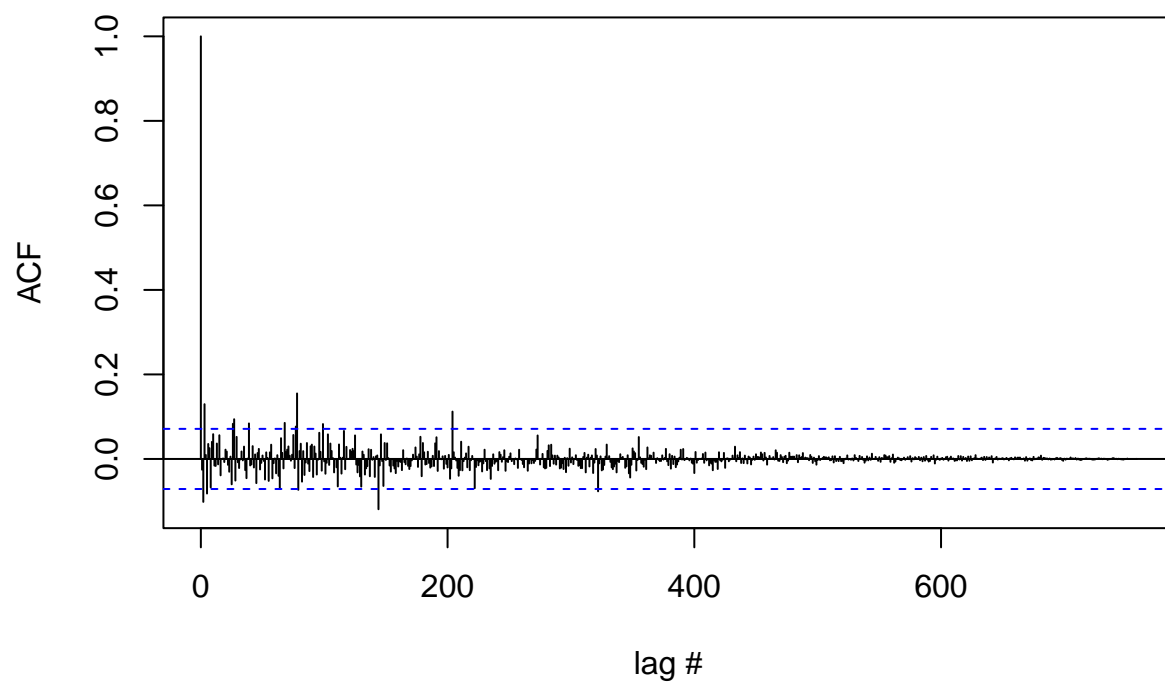
```
adf.test(dogelogdiff)
```

```
##
##  Augmented Dickey-Fuller Test
##
## data:  dogelogdiff
## Dickey-Fuller = -8.1817, Lag order = 9, p-value = 0.01
## alternative hypothesis: stationary
```

```
doge_m_binseg <- cpt.mean(dogelogdiff, penalty = "None", method = "BinSeg", Q = 15)
plot(doge_m_binseg, type = "l", xlab = "Index", cpt.width = 4)
```
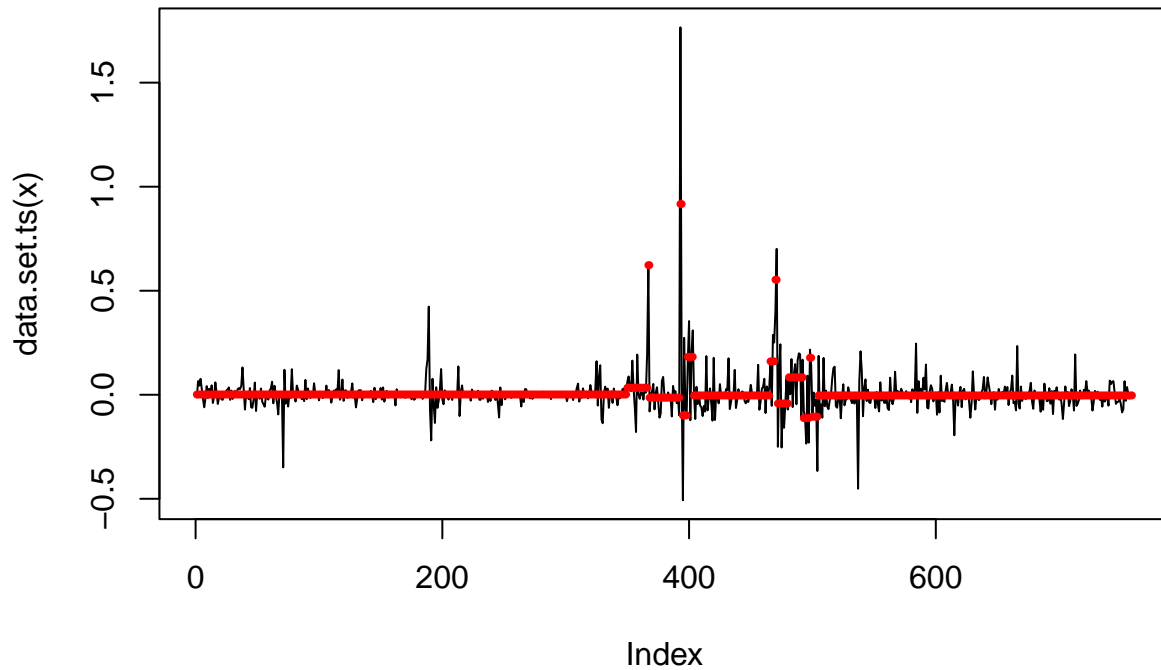
```
doge_cpt_date = doge_hist$timestamp[1] + cpts(doge_m_binseg)
doge_cpt_date <- format(as.POSIXct(doge_cpt_date,format="%Y-%m-%d %H:%M:%OS"),format='%m/%d/%Y')
doge_cpt_date <- as.Date(as.character(doge_cpt_date), format='%m/%d/%Y')

doge_hist['breakpoint'] <- doge_hist$timestamp %in% doge_cpt_date

dogecrypto <- elon[grepl("Doge", elon[["tweet"]]) | grepl("dogecoin", elon[["tweet"]]),]
as.data.frame(dogecrypto)
```

```
##          X            id conversation_id   created_at                  date timezone
## 2292 19 1.113179e+18    1.113179e+18 1.554238e+12 2019-04-02 16:38:38     -500
## 3887 12 1.357244e+18    1.357244e+18 1.612427e+12 2021-02-04 03:27:10     -500
## 3889 14 1.357241e+18    1.357241e+18 1.612427e+12 2021-02-04 03:15:26     -500
## 3892 17 1.357231e+18    1.357230e+18 1.612424e+12 2021-02-04 02:35:35     -500
## 3920  1 1.360008e+18    1.359791e+18 1.613086e+12 2021-02-11 18:27:37     -500
## 3931 12 1.359520e+18    1.359520e+18 1.612970e+12 2021-02-10 10:08:11     -500
## 3956 17 1.361096e+18    1.361094e+18 1.613346e+12 2021-02-14 18:33:22     -500
## 3957 18 1.361094e+18    1.361094e+18 1.613345e+12 2021-02-14 18:25:16     -500
## 3989 10 1.374988e+18    1.374868e+18 1.616658e+12 2021-03-25 03:33:56     -500
## 4032  2 1.392974e+18    1.392974e+18 1.620946e+12 2021-05-13 18:45:16     -500
## 4048 18 1.392030e+18    1.392030e+18 1.620721e+12 2021-05-11 04:13:35     -500
## 4055  5 1.395438e+18    1.395375e+18 1.621533e+12 2021-05-20 13:56:35     -500
## 4056  6 1.395438e+18    1.395375e+18 1.621533e+12 2021-05-20 13:53:25     -500
## 4063 13 1.395367e+18    1.395329e+18 1.621516e+12 2021-05-20 09:14:02     -500
## 4064 14 1.395367e+18    1.395329e+18 1.621516e+12 2021-05-20 09:13:50     -500
```

```
## 4068 18 1.395329e+18      1.395329e+18 1.621507e+12 2021-05-20 06:41:00      -500
## 4096 26 1.399115e+18      1.399100e+18 1.622410e+12 2021-05-30 17:24:28      -500
## 4159  9 1.410530e+18      1.410530e+18 1.625131e+12 2021-07-01 05:24:21      -500
## 4163 13 1.410519e+18      1.410519e+18 1.625129e+12 2021-07-01 04:43:41      -500
## 4325 15 1.437268e+18      1.437205e+18 1.631506e+12 2021-09-13 00:12:44      -500
## 4337 27 1.437165e+18      1.437154e+18 1.631482e+12 2021-09-12 17:21:49      -500
## 4358  2 1.440780e+18      1.440771e+18 1.632344e+12 2021-09-22 16:50:08      -500
## 4495 20 1.453418e+18      1.453417e+18 1.635357e+12 2021-10-27 13:47:54      -500
## 4530 55 1.452348e+18      1.451983e+18 1.635102e+12 2021-10-24 14:55:51      -500
## 4532 57 1.452334e+18      1.452313e+18 1.635098e+12 2021-10-24 14:01:32      -500
## 4533 58 1.452333e+18      1.451930e+18 1.635098e+12 2021-10-24 13:54:27      -500
## 4535 60 1.452332e+18      1.451930e+18 1.635098e+12 2021-10-24 13:51:57      -500
## 4537 62 1.452329e+18      1.451930e+18 1.635097e+12 2021-10-24 13:38:14      -500
## 4542 67 1.452075e+18      1.451930e+18 1.635037e+12 2021-10-23 20:48:54      -500
## 4608  2 1.473914e+18      1.473867e+18 1.640244e+12 2021-12-23 02:11:42      -500
## 4727  4 1.483908e+18      1.483736e+18 1.642626e+12 2022-01-19 16:01:55      -500
##      place
## 2292    NA
## 3887    NA
## 3889    NA
## 3892    NA
## 3920    NA
## 3931    NA
## 3956    NA
## 3957    NA
## 3989    NA
## 4032    NA
## 4048    NA
## 4055    NA
## 4056    NA
## 4063    NA
## 4064    NA
## 4068    NA
## 4096    NA
## 4159    NA
## 4163    NA
## 4325    NA
## 4337    NA
## 4358    NA
## 4495    NA
## 4530    NA
## 4532    NA
## 4533    NA
## 4535    NA
## 4537    NA
## 4542    NA
## 4608    NA
## 4727    NA
##
## 2292
## 3887
## 3889
## 3892
## 3920
```

```
## 3931
## 3956
## 3957
## 3989
## 4032
## 4048
## 4055
## 4056
## 4063
## 4064
## 4068
## 4096
## 4159
## 4163
## 4325
## 4337
## 4358
## 4495
## 4530                                                  @ProTheDoge Lots of people I talked to on the pr
it felt like the people's crypto.
## 4532 @Filasophical @ShibaInuHodler Out of curiosity, I acquired some ascii hash strings called "Bitc
## 4533
## 4535                                            @itsALLrisky @TeslaGong @mishaboar (
## 4537                             @TeslaGong @mishaboar @DogecoinFdn Not recently. Wha
## 4542
## 4608
## 4727           @blueskykites @Grimezsz @WholeMarsBlog @SpaceXMR @musky_meme @CovelloMassimo @Sp
I do think a lot about rocket engine chamber pressure ahaha
##      language hashtags cashtags  user_id user_id_str username      name day
## 2292       en       []       [] 44196397    44196397 elonmusk Elon Musk   2
## 3887       en       []       [] 44196397    44196397 elonmusk Elon Musk   4
## 3889       en       []       [] 44196397    44196397 elonmusk Elon Musk   4
## 3892       en       []       [] 44196397    44196397 elonmusk Elon Musk   4
## 3920       en       []       [] 44196397    44196397 elonmusk Elon Musk   4
## 3931       en       []       [] 44196397    44196397 elonmusk Elon Musk   3
## 3956       en       []       [] 44196397    44196397 elonmusk Elon Musk   7
## 3957       en       []       [] 44196397    44196397 elonmusk Elon Musk   7
## 3989       en       []       [] 44196397    44196397 elonmusk Elon Musk   4
## 4032       en       []       [] 44196397    44196397 elonmusk Elon Musk   4
## 4048       en       []       [] 44196397    44196397 elonmusk Elon Musk   2
## 4055       en       []       [] 44196397    44196397 elonmusk Elon Musk   4
## 4056       en       []       [] 44196397    44196397 elonmusk Elon Musk   4
## 4063      und       []       [] 44196397    44196397 elonmusk Elon Musk   4
## 4064       de       []       [] 44196397    44196397 elonmusk Elon Musk   4
## 4068       en       []       [] 44196397    44196397 elonmusk Elon Musk   4
## 4096      und       []       [] 44196397    44196397 elonmusk Elon Musk   7
## 4159       en       []       [] 44196397    44196397 elonmusk Elon Musk   4
## 4163       en       []       [] 44196397    44196397 elonmusk Elon Musk   4
## 4325       en       []       [] 44196397    44196397 elonmusk Elon Musk   1
## 4337      und       []       [] 44196397    44196397 elonmusk Elon Musk   7
## 4358       en       []       [] 44196397    44196397 elonmusk Elon Musk   3
## 4495       en       []       [] 44196397    44196397 elonmusk Elon Musk   3
## 4530       en       []       [] 44196397    44196397 elonmusk Elon Musk   7
## 4532       en       []       [] 44196397    44196397 elonmusk Elon Musk   7
```

```
## 4533       und       []        []  44196397    44196397 elonmusk Elon Musk     7
## 4535        en       []        []  44196397    44196397 elonmusk Elon Musk     7
## 4537        en       []        []  44196397    44196397 elonmusk Elon Musk     7
## 4542        en       []        []  44196397    44196397 elonmusk Elon Musk     6
## 4608        en       []        []  44196397    44196397 elonmusk Elon Musk     4
## 4727        en       []        []  44196397    44196397 elonmusk Elon Musk     3
##       hour                                                         link
## 2292    16 https://twitter.com/elonmusk/status/1113178951403180032
## 3887     3 https://twitter.com/elonmusk/status/1357244295091208193
## 3889     3 https://twitter.com/elonmusk/status/1357241340313141249
## 3892     2 https://twitter.com/elonmusk/status/1357231313376456708
## 3920    18 https://twitter.com/elonmusk/status/1360007611781795840
## 3931    10 https://twitter.com/elonmusk/status/1359519541219500033
## 3956    18 https://twitter.com/elonmusk/status/1361096223428653056
## 3957    18 https://twitter.com/elonmusk/status/1361094185412100096
## 3989     3 https://twitter.com/elonmusk/status/1374987902120206337
## 4032    18 https://twitter.com/elonmusk/status/1392974251011895300
## 4048     4 https://twitter.com/elonmusk/status/1392030108274159619
## 4055    13 https://twitter.com/elonmusk/status/1395438318095986693
## 4056    13 https://twitter.com/elonmusk/status/1395437522306490371
## 4063     9 https://twitter.com/elonmusk/status/1395367211083067399
## 4064     9 https://twitter.com/elonmusk/status/1395367159866351618
## 4068     6 https://twitter.com/elonmusk/status/1395328697436033032
## 4096    17 https://twitter.com/elonmusk/status/1399114511202852871
## 4159     5 https://twitter.com/elonmusk/status/1410529698497630212
## 4163     4 https://twitter.com/elonmusk/status/1410519466518233089
## 4325     0 https://twitter.com/elonmusk/status/1437267981889937415
## 4337    17 https://twitter.com/elonmusk/status/1437164571467390980
## 4358    16 https://twitter.com/elonmusk/status/1440780474662543370
## 4495    13 https://twitter.com/elonmusk/status/1453418189862342660
## 4530    14 https://twitter.com/elonmusk/status/1452348126753349640
## 4532    14 https://twitter.com/elonmusk/status/1452334458066149377
## 4533    13 https://twitter.com/elonmusk/status/1452332676929761282
## 4535    13 https://twitter.com/elonmusk/status/1452332044743323654
## 4537    13 https://twitter.com/elonmusk/status/1452328592810160134
## 4542    20 https://twitter.com/elonmusk/status/1452074589257883654
## 4608     2 https://twitter.com/elonmusk/status/1473914193527070770
## 4727    16 https://twitter.com/elonmusk/status/1483907599036780557
##                                                                                                    urls
## 2292 ['https://www.theonion.com/bitcoin-plunge-reveals-possible-vulnerabilities-in-craz-1821134169']
## 3887                                                                                                 []
## 3889                                                                                                 []
## 3892                                                                                                 []
## 3920                                                                                                 []
## 3931                                                                                                 []
## 3956                                                                                                 []
## 3957                                                                                                 []
## 3989                                                                                                 []
## 4032                                                                                                 []
## 4048                                                                                                 []
## 4055                                                                                                 []
## 4056                                                                                                 []
## 4063                                                                                                 []
## 4064                                                                                                 []
```

```
## 4068                                                                      []
## 4096                                                                      []
## 4159                                                                      []
## 4163                                                                      []
## 4325                                                                      []
## 4337                                                                      []
## 4358                                                                      []
## 4495                                                                      []
## 4530                                                                      []
## 4532                                                                      []
## 4533                                                                      []
## 4535                                                                      []
## 4537                                                                      []
## 4542                                                                      []
## 4608                                                                      []
## 4727                                                                      []
##                                                    photos video
## 2292                                                  []     0
## 3887                                                  []     0
## 3889                                                  []     0
## 3892                                                  []     0
## 3920                                                  []     0
## 3931                                                  []     0
## 3956                                                  []     0
## 3957                                                  []     0
## 3989                                                  []     0
## 4032                                                  []     0
## 4048                                                  []     0
## 4055                                                  []     0
## 4056                                                  []     0
## 4063                                                  []     0
## 4064                                                  []     0
## 4068 ['https://pbs.twimg.com/media/E100DerVEAAfKpp.jpg']     1
## 4096                                                  []     0
## 4159                                                  []     0
## 4163 ['https://pbs.twimg.com/media/E5Mr-oXXwAEWFtP.jpg']     1
## 4325                                                  []     0
## 4337                                                  []     0
## 4358                                                  []     0
## 4495                                                  []     0
## 4530                                                  []     0
## 4532                                                  []     0
## 4533                                                  []     0
## 4535                                                  []     0
## 4537                                                  []     0
## 4542                                                  []     0
## 4608                                                  []     0
## 4727                                                  []     0
##                                 thumbnail retweet nlikes nreplies
## 2292                                        False  19496     1056
## 3887                                        False 747044    21388
## 3889                                        False 535291    18505
## 3892                                        False 251826     8922
## 3920                                        False  28120     2074
```

```
## 3931                                                                  False 529825    27515
## 3956                                                                  False   5815      447
## 3957                                                                  False 319018    27398
## 3989                                                                  False   7711      122
## 4032                                                                  False 535949    63863
## 4048                                                                  False 393625    96889
## 4055                                                                  False  51198     5104
## 4056                                                                  False  23424      956
## 4063                                                                  False   3754      265
## 4064                                                                  False  10551     1173
## 4068 https://pbs.twimg.com/media/E100DerVEAAfKpp.jpg  False 303787    71021
## 4096                                                                  False  36782     1339
## 4159                                                                  False 280121    45258
## 4163 https://pbs.twimg.com/media/E5Mr-oXXwAEWFtP.jpg  False 129068    11187
## 4325                                                                  False   3123      437
## 4337                                                                  False   2237      109
## 4358                                                                  False  23940     2225
## 4495                                                                  False  47125    10908
## 4530                                                                  False  33363     4089
## 4532                                                                  False  36341     5468
## 4533                                                                  False   8762      785
## 4535                                                                  False   5399      742
## 4537                                                                  False   3527      838
## 4542                                                                  False   5049      758
## 4608                                                                  False  31172     4226
## 4727                                                                  False  17897      646
##      nretweets quote_url search near geo source user_rt_id user_rt retweet_id
## 2292      1891            None   NA  NA     NA         NA      NA         NA
## 3887    107650            None   NA  NA     NA         NA      NA         NA
## 3889     98378            None   NA  NA     NA         NA      NA         NA
## 3892     43194            None   NA  NA     NA         NA      NA         NA
## 3920      8314            None   NA  NA     NA         NA      NA         NA
## 3931     56100            None   NA  NA     NA         NA      NA         NA
## 3956       694            None   NA  NA     NA         NA      NA         NA
## 3957     33049            None   NA  NA     NA         NA      NA         NA
## 3989       227            None   NA  NA     NA         NA      NA         NA
## 4032     82625            None   NA  NA     NA         NA      NA         NA
## 4048     95316            None   NA  NA     NA         NA      NA         NA
## 4055     12012            None   NA  NA     NA         NA      NA         NA
## 4056      2679            None   NA  NA     NA         NA      NA         NA
## 4063       286            None   NA  NA     NA         NA      NA         NA
## 4064      1385            None   NA  NA     NA         NA      NA         NA
## 4068     52679            None   NA  NA     NA         NA      NA         NA
## 4096      2009            None   NA  NA     NA         NA      NA         NA
## 4159     47906            None   NA  NA     NA         NA      NA         NA
## 4163     16023            None   NA  NA     NA         NA      NA         NA
## 4325       310            None   NA  NA     NA         NA      NA         NA
## 4337        75            None   NA  NA     NA         NA      NA         NA
## 4358      4146            None   NA  NA     NA         NA      NA         NA
## 4495      6278            None   NA  NA     NA         NA      NA         NA
## 4530      7198            None   NA  NA     NA         NA      NA         NA
## 4532      6234            None   NA  NA     NA         NA      NA         NA
## 4533      1187            None   NA  NA     NA         NA      NA         NA
## 4535       763            None   NA  NA     NA         NA      NA         NA
```

```
## 4537     577           None  NA  NA    NA      NA    NA    NA
## 4542     483           None  NA  NA    NA      NA    NA    NA
## 4608    6221           None  NA  NA    NA      NA    NA    NA
## 4727     522           None  NA  NA    NA      NA    NA    NA
##
## 2292
## 3887
## 3889
## 3892
## 3920
## 3931
## 3956
## 3957
## 3989
## 4032
## 4048
## 4055
## 4056
## 4063
## 4064
## 4068
## 4096
## 4159
## 4163
## 4325
## 4337
## 4358
## 4495
## 4530
## 4532
## 4533
## 4535
## 4537
## 4542
## 4608
## 4727 [{'screen_name': 'blueskykites', 'name': 'Gary Mark • Blue Sky Kites', 'id': '87101095'}, {'scr
##      retweet_date translate trans_src trans_dest
## 2292           NA        NA        NA         NA
## 3887           NA        NA        NA         NA
## 3889           NA        NA        NA         NA
## 3892           NA        NA        NA         NA
## 3920           NA        NA        NA         NA
## 3931           NA        NA        NA         NA
## 3956           NA        NA        NA         NA
## 3957           NA        NA        NA         NA
## 3989           NA        NA        NA         NA
## 4032           NA        NA        NA         NA
## 4048           NA        NA        NA         NA
## 4055           NA        NA        NA         NA
## 4056           NA        NA        NA         NA
## 4063           NA        NA        NA         NA
## 4064           NA        NA        NA         NA
## 4068           NA        NA        NA         NA
## 4096           NA        NA        NA         NA
```

```
## 4159          NA        NA        NA        NA
## 4163          NA        NA        NA        NA
## 4325          NA        NA        NA        NA
## 4337          NA        NA        NA        NA
## 4358          NA        NA        NA        NA
## 4495          NA        NA        NA        NA
## 4530          NA        NA        NA        NA
## 4532          NA        NA        NA        NA
## 4533          NA        NA        NA        NA
## 4535          NA        NA        NA        NA
## 4537          NA        NA        NA        NA
## 4542          NA        NA        NA        NA
## 4608          NA        NA        NA        NA
## 4727          NA        NA        NA        NA
```

```r
dogecrypto$date <- format(as.POSIXct(dogecrypto$date,format="%Y-%m-%d %H:%M:%OS"),format='%m/%d/%Y')
dogecrypto$date <- as.Date(as.character(dogecrypto$date), format='%m/%d/%Y')
doge_hist['tweet'] <- doge_hist$timestamp %in% dogecrypto$date

colorsD <- c("tweets" = "green",  "breaking points" = "orange")
doge_hist[300:760,] %>%
ggplot(aes(x = timestamp, y = open)) +
geom_line() +
geom_point(data = . %>% filter(tweet == TRUE), aes(color = "tweets"), size = 3) +
geom_point(data = . %>% filter(breakpoint == TRUE), aes(color = "breaking points"), size = 3) +
ggtitle("Elon Musk's Tweets and Breaking Points") +
theme(plot.title = element_text(hjust = 0.5)) +
labs(x = "timestamp",
        y = "DOGE value",
        color = "Legend") + scale_color_manual(values = colorsD)
```

Elon Musk's Tweets and Breaking Points
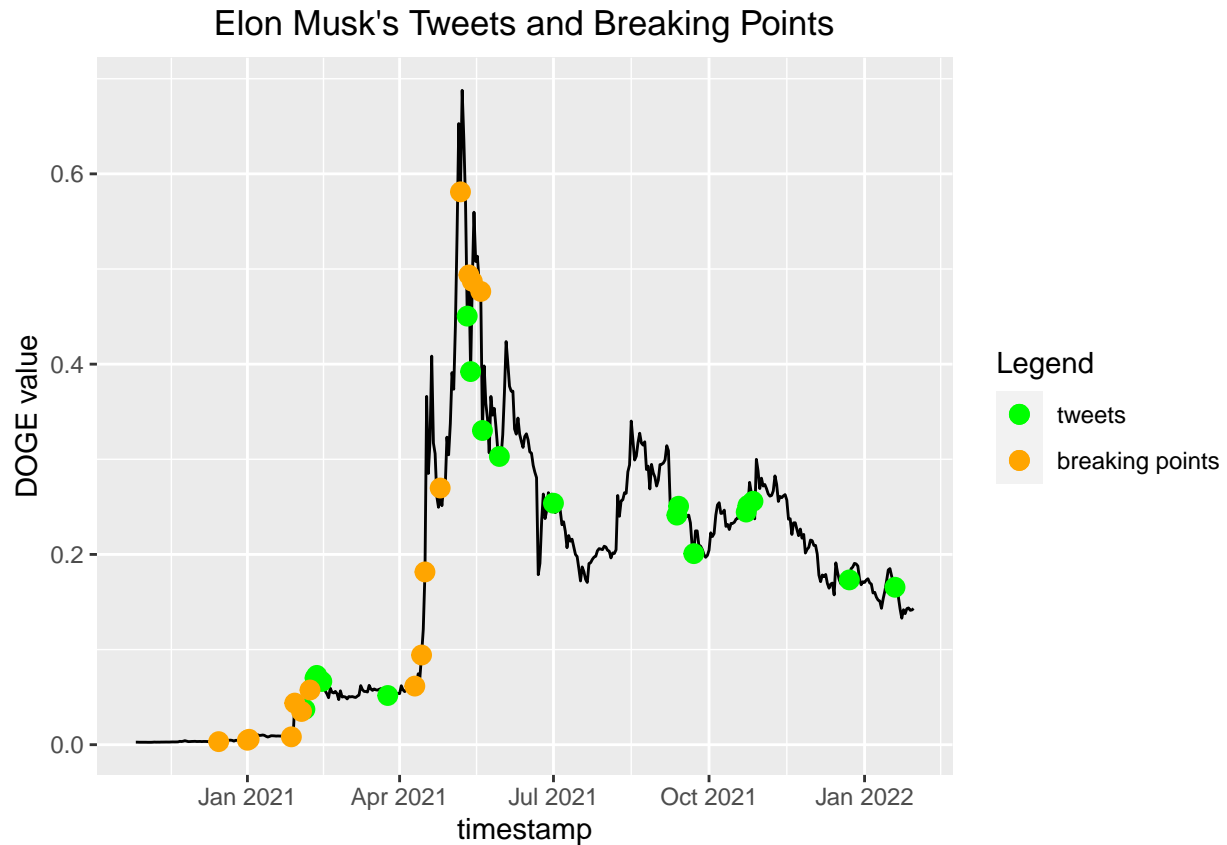
Conclusion

dfihdfhdhfidf

Annex

Python code to extract Elon Musks's tweets via Twitter API

```python
import twint
import datetime

def delist(x):
    df = x[0]
    for i in range(1, len(x)):
        df = df.append(x[i])
    return df

def ElonPaginated():
    data = []
    start = datetime.datetime.strptime("2011-01-01", "%Y-%m-%d")
    end = datetime.datetime.strptime("2022-02-01", "%Y-%m-%d")
    date_generated = [start + datetime.timedelta(days=x) for x in range(0, (end - start).days)]
    date_generated = date_generated[::7]
```

```python
    date_generated = [date_obj.strftime("%Y-%m-%d") for date_obj in date_generated]
    for i in range(0, len(date_generated) - 1):
        c = twint.Config()
        c.Username = "elonmusk"
        c.Since = date_generated[i]
        c.Until = date_generated[i + 1]
        c.Pandas = True
        twint.run.Search(c)
        Tweets_df = twint.storage.panda.Tweets_df
        if Tweets_df.empty:
            pass
        else: data.append((Tweets_df))
    return data

data = ElonPaginated()
data = delist(data)
print(data)
data.to_csv('/Users/federicopiazza/Desktop/MONTREAL/QM/elon.csv')
```