# BITCOIN
# TRANSACTION HISTORICAL DATA ANALYSIS

**Presented to Professor DAVIDE PATTI**
**IoT-Based Applications for Intelligent Systems**

# BLOCKCHAIN TECHNOLOGY

Blockchain technology, introduced by Satoshi Nakamoto in 2009 as an integral part of Bitcoin, serves as a distributed and public ledger for recording transactions. Its implementation ensures secure peer-to-peer communication by linking blocks with hash pointers, timestamps, and transaction data. Bitcoin, a decentralized digital currency, utilizes blockchain to store transactions in a distributed manner, addressing vulnerabilities in the traditional financial industry.

# ABOUT PROJECT

## SCOPE

This project involves accessing information related to blockchain blocks and transactions from the **bigquery-public-data:crypto_bitcoin** dataset, updated every 10 minutes on Google Cloud's BigQuery platform. Extracted data will be processed as data frames to derive insightful analyses.

## TOOLS

GOOGLE CLOUD

BIG QUERY

PYTHON 3

JUPYTER NOTEBOOK

# INSIGHTFUL ANALYSES

01

## TRANSACTION COUNT OVER TIME

How does the historical trend of transaction counts correlate with major events?

02

## TRANSFER VOLUME

What are the top 3 transfer volume of BTC over time?

03

## MEAN TRANSFER VOLUME

What insights can be gained from changes in the mean transfer volume over time? Are there specific periods of notable volatility or stability?

# INSIGHTFUL ANALYSES

04

## AVERAGE INPUT-OUTPUT OVER TIME

Are there specific periods where the average input-output count deviates significantly from the norm?

05

## DIFFICULTY OVER TIME

How much difficulty of mining a block vary over time or the trend of difficulty is correlated any major event?

06

## ACTIVE ADDRESSES OVER TIME

How does the growth or decline of active addresses correspond to shifts in user behavior, market sentiment, or technological advancements?

# ENTITY RELATIONAL DIAGRAM - ERD

**bigquery-public-data:crypto_bitcoin.blocks**

| | |
|---|---|
| **hash** | STRING |
| size | INTEGER |
| stripped_size | INTEGER |
| weight | INTEGER |
| number | INTEGER |
| version | INTEGER |
| merkle_root | STRING |
| timestamp | TIMESTAMP |
| timestamp_month | PARTITIONED FIELD & DATE |
| nonce | STRING |
| bits | STRING |
| coinbase_param | STRING |
| transaction_count | INTEGER |

**bigquery-public-data:crypto_bitcoin.transactions**

| | |
|---|---|
| **hash** | STRING |
| size | INTEGER |
| virtual_size | INTEGER |
| version | INTEGER |
| lock_time | INTEGER |
| block_hash | STRING |
| block_number | INTEGER |
| block_timestamp | TIMESTAMP |
| block_timestamp_month | PARTITIONED FIELD & DATE |
| input_count | INTEGER |
| output_count | INTEGER |
| input_value | NUMERIC |
| output_value | NUMERIC |
| is_coinbase | BOOLEAN |
| fee | NUMERIC |
| inputs | RECORD |
| inputs.index | INTEGER |
| inputs.spent_transaction_hash | STRING |
| inputs.spent_output_index | INTEGER |
| inputs.script_asm | STRING |
| inputs.script_hex | STRING |
| inputs.sequence | INTEGER |
| inputs.required_signatures | INTEGER |
| inputs.type | STRING |
| inputs.addresses | STRING |
| inputs.value | STRING |
| outputs | RECORD |
| outputs.index | INTEGER |
| outputs.script_asm | STRING |
| outputs.script_hex | STRING |
| outputs.required_signatures | INTEGER |
| outputs.type | STRING |
| outputs.addresses | STRING |
| outputs.value | STRING |

**bigquery-public-data:crypto_bitcoin.inputs (view)**

| | |
|---|---|
| **transaction_hash** | STRING |
| block_hash | STRING |
| block_number | INTEGER |
| block_timestamp | TIMESTAMP |
| **index** | INTEGER |
| spent_transaction_hash | STRING |
| spent_output_index | INTEGER |
| script_asm | STRING |
| script_hex | STRING |
| sequence | INTEGER |
| required_signatures | INTEGER |
| type | STRING |
| addresses | STRING |
| value | NUMERIC |

**bigquery-public-data:crypto_bitcoin.outputs (view)**

| | |
|---|---|
| **transaction_hash** | STRING |
| block_hash | STRING |
| block_number | INTEGER |
| block_timestamp | TIMESTAMP |
| **index** | INTEGER |
| script_asm | STRING |
| script_hex | STRING |
| required_signatures | INTEGER |
| type | STRING |
| addresses | STRING |
| value | NUMERIC |

# TRANSACTION INSIGHTS

# TRANSACTIONS

01

Bitcoin is a type of digital money that people use a lot. It's special because no one person or government controls it. People like to keep an eye on something called "Bitcoin transfer volume." This just means the total amount of Bitcoin moving from one place to another. People might use Bitcoin to buy things, move money between their own digital wallets, or even trade it like stocks. The transfer volume tells us how much Bitcoin is being used for different things.

02

Transfer Volume (Total) is the total amount of coins that were successfully transferred on the Bitcoin blockchain. It does not include failed transactions or transactions that were not confirmed on the blockchain.

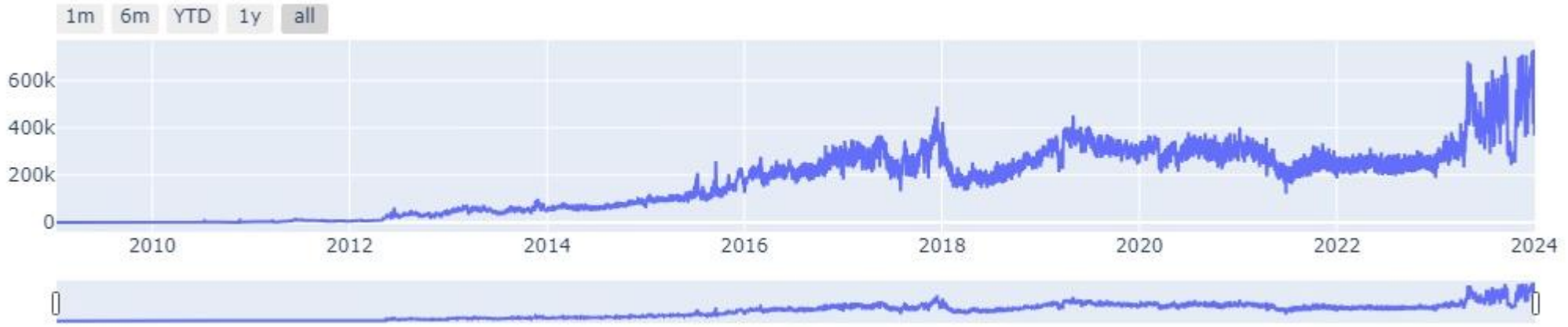
```
transactions.head()
```

| | date | transaction_count | total_transfer_volume | mean_transfer_volume | biggest_transfer_volume |
|---|---|---|---|---|---|
| 0 | 2009-01-12 | 7 | 179.0 | 25.571429 | 50.0 |
| 1 | 2009-01-14 | 1 | 61.0 | 61.000000 | 61.0 |
| 2 | 2009-01-15 | 8 | 500.0 | 62.500000 | 250.0 |
| 3 | 2009-01-16 | 2 | 200.0 | 100.000000 | 100.0 |
| 4 | 2009-01-18 | 1 | 150.0 | 150.000000 | 150.0 |

```
transactions.tail()
```

| | date | transaction_count | total_transfer_volume | mean_transfer_volume | biggest_transfer_volume |
|---|---|---|---|---|---|
| 5215 | 2023-12-31 | 731195 | 5.752295e+05 | 0.786698 | 16505.635412 |
| 5216 | 2024-01-01 | 657597 | 5.298955e+05 | 0.805806 | 16489.114643 |
| 5217 | 2024-01-02 | 367188 | 8.482888e+05 | 2.310230 | 16559.444607 |
| 5218 | 2024-01-03 | 502591 | 8.582424e+05 | 1.707636 | 16469.047638 |
| 5219 | 2024-01-04 | 482387 | 1.053271e+06 | 2.183456 | 210010.074441 |

# TRANSACTION COUNT OVER TIME




Bitcoin's price briefly reaches a new all-time high of US19,783.06.

17 DEC 2017

Bitcoin falls below US11,000, a fall of 45% from its peak.

22 DEC 2017

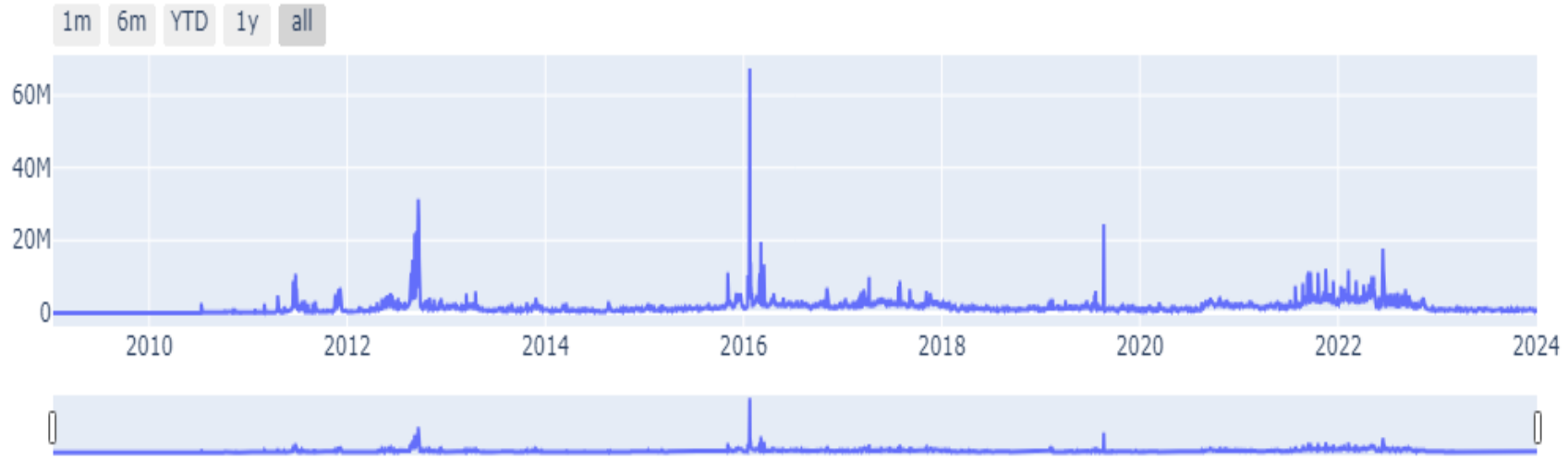
Bitcoin had dropped in value by 30% to US31,000. This was partly in response to Elon Musk's announcement that Tesla would suspend payments using the Bitcoin network due to environmental concerns, along with an announcement from the People's Bank of China reiterating that digital currencies cannot be used for payments.

19 MAY 2021

trend of Ordinal inscriptions taking place on the Bitcoin blockchain, a phenomenon that has captured the attention of both enthusiasts, BRC20 traders, and non-fungible token (NFT) collectors.

1 MAY 2023

# TRANSFER VOLUME OVER TIME




21 AUG 2019

BTC TRANSFERRED
**24.52 M**

19 SEPT 2012

BTC TRANSFERRED
**31.318 M**

24 JAN 2016

BTC TRANSFERRED
**67.349 M**

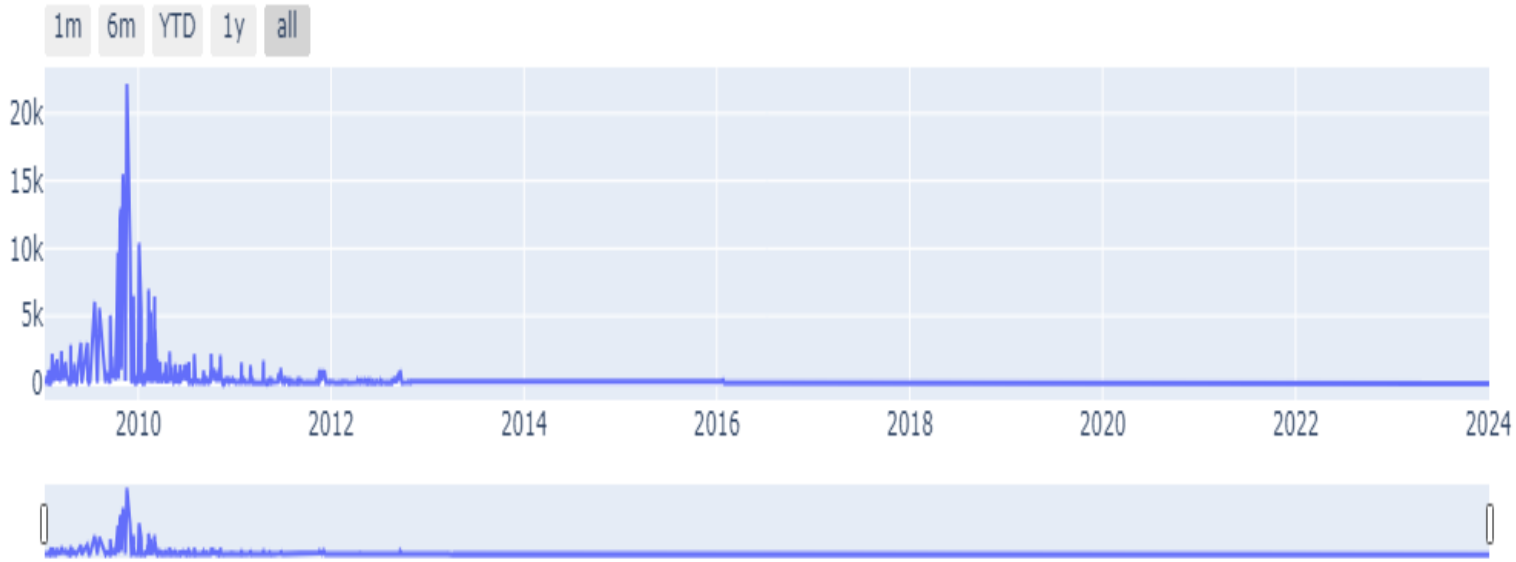
# MEAN TRANSFER VOLUME OVER TIME

**19 NOV 2009**

**BITCOIN**

MEAN TRANSFERRED

**22.175k**



# AVG INPUT-OUTPUT COUNT


MAX
INPUT AVG ON
1ST DEC 2009
**168 BTC**

We can see that, in initial days when bitcoin was launched the highest average of input is 168 BTC and highest output is 13.6 BTC. Apart from that we can see the constant line of input & output

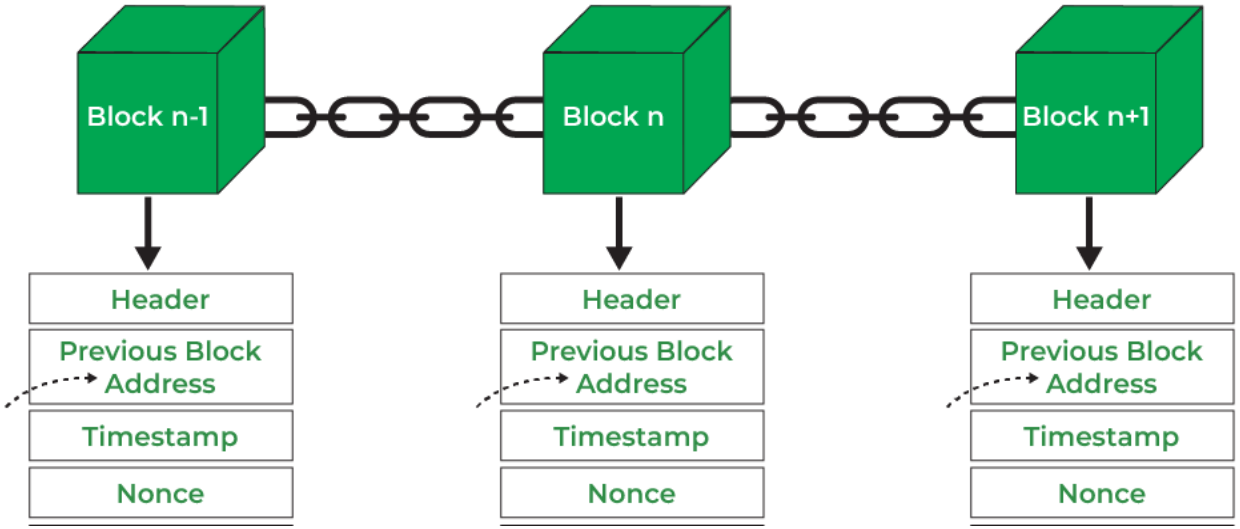
MAX
OUTPUT AVG ON
1ST AUG 2015
**13.6 BTC**

# BLOCKS INSIGHTS

# BLOCKS

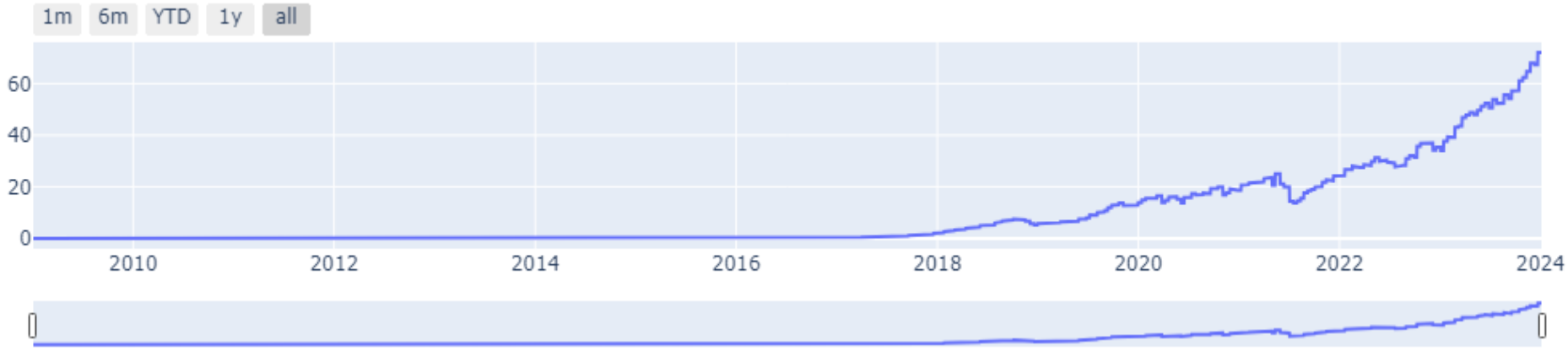
01

A blockchain is “a distributed database that maintains a continuously growing list of ordered records, called blocks.” These blocks “are linked using cryptography. Each block contains a cryptographic hash of the previous block, a timestamp, and transaction data.




# DIFFICULTY OVER TIME

| | date | bits |
|---|---|---|
| 0 | 2009-01-03 | 1d00ffff |
| 1 | 2009-01-09 | 1d00ffff |
| 2 | 2009-01-10 | 1d00ffff |
| 3 | 2009-01-11 | 1d00ffff |
| 4 | 2009-01-12 | 1d00ffff |




```
min_diff_per_day.tail()
```

| | date | bits |
|---|---|---|
| 5471 | 2024-01-01 | 1703e8b3 |
| 5472 | 2024-01-02 | 1703e8b3 |
| 5473 | 2024-01-03 | 1703e8b3 |
| 5474 | 2024-01-04 | 1703e8b3 |
| 5475 | 2024-01-05 | 1703e8b3 |

The difficulty of mining a bitcoin block fell by 7.32%, with miners powering off machines as a brutal bear market eats into profit.
The adjustment at block height 766,080 is the biggest downward change since July 2021. That was when hordes of miners dropped off the network following China's ban on the industry. At the time, the country was the world's biggest bitcoin mining hub.

**7.32%**

DROP IN DIFFICULTY IN

**JULY 2021**

# INPUTS / OUTPUTS INSIGHTS

# INPUTS / OUTPUTS - ADDRESSES

01

In the context of blockchain technology, an "address" typically refers to a unique identifier that represents a destination for cryptocurrency transactions. Each cryptocurrency has its own addressing system, but I'll use Bitcoin as an example.
A Bitcoin address is a 26-35 character alphanumeric string that starts with either a 1, 3, or bc1. It serves as a destination for Bitcoin transactions, allowing users to send or receive bitcoins. The address is generated through a mathematical process involving the user's private key, and it is often represented in QR code format for easy scanning.

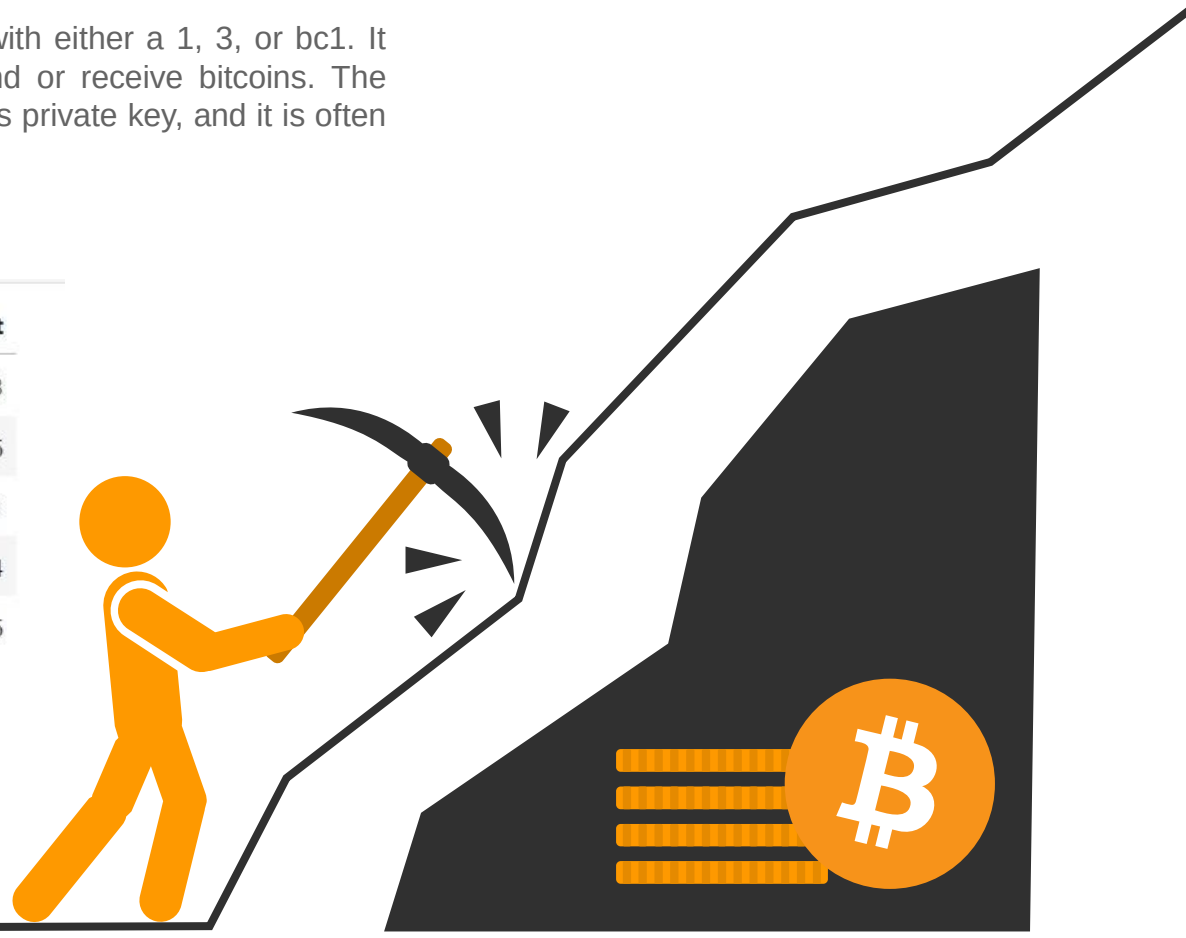
```
active_addresses_data.head()
```

[19]:

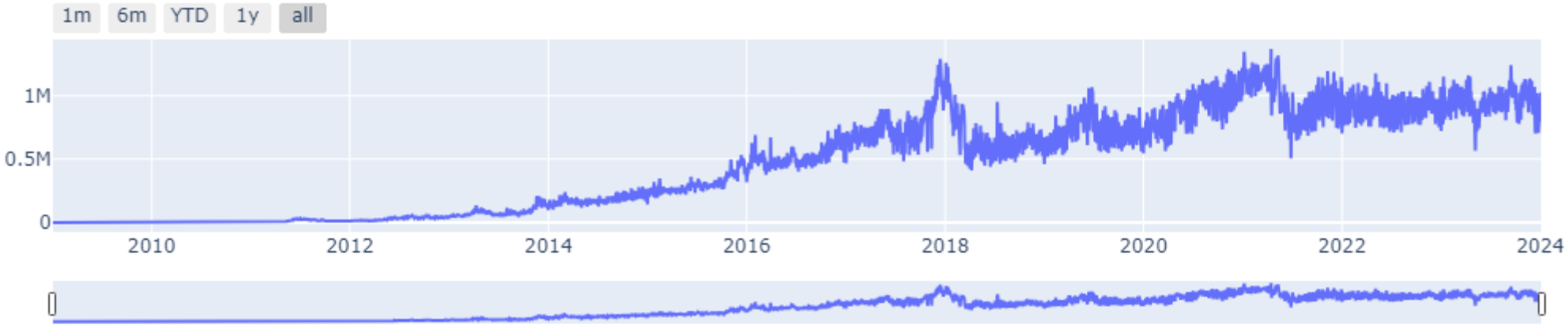
| | date | active_addresses_count |
|---|---|---|
| 0 | 2009-01-03 | 1 |
| 1 | 2009-01-09 | 14 |
| 2 | 2009-01-10 | 61 |
| 3 | 2009-01-11 | 93 |
| 4 | 2009-01-12 | 102 |

[30]:

| | date | active_addresses_count |
|---|---|---|
| 5470 | 2023-12-31 | 793703 |
| 5471 | 2024-01-01 | 845486 |
| 5472 | 2024-01-02 | 876861 |
| 5473 | 2024-01-03 | 958234 |
| 5474 | 2024-01-04 | 1025456 |



# ACTIVE ADRESSES OVER TIME




## Bitcoin Records Second-Highest Daily New Addresses in 2017

There are several reasons a blockchain can see massive onboarding of users in a single day. In the case of Bitcoin, a resurgence of attention on the largest cryptocurrency has likely occurred. The increase in user adoption shows the level of interest investors have in Bitcoin.

In 2017, when bitcoin's price cratered from a high above $19,587 (ATH) per coin on December 16 to below $6900 on February 5, 2018, the number of active addresses also fell from a high of 1.284 million on December 14, 2017, to just 528,000 on February 25, 2018.

**The number of addresses that actively sent or received Bitcoin on the blockchain peaked in April 2021**, nearly reaching 1.5 million on a single day. In the following months, this number varied dramatically from day to day, reaching around 700,000 addresses at is lowest point. Bitcoin has a limited supply, as it is programmed to have a maximum supply of 21 million coins at most. By late 2022, more than 90 percent of this maximum limit was reached.

# CONCLUSION

In simple terms, the number of transactions in Bitcoin doesn't only depend on its price or the technical analysis of its value. Other things like people's feelings about Bitcoin, news from the US market, and what's happening in the world can also affect how many transactions happen.

It's like a mix of different ingredients that together decide how busy or active the Bitcoin system is. Similarly, when we talk about how hard it is for people to mine new Bitcoins (the difficulty), it's not just about the technical stuff. Things like changes in rules, what's happening in different countries, and new technology also play a big role in making it more or less challenging for miners. So, understanding Bitcoin involves looking at the bigger picture of what's going on in the world, not just the numbers and graphs.

# REFERENCES


- https://miro.medium.com/v2/resize:fit:2000/format:webp/1*Sl3uCSP1qTxB4iP-W5KL-w.png
- https://en.wikipedia.org/wiki/Cryptocurrency_bubble
- https://www.reddit.com/r/btc/comments/42ean7/up_until_jan_17_2016_daily_btc_txn_volume_was/
- https://news.bitcoin.com/bitcoins-historic-surge-record-682281-transactions-in-a-day-mark-2023-as-year-of-increased-activity/
- https://chain.link/education-hub/ordinals-bitcoin-nfts#:~:text=What%20Are%20Ordinal%20Inscriptions%3F,a%20separate%20layer%20from%20Bitcoin.
- https://medium.datadriveninvestor.com/unlocking-insights-on-bitcoin-transfer-volume-with-bigquery-f156e163eb21
- https://www.coindesk.com/tech/2022/12/06/bitcoin-mining-difficulty-drops-most-since-july-2021-as-crypto-winter-cuts-profitability/
- https://coinfomania.com/bitcoin-records-second-highest-daily-new-addresses-since-2017/#:~:text=Notably%2C%20Bitcoin's%20latest%20metric%20trails,high%20(ATH)%20of%20800%2C180
- https://www.statista.com/statistics/1343505/bitcoin-active-addresses/#:~:text=The%20number%20of%20addresses%20that,addresses%20at%20is%20lowest%20point
- https://markets.businessinsider.com/currencies/news/active-bitcoin-addresses-dropped-from-april-peak-glassnode-data-2021-6-1030500988
- https://cointelegraph.com/news/bitcoin-s-active-addresses-fall-below-ethereum-s-after-60-drop-in-six-weeks
- https://blog.devgenius.io/query-bitcoin-blockchain-for-active-addresses-in-bigquery-be440f362dd9
- https://gist.github.com/Someguy123/1e4a1d1ead52c523a3ca4b1578ef1dad

# THANK YOU


**SAMEER AFZAL**

1000053143

**ASAD ASLAM**

1000053142