# Portfolio Construction with Cryptocurrencies

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# OBJECTIVES

• To **understand** the working and construction of cryptocurrency and explore the market boom in the last 5 years globally and domestically.

•To **establish** the key drivers of Bitcoin prices using ETF proxies of market segments

•To **understand** the prowess of Portfolio Diversification and related concepts to implement the same.

•To **construct** an investable optimized portfolio that includes cryptocurrency

•To **build** an efficient frontier from the thus derived portfolio and assess the results

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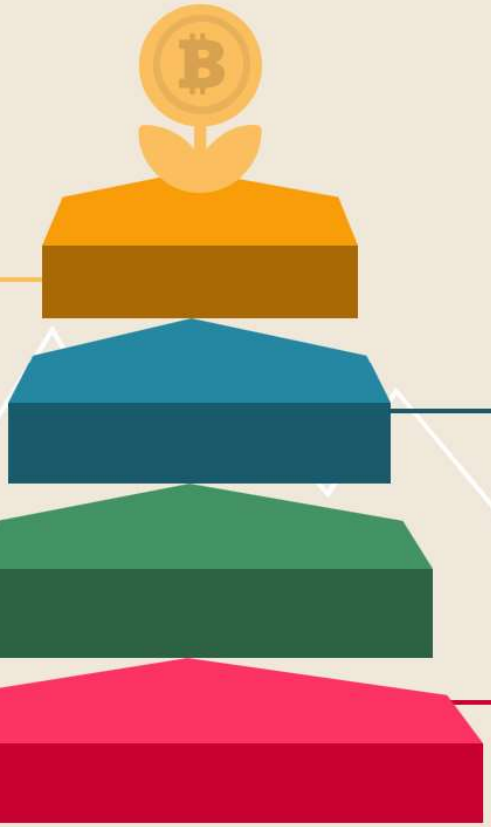


## The World of Crypto

The Working, Blockchain, Market - Global and Indian overview

## What ticks Bitcoin?

Segment-wise Factor Analysis of Key Drivers of Prices

## Data Profile & Portfolio Theory

Asset Selection, CAPM, CAL and Construction Process

## Portfolio Construction

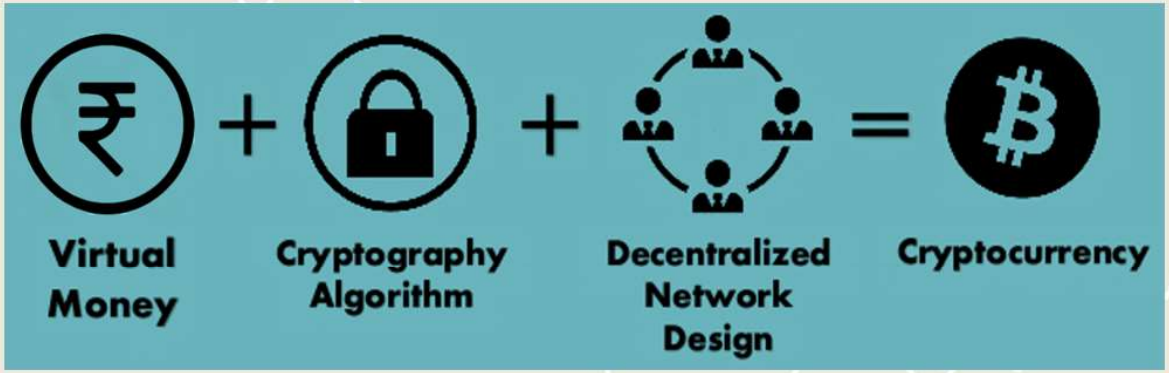
Step-by-Step Breakdown, Shrinkage Estimator, Efficient Frontier

# 01

# Cryptocurrency

The Working, Blockchain, Market
- Global and Indian overview

# What is Cryptocurrency?




Internet-based medium of exchange

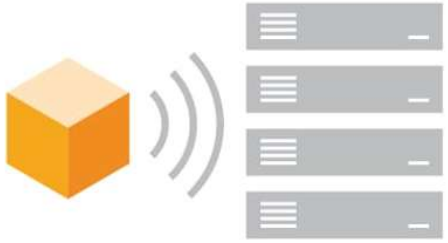
Leverages blockchain technology → decentralization, transparency, and immutability

Not controlled by any central authority

Sent directly between two parties via the use of private and public keys

# BLOCKCHAIN

Someone requests transaction.



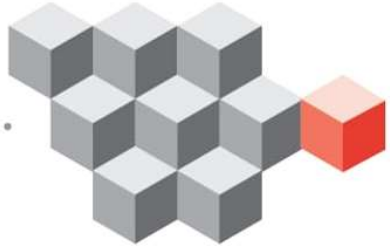
The requested transaction is broadcast to a **P2P network consisting of computers, known as nodes.**

**Validation**

The network of nodes **validates the transaction and the user's status using known algorithms.**

**A verified transaction** can involve **cryptocurrency**, contracts, records, or other information

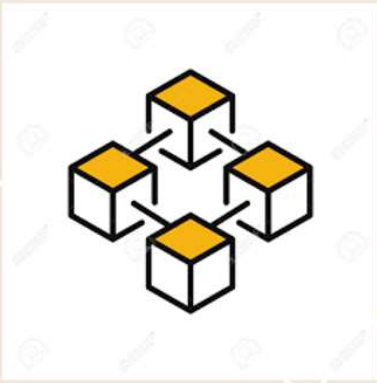
**The transaction** is completed

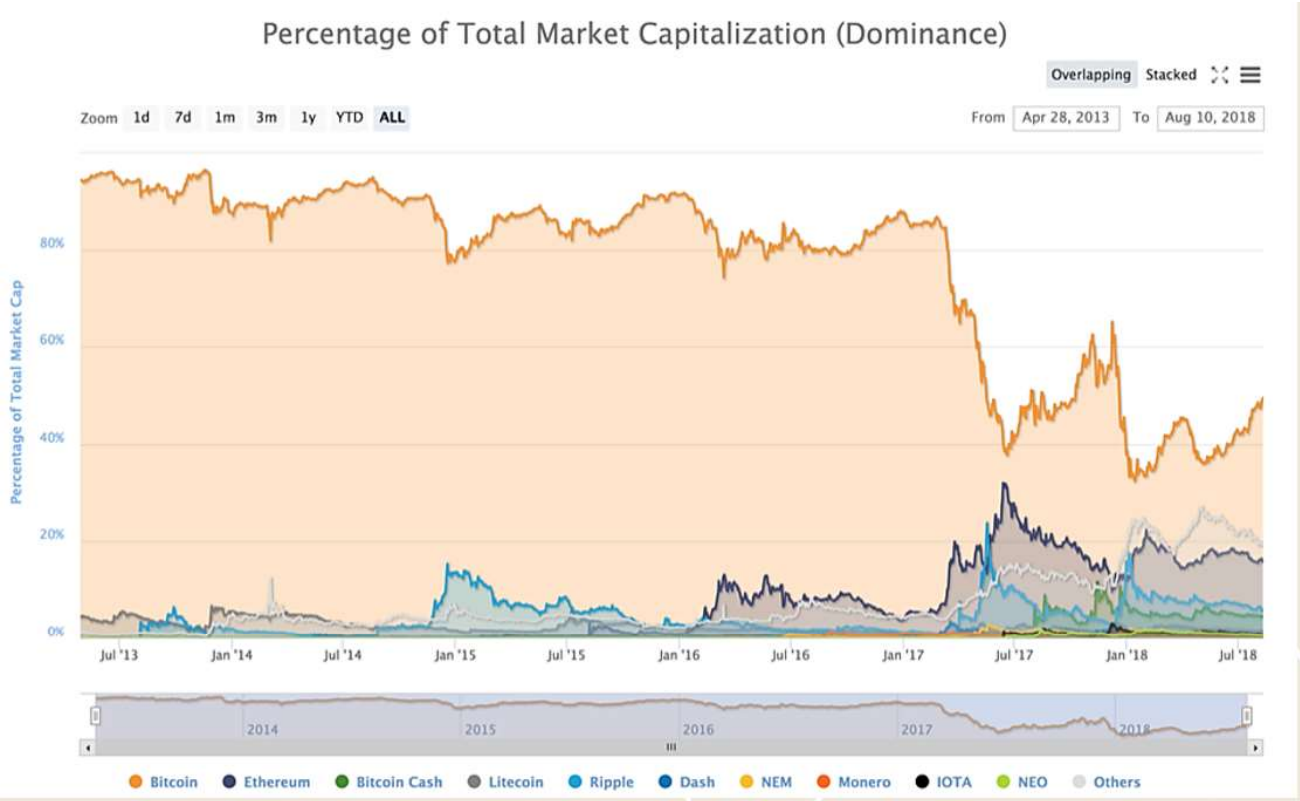


**The new block is then added to the existing blockchain**, in a way that is permanent and unalterable

Once verified, the transaction is combined with other transactions **to create a new block of data for the ledger**.

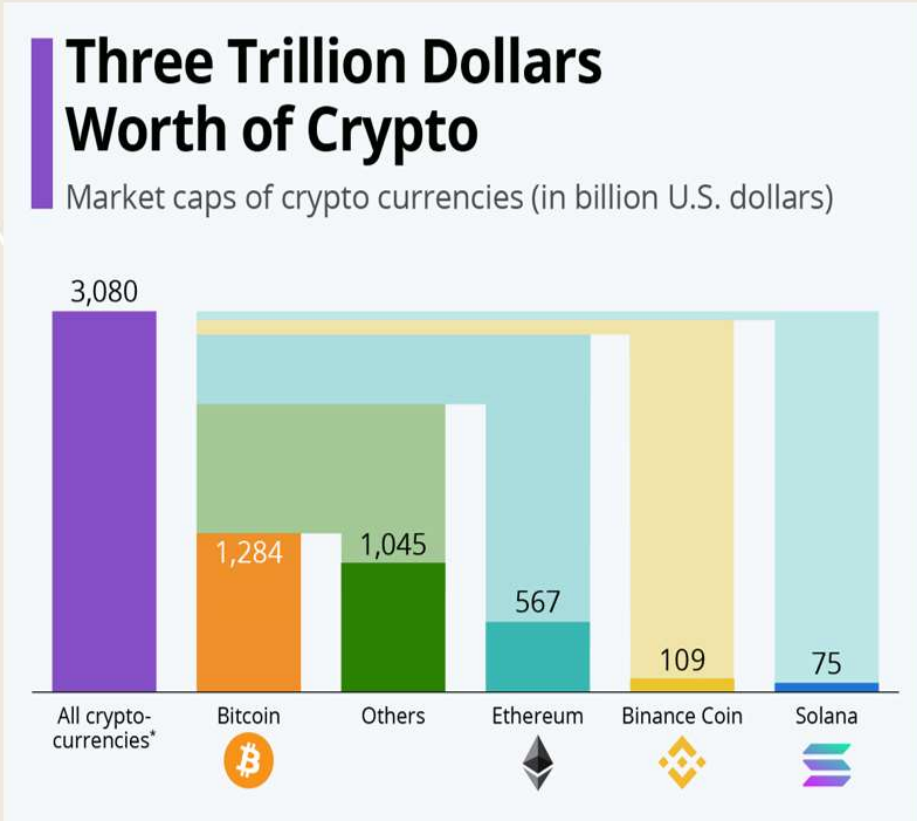
Shared database , which stores data in blocks that are then linked together via cryptography.




Percentage of Total Market Capitalization (Dominance)
Overlapping
Stacked
Zoom 1d 7d 1m 3m 1y YTD ALL
From Apr 28, 2013
To Aug 10, 2018
Percentage of Total Market Cap
80%
60%
40%
20%
0%
Jul '13
Jan '14
Jul '14
Jan '15
Jul '15
Jan '16
Jul '16
Jan '17
Jul '17
Jan '18
Jul '18
2014
2015
2016
2017
2018
Bitcoin
Ethereum
Bitcoin Cash
Litecoin
Ripple
Dash
NEM
Monero
IOTA
NEO
Others


Bitcoin
$64B
Cryptocurrencies
$111B
Amazon
$802B
US Dollar
$3.36T
Gold
$7.8T
US Stocks
$21.15T
US Treasury Bonds
$21.91T

# The Market


Three Trillion Dollars Worth of Crypto
Market caps of crypto currencies (in billion U.S. dollars)
3,080
1,284
1,045
567
109
75
All crypto-currencies*
Bitcoin
Others
Ethereum
Binance Coin
Solana

# 3 Cryptocurrency Statistics You Should Know

FinancesOnline
REVIEWS FOR BUSINESS

## 1 Cryptocurrency Market Snapshot

Sources: E-Crypto News, Knoema, Crystal

**900%**
increase in global cryptocurrency market value from March 2020 to February 2021

**78%**
the increase in cryptocurrency total volume of transactions from 2019 to 2020

**60%**
share of the financial sector in the total blockchain market value

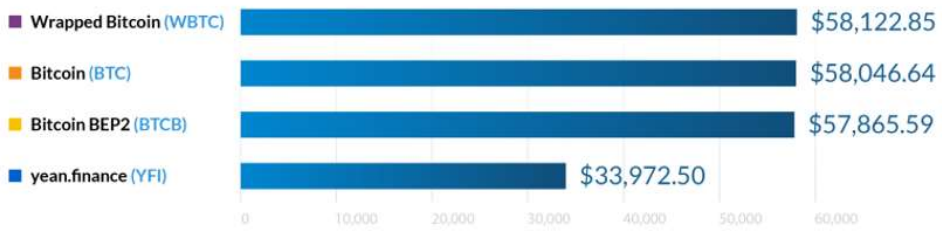
**$324.7 BILLION**
total market capitalization of all cryptocurrencies

**7,812**
number of cryptocurrencies worldwide as of January 2021

## 2 The Most Expensive Cryptocurrencies

(as of March 29, 2021)

Source: CoinMarketCap



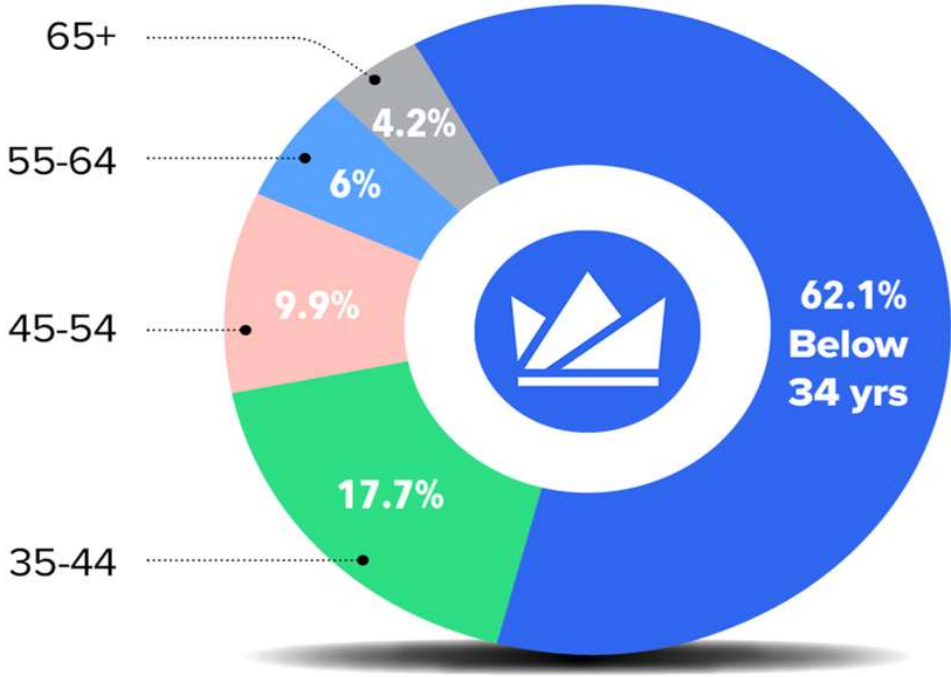

## 3 Where are cryptocurrency owners and users from?

Source: Statista


# Demographics

**WazirX saw a 337% rise in users over 45 in the past 3 months**

Age-wise demographics as of April 29, 2021



# 02

# Key Drivers

Segment-wise Factor Analysis of factors affecting of Prices of Bitcoin

# Factors That Affect the Price of 1 Bitcoin

Supply

Demand

Cost of production

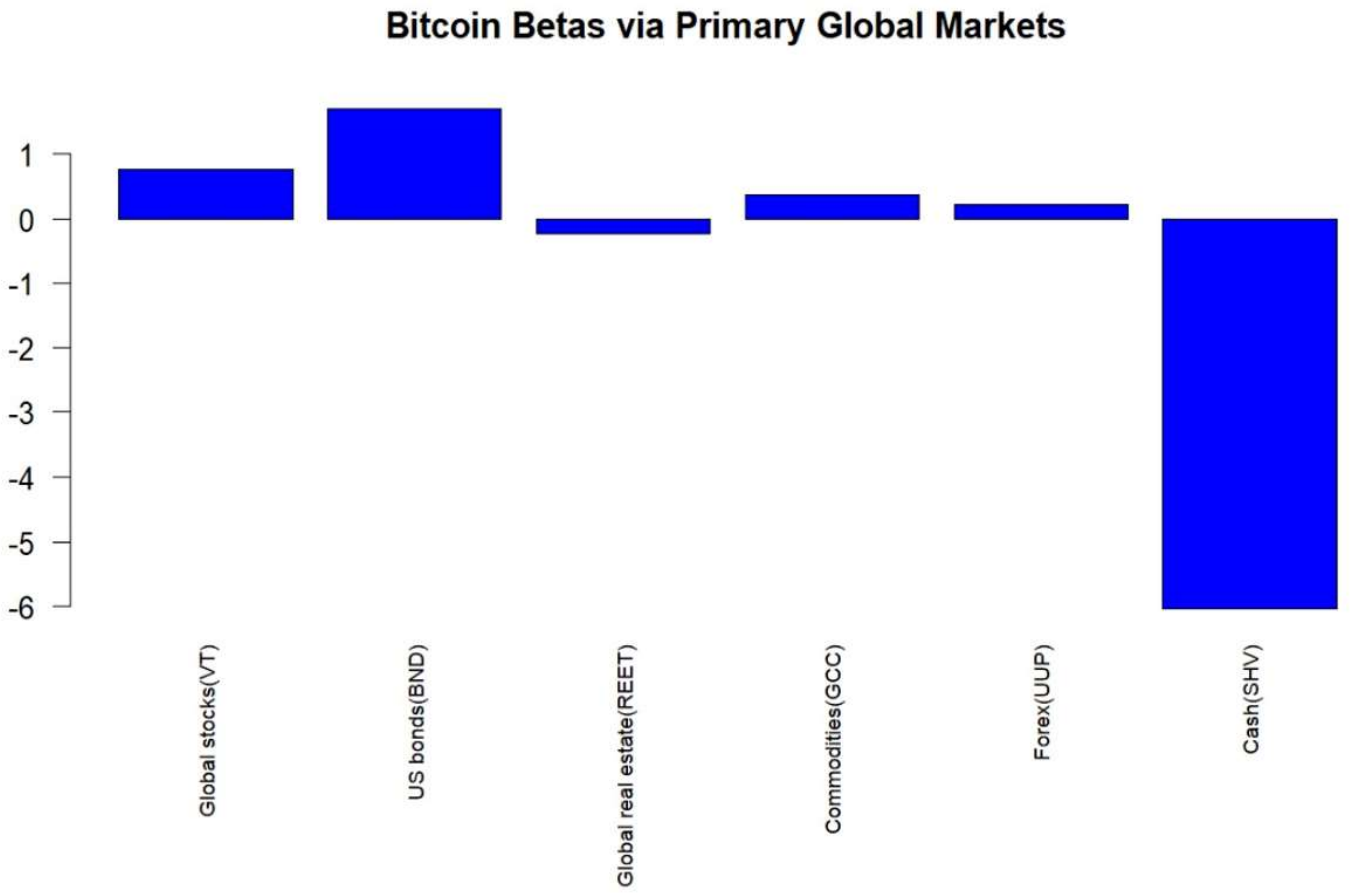
Number of competitors

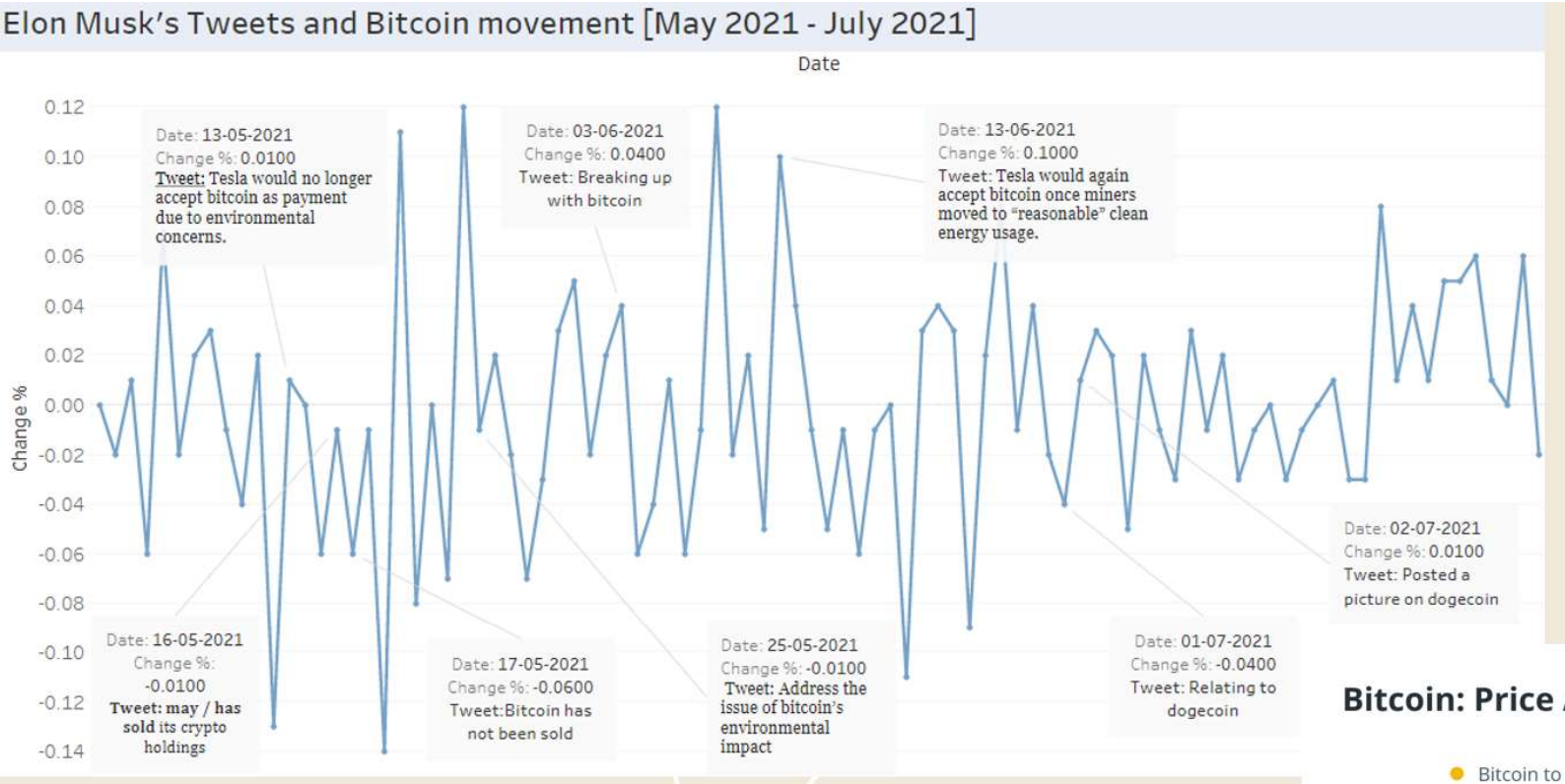
Regulation


Media coverage

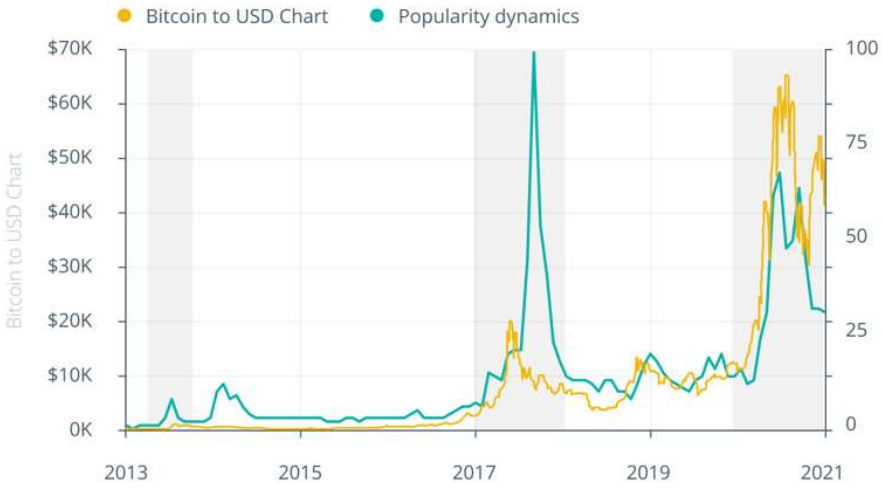
# WHAT MAKES BITCOIN TICK?

```
Call:
lm(formula = BTC ~ ., data = data)

Residuals:
      Min        1Q    Median        3Q       Max
-0.218510 -0.019349 -0.001612  0.018123  0.251781

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept)  0.003522   0.001098   3.206  0.00137 **
VT           0.750214   0.161821   4.636 3.81e-06 ***
BND          1.681655   0.381112   4.412 1.08e-05 ***
REET        -0.231692   0.144066  -1.608  0.10796
GCC          0.368989   0.157427   2.344  0.01919 *
UUP          0.211297   0.251834   0.839  0.40156
SHV         -6.044579   7.567116  -0.799  0.42451
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.04535 on 1794 degrees of freedom
Multiple R-squared:  0.04113,   Adjusted R-squared:  0.03792
F-statistic: 12.83 on 6 and 1794 DF,  p-value: 3.129e-14
```






# Google Search Trends and Musk's Tweets



# 03

# Data Profile

Asset Selection, Correlation,
Relationships with Bitcoin

# ASSETS SELECTED FOR STUDY

## Cryptocurrencies

- Bitcoin
- Tether
- Doge Coin

## Commodities

- Gold
- Crude Oil
- Copper
- Cotton
- Coffee

## Miscellaneous

- Adani Power
- Pfizer
- Reliance
- Tata Steel

## Banking

- JP Morgan
- ICICI
- SBI

## Tech & E-Commerce

- Amazon
- Google
- Infosys

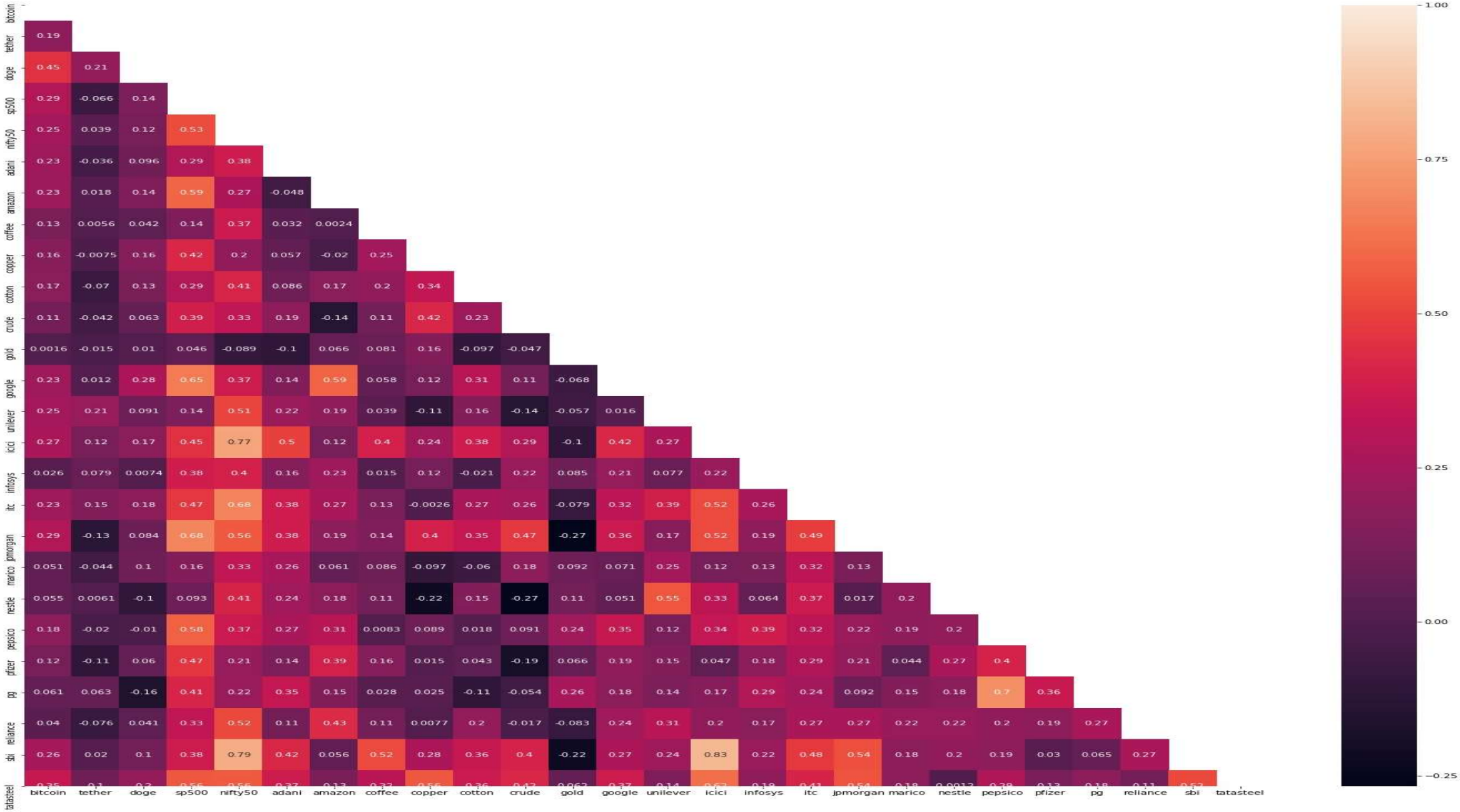
## Indices

- Standard & Poor's 500 (S&P 500)
- Nifty 50

## Consumer Products

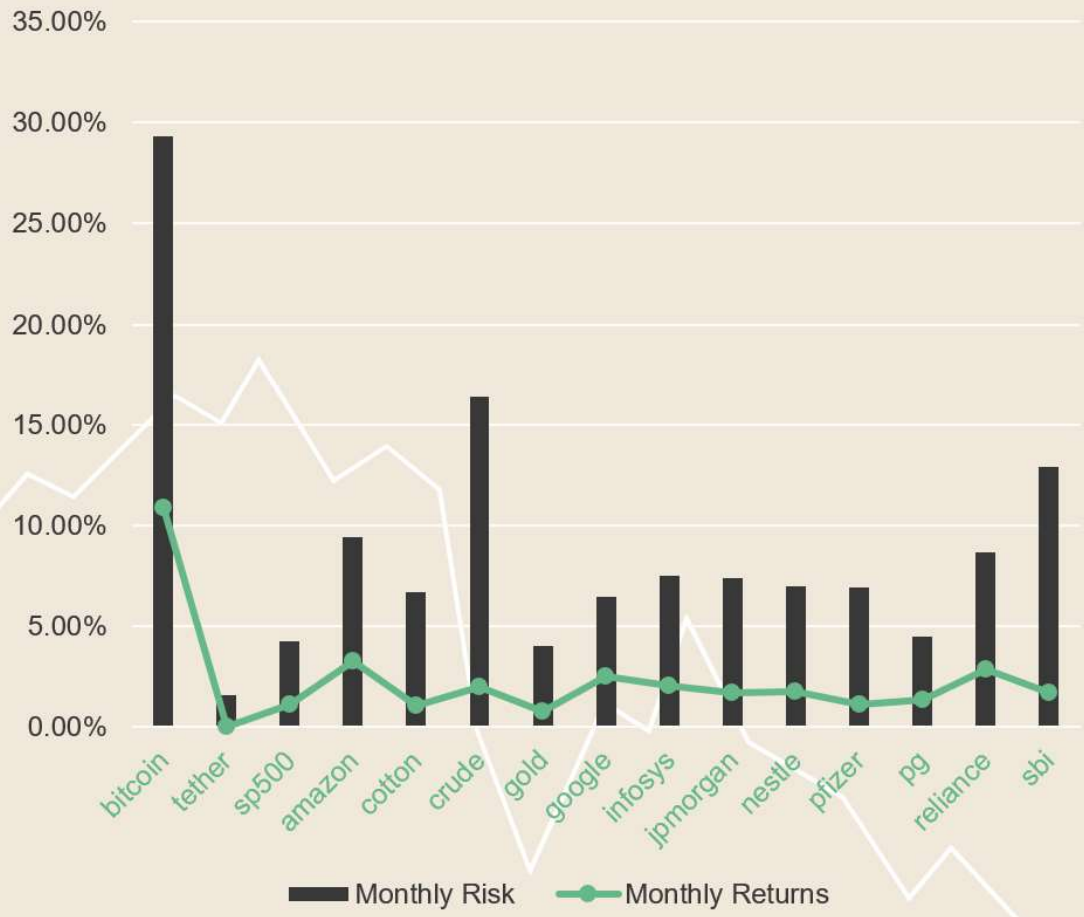
- Proctor & Gamble (P&G)
- ITC
- Hindustan Unilever
- Nestle India
- Pepsi Co.
- Marico

TIMELINE: Nov, 2017 -> Feb, 2022
Source: Yahoo Finance (Monthly Closing Prices)

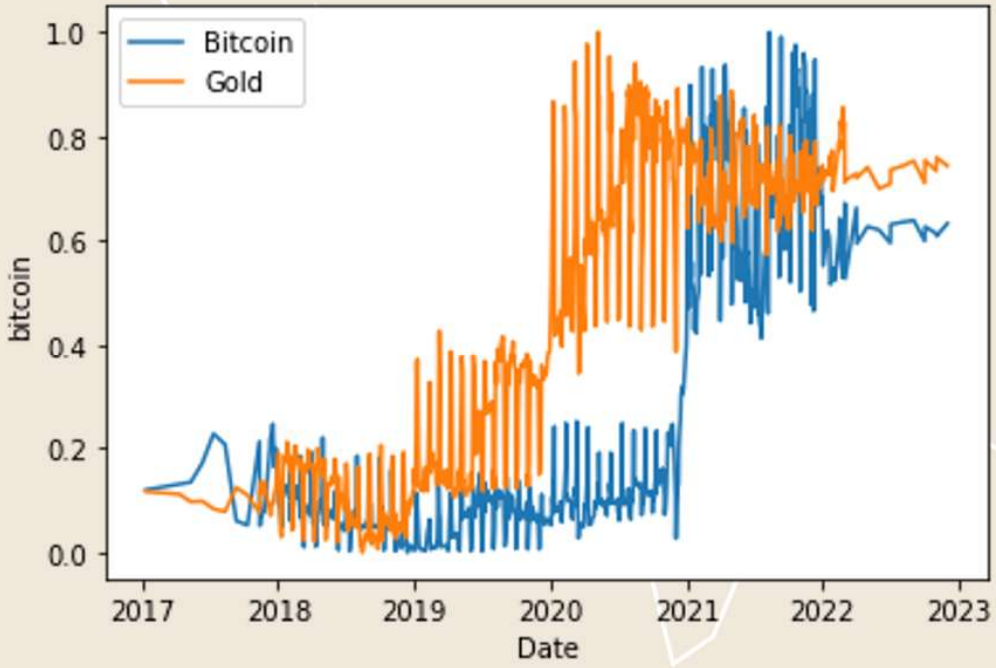

bitcoin
tether
doge
sp500
nifty50
adani
amazon
coffee
copper
cotton
crude
gold
google
unilever
icici
infosys
itc
jpmorgan
marico
nestle
pepsico
pfizer
pg
reliance
sbi
tatasteel
1.00
0.75
0.50
0.25
0.00
−0.25

# Shortlisted Assets for Portfolio

| Assets | Monthly Returns | Monthly Risk |
|---|---|---|
| bitcoin | 10.84% | 29.29% |
| tether | 0.01% | 1.61% |
| sp500 | 1.14% | 4.24% |
| amazon | 3.25% | 9.40% |
| cotton | 1.04% | 6.68% |
| crude | 1.97% | 16.35% |
| gold | 0.75% | 4.03% |
| google | 2.50% | 6.46% |
| infosys | 2.05% | 7.50% |
| jpmorgan | 1.68% | 7.39% |
| Nestle | 1.77% | 6.98% |
| Pfizer | 1.14% | 6.90% |
| Pg | 1.34% | 4.51% |
| Reliance | 2.86% | 8.69% |
| sbi | 1.68% | 12.90% |

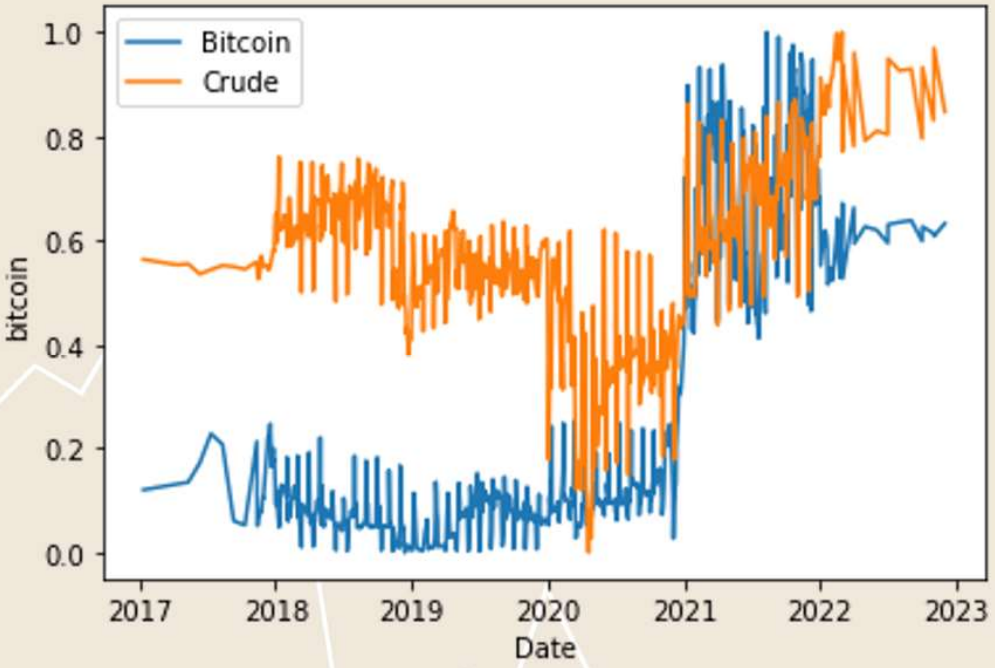


# Bitcoin & Gold



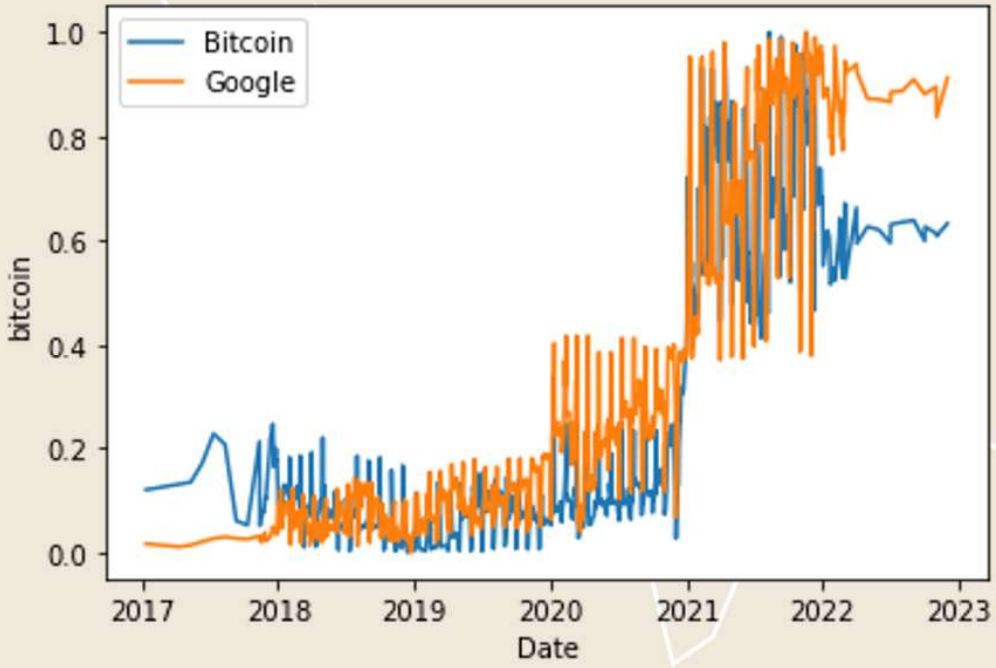

```
intercept of Gold-Bitcoin: [-50014.70740512]
slope of Gold-Bitcoin: [[44.337523]]
Bitcoin = [[44.337523]] Gold + [-50014.70740512]
```

# Bitcoin & Crude



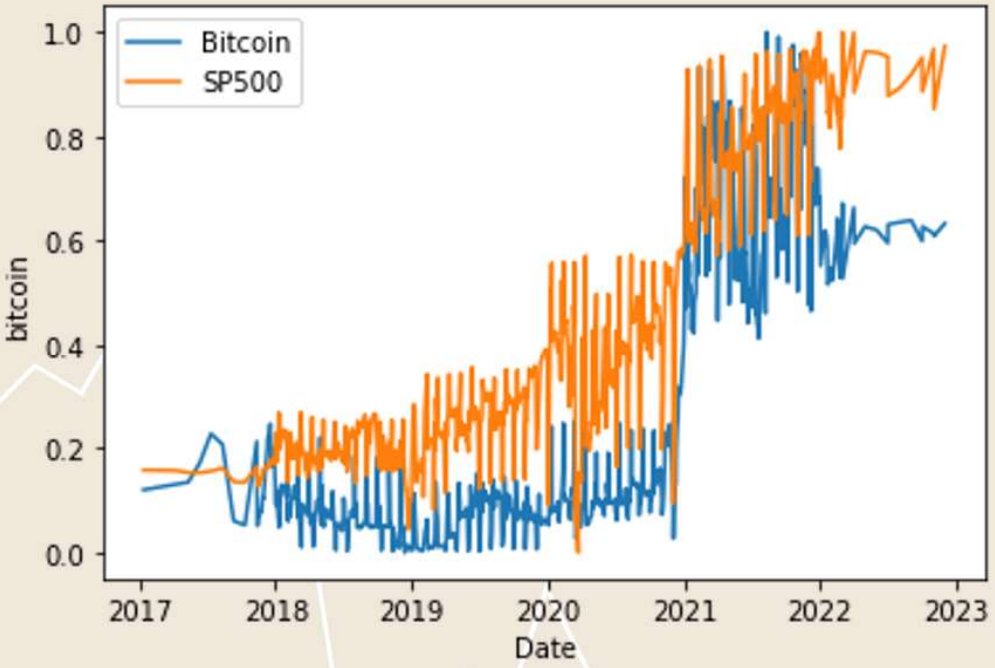

```
intercept of Crude-Bitcoin: [-17247.76183633]
slope of Crude-Bitcoin: [[623.06483293]]
Bitcoin = [[623.06483293]] Crude + [-17247.76183633]
```

# Bitcoin & Google




```
intercept of Google-Bitcoin: [-21979.4806817]
slope of Google-Bitcoin: [[25.65581401]]
Bitcoin = [[25.65581401]] Google + [-21979.4806817]
```

# Bitcoin & S&P500




```
intercept of SP500-Bitcoin: [-59568.41334437]
slope of SP500-Bitcoin: [[23.72641]]
Bitcoin = [[23.72641]] SP500 + [-59568.41334437]
```

# 04

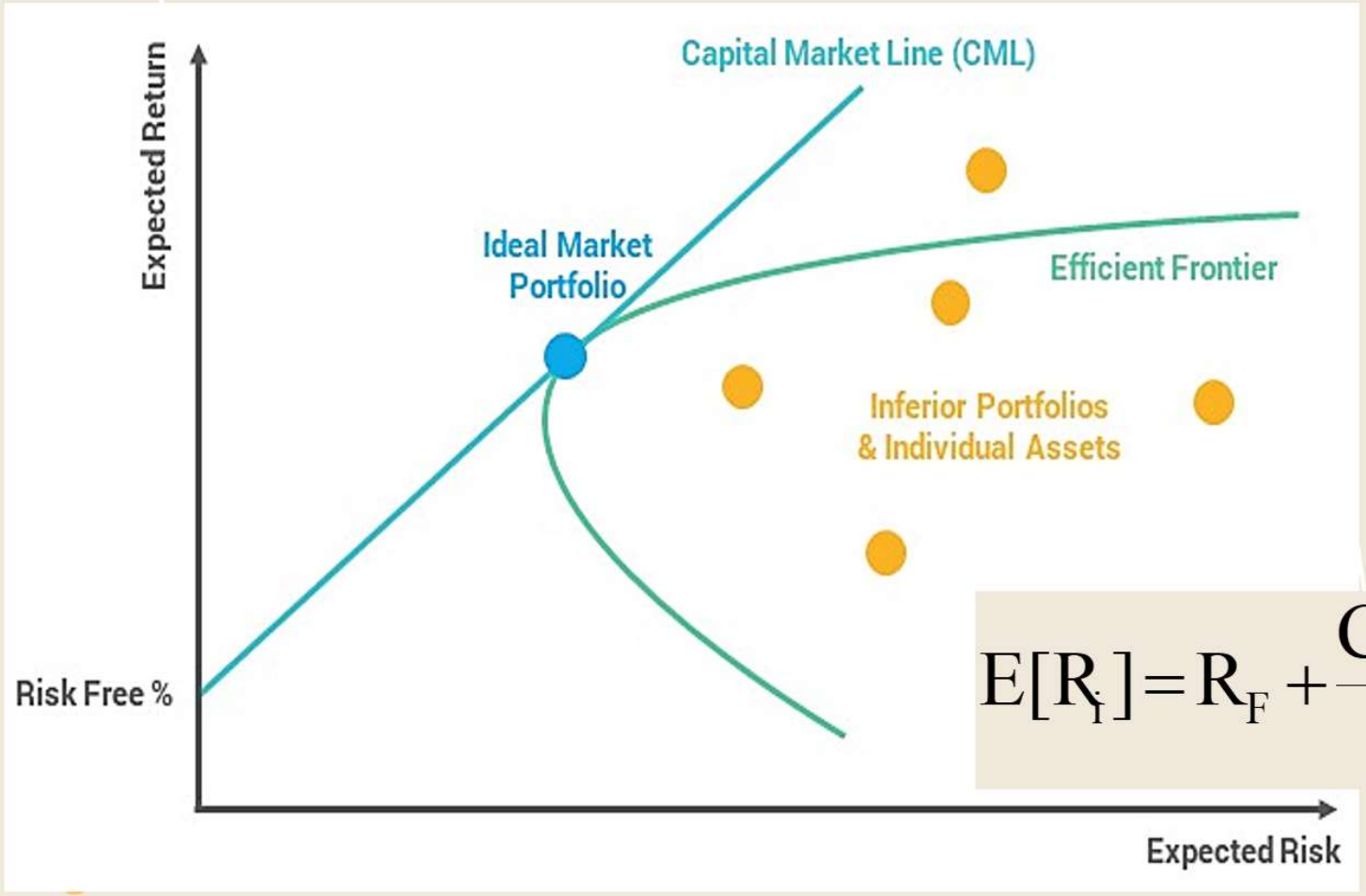
# Portfolio Theory

CAPM, Efficient Frontier, Expected Returns, Portfolio Risk, Covariance

# Portfolio Diversification

- A diversified portfolio is a **collection of different investments** that combine to reduce an investor's overall risk profile.
- Diversification includes owning stocks from several different industries, countries, and risk profiles, as well as other investments such as bonds, commodities, and real estate.
- These various assets work together to <u>reduce</u> an investor's <u>risk of a permanent loss of capital</u> and their portfolio's <u>overall volatility</u>.

# Capital Asset Pricing Model




CAPM is an framework for determining the equilibrium expected return for risky assets.

Relationship between expected return and systematic risk of individual assets or securities or portfolios.

$$E[R_i] = R_F + \frac{Cov(R_i, R_M)}{Var(R_M)}[E[R_M] - R_F]$$

# EFFICIENT FRONTIER

02

Successful optimization of the return versus risk paradigm should place a portfolio along the efficient frontier line.

01

Comprises investment portfolios that offer the highest expected return for a specific level of risk.


03

Optimal portfolios that comprise the efficient frontier usually exhibit a higher degree of diversification.

# THREE IMPORTANT POINTS

$$Er(P) = w_A * Er(A) + w_B * Er(B)$$

EXPECTED RETURN OF PORTFOLIOS

VARIANCE OR STANDARD DEVIATION AS A MEASURE OF THE RETURN VARIABILITY (RISK)

COVARIANCE OF THE ASSETS IN THE PORTFOLIO

# 05

# Portfolio Construction

Step-by-Step Breakdown, Shrinkage Estimator, Efficient Frontier

# PROCESS

MONTHLY PRICES (72 x 15)

↓

RETURNS (71 x 15) = $(P_n/P_{n-1}) - 1$

AVG. MONTHLY RETURNS (1 x 15) = AVERAGE(Returns)

↓

EXCESS RETURNS (71 x 15) Excess Return(i) = Return(i) – Avg Return = X

↓

ANNUALIZED SHRINKAGE-ADJUSTED VARIANCE COVARIANCE MATRIX (15 x 15)

↓

Equally Weighted Portfolio:
EXPECTED RETURNS = SUM ( Weights * Annual Returns)
EXPECTED RISK = SQRT($Weights^T$ * Variance Covariance Matrix * Weights)
SHARPE RATIO = (Expected Return – RFR) / Expected Risk

↓

Optimally Weighted Portfolio:
OPTIMIZED USING EXCEL SOLVER – MAX(SHARPE RATIO)

# SHRINKAGE ESTIMATOR

- A matrix obtained from the sample covariance matrix through a transformation called shrinkage.
- This tends to pull the most extreme coefficients towards more central values, thereby systematically reducing estimation error where it matters most.

*"Honey, I Shrunk the Covariance Matrix"*
*- **Olivier Ledoit and Michael Wolf** (2004)*

**{[Transpose(X)] * (X)} * 12/70 = A**

**(15 x 15) Variance Matrix = B**

↓

**Shrinkage Estimator = λ (= 0.2)**

↓

**Shrinkage Adj. Variance Covariance Matrix**
**= (A * λ) + (B * (1 - λ))**

# PORTFOLIO DISTRIBUTION

| Portfolio 1 -Weights | |
|---|---|
| Bitcoin | 5.2684% |
| Tether | 0.0000% |
| Sp500 | 0.0000% |
| Amazon | 10.0262% |
| Cotton | 1.7597% |
| Crude | 2.3634% |
| Gold | 9.2468% |
| Google | 17.8300% |
| Infosys | 9.8680% |
| JPMorgan | 4.8586% |
| Nestle | 10.9666% |
| Pfizer | 0.6513% |
| Pg | 15.3431% |
| Reliance | 11.8178% |
| Sbi | 0.0000% |

| | |
|---|---|
| Expected Returns | 30.08% |
| Expected Variance | 1.16% |
| Expected Std Dev | 10.76% |
| Sharpe Ratio | 2.33 |

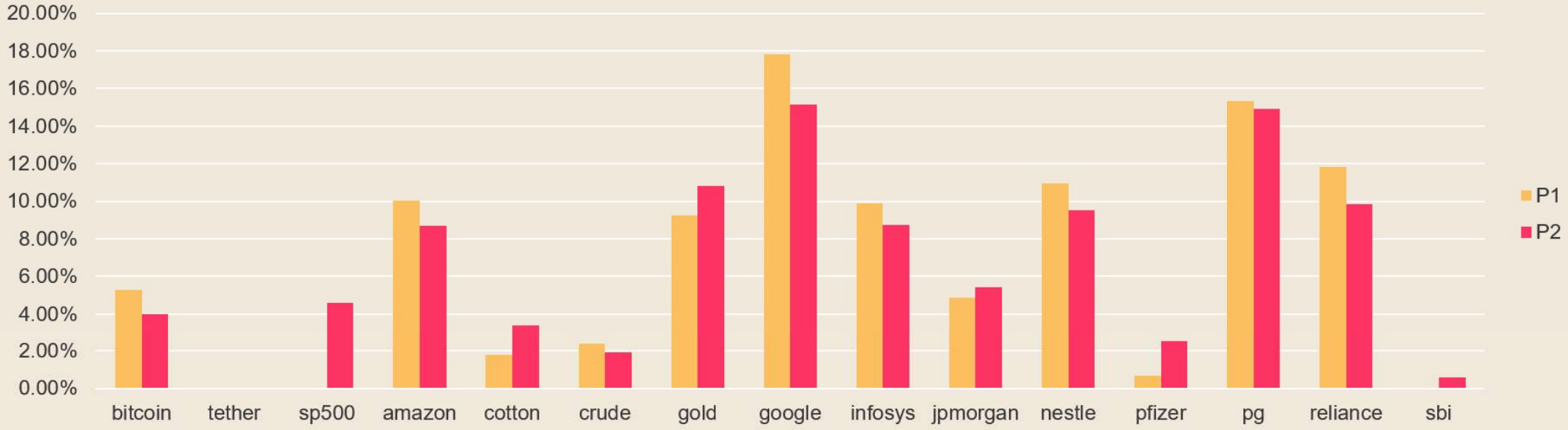
| | |
|---|---|
| RFR | 5% |

| Portfolio (Mirror Portfolio) -Weights | |
|---|---|
| Bitcoin | 3.9756% |
| Tether | 0.0000% |
| Sp500 | 4.5793% |
| Amazon | 8.6891% |
| Cotton | 3.3775% |
| Crude | 1.9167% |
| Gold | 10.8150% |
| Google | 15.1289% |
| Infosys | 8.7401% |
| JPMorgan | 5.3952% |
| Nestle | 9.5260% |
| Pfizer | 2.5284% |
| Pg | 14.9131% |
| Reliance | 9.8479% |
| Sbi | 0.5673% |

| | |
|---|---|
| Expected Returns | 27.08% |
| Expected Variance | 0.90% |
| Expected Std Dev | 9.47% |
| Sharpe Ratio | 2.54 |

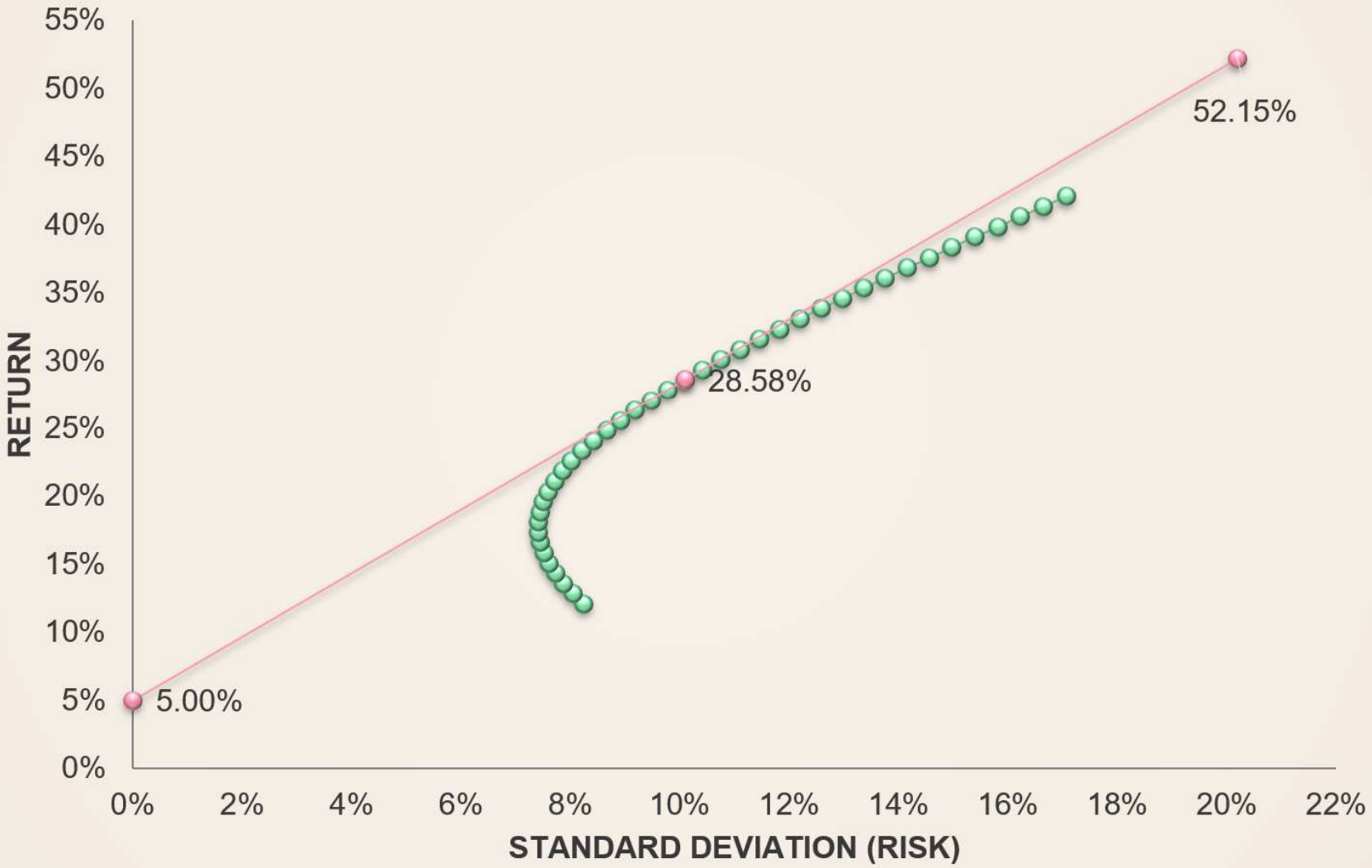
| | |
|---|---|
| RFR | 3% |

# Weight Distribution of P1 and P2




| | |
|---|---|
| Mean of Portfolio 1 | 30.08% |
| Mean of Portfolio 2 | 27.08% |
| | |
| Variance of P1 | 1.16% |
| Variance of P2 | 0.90% |
| Covariance P1 and P2 | 0.0101 |
| Correlation of P1 and P2 | 0.9904 |

# Efficient Frontier & CAL




| OPTIMAL PORTFOLIO | |
|---|---|
| Std. Dev (Risk) | 10.09% |
| Expected Return | 28.58% |
| Sharpe Ratio | 2.34 |

# LIMITATIONS

- The dynamic environment of the market is not captured due to the static nature of the data and the derivations.
- Since, cryptocurrency is an immature market place and has not acquired a stability as to its corresponding other financial markets like stock market, time is the only solution to bring more stable grounds here.

# FUTURE SCOPE

- Extending the project to a financial machine learning dimension by using financial models available on python.
- Parallelly studying other research papers, and increasing the adaptability of the project's problem statement with other statistical methods.
- Producing a research paper to contribute to the financial statistical domain.
- Sharing the knowledge to various fintech start ups to increase awareness of the intersection of finance, data and statistics.

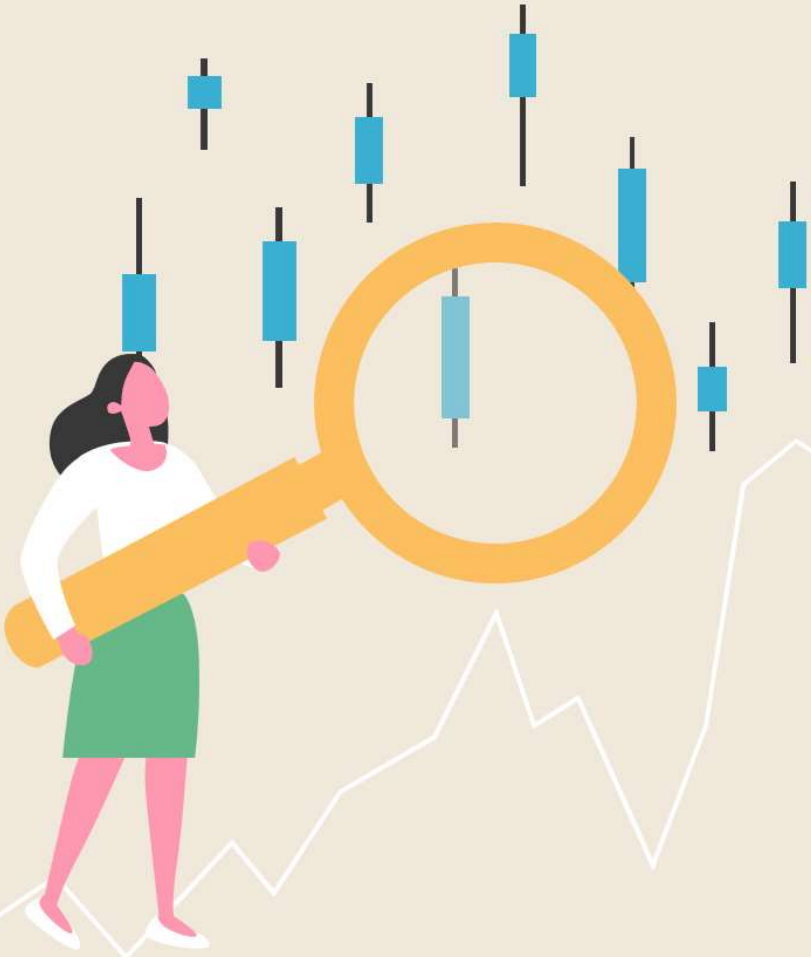
# ACKNOWLEDGEMENTS


- We would like to thank our Mentor, Jainendra Shandiliya Sir, for helping us structure, format and understand the concepts employed in this project.

- We would like to thank NMIMS Deemed to be University, Navi Mumbai, for providing us with this opportunity and impart us the necessary tools and resources in order to fulfil the project.

- Lastly, we would like to express our gratitude to various sources, academicians and students from other universities who contributed and helped us build this project.

# REFERENCES

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- What's Driving Bitcoin? Factor Analysis Profiles, Part I | Seeking Alpha
- Portfolio Optimization Seven Security Example with Excel Solver - YouTube

# THANK YOU!