



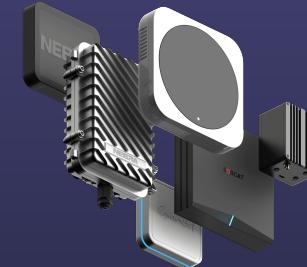
Helium Computational Investing Project

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Project Outline:

- (1) Why did we choose Helium?
- (2) Brief background and introduction to Helium
- (3) Explaining objective of research and how we obtained the data
- (4) Going through the code step-by-step
- (5) Results and Conclusions

Why did we choose Helium?

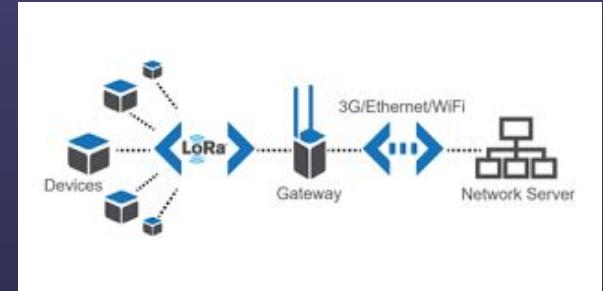


- Originally learned about Helium in May of 2021 through social media and the idea of a blockchain application in the real-world with practical context peaked interest
- Saw buying a Helium hotspot as an opportunity to make money quickly and earn passive income
- Bought a couple hotspots from an affiliated third party seller and simply plugged them into the wall in different locations
- Our group found the concept interesting and thought to go more into depth on the structure of the crypto/network and see if data can prove Helium hotspots as a valid and profitable investment

Research Objectives

- How is the Helium network trending?
- What data can we obtain that offers insightful analysis?
- How can a hotspot investment be most profitable?

What is the Internet of Things?



- The Internet of Things describes the network of physical objects embedded with sensors, software, and other technology for the purpose of connecting and exchanging data with other devices and the internet
- Helium attempts to connect Internet of Things devices to each other and the internet with the use of a decentralized network connected by hotspot devices available for purchase around \$400+
- The Helium network is differentiated from simply using WiFi routers because of its longer range capability using LoRaWAN (Low Power Wide Area Network) and the decreased battery costs to low power devices when transmitting data
- A single Helium hotspot can deliver coverage for 2-3 miles in urban settings and up to 10 miles in more rural areas

Real-life Applications of Helium LoRaWAN



Lime

Users

Micromobility Location Tracking

Simple and cost-effective
micromobility solutions for bikes
and scooters.



salesforce

Users

Frictionless Employee Onboarding

An innovative IoT program to allow
employees easy access to
onboarding resources.



LONESTAR
TRACKING

Users

Indoor/Outdoor Location Tracking

Ensuring your assets are protected,
wherever you go.



InvisiLeash

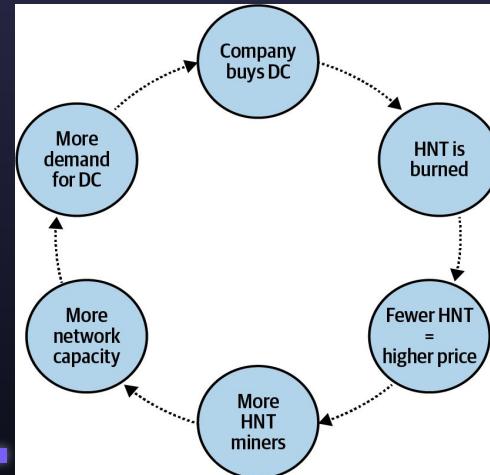
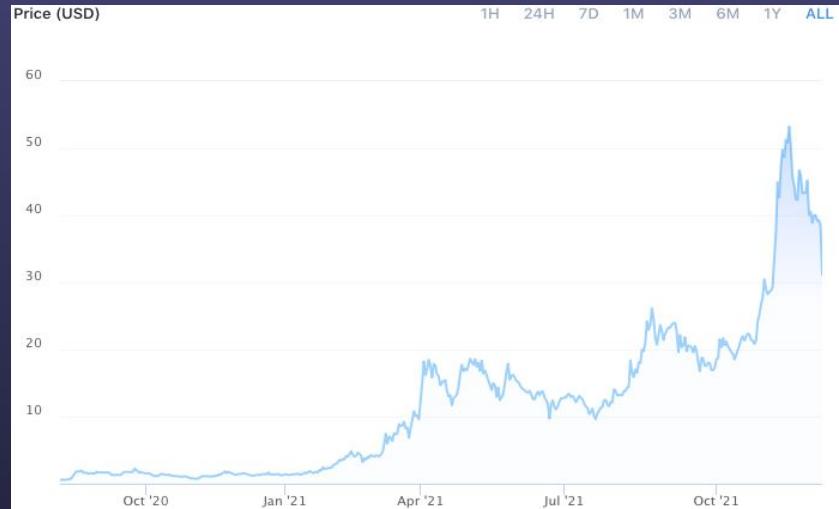
Users

Smart Pet Tracking

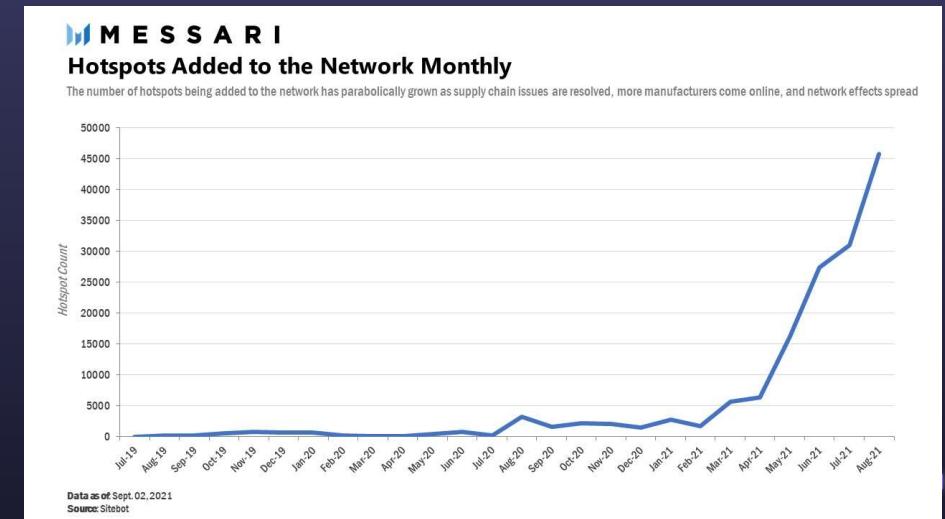
Smart, affordable pet products that
ensure pets are never lost.

Helium Tokenomics

- Buyers in the market are companies who utilize low-power devices in the Helium Network
- Buyers want a fixed price for data transfer so costs will not increase if the Helium token appreciates in value
- The solution was to create two separate tokens: Helium Network Tokens (HNT) and Data Credits (DC)
- Data Credits are a stable unit of purchasing power to use the network set at \$0.0001 per data fragment, or around 24 cents per megabyte
- Data Credits can be acquired by burning HNT and removing it from circulation for the equal value of Data Credits



Current Helium Global Network



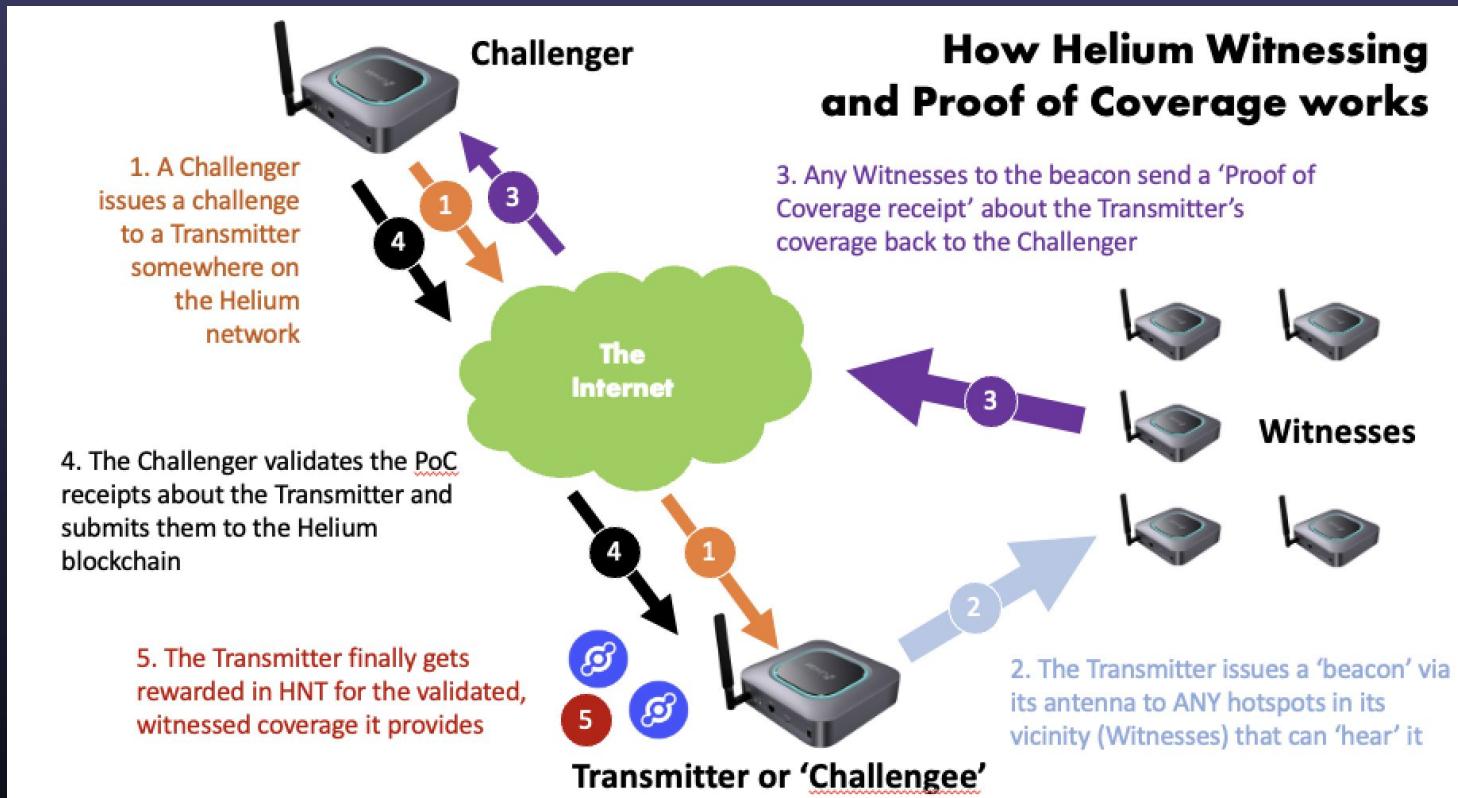
- The current number of Helium hotspots stands around 385,000, with almost 100,000 added in the last month alone



Why use the Blockchain?

- The creators of Helium had originally found difficulty in finding a way to incentivize people to build the network with individual hotspots and create a peer-to-peer grid
- This was until the crypto boom in 2016 which proved that the token itself along with the blockchain are incentive enough to get people into the network
- Simply paying people in USD would create costs that need substantial investment, but kickstarting a blockchain with a native coin allows for rewards to be earned for Hotspot owners who expand the network
- Miners hope that the Helium token rises in value, like an investment, as the network grows and develops
- Besides an incentive to get people to buy hotspots, the blockchain works to add increased security through encryption and a comprehensive ledger for transactions

Helium Proof-of-Coverage



Reward Structure Overview

Reward Type	Percentage	HNT Earned by Reward Type
PoC Challenger	0.90%	15.6250
PoC Challengees	5.02%	87.1527
Witnesses	20.08%	348.6111
Consensus Group	6%	104.1666
Security Tokens	33%	572.9166
Network Data Transfer	<i>Up to 35%</i>	<i>Up to 607.6389</i>
Total	100%	1736.1111

Reward Type	Description
PoC Challenger	Rewarded to any Hotspot that creates a valid PoC challenge and submits the corresponding receipt to the blockchain.
PoC Challengees	Awarded to any Hotspot that transmits a POC packet after being targeted by the challenger.
Witnesses	Distributed to all Hotspots that witness a beacon packet as part of a PoC Challenge.
Consensus Group	Divided equally among the Validators that are part of the outgoing Consensus Group, responsible for mining blocks.
Security	Awarded to Helium, Inc and other Network investors who hold Security Tokens.
Network Data Transfer	Distributed each epoch to Hotspots that route LongFi sensor data for sensors on the Network during that epoch.

Gathering Data

- Accessed data through Helium blockchain API
- Scrapped in JSON format by making API requests
- Need User-Agent HTTP header field to gain access
- All JSON data converted to pandas dataframes

```
def scrape_network_rewards(time_frame):  
  
    response = requests.get('https://api.helium.io/v1/rewards/sum/' +  
                           str(time_frame), headers=headers)  
    data = response.json()  
  
    rows = []  
    for i in range(len(data['data'])):  
        reward_data = data['data'][i]  
        rows.append(reward_data)  
  
    df = pd.DataFrame(rows)  
  
    return df
```

More Data Collection & Scraping Functions

```
def scrape_hotspots_by_loc(loc):

    response = requests.get('https://api.helium.io/v1/hotspots/location/distance/' + loc, headers=headers)
    data = response.json()

    rows = []
    for i in range(len(data['data'])):
        hotspot_loc_data = data['data'][i]
        rows.append(hotspot_loc_data)

    df = pd.DataFrame(rows)

    df = pd.concat([df.drop(['status', 'geocode'], axis=1),
                    pd.json_normalize(df['status']),
                    pd.json_normalize(df['geocode'])], axis=1)

    return df
```

```
def scrape_dc_burns(time_frame):

    response = requests.get('https://api.helium.io/v1/dc_burns/sum/' + time_frame, headers=headers)
    data = response.json()

    rows = []
    for i in range(len(data['data'])):
        dc_burns_data = data['data'][i]
        rows.append(dc_burns_data)

    df = pd.DataFrame(rows)

    return df
```

```
def scrape_hotspot_rewards(address, time_frame):

    response = requests.get('https://api.helium.io/v1/hotspots/' + address + '/rewards/sum/' + time_frame, headers=headers)
    data = response.json()

    df = pd.DataFrame([data['data']])

    return df["total"].iloc[0]
```

More Data Collection & Scraping Functions

```
def hotspot_collector(start, end):
    i = 0
    while i != 11:
        #1. new col. for number of witnesses
        for i in range(start, end +1):
            address = hotspot_df.loc[i, "address"]
            witness_number = len(list_witnesses_for_hotspot(hotspot_address = address))
            hotspot_df.loc[i, "witness"] = witness_number

        start = start + 10
        end = end + 10
        if end > 1000:
            break
        else:
            print("sleep now ... zzz")
            t.sleep(93)
            i += 1
    return(hotspot_df["witness"])

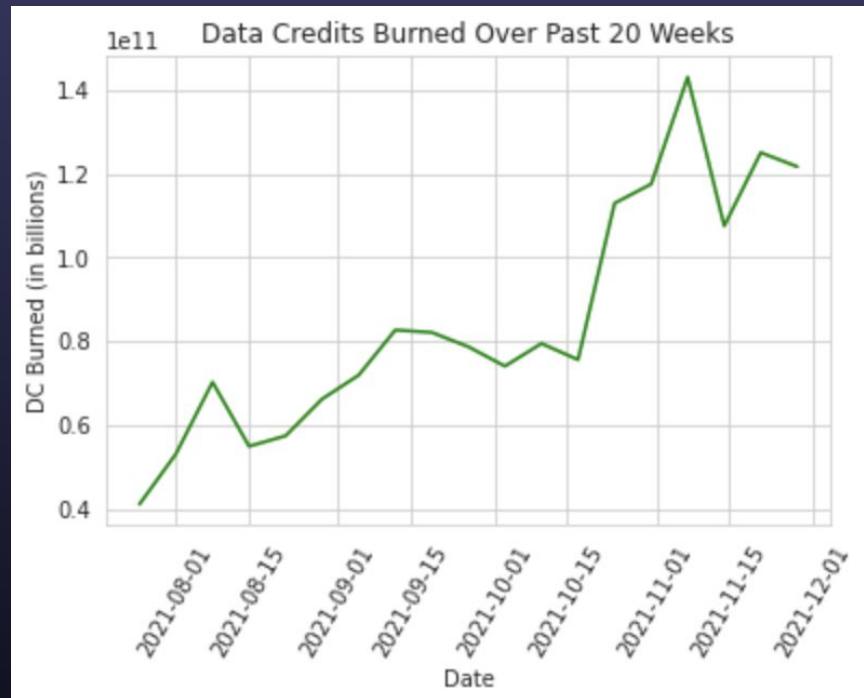
#hotspot_collector(129,132)
#hotspot_df.to_excel('Witness2.xlsx')
```

Limitations

- HTTP 429 Errors:: can't make too many API requests in a given period of time
- Can pull a maximum of 1000 entries from a given page
- Many hotspots with incomplete information
- Solution: consider more specific cases, smaller time frames

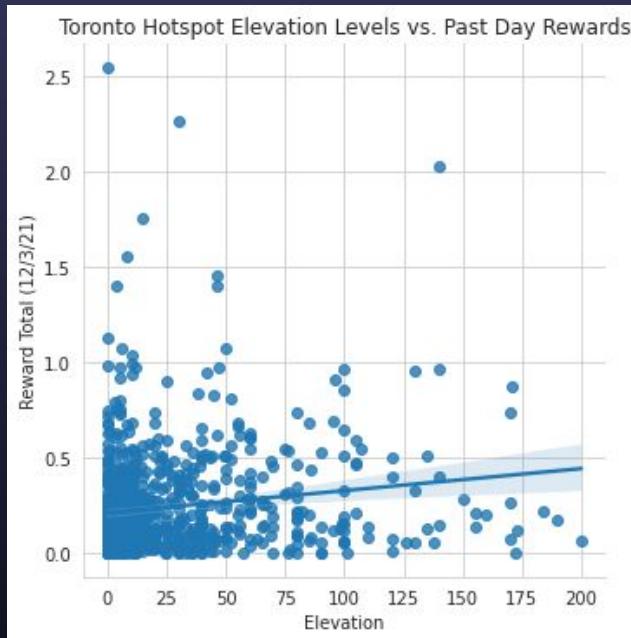
Helium Network Activity

- The burning of Data Credits shows the amount of transaction fees that take place on the network
- The increase in Data Credit burning from 400 million to over 1.2 billion between August and December of 2021 expresses the increased use of the network by IoT companies for their data transfers
- 1.2 billion Data Credits translates to about 500 GB of information being sent through the network in the final week

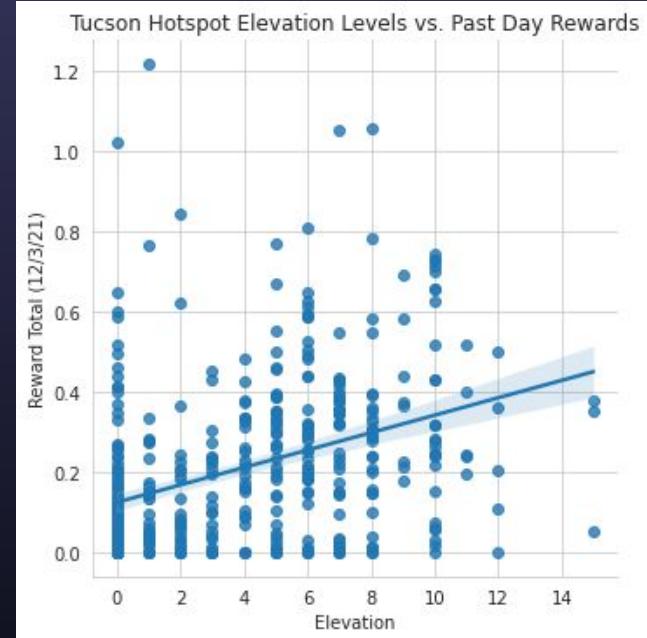


How Does Elevation Affect Rewards?

Toronto vs. Tucson



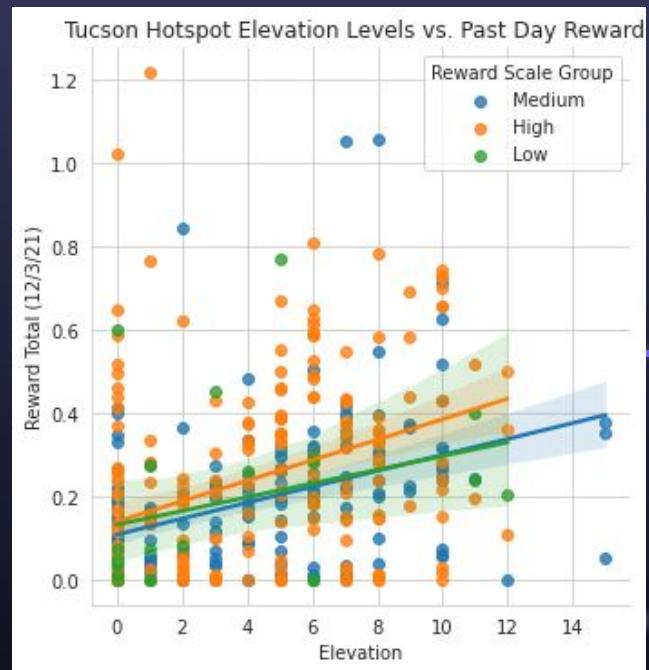
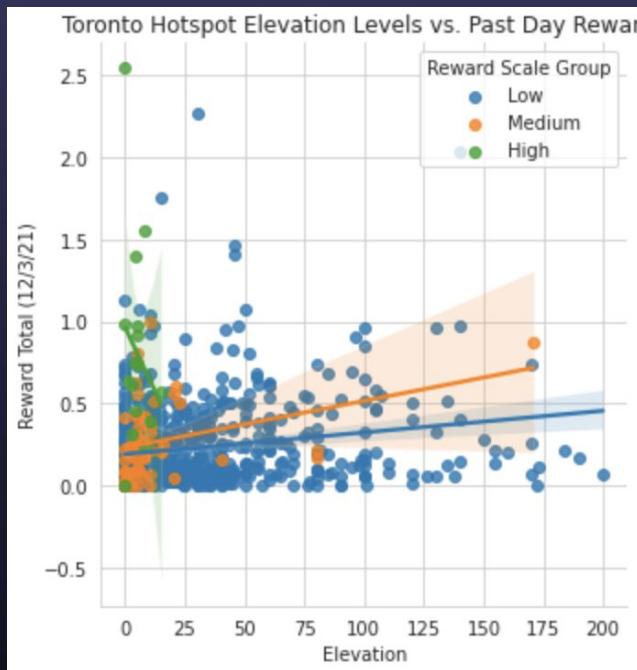
Correlation = 0.15



Correlation = 0.38

How Does Elevation Affect Rewards?

Toronto vs. Tucson



Elevation & Rewards – Regression

Tucson

Durbin-Watson: **1.871**

R-squared: **0.160**

Adj. R-squared: **0.156**

	coef	std err	t	P> t	[0.025	0.975]
const	0.1489	0.016	9.522	0.000	0.118	0.180
elevation	0.0216	0.002	8.713	0.000	0.017	0.026
log_reward_scale	0.0621	0.022	2.852	0.005	0.019	0.105

Toronto

Durbin-Watson: **1.940**

R-squared: **0.074**

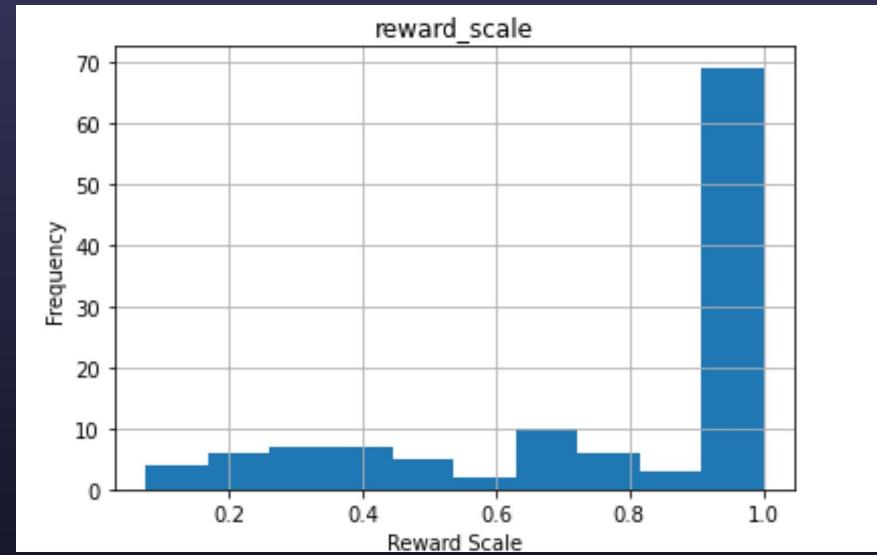
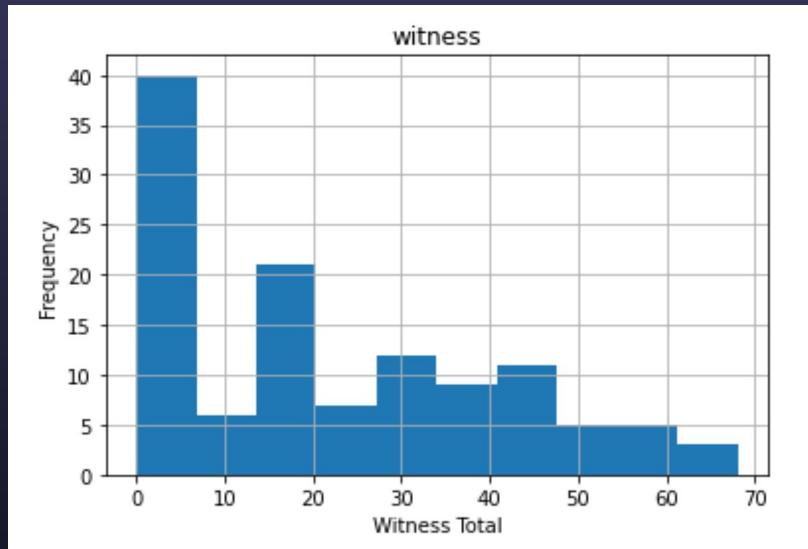
Adj. R-squared: **0.072**

	coef	std err	t	P> t	[0.025	0.975]
const	0.3435	0.022	15.924	0.000	0.301	0.386
elevation	0.0019	0.000	7.073	0.000	0.001	0.002
log_reward_scale	0.0762	0.011	6.983	0.000	0.055	0.098

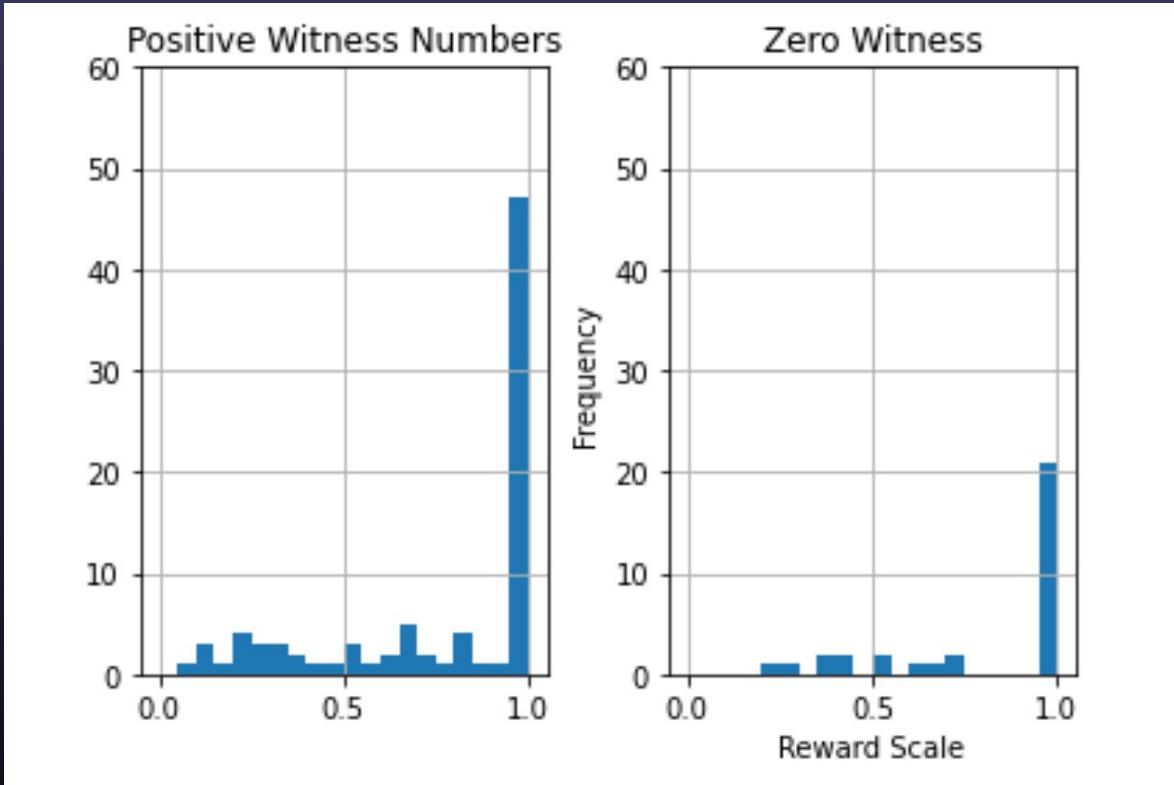
- Every one meter increase in elevation is associated with a 0.02 HNT (\$0.62) increase in total rewards.
- A one percent increase in reward scale is associated with a 0.06 HNT (\$1.90) increase in total rewards.

- Every one meter increase in elevation is associated with a 0.001 HNT (\$0.06) increase in total rewards.
- A one percent increase in reward scale is associated with a 0.08 HNT (\$2.33) increase in total rewards.

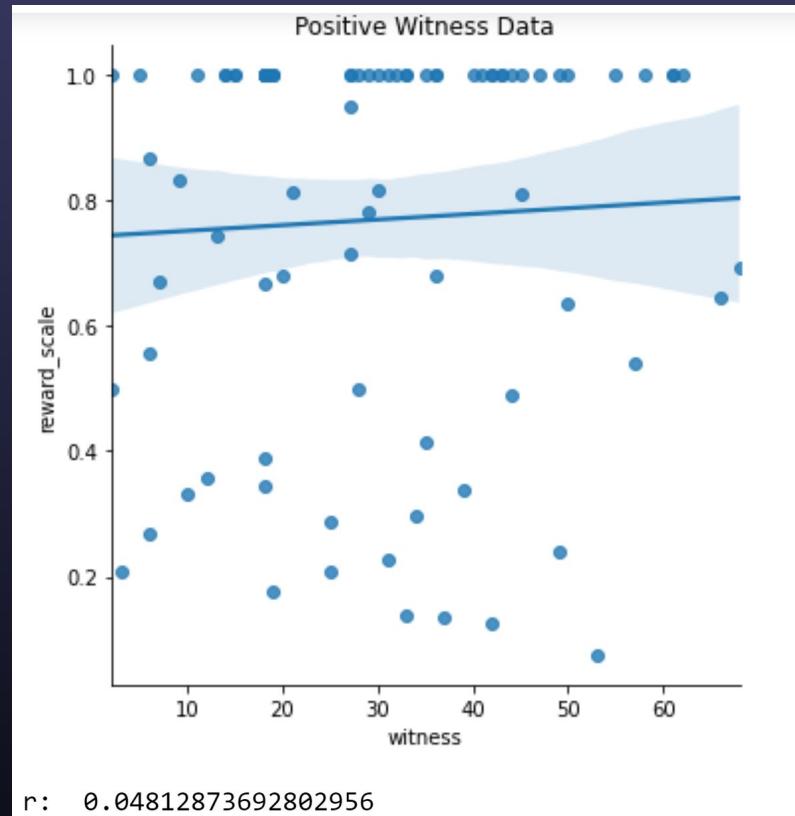
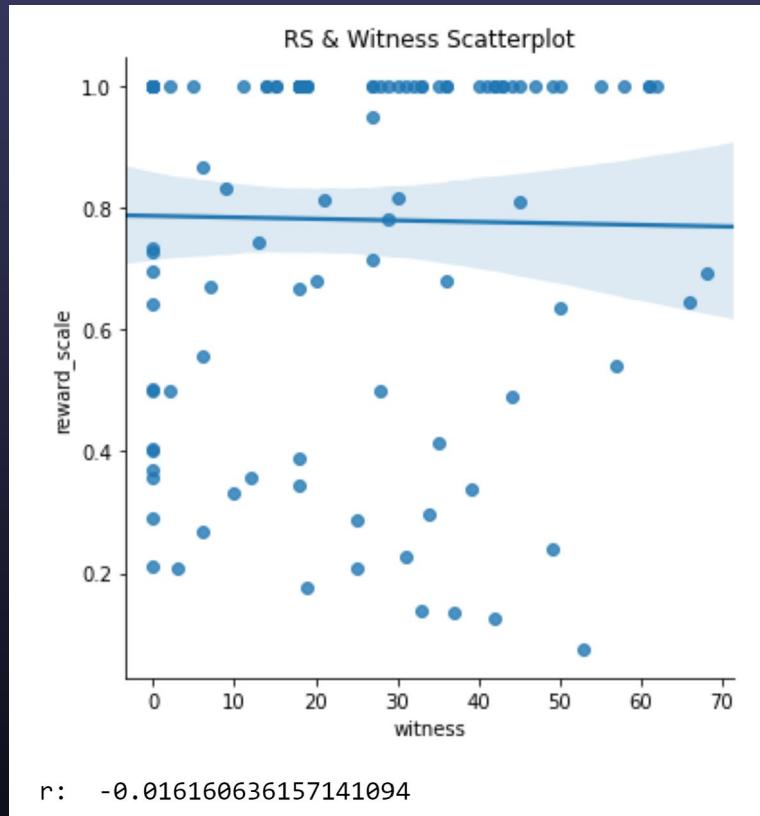
Reward and Witness Data from Hotspots



Witness Data from Hotspots



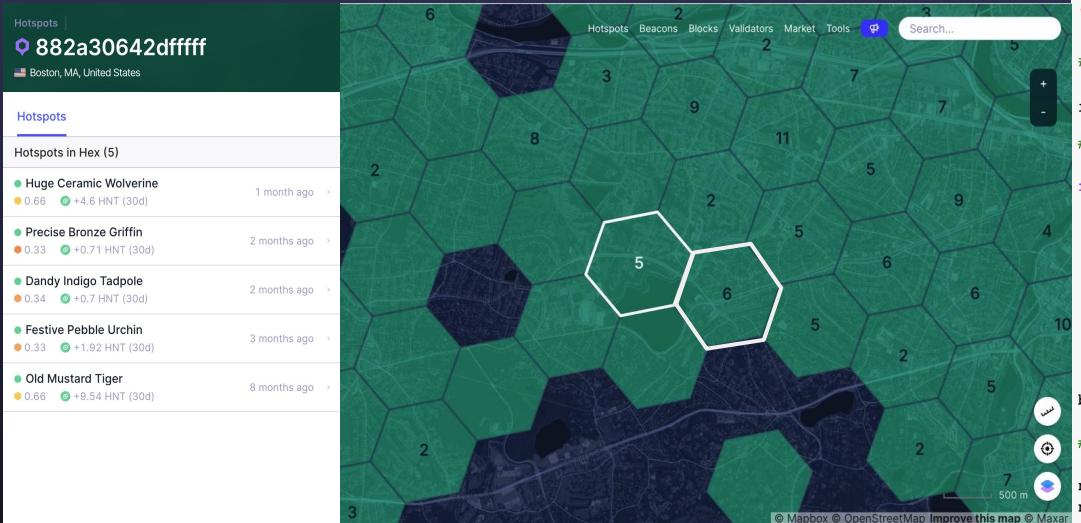
Witness Data from Hotspots



Data Analysis Conclusions

- How is the Helium network trending?
 - With close to 800 million more Data Credits being burned between August and December of 2021 (400 million -> 1.2 billion), more and more companies are utilizing the network and adding value through increased data transfers
- How can a hotspot investment be most profitable?
 - Using Tuscon as our case study:
 - Elevation is key to increased rewards with a positive correlation of 0.38 - more rewards can be expected for every additional meter a hotspot is placed above the ground as it offers longer range capabilities
 - A one percent increase in reward scale is associated with a 0.06 HNT (\$1.90) increase in total rewards - Hotspots should be placed in proximity to other Hotspots in order to have a larger reward scale

Hotspot Rewards Near BC



```
# List addresses of hotspots in the hexagonal region near BC

bc_addresses = ["112LtKYN2c3Qy4GH7dbecTfGW8RNFaET6g4iT0og3fFayduMJ8qx",
"112oZ6sBqSLStg8vRcXLkQMGKzdWR8WkCqYsqu3BoF4xYkATYYa7",
"112GqcBXtmgDGP2N1rxhLAnmNpgt18VAT4d3dEoJ9du6shBb7yKa",
"11GMnuKam29omnGTRssuBP5nNrSM5iQL4ZyDbyrq8RBLbcKBVFY",
"11rCSYrJGrqEBGUuYPVNhsuaEp2bnderu4SBVJxvhgfYxv7H9sg",
"11sHzBUwyuXL6h3MYrsPYQuCanFujcBy32AdHWqW6UAUNtwuPW4",
"11Qu1REHNzE3bU123DiepvhKYczAfK6uLYwzRk148ENBWZuGKQD",
"11sXAVvuatWJnGmu4HQjPnr7V8Z8s1upatkgKzwviNV4obCzb",
"11vgS7YCieg78WfwCztimDuJ9s1E49zzPgiDB6swWteN8fg3fuE",
"11KtFhfGhAbez99Hwp39YbMfAe3RxpHhQt2yNEBmYmkEQJcc",
"118WKcbm76cpQgefSnSV5gmlD2VZfn8Z157fNENYzJeI2Tw4sZ"]

# Empty dataframe for rewards

reward_dfs = []

# Get rewards for the past 30 days for each hotspot

for address in bc_addresses:
    print(address)
    response = requests.get('https://api.helium.io/v1/hotspots/' +
        address + '/rewards/sum/' +
        "?min_time=-30*20day&bucket=day", headers=headers)
    data = response.json()
    df = pd.DataFrame(data['data'])
    df['address'] = address
    reward_dfs.append(df)

bc_rewards = pd.concat(reward_dfs, axis=0)

# Daily average and 30-day average

np.mean(bc_rewards[bc_rewards["total"] != 0]["total"])
np.mean(bc_rewards[bc_rewards["total"] != 0]["total"])*30
```



How long to breakeven?*

- Average 30 day rewards for the nine (valid) hotspots around Boston College = 4.014 Helium
- At the current (12/8 midnight) price of Helium at \$30.52, the average miner earned \$122.52 in the last month
- The current price for a Bobcat Miner with tax is \$455.81
- Disregarding the shipping time and keeping prices and number of Hotspots constant, it would take approximately 3.72 months to reach the breakeven point if you made the investment right now

*Assuming other variables like HNT price, reward scale, etc. are constant



Questions?

Works Cited

- <http://whitepaper.helium.com>
- <https://explorer.helium.com/hotspots/112g6724QiTqFN2ge1Su6Cgjmt5kTKwzSyZFdL4E1bBeiEcpdSeQ>
- <https://crypto.com/price/helium>
- <https://docs.helium.com/blockchain/mining/>
- <https://levelup.gitconnected.com/why-this-helium-hotspot-makes-2000-a-month-6d96d3553d9>