Review of Cryptocurrencies and Non-Fungible Tokens

Code First Girls Data Analysis Degree

Data 1 - Group 5 Project

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Introduction

This project focuses on the Fintech industry, particularly blockchain and the emergence of digital assets and currencies. We aim to look at digital currencies and Non-Fungible Tokens (NFTs) as a digital asset to determine how popular they have become and what would potentially be a good investment by considering how stable cryptocurrencies are and the growth of NFT sales, comparing NFT collections to see which are the best to invest in and then concluding with a comparison of accounts to show how others invest in this area. This would be useful for anyone starting investments with cryptocurrencies and digital assets such as NFTs.

Background

The news of the rise in cryptocurrency values as well as some high-profile sales of NFTs led us to question the value of these compared to more traditional currencies. Media attention over high growth and high-profile sales of NFTs show this is a significant area of investment that is worth comparing to older more traditional markets for anyone considering moving into this area.

Objectives

In this report we will answer:

1. How has the cryptocurrency market changed over time and how does this compare to the value of other currencies and traditional stocks?
2. What are the best markets to buy NFTs?
3. Which NFT collections are the best to invest in?
4. What are the sales histories for different collections?
5. What NFT collections do the largest investors hold?

Step Specification

We pulled together different proposals for potential projects. Originally we chose to look at fitness data and nutrition apps to determine how accurate they were, however we were unable to gather enough suitable data to fulfil the project criteria. We then went through the following steps:

1. Defining the question

Initially we were only going to look at NFTs however we decided this scope was too narrow to meet the project requirements so it was extended into cryptocurrencies. When defining the questions we researched areas of digital assets and cryptocurrencies we did not fully understand and this lead to questions such as is cryptocurrency safe and how is it traded, how are NFTs bought and sold, what prices do NFTs sell for and have they become similar assets to things like art work. This helped us scope our objectives and what questions we thought would be useful to anyone interested in investing in this area.

2. Data gathering

We used the following data sources for the project:

Yahoo Finance was used for comparing the cryptocurrencies as this allowed us to look at the stock market, other currencies and cryptocurrencies together. Adjusted closing values were gathered using a data reader for comparison. We had used this source as part of the course so we had been aware of it's capabilities.

NFT CSV files – These provided relevant and historical data relating to how the prevalence of cryptocurrencies and digital assets is giving investors greater investment opportunities and choice. We used datasets from Kaggle, Statista, and Cryptoslam.io. These were found during research.

CryptoSlam.io (https://cryptoslam.io) - is one of the largest NFT data aggregators that features information on upcoming NFTs, the activity history and value of the most popular collections. It ranks top collections by 24-hour, 7-days, 30-days and all-time volume which allows traders to easily track top-selling and emerging NFTs. The two chosen datasets from here showcase the historical sales volumes of Crypto Punks and Bored Ape Yacht Club. The website gave us access to these datasets in limited csv form where we could see the sales of each NFT in the period of 2017 to 2022.

Etherscan.io is a 'blockchain explorer for the Ethereum network'. It has a developer API that lets the user choose an account and investigate its transactions over time. It was used to build time series data on a set of 'whale' accounts. Whales are NFT holders that have amassed a large fortune in their accounts.

NFTgo.io developer API allows the user to search for NFT collections held by different accounts and gives market information. Unfortunately the free to use features could not provide up to date information on the most popular NFT collections by sales, which would have provided a comparison with the csv data. However it did provide information on the NFT collections held by specific accounts and summaries of all NFT sales across the major NFT sales platforms over time.

The NFT APIs and market sites were found as we progressed and learned more about how NFT markets worked.

3. Pre-processing

Once we had our datasets, we cleaned them to ensure they had reliable information. CSV files were also reviewed in excel. This allowed some initial understanding of the data quality. Due to the amount of data that could be read in from yahoo finance we removed information not required for the analysis.

Many of the datasets had missing values which would affect time series analysis so interpolation was used to fill missing values with similar values in the time period. For NFT sales, NaN values were dropped so they did not affect overall analysis.

As we were using sales and stock information there were considerable outliers. After discussion we determined that outliers were valid data points as values will fluctuate for a variety of reasons and therefore were retained.

Other cleaning tasks completed were fixing incorrect data types and reindexing dataframes, renaming columns for clarity and merging relevant datasets for analysis.

4. Analysis and Visualisations

We split the report into three sections we each worked on all aspects of analysis and visualisations. We did time series analysis to look for trends in the data, summary statistics to summarise values and popularity of NFTs collections and markets, identified whether correlations existed, and did some descriptive overviews of the cryptocurrency and NFT markets from insights gained.

API's, data was collected to track the transaction amounts of large account holders over time and to investigate their NFT collection holdings.

Market summaries at different timepoints were compared to find how the sales of NFTs had changed and diversified over time. Finally NFT collections from different whale accounts were merged, counted and visualised to find a core set of NFT collections that were all held by the largest account holders.

Implementation and execution

The project was split into three areas:

Firstly looking at cryptocurrency values and seeing how they have grown and analysing their percentage changes. This was compared to the growth of British Pound in USD and the DJI to see how Cryptocurrencies compare to other more traditional markets.

Secondly, showing how NFTs differ from fungible digital assets such as cryptocurrencies and how this differentiation affects their sales.

Thirdly, the NFT market to see if we could determine how active NFT sales are and how much investment currently goes through NFT sales.

We initially met with some challenges finding suitable datasets, as a result we had to make the decision to change our project two weeks into the time frame. Other time constraints that had to be factored in included work commitments, other college and university work, families and holidays. As a result we decided to work on distinct project areas which allowed us to work more independently at times that suited. This meant we focussed on the core project requirements.

We used an agile process with a Trello board to keep track of work being done and by who. Meetings were an opportunity to discuss goals from the previous 24-48 hours and set new ones, using an agile framework of huddles and small sprints. Sprints included project idea research, data cleaning progress, analysis progress, agree visualisations, combine data sets, agree overlap and co-ordinate insights, code review.

Project Breakdown and team member roles were:

- Barbara - Gather and analyse data about cryptocurrencies and traditional currencies, Trello board, finalise report.
- Fatima - top 10 NFTs, top collections, drive, merge notebooks, GitHub
- Avu - history of sales, top collections, finalise PowerPoint
- Helen - work on data retrieval from API, locate whale accounts
- All - add analysis summary and findings to report, add slides for presentation of specific project area, code reviews.

Tools and libraries Used

Python Libraries: Pandas, Numpy, Matplotlib, Seaborn, Requests, mplfinance, yfinance, datareader

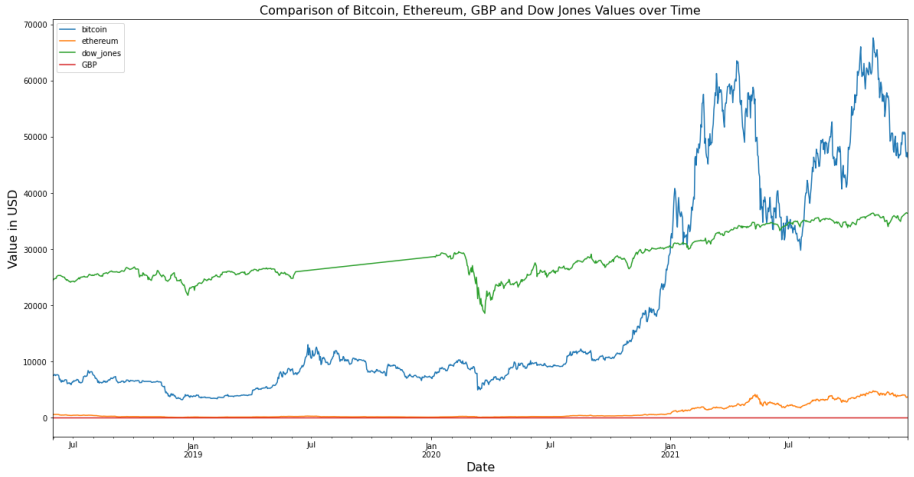
Other Tools: Jupyter Notebook, GitHub, Trello, Goggle Collab, Goggle Drive

Result Reporting

Q1 How has the cryptocurrency market changed over time and how does it compare to the value of other currencies and traditional stocks?

A number of cryptocurrencies were analysed but this report will focus on Bitcoin(BTC) and Ethereum (ETH) and comparisons with the Dow Jones Index (DJI).

Fig 1 plots the value of BTC, ETH, GBP and DJI from 2018 to 2021. BTC clearly has the highest market value of all cryptocurrencies followed by DJ and then ETH.



The values of Cryptocurrencies fluctuated more significantly than the DJI. In early 2020 we can see the DJI and BTC had a similar reduction, this would have been at the beginning of Covid19 suggesting both were affected in a similar way. In early 2021 BTC, Ethereum and the DJI all grew, with BTC showing the largest growth. ETH and DJI's growth were very similar. The DJI had a positive correlation with BTC and ETH.

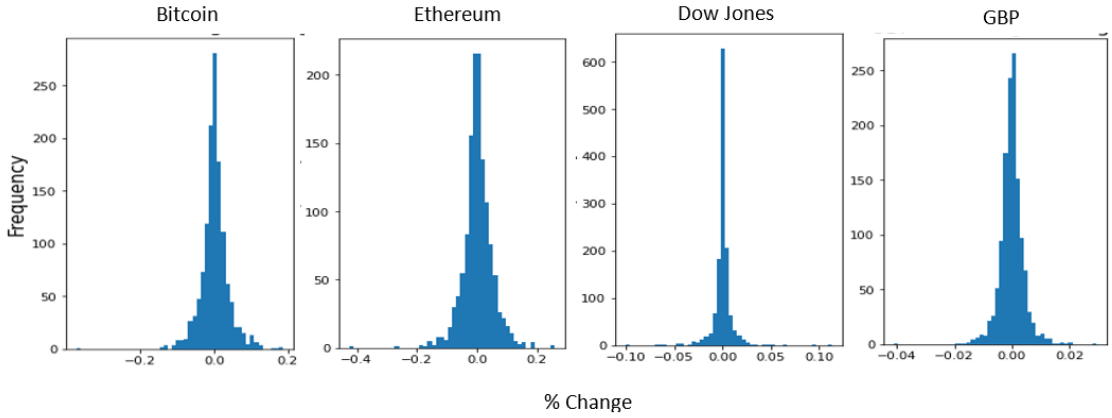
Recognised methods of comparing stocks are % change to compare fluctuations on growth and loss, variance to determine risk and standard deviation to determine volatility. The wider the % change range means stocks have higher amounts of fluctuations. Fig 2 shows the % changes. We can see that the range of % change for cryptocurrencies ranges between -0.4 and 0.25 with variability of 0.015 and 0.002 respectively. The DJI ranges from -0.1 to 0.1 with variance of 0.0001.

As the % change range of cryptocurrencies is wider than the DJI, and have higher variance, these are considered to be more risky investments.

BTC, ETH and the DJI all had high standard deviations for their values of 18472, 1258, and 4180 respectively. From these three, ETH was the least volatile.

We plotted kernel densities to look at the distribution of % change. BTC, ETH and GBP have slight negative skew. The DJI had symmetrical distributions. All datasets had outliers however these were retained as large changes in the stock market can be expected and are valid in determining volatility and risk.

Fig 2 Histogram of % change values for BTC, ETH,GBP and DJI between January 2018 and Dec 21



During the analysis it was noted that the rise of Ethereum directly correlated with NFTs gaining popularity in 2021 as Ethereum is the main market for NFTs, this is shown Fig 3. Fig 4 shows a positive correlation between NFT sales and Ethereum values.

Fig 3 NFT Sales over time

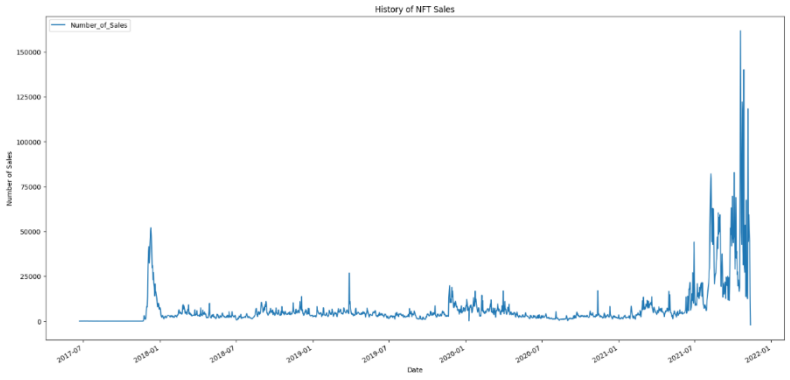
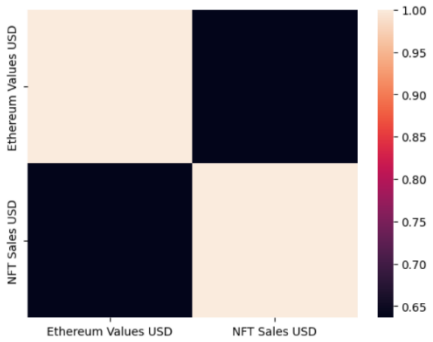


Fig 4 Correlation between NFT Sales and Ethereum



Q2: What are the best markets to buy NFTs?

Opensea claims to be the first NFT marketplace where the sale and exchange of NFT collections was possible; they opened their business in 2017. Fig 5 below, shows the volume in US dollars of all marketplaces where NFT's are traded, since the marketplace opened for business in 2017. By volume, Opensea has the largest share of the market reaching a volume of 3.3x10exp10 US dollars over time. Fig 6 shows more recent activity, Looks Rare have overtaken Opensea having the largest volume share of 2.7x10exp10 US dollars for the last twelve months. When Opensea opened for business they were not subject to competition, however now there are more platforms available which are competing for the market share. The graphs also indicate there is a total increase in the volume of sales across all platforms. The volume of sales gives an indication of the number of users on the sites. By looking at sales for the last twelve months, Fig 7, it is apparent that OpenSea is still the dominant platform and the LooksRare site facilitates a low number of sales of high value items.

Fig 5 showing marketplace metrics

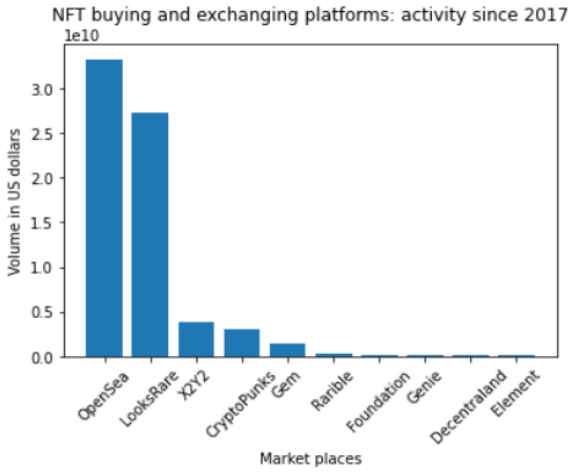


Fig 6 showing marketplace Sales

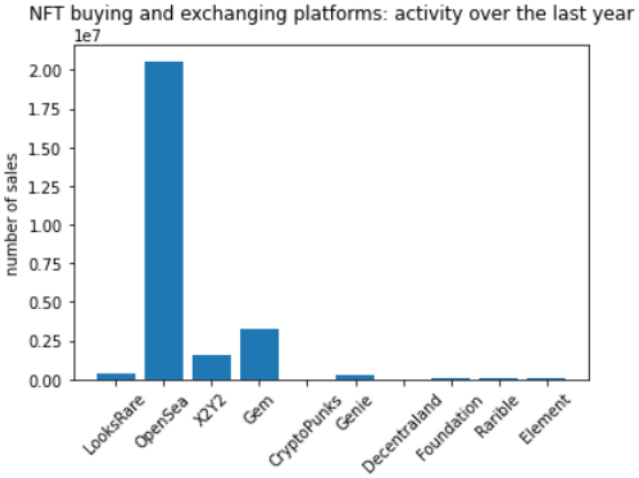
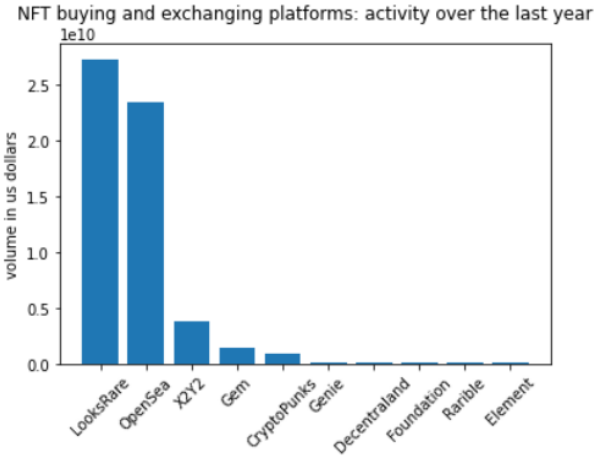


Fig 7 Bar Graph of marketplace Volume



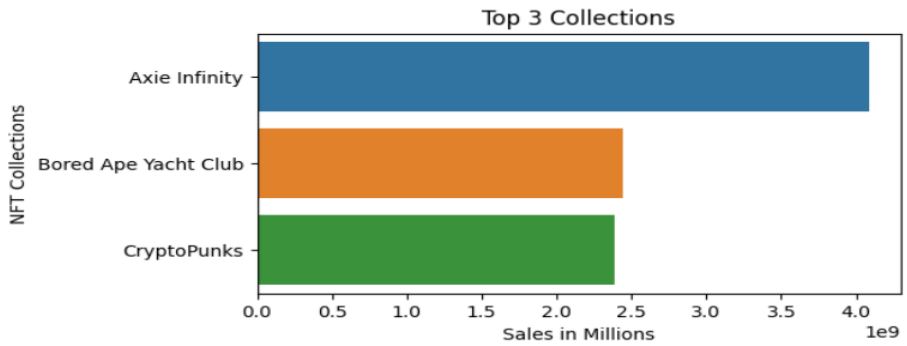
Q3: Which NFT collections are the best to invest in?

Fig 8 shows 3 best NFT collections to invest in are ‘Axie Infinity’, ‘Bored Ape’, and ‘CryptoPunks’. This conclusion was made after analysing the collections that have made over $100 million and creating a bar plot to show the sales for each collection. Most NFT collections have made over $100 million in sales, this is a good indication that they are a good investment as they do make profits and returns in investments in the same way that other traditional investments do:

We then took the top 3 collections to further analyse the sales and amount of buyers:

The total sales for the ‘Axie Infinity’ are $4,090,222,023, the ‘Bored Ape’ collection has made $2,439,754,017, and ‘CryptoPunks’ made $2,388,467,992. All 3 of the above collections have made over $2 billion in sales, in comparison to the rest of the NFT collections these are making the most in sales indicating that they would be the best collections to invest in as you are more likely to make a larger return on your investment and successfully resell the NFT.

Fig 8 Top NFT Collections



The 'Axie Infinity' collection has made the most sales overall and has the most buyers, so buying and selling an NFT from this collection is easier as the market for it is more active and popular therefore, there are more potential buyers.

Collections that have made over $100 million:

Less than 20% of NFT collections are able to reach sales over $100 million indicating that the NFT collection choice is very important when it comes to making a good investment (Fig 9).

We can see from Fig 10 the only collection that appears more than once in the top 10 is the 'Bored Ape' collection which again indicates it is a good collection to invest in.

Fig 9: % of NFT sales over $100 Million

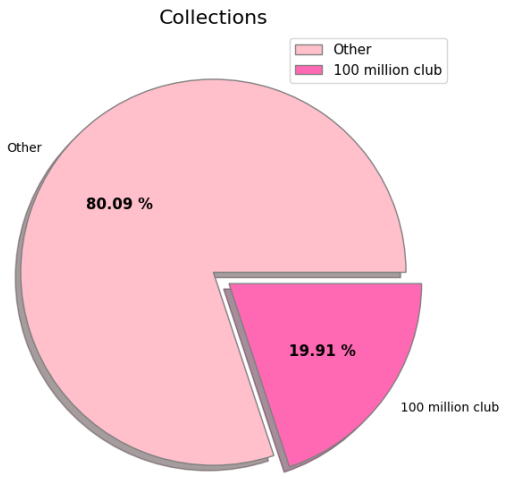
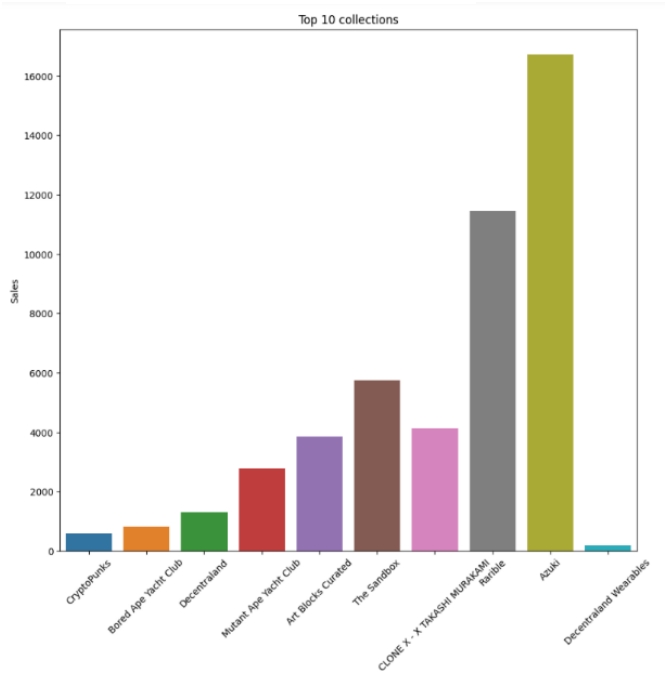


Fig 10: Top 10 NFT Collections



Q4: What are the sales histories for different collections?

Fig 11 and 12 show the sales history for the 'Bored Apes' and the 'CryptoPunks' NFT collections. The plots show their growth in sales which is mainly in 2021 and this is the same time as the rise in Ethereum values:

Fig 11:

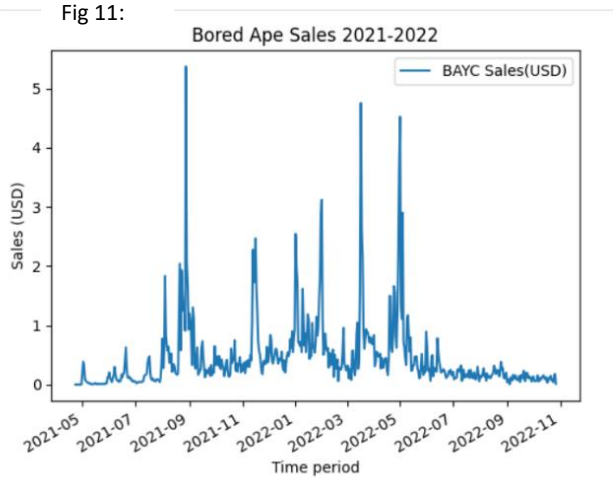
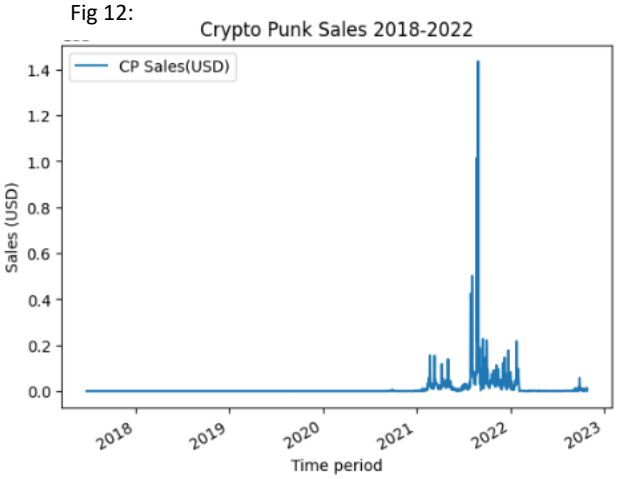


Fig 12:



The contrast in sales growth between the two NFT collections is best illustrated by the above line chart where we can see that Crypto Punks has experienced long periods of no sales growth from the year 2018 to 2021. Sales growth began at the end of 2021 which was due to increased demand in cryptocurrencies and growth of various digital currencies hitting the mainstream.

Bored Ape had fluctuating growth in sales through mid 2021 to mid 2022, similarly illustrating the growing interest in cryptocurrencies during this period. Unlike Crypto Punks, Bored Apes had more frequent periods of spikes in sales growth during this period which only began to steadily decline in mid 2022. Based on these findings, we can infer that there is a higher probability for Bored Ape NFTs to experience spikes in sales in the upcoming year of 2023 than Crypto Punk NFTs.

In addition, the key findings from the above analysis highlights the unpredictability of investing in NFTs as demonstrated by their sales growth. Our findings corroborate on other evaluations of NFT's as extremely volatile as we could see growth periods of even the top collections is not sustained for long time periods. This part of our analysis was significant to our project as it offered an unbiased view of investing in NFTs by drawing on historical data to show sales growth before their hype and growing popularity in 2021-22. In doing so, we fulfilled our objective of giving comparative analyses of NFTs against other digital currencies and traditional stocks.

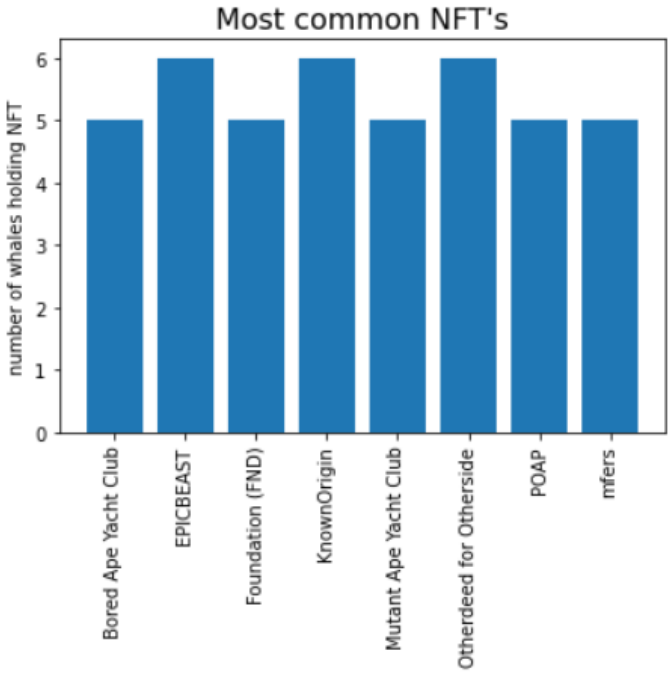
Q5: What NFT collections do the largest investors hold?

Whales are ETH account holders with more than 1 million dollars worth of NFT's According to medium.com, '600 whales hold $2.08B worth of NFTs. This gives them a market share of 34.10%.' Tracking the activity of whales can give an insight into the investor behaviour of some of the most influential NFT account holders, a process known as whale watching. The individual account numbers of 10 whale accounts were used to obtain information from the NFTgo.io developer API. The information was filtered to obtain individual collection information that each whale had. Data sets were merged and counted to form a dataframe of commonly shared NFT collections. Fig 13 shows the collections that are shared by 50% of whales. Fields of data had to be removed from the table if they did not meet the required level of detail, i.e. they showed the market place but not the collection bought. The remaining data shows the NFT collections that half of the whales sampled, shared and their relative popularity.

The data shows an even spread of NFT's that are held by five or six whales, but there is not one particular NFT collection that is more popular than the rest. Otherdeed for Otherside, Known origin and EPICBEAST are jointly the most popular NFT collections, held by 60% of whales. However the rest of the collections held by 50% of whales still represent a significant commonality.

A larger sample size of whale account numbers would have improved the validity of the data set, however whale numbers were not available as a data set or in a format that would allow web scraping. The threshold for common NFT collections shared by whale account holders was set high, at 50%, if the sample size was larger then this threshold could be reduced.

Fig 13 showing the most common NFT's shared by whales.



A further analysis of whale account activity over time was conducted to attempt to find trends in sales over time.

The transactions of each whale account were obtained and then sorted over time to produce a series of dataframes showing the amount of ether earned over time. The data frames could not be merged into a single frame, it would have produced an excessive amount of Null values as the dates for each transaction were different for each account.

The subplots in Fig 14 show that the pattern of behaviour is heterogeneous. Activity spikes at different timepoints and follows different patterns over time. Further analysis could not find any trends in the data to explore further. The dataset was originally in Ether however the graphs have been plotted in US dollars using the value of ether to USD on 1/11/2022. A more accurate calculation would have used the correct exchange rate for the date the transaction took place on. The graphs were plotted in US dollars as dollars are a more meaningful and well known unit of currency than ether, it also gave consistency across the project.

The patterns of behaviour show the most contrast between subplot four and six. Plot 6 shows a mainly inactive account which is active for a period between the 13th April and 20th May 2022 during this time 1.4million dollars enters and leaves the account. Unfortunately the individual transaction cannot be investigated further without the corresponding contract number. plot 4 shows the transaction history of an account holder that held $4089 at opening, by July 2022, they had lost a total of $-5.896521e+06(take a further 4089) before beginning to make a profit again the account now sits at a balance of $-861,421.

Fig 14: Subplots showing the activity of the whale accounts over time. The y axis represents US dollars in millions and the x axis is labelled with date ranges.

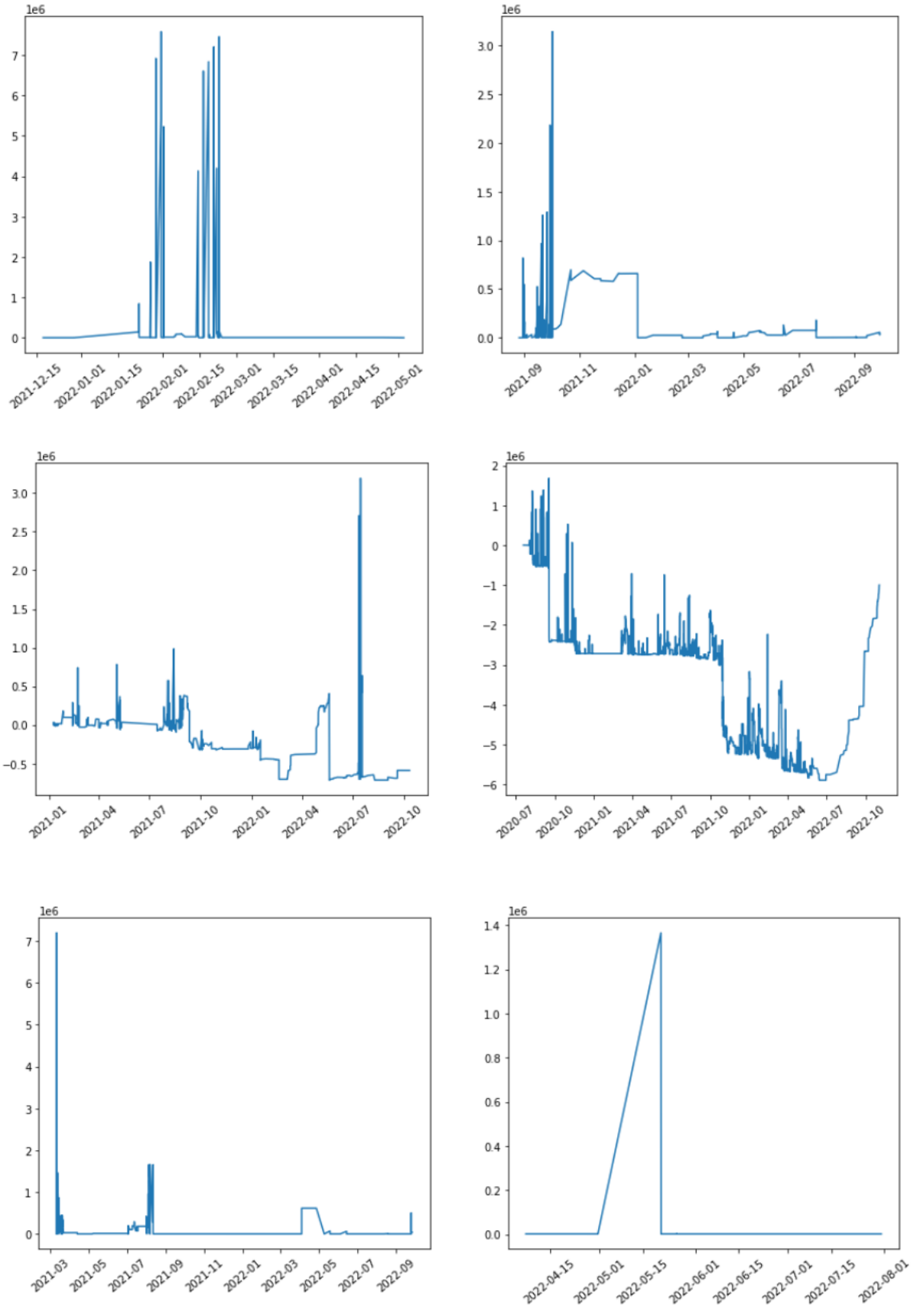


Fig 15.

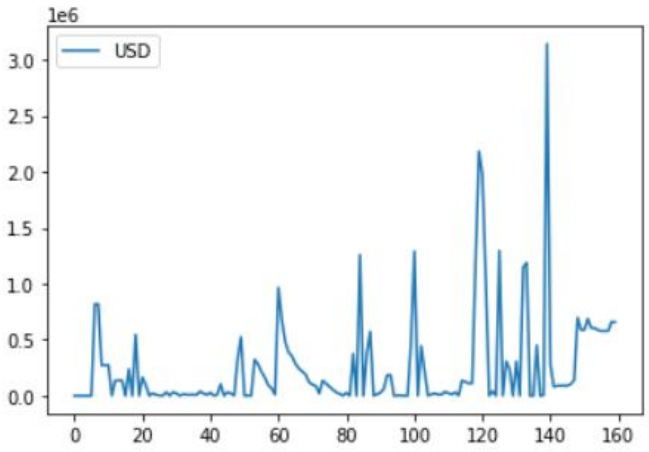


Fig 16 Whale account profit and losses

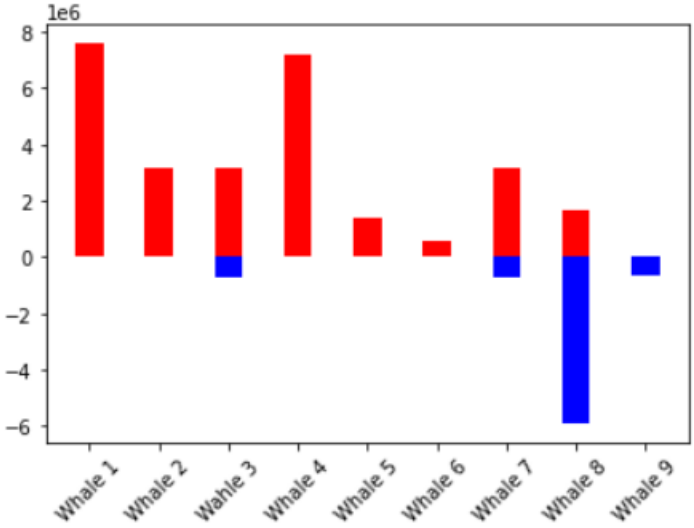


Fig 15 shows the transaction history from subplot 2, it shows how the whale ” ” made 3 million dollars over 140 transactions, in 2009, the account had some subsequent activity before becoming largely inactive again in January 2021.

Fig 16 shows the amount in millions of US dollars that each whale earnt or lost over the history of their account. The most successful whales are whale1 and 4 while whale number 8 can be seen as the least successful.

Conclusion

The top cryptocurrencies were BTC and ETH. As investments they are slightly riskier compared to investing in the Dow Jones however, ETH has less volatility than BTC and the DJI with good growth. With a strong positive correlation to DJI values and with increasing NFT sales, ETH would be a good option for those starting to invest in cryptocurrency.

For people wishing to invest in NFTs, Bored Ape NFT collection has proved one of the most popular NFTs over time, through sales data and through the repeated selection of Bored Ape collections by Whale account holders.

A good method to identify collections that may become more popular and therefore more valuable would be to follow whale accounts and look at collections that are increasing in popularity within this group.

Future Extensions

Potential future extensions to this project could include:

- Factoring in inflation for currencies and then comparing other currencies to cryptocurrencies.
- Predictive modelling on whale accounts to identify up and coming collections early.