HW6
Rijish Ganguly

1. Relevance

    1. The primary thing I'm interested in is estimating the Beta of Bitcoin with respect to three different portfolios and answer the question of whether we should include bitcoin as part of our investment portfolio using Markowitz Portfolio Optimization. A beta coefficient is a measure of the volatility, or systematic risk, of an individual asset in comparison to the unsystematic risk of the entire market. Beta is used in the capital asset pricing model (CAPM), which calculates the expected return of an asset using beta and expected market returns. The existing disciplines it overlaps are finance and statistics.

    2. It affects almost every country and people who invest in the stock market/cryptocurrencies. Bitcoin is a decentralized digital currency without a central bank or single administrator that can be sent from user to user on the peer-to-peer bitcoin network without the need for intermediaries.

    3. The average non-technical person who invests in the financial markets/cryptocurrencies is acquainted with Beta and Alpha as they are fundamental measurements to determine a portfolio's performance. Hence, learning about the beta of Bitcoin is of utmost importance to an investor

    4. Not applicable. All financial markets across the world which include cryptocurrencies as an asset are affected by this.

    5. The predominant subsystems are – exploring how volatile Bitcoin is an asset and determining whether we should include Bitcoin into our optimal portfolio

    6. Any insights gleaned from my study can be applied to any part of the world. However, my study is focused on the US financial markets and I'll use three indices S&P 500, the Dow Jones and the FTSE Global All Cap Index to determine the volatility of Bitcoin.

The study can be expanded, and the Beta of any cryptocurrency can be estimated with respect to a local benchmark index.

7. Physical models aren't applicable because we lack sufficient knowledge and there is no unanimous consensus regarding Bitcoin as an asset among financial experts. Owing to the high volatility of Bitcoin as an asset, physical models may become redundant over time. Currently, there is not a sufficient amount of data to conclude whether bitcoin responds positively to a bearish stock market.

8. The historical method used to estimate beta is to regress asset returns against market returns. The slope of the regression corresponds to the beta of the asset and measures the riskiness of the asset. We decide on an estimating period, decide on a return interval and choose a particular market index.

    1. http://people.stern.nyu.edu/adamodar/pdfiles/eqnotes/discrate2.pdf
    2. https://arxiv.org/pdf/1109.4422.pdf

    There hasn't been any proper scientific study to measure the beta of Bitcoin and it's relative volatility to different market indices

9. An improved model of the system can make an investor make more informed financial decisions backed by actual data.

10. Some of the open questions related to my subject are as follows:

    i. Can Bitcoin be considered as a financial asset?
    ii. Should an investor include Bitcoin in his portfolio?
    iii. Is there a correlation between market movement and the Bitcoin price movement?

2. Scope

    1. Questions I want to answer:

        i. Is there a correlation between market indices like Dow-Jones, SPY, and VTWSX with Bitcoin?

ii. Should Bitcoin be included in an investor's portfolio despite the high volatility?

2. Answers to these questions can help an investor make an optimal and sound financial decision regarding investing in Bitcoin and other cryptocurrencies. The optimal portfolio would give the highest return for the lowest risk and as such we can make a sound conclusion regarding the inclusion of Bitcoin into the portfolio.

3. The problem can be decomposed into three major components:

    i. Exploring the volatility of Bitcoin as a financial asset
    ii. Optimal return of a portfolio containing Bitcoin and whether Bitcoin weightage in that portfolio is significant or not
    iii. Determining is there any correlation between the stock market and Bitcoin

4. The question that cannot be answered by the model is the reason behind the correlation or uncorrelation of Bitcoin with the stock market

5. A potential correlation that would be interesting from a practical point of view would be correlation between Bitcoin with SPY500. If bitcoin is not correlated to the stock market, it may make it an excellent addition to a traditional portfolio for diversification. And, as an uncorrelated asset, it would serve a different function than gold, which tends to be negatively correlated with the performance of the stock market.

3. Data

    1. The source of my data is Yahoo Finance. I will be using the following Python packages to import the data:
        i. pandas_datareader
        ii. yfinance

        This data will be used for both calculating the beta of Bitcoin with respect to three different portfolios and Markowitz Optimization to get the optimal portfolio.
    2.

Date	High	Low	Open	Close	Volume	Adj Close
2016-01-04	744.059998	731.257996	743.000000	741.840027	3272800	741.840027
2016-01-05	752.000000	738.640015	746.450012	742.580017	1950700	742.580017
2016-01-06	747.179993	728.919983	730.000000	743.619995	1947000	743.619995
2016-01-07	738.500000	719.059998	730.309998	726.390015	2963700	726.390015
2016-01-08	733.229980	713.000000	731.450012	714.469971	2450900	714.469971
...	...	...	...	...	...	...
2016-12-23	792.739990	787.280029	790.900024	789.909973	623400	789.909973
2016-12-27	797.859985	787.656982	790.679993	791.549988	789100	791.549988
2016-12-28	794.229980	783.200012	793.700012	785.049988	1153800	785.049988
2016-12-29	785.929993	778.919983	783.330017	782.789978	744300	782.789978
2016-12-30	782.780029	770.409973	782.750000	771.820007	1770000	771.820007

    The columns are
        a. highest stock value for a particular day and asset
        b. lowest stock value for a particular day and asset
        c. The opening stock value for a particular day and asset
        d. The closing stock value for a particular day and asset
        e. Adjusted closing stock value for a particular day and asset

    3.

    The variables I want to model are beta, intercept and, sigma of the regression between Bitcoin and other portfolios.

4. The basic unit of observation is the daily price of an asset in dollars.

5. For the beta calculation, I'm collecting daily returns for Bitcoin and other indices from 2015-01-01 to 2018-12-01. Hence, in total, I have 1432 rows and 6 columns.

6. Not applicable to my project. I have all the data which are required for my project.

7. The data is in the format of a Pandas data-frame imported directly from yahoo with the help of a few python packages. There is no intermediate file.

8. There are no groups or repeated measures in my data.

9. Check question 2 for sample data.

10. There are temporal co-ordinates in my data. I have date-stamps which record the prices for a particular asset on a particular date.