Analysis of Cryptocurrency

Math23C Spring 2018 Final Project - One Page Handout

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Dataset and Initial Exploration

We used two datasets:

- Cryptocurrency pricing for four cryptocurrencies (Bitcoin (BTC), Ethereum (ETH), Monero (XMR), Ripple (XRP). Bitcoin and Ethereum represent the majority of overall cryptocurrency market capitalization. We chose Monero and Ripple to see if market dynamics affected all cryptocurrencies equally.
- For comparison against traditional markets, we downloaded eightteen other historical financial metrics including: S&P500, NASDAQ, DOW, Russell 2000, Foreign exchange rates (Yen-USD, Euro-USD, etc.), LIBOR rates (1M, 3M, 12M), commodity prices (gold, crude oil).

The data was cleaned and merged to the same time periods, resulting in over 600 observations of 20 columns. As required by the context, we both standardized and normalized the data.

Initial exploration revealed high variance in cryptocurrency price changes. While the same general pattern was observed across currencies, wild fluctuations could occur to one currency months before the effect was seen in another currency.

Topic 1: Distribution of Price Changes

We examined price changes to test the well-known A Random Walk Down Wall Street claims that price movements in traditional markets are random and should follow a Gaussian distribution. We clearly found by three different methods that price change variance **does not follow a Gaussian distribution**. In order to determine which would be a more appropriate model, we attempted to fit beta, inverse gamma and Cauchy distributions. Ultimately, Cauchy was closest. We then attempted to fit Cauchy to the higher variance cryptocurrency price variations. While this was closer, it was still not entirely satisfactory. It is interesting to note that the Cauchy probability distribution has infinite variance. This probably reflects the uncertainty and speculative nature of the cryptocurrency market!

Topic 2: Correlation of Cryptocurrencies

By traditional measures (covariance, permutation test, heatmap), cryptocurrency price changes seem highly correlated. However, these summary statistics fail to account for the temporal differences of when these changes occur, which can have an enormous impact on effective return rates. This was an interesting lesson in not trusting aggregate statistics that do not account for *when these correlations occur*. We tried using the price changes in one currency to forecast price changes in another currency using linear regression, which yielded results that were too noisy to be used for trading purposes.

Conclusion

The cryptocurrency market is too immature, too speculative and not grounded in tangible asset values to use traditional financial statistical measures. Even less common distribution functions do not model this new market to a satisfactory level. Any investment in this market would be based purely on emotion as rational investment opportunities could not be found by our analysis.