Data Integration and Graphical Models for Cryptocurrencies

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- We leverage **crypto-asset prices** as well as related social media information with a novel **data integration** methodology based on graphical and dependence models producing accurate predictions and assessments of financial risks.

Motivations

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- On the one hand, due to the recent events affecting the world population and politics (i.e. the Covid-19 pandemic and lockdown, the war in Ukraine, etc.) market unpredictability is making financial forecasts based on historical asset prices **less reliable**.
- On the other hand, social media data are generated by users on a voluntary basis and may **not capture** information about the **entire population**.

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- In contrast to other “black-box” approaches, graphical and dependence models allow a **transparent and immediate interpretation** of results.

Graphical models

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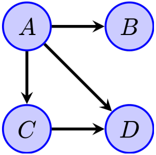
- Graphs are an intuitive way of **representing and visualising** the relationships between many variables.
- A graph allows us to abstract out the **conditional independence relationships** between the variables from the details of their parametric forms.
- Graphical models allow us to define general message-passing **algorithms** that implement probabilistic inference efficiently (Maathuis, 2018).



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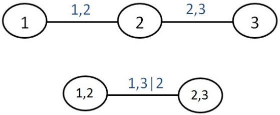
- Vine copulas use bivariate copulas as building blocks to define highly flexible multivariate distributions that are represented via graphical models as nested set of connected trees.
- The flexibility of vine copulas allows us to overcome many of the issues associated with commonly used distributions by allowing different complex **asymmetric dependencies** and tail behaviours to be modelled (Czado, 2019).



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- We apply the methodology to **integrate crypto-asset prices** and social media data, extracted from platforms such as Twitter and Google Trends, producing precise predictions and measuring financial risk accurately.

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- Bitcoin data **time horizon**: February–June 2021
- We implement time series to model the data dynamics of **cryptocurrencies** and **online** gathered **information**.
- Subsequently, we use graphical and dependence models, such as vine copulas, to capture the **dependence structure** between variables.

Preliminary results: Google trends

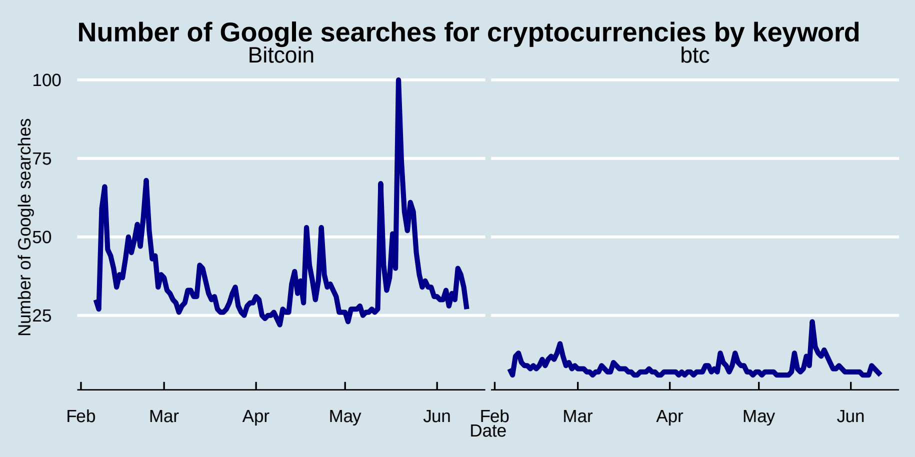


Figure: Number of Google Trends searches by keyword ("Bitcoin" on the left and "btc" on the right).

Preliminary results: Google trends

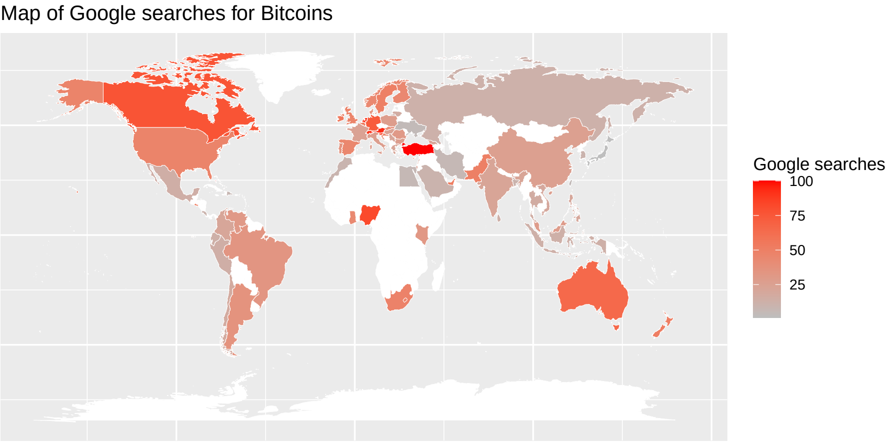
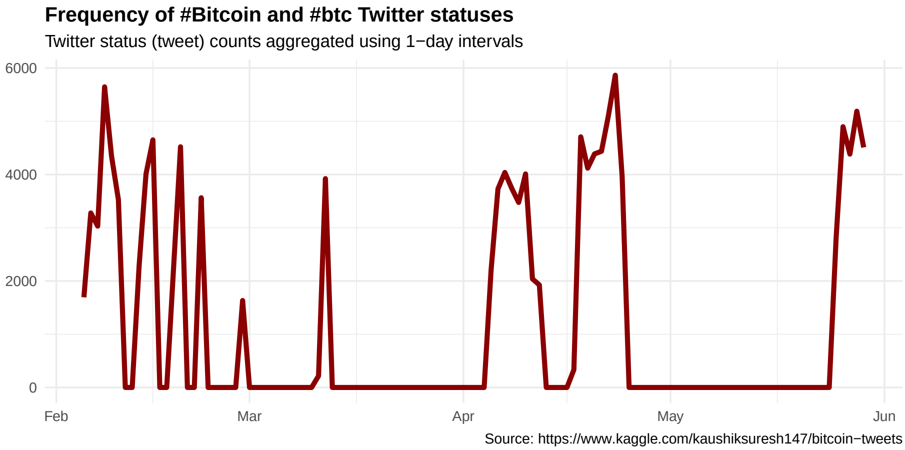


Figure: Map of the number of Google Trends searches by country.

Preliminary results: Twitter



Source: https://www.kaggle.com/kaushiksuresh147/bitcoin−tweets

Figure: Number of Tweets containing the hashtags “Bitcoin” and “btc”.

Preliminary results: Twitter

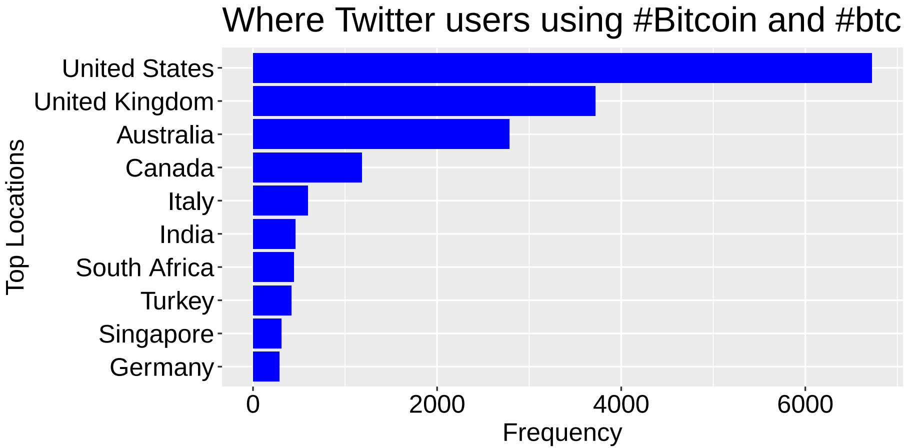


Figure: Top locations of tweets containing the hashtags "Bitcoin" and "btc".

Preliminary results: Twitter

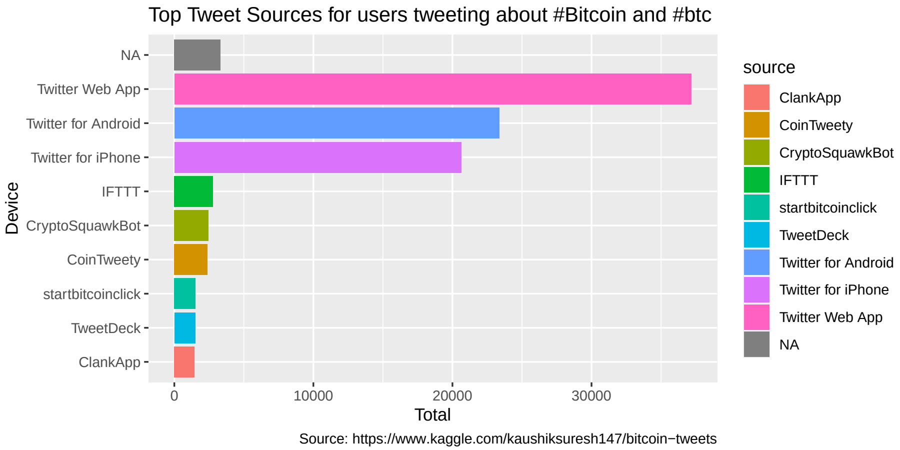


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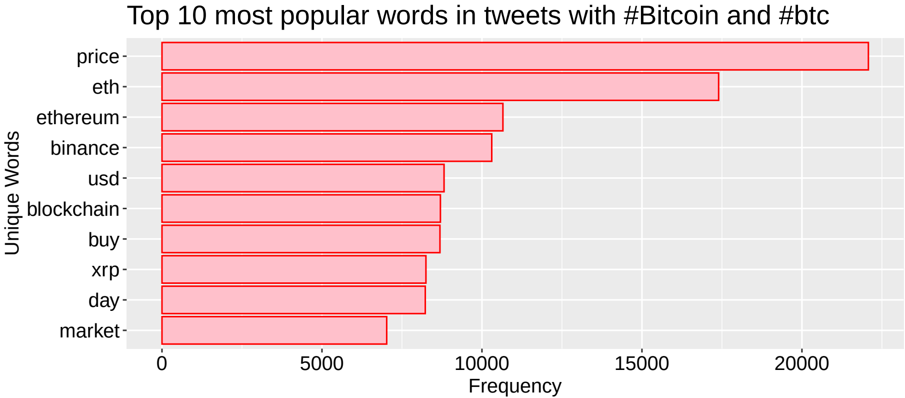
Figure: Top tweet sources for users tweeting about “Bitcoin” and “btc”.

Preliminary results: Twitter



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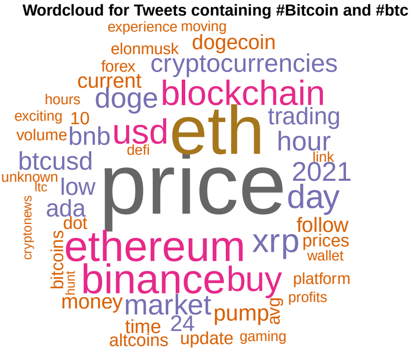

Figure: Wordcloud for tweets containing “Bitcoin” and “btc”.

Preliminary results: Twitter

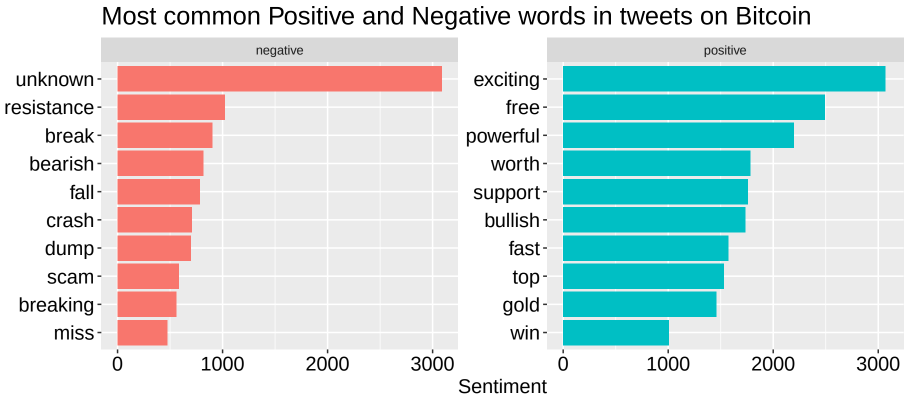

Figure: Most common positive and negative words in tweets containing the hashtags "Bitcoin" and "btc".

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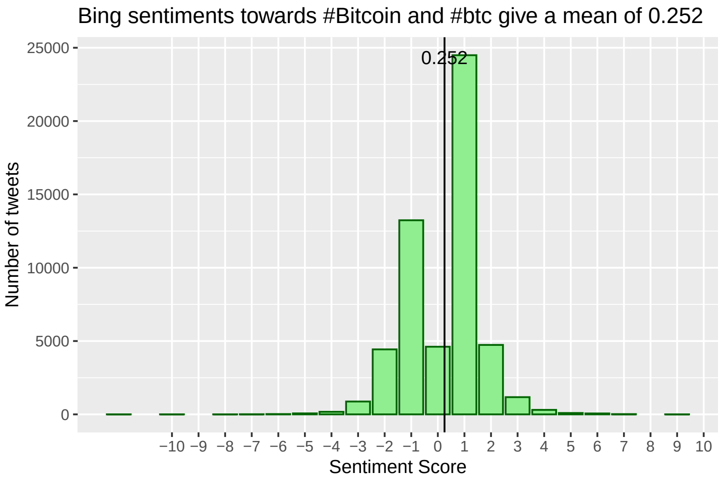
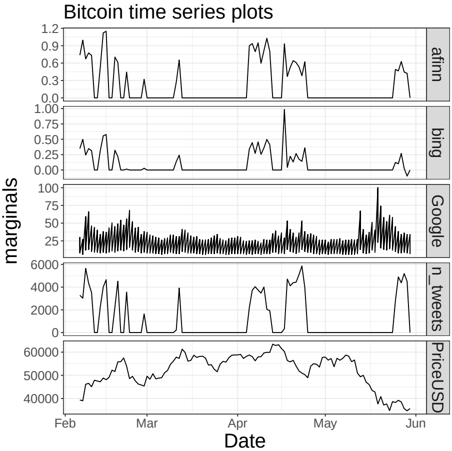


Figure: Histogram of Bing sentiment scores for tweets with hashtags "Bitcoin" and "btc".

Next steps

1. Time series analysis of crypto-asset prices and social media information
2. Data integration using graphical and dependence models
3. Calculate predictions based on the data integration model



References

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