Presentation :

1. Introduction

Cryptocurrencies are assets like Bitcoin that can be traded over online platforms. Over the last 5 years, their capitalization went from less than 5 billion USD to more than 340 billion today.  
This explosion of the cryptocurrency market made cryptocurrency a subject of research for many.

In my research, I study market imperfections, when the price for two identical assets isn’t the same, which is an opportunity for arbitrage. Arbitrage on cryptocurrency markets has been studied by numerous articles but none has tried to measure how big they can be, which is the focus of my research.

1. Arbitrage

When at the same time a person A sells at price 𝑥 and a person B buys at price 𝑦 and where 𝑥 < 𝑦

🡪 A person C can buy the asset from A, sell it to C and make a profit 𝑝≤𝑦−𝑥

1. Cryptocurrency Markets

Cryptocurrency markets can be roughly summarized by the following drawing:

There are different online platforms called ‘exchanges’ where cryptocurrencies are traded. Prices may differ a bit from one platform to another, and cryptocurrency can be sent from one platform to another at a very low fee, which makes arbitrage an option

1. Example

Here is an example with real data:  
Somebody buys 1500$ of Bitcoin on a platform, send his Bitcoin to a Korean exchange to buy at the lowest price possible the ‘Litecoin’ currency, and then proceeds to send that Litecoin to Hubi, a Hong-Kong exchange where the Litecoin’s value is the highest at that time. For 1500$ invested, a profit estimated of 180$

1. Graph Theory Approach

This problem can be formulated as a max-flow problem:

Finding all arbitrages is the same as finding augmenting paths when comparing prices among markets for all currencies, on all exchanges. Unlimited amounts can be sent between platforms, but trading is limited by the amount others are willing to buy or sell.

1. Statistical Approach

Using the volume traded of every pair, we can determine the market price of the cryptocurrency used.  
Once we have the market price of a cryptocurrency, the difference between the market price and the pair’s price, multiplied by the volume traded gives the arbitrage of the cryptocurrency.

The advantage of the statistical method is that it is very efficient but doesn’t tell where are the arbitrages, while the graph theory method is very complex but on the other hang gives the proof of its result by returning the augmenting path.

1. Results

Due to the algorithmic complexity of the problem, the graph theory method couldn’t be computed on the whole dataset. By running the algorithm on five random samples of the dataset with a volume of 1 billion USD and extrapolating to the total dataset volume, all results were matching the statistical estimation with a margin of ±10%.

Statistical method gave me an estimation of 200 063 807 USD that can be arbitraged at any minute for the  
 78 071 059 706 USD of volume analyzed, so around 0.25% of the volume, at any time.

Other consequence, if all market discrepancies were arbitraged, to match the total volume, we should expect an increase in volume traded of 65%.