Intra-Exchange Triangular Arbitrage

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Introduction

Our goal was to create an arbitrage bot that identifies the price inefficiencies between cryptocurrency pairs within an exchange. To do this we needed to select a model for price inefficiency arbitrage, find an exchange capable of supporting enough coin pairs for a successful arbitrage, and finally code our arbitrage method to provide real time analysis of arbitrage opportunities in the market.

Step 1: Formulate Approach

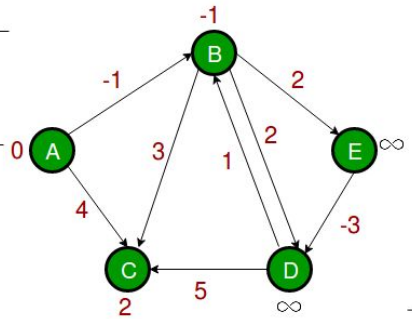
We explored many models that would help us identify our artribage inefficiencies. Among those we discovered three arbitrage models to analyze:

1. Bellman-Ford model (BF)
2. Purchasing Power Parity model (PPP)
3. Intra-exchange Triangular Arbitrage model (IETA)

Based on research we concluded that Intra-exchange triangular arbitrage, results from a price inefficiency between three currency pairs. If the listed price exchange price does not equal the effective exchange price calculated by analyzing two other related currency exchange pairs, then there is an arbitrage opportunity.

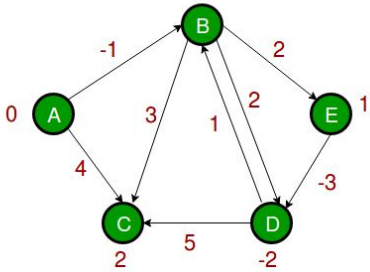
Bellman-Ford Algorithm 1.1

A	B	C	D	E
0	∞	∞	∞	∞
0	-1	∞	∞	∞
0	-1	4	∞	∞
0	-1	2	∞	∞



Like other Dynamic Programming Problems, the Bellman-Ford algorithm calculates shortest paths in a bottom-up manner.
It first calculates the shortest distances which have at-most one edge in the path. Then, it calculates the shortest paths with at-most 2 edges, and so on.

A	B	C	D	E
0	∞	∞	∞	∞
0	-1	∞	∞	∞
0	-1	4	∞	∞
0	-1	2	∞	∞
0	-1	2	∞	1
0	-1	2	1	1
0	-1	2	-2	1

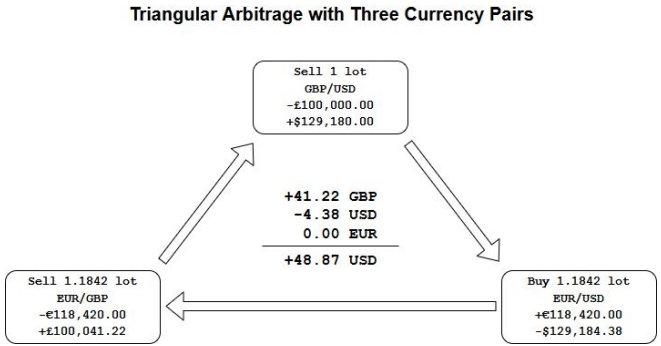


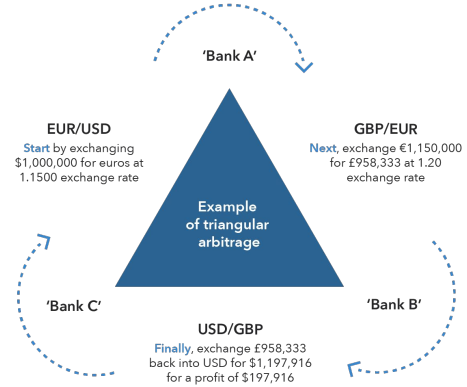
Purchasing Power Parity

Use Cases/Markets:

- Basket of goods
- Liquidity and use of cryptocurrencies
- Translation of FX exchange rates
- Market Development and future opportunities

Triangular Arbitrage





Intra-Exchange Arbitrage

Inter-Exchange Arbitrage

Key Points:

a. If executed properly, there is no exposure to currency risks.

b. All one exchange— no need to transfer from where you buy to the exchange where you sell, unlike is the case with inter-arbitrage technique.

Step 2: Gather Necessary Data

We needed to select an exchange that provides the necessary data on a real-time basis and a suitably diverse mix of trade pairs to enable triangular arbitrage capabilities. We chose the Coinbase Pro exchange.

Some of the elements that Coinbase Pro offers us are:

- Real-time exchange price data
- 3+ currency pairs that fit the triangular arbitrage model
- A robust trade screen with quickly updated information
- Good daily trade volume
- API with generous free data pull levels, even though not enough to satisfy the model alone

Step 3 Implement Triangular Arbitrage Math

See corey’s walk through