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TRIANGULAR ARBITRAGE

CEFI AND DEFI CRYPTO ARBITRAGE

WITH PYTHON AND JAVASCRIPT



WHY SHARE THIS INFORMATION?

CEFI EXCHANGES

<https://coinmarketcap.com/rankings/exchanges/>

← → C coinmarketcap.com/rankings/exchanges/

Cryptos: 16,204 Exchanges: 450 Market Cap: \$2,200,849,199,543 24h Vol: \$96,863,358,514 Dominance: BTC: 40.3% ETH: 20.0% ETH Gas: 101 Gwei

 CoinMarketCap Cryptocurrencies Exchanges NFT Portfolio Watchlist Calendars Products Learn  Log In

Top Cryptocurrency Spot Exchanges

CoinMarketCap ranks and scores exchanges based on traffic, liquidity, trading volumes, and confidence in the legitimacy of trading volumes reported. [Read More](#)

 Crypto Tutorials
 What is Web 3.0?

 CoinMarketCap Unwrapped 2021
Crypto by the numbers

#	Name	Exchange Score	Volume(24h)	Avg. Liquidity	Weekly Visits	# Markets	# Coins	Fiat Supported
1	 Binance	9.9	\$19,360,275,479 ▲ 6.99%	793	35,512,543	1639	419	AED, ARS, AUD and +43 more
2	 Coinbase Exchange	8.7	\$4,534,579,499 ▼ 3.6%	722	4,516,259	416	141	USD, EUR, GBP
3	 FTX	8.4	\$2,376,899,735 ▲ 17.26%	726	5,181,630	437	304	USD, EUR, GBP and +7 more
4	 Kraken	8.1	\$1,254,708,884 ▲ 4.29%	730	2,557,464	378	102	USD, EUR, GBP and +4 more

# ▲	Name	Exchange Score ⓘ	Volume(24h)	Avg. Liquidity	Weekly Visits ⓘ	# Markets	# Coins	Fiat Supported	Volume Graph (7d)
302	Globe Derivative Exchange	0.1	▼ 5.32%	--	3,406	4	5	--	
303	ApolloX	0.1	▲ 18.7%	--	71,693	13	14	--	
304	MoonSwap(Moonriver)	0.1	▼ 0.74%	--	5,482	5	5	--	
305	Jswap	0.1	▼ 28.79%	--	22,620	32	18	--	
306	KyberSwap (BSC)	0.1	▼ 100%	--	--	9	10	--	
307	BitCoke	0.1	▲ 16.5%	--	5,837	31	32	--	

Showing 1 - 307 out of 307

x307

DEFI EXCHANGES

<https://coinmarketcap.com/rankings/exchanges/dex/>

Cryptos: 16,204 Exchanges: 450 Market Cap: \$2,200,473,601,426 24h Vol: \$96,549,955,636 Dominance: BTC: 40.3% ETH: 20.0% ETH Gas: 87 Gwei

English USD

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Top Cryptocurrency Decentralized Exchanges

CoinMarketCap ranks the top decentralized exchanges based on trading volumes, market share of DeFi markets.

Watchlist Spot Derivatives Dex Lending

#	Name	Volume(24h)	% Mkt Share	No. Markets	Type	Launched	Vol. Graph (7d)
1	dYdX	\$1,853,523,971 ▲ 20.83%	3.5286%	10	Orderbook	Apr 2019	
2	Uniswap (V3)	\$1,486,122,435 ▼ 14.27%	2.8291%	670	Swap	May 2021	
3	PancakeSwap (V2)	\$1,084,955,089 ▼ 6.19%	2.0654%	3147	Swap	--	
4	ApolloX DEX	\$658,423,081 ▲ 18.54%	1.2534%	13		Nov 2021	
5	Uniswap (V2)	\$431,457,616	0.8214%	1785	Swap	Nov 2018	

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← → C coinmarketcap.com/rankings/exchanges/dex/ ⬤ ☆ 📺 🧩 🚪

# ▲	Name	Volume(24h)	% Mkt Share	No. Markets	Type	Launched	Vol. Graph (7d)
133	dswapchain	\$0	--	5	Swap	Sep 2020	
134	BEPswap	\$0	--	12	Swap	Aug 2020	
135	IDEX BSC	\$0	--	3	Orderbook	Jan 2021	
136	PlasmaSwap (ETH)	\$0 ▼ 100%	--	10		Feb 2021	
137	MDEX(BSC)	\$0	--	69	Swap	Apr 2021	
138	WaultSwap (BSC)	\$0	--	57		Apr 2021	
139	Nowswap	\$0	--	1		Apr 2021	
140	Unifi Protocol DAO	\$0	--	1		Nov 2020	

x140



WHAT IS YOUR MAIN ADVANTAGE?



FILM: LIMILESS



WHAT ARE THE DANGERS?

ARBITRAGE DANGERS

CALCULATION

- POOR EXCHANGE API
- LATENCY
- PICNIC
- CALL LIMITS
- CONVERSION

EXECUTION

- SLIPPAGE
- GAS FEES
- MANUAL VS AUTO
- COMPETITION
- DOMAIN

WHY WILL YOU SUCCEED



PRINCIPLE BASED
LEARNING



SANITY CHECKING



PERSISTENCE

COURSE STRUCTURE

INTRODUCTION

INTUITION

PROGRAMMING BASICS

CEFI Triangular Arbitrage

DEFI Triangular Arbitrage

Python

JavaScript

INTUITION

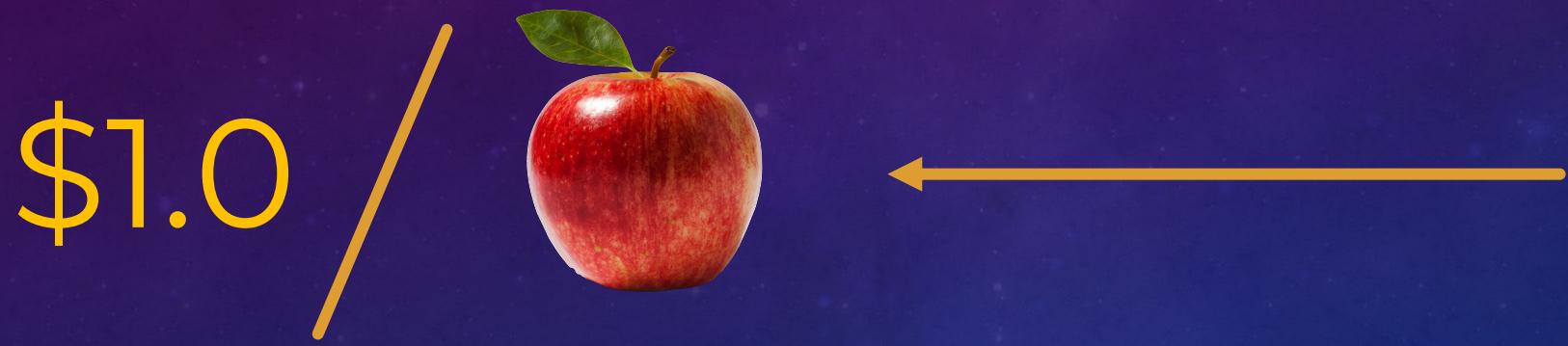


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WHAT IS TRIANGULAR ARBITRAGE?

WHAT IS STANDARD ARBITRAGE?



Shop A



WHAT IS STANDARD ARBITRAGE?



Shop A



Shop B



WHAT IS STANDARD ARBITRAGE?



+ 20% Gain



Shop A



Shop B





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Shop A
Apple / Orange
 

0.5

Shop A

 Apple / Banana 

1.2

1.5

Shop A
Orange / Banana
 

BASIC TRIANGULAR ARBITRAGE
EXAMPLE



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Shop A
Apple / Orange
 

0.8

Shop A
 Apple / Banana 

Trade 1

1.2

1.5

Shop A
Orange / Banana
 

BASIC TRIANGULAR ARBITRAGE
EXAMPLE

Trade 1

10 Apples x 1.2 = 12 Bananas



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Shop A
Apple / Orange
 

0.8

Shop A
 Apple / Banana 

Trade 1

1.2

Shop A
Orange / Banana
 

Trade 2

12 Bananas x (1 / 1.5) = 8 Oranges

BASIC TRIANGULAR ARBITRAGE
EXAMPLE

Trade 1

10 Apples x 1.2 = 12 Bananas



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Shop A
Apple / Orange
 



BASIC TRIANGULAR ARBITRAGE
EXAMPLE

Trade 1

10 Apples x 1.2 = 12 Bananas

Trade 2

12 Bananas x (1 / 1.5) = 8 Oranges

Trade 3

8 Oranges x (1 / 0.5) = 16 Apples

Shop A
Orange / Banana
 



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Additional
X6 Apples

+ 60%

Shop A
Apple / Orange



Trade 3
0.5

Shop A
Apple / Banana



Apple / Banana



Trade 1

1.2

Trade 1

10 Apples x 1.2 = 12 Bananas

Trade 2

12 Bananas x (1 / 1.2) = 8 Oranges

Trade 3

8 Oranges x (1 / 0.5) = 16 Apples

Shop A
Orange / Banana



Trade 2
1.5

BASIC TRIANGULAR ARBITRAGE
EXAMPLE



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BASE	QUOTE	BaseToQuote	QuoteToBase	10 Start Apples		
APPLE	BANANA	0.83	1.20	12.0	Bananas	T1
ORANGE	BANANA	0.67	1.50	8.0	Oranges	T2
APPLE	ORANGE	2.00	0.50	16.0	End Apples	T3

Calculation Rules

BASE	QUOTE	BaseToQuote	QuoteToBase	100 Start USD		
GBP	USD	0.80	1.25	80.0	GBP	T1
EUR	USD	0.85	1.18	100.1	End USD	T3
GBP	EUR	0.94	1.06	84.8	EUR	T2

Calculation Rules



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BASE	QUOTE	BaseToQuote	QuoteToBase	100 Start USDT		
USDT	BTC	0.000021000000	47619.047619047600	0.0021000000	BTC	T1
ETH	BTC	0.079365079365	12.60000000000000	0.0264600000	ETH	T2
USDT	ETH	0.000263000000	3802.281368821290	100.6083650190	End USDT	T3

Calculation Rules

Calculation Rules

1. Establish the 1/Price based on strength and quoting structure
2. Where Bid/Ask is involved, always assume you get the worst price if in doubt
3. Each triangular group should have two of each item

INTUITION



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SURFACE VS DEPTH



SURFACE VS DEPTH

Surface Rate

The rate in which an arbitrage opportunity shows at the best price, excluding depth

Example output:



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```
{  
  "BTC_BTS": {  
    "id": 14,  
    "last": "0.00000090",  
    "lowestAsk": "0.00000091",  
    "highestBid": "0.00000089",  
    "percentChange": "-0.02173913",  
    "baseVolume": "0.28698296",  
    "quoteVolume": "328356.84081156",  
    "isFrozen": "0",  
    "postOnly": "0",  
    "high24hr": "0.00000093",  
    "low24hr": "0.00000087"  
  },  
  ...  
  "USDT_BTC": {  
    "id": 121,  
    "last": "49180.04839060",  
    "lowestAsk": "49180.04839060",  
    "highestBid": "49180.04839059",  
    "percentChange": "0.03239621",  
    "baseVolume": "21455272.54522586",  
    "quoteVolume": "443.41063575",  
    "isFrozen": "0",  
    "postOnly": "0",  
    "high24hr": "49752.00000000",  
    "low24hr": "46906.00000001"  
  }  
}
```

SURFACE VS DEPTH

Real Rate

The arbitrage rate calculated after taking into account all prices based upon trading input /exchange capital.

Example output for a selected market:

```
{  
  "asks": [  
    ["0.06888014", 0.1],  
    ["0.06888703", 0.3],  
    ["0.06890651", 1],  
    ["0.06896540", 0.6],  
    ["0.06898010", 1.75],  
    ...  
  ],  
  "bids": [  
    ["0.06887324", 3.1627875],  
    ["0.06886100", 2.8904],  
    ["0.06885672", 3],  
    ["0.06885041", 1],  
    ["0.06884079", 1],  
    ...  
  ],  
  "isFrozen": "0",  
  "postOnly": "0",  
  "seq": 1262665345  
}
```