



Cross Market Surveillance

Inca Digital combines crypto trading data from 300+ markets and performs cross-market surveillance, analyzing for price, liquidity, fake trading volumes, wash trading, front-running, and more.

First Digit distribution

This distribution was calculated by counting leading digits for volume numbers of all trades for the chosen date and then counting their relative percentage values, represented by bars. The line represents theoretical Benford's Law distribution.



The critical value for Benford's 1st digit distribution

- Chi-square test - **13.362**
- K-S test - **0.432**

By comparing test statistics with the reference values a user checks the goodness of fit, in particular, the fact that the data comes from the specified distribution.

Market Venue/Test	Chi - square	Goodness of Fit	Kolmogorov-Smirnov	Goodness of Fit
BYBIT	12.004	DIFFERENT	0.03	GOOD FIT
COINBASE	1.993	DIFFERENT	0.05	GOOD FIT

Second Digit distribution

The expected third digit test is further more even than the expected second digit distribution.



The critical value for Benford's 2nd digit distribution

- Chi-square test - **14.684**
- K-S test - **0.410**

By comparing test statistics with the reference values a user checks the goodness of fit, in particular, the fact that the data comes from the specified distribution.

Market Venue/Test	Chi - square	Goodness of Fit	Kolmogorov-Smirnov	Goodness of Fit
BYBIT	3.959.37	DIFFERENT	0.03	GOOD FIT
COINBASE	430.95	DIFFERENT	0.04	GOOD FIT

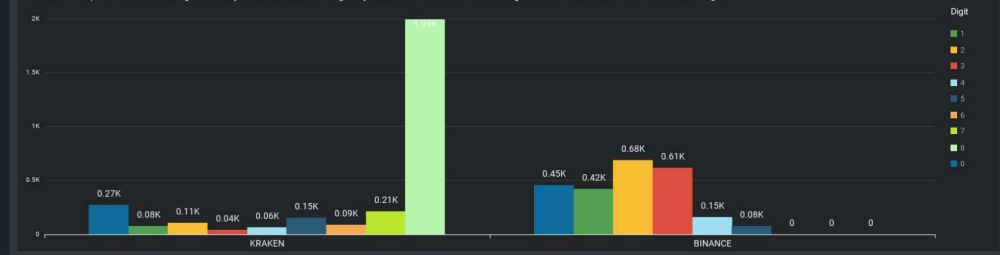
Potential Wash Trade Events

This table shows outstanding trade volumes according to Inca Inflated Volume Score which catches volume surges executed at suspiciously low volatility periods. This is a commonly observed scenario for the way exchanges demonstrate fake activity.

Date	Market Venue Pair	Volume	Number of trades	Trade value	Trade Price
Nov 14, 2022 4:00pm	BINANCE:BTC-AAVE	1.78	5	0.0062	0.0035
Nov 14, 2022 4:00pm	BINANCE:BTC-AVAX	37.06	19	0.0296	0.0068
Nov 14, 2022 4:00pm	BINANCE:BTC-LTC	44.28	13	0.1505	0.0034
Nov 14, 2022 4:00pm	BINANCE:BTC-SOL	1,250.13	301	1.0001	0.0068
Nov 14, 2022 4:00pm	BINANCE:BTC-LUNI	31.46	8	0.0125	0.0064
Nov 14, 2022 4:00pm	KRAKEN:BTC-ETH	3	2	0.2250	0.0750
Nov 14, 2022 4:00pm	KRAKEN:BTC-SOL	8.75	2	0.0070	0.0068
Nov 14, 2022 3:59pm	BINANCE:BTC-AAVE	0.6	1	0.0021	0.0035
Nov 14, 2022 3:59pm	BINANCE:BTC-AVAX	35.71	8	0.0285	0.0068
Nov 14, 2022 3:59pm	BINANCE:BTC-ETH	27.04	90	2.0310	0.0751
Nov 14, 2022 3:59pm	BINANCE:BTC-LTC	22.19	7	0.0754	0.0034
Nov 14, 2022 3:59pm	BINANCE:BTC-SOL	838.46	142	0.6707	0.0068
Nov 14, 2022 3:59pm	BINANCE:BTC-LUNI	81.36	8	0.0325	0.0064
Nov 14, 2022 3:58pm	KRAKEN:BTC-LTC	0.94	9	0.0993	0.0094

Percentage of trades by digits number

The percentage of trades by degree of rounding refers to the number of trades executed at whole numbers, or 1-9 decimal places denominated by the symbol. This statistic depends on the exchange as it may limit the number of digits by default to some level. Use the legend to associate a bar with a number of digits.



Delivery:

- Websocket API Streaming
- REST API (1-minute, 1-hour windows)
- Kafka Streaming
- AWS QuickSight with alerting functionality

Metrics include:

Price Disparity

User sets flag/alert for any pair X% away from average price.

Benford's Law

Trade size distribution analysis by the leading digit/second digit/third digit. Benford's law is often used by auditors to spot fake financial reporting.

Volume Distribution

Identifies and flags volume spikes over time that indicate anomalies in trading behavior.

Time Of Trade

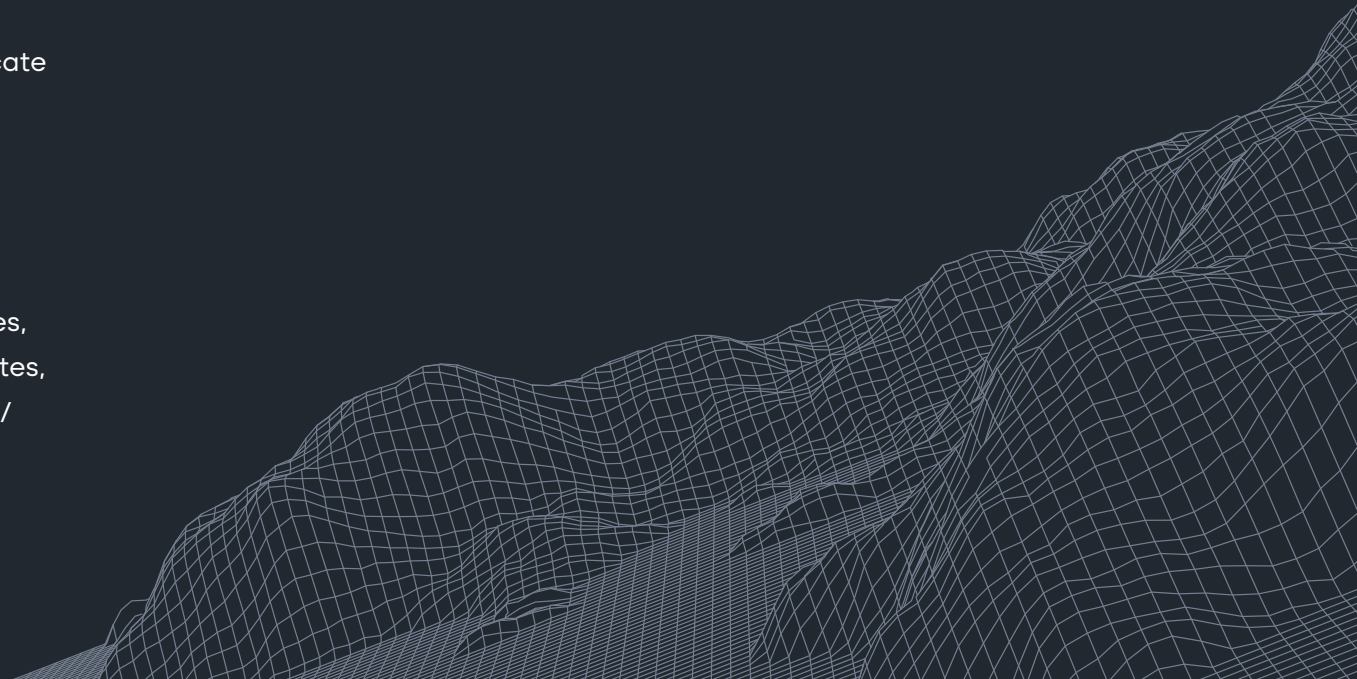
Distribution of the volume of trades by econds/minutes, distribution of the number of trades by seconds/minutes, distribution of the quote volume of trades by seconds/minutes.

Inflated Volume Score

Inca-derived metric based on the correlation between price volatility and trade volume for a given pair.

Trades by degree of rounding

Identify market manipulation by analyzing frequency distributions for logged trade volumes, which should have a near linear relationship with a negative slope, and a long tail (at the high end of trade size).



Inca calculates VWAP as it adjusts the average price for the trading volume.

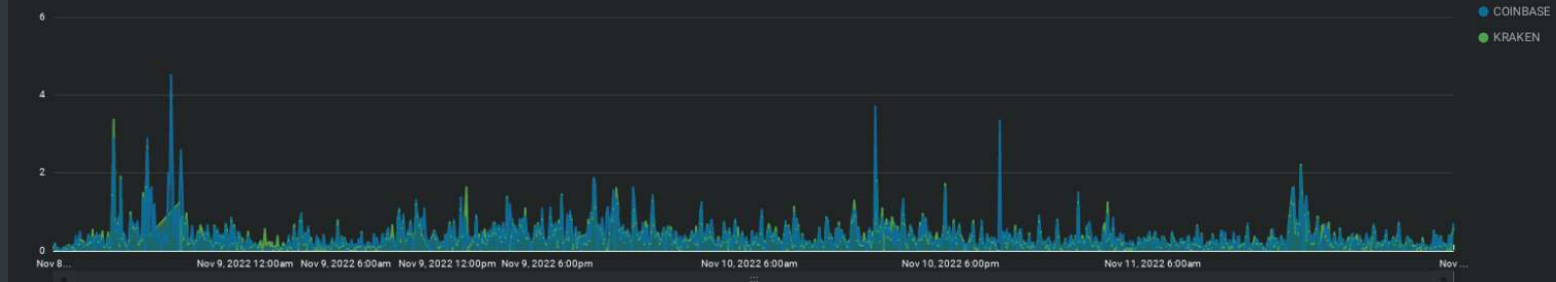
VWAP



VWAP Discrepancy - 5 minutes span

Market Venue	COINBASE	KRAKEN
Max Price Discrepancy	37.02%	37.13%

This time chart is meant to identify percentage price discrepancies between the picked market venues and Inca's Price Index.



This presents the **maximum price difference** across the different venues. The list includes the top 20 spot exchanges by volume.

