Market Data Documentation

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Contents

1 Introduction

This document provides an overview of the data concepts and coverage universe from the Coin Metrics Market Data Feed, Coin Metrics Reference Rates, and Coin Metrics Bletchley Indexes (CMBI).

2 Data Concepts

Coin Metrics provides data for the following data concepts:

- Trades
- Candles
- Quotes
- Order Books
- Futures Contract Specifications
- Futures Open Interest
- Futures Liquidations
- Futures Funding Rates
- Reference Rates
- Real-Time Reference Rates
- Index Levels
- Index Constituents

In the following sections, we provide a conceptual definition and background information for each data concept. A sample of the data concept is provided followed by a description of each field within the data sample. Each section concludes by describing the coverage universe of the data concept.

2.1 Trades

2.1.1 Conceptual Definition

Trades represent the exchange of a financial asset between a buyer and seller from a market on a trading exchange. In this context, a financial asset can be a cryptoasset, a fiat currency, or a cryptoasset derivatives contract.

Markets can be categorized into spot and derivatives markets. A spot market represents a trading pair in which a buyer exchanges units of one asset in return for units of another asset in amounts specified by the market's price or exchange rate. By convention, the exchange rate consists of a base asset and a quote asset and represents the number of units of the quote asset needed to buy one unit of the base asset. Cryptoassets and fiat currencies can serve as either base assets or quote assets, depending on the market.

Derivatives markets represent a venue where contracts of a financial derivative are bought and sold. Instead of an exchange rate, the price of a derivatives market represents the price of one contract. Each financial derivatives contract has unique contract specifications which describe how the contract is quoted and the amount of notional exposure that a contract represents.

2.1.2 Data Sample

A sample of the trades data from Coinbase's Bitcoin-U.S. Dollar spot market is provided below.

market	time	coin_metrics_id	amount	price	database_time	side
coinbase-btc-usd-spot	2020-12-04 22:54:35	112476735	0.1235213	18745.17	2020-12-04 22:54:35	sell
coinbase-btc-usd-spot	2020-12-04 22:54:36	112476736	0.0010826	18750.00	2020-12-04 22:54:36	buy
coinbase-btc-usd-spot	2020-12-04 22:54:36	112476737	0.0027437	18751.50	2020-12-04 22:54:36	buy
coinbase-btc-usd-spot	2020-12-04 22:54:36	112476738	0.0379907	18751.50	2020-12-04 22:54:36	buy
coinbase-btc-usd-spot	2020-12-04 22:54:36	112476739	0.0091300	18754.03	2020-12-04 22:54:36	buy

Field Descriptions:

- **market**: The id of the market. Market ids use the following naming convention: exchangeName-baseAsset-quoteAsset-spot for spot markets and exchangeName-futuresSymbol-future for futures markets.

- **time**: The exchange-reported time in ISO 8601 date-time format.

- **coin_metrics_id**: Identifier of a trade that is unique per exchange. We use the exchange-reported value if exchange reports a numeric trade id, otherwise we convert to numeric using bijective mapping from exchange-reported trade id's string.

- **amount**: The amount of the base asset traded for spot markets or the number of contracts of a financial derivative.

- **price**: The price of the base asset quoted in the quote asset that the trade was executed at for spot markets or the price of one contract for derivatives markets.

- **database_time**: The time that the trade was inserted into our database in ISO 8601 date-time format.

- **side**: The side that is taking liquidity. A value of "buy" means that an ask was removed from the order book by an incoming buy order, while "sell" means that a bid was removed from the order book by an incoming sell order.

2.1.3 Coverage Universe

The coverage universe for trades consists of the following:

- 1,654 assets

- 31 exchanges

- 9,019 spot markets

- 2,013 futures markets

For a full list of assets, exchanges, spot markets, and futures markets, please consult the Coin Metrics Data Coverage file.

The coverage universe by exchange including the number of spot and futures markets and when coverage began for these markets is presented below. Certain exchanges do not allow users to query historical data, so data for those exchanges begin at the date that Coin Metrics began collection. Other exchanges allow users to query all historical data, so our coverage for these exchanges begins at exchange inception.

	Spot Markets		Futures Markets	
Exchange Name	Count	Start Date	Count	Start Date
bibox	202	2019-04-24	NA	NA
binance	1089	2017-07-14	115	2019-09-08
binance.us	105	2019-09-23	NA	NA
bitbank	11	2017-02-14	NA	NA
bitfinex	445	2013-01-14	18	2019-07-03
bitflyer	6	2019-05-28	22	2020-07-27
bithumb	91	2013-12-27	NA	NA
bitmex	NA	NA	237	2014-11-22
bitstamp	36	2011-08-18	NA	NA
bittrex	667	2019-03-21	NA	NA
cex.io	164	2013-12-27	NA	NA
coinbase	106	2014-12-01	NA	NA
deribit	NA	NA	54	2017-01-06
ftx	289	2019-07-21	379	2019-03-05
gate.io	612	2017-09-29	NA	NA
gatecoin	80	2014-11-11	NA	NA
gemini	45	2018-10-16	NA	NA
hitbtc	1164	2013-12-27	NA	NA
huobi	776	2019-03-15	588	2020-06-12
itbit	7	2019-03-13	NA	NA
kraken	247	2013-09-10	17	2020-09-06
kucoin	517	2020-04-02	NA	NA
lbank	273	2017-09-29	NA	NA
liquid	421	2014-07-17	NA	NA
localbitcoins	111	2013-03-11	NA	NA
mt.gox	16	2010-07-17	NA	NA
okex	524	2018-12-25	583	2019-12-25
poloniex	318	2014-01-18	NA	NA
therocktrading	24	2011-11-09	NA	NA
upbit	401	2019-03-14	NA	NA
zb.com	272	2019-03-04	NA	NA

2.2   Candles

2.2.1   Conceptual Definition

Candles consist of summary statistics that describe the trading activity of a market over an interval of time. Coin Metrics engineers six statistics based on trades data that occurred over an interval of time: the opening price, the high price, the low price, the close price, the volume-weighted average price, and the total volume. Candles are generated at regular time intervals and at a time granularity that is suitable for charting and analysis. For instance, several technical analysis indicators can be calculated using data in candles format.

2.2.2   Data Sample

A sample of the candles data from Coinbase's Bitcoin-U.S. Dollar spot market is provided below.

market	time	price_open	price_close	price_high	price_low	vwap	volume
coinbase-btc-usd-spot	2020-11-29	17736.10	18202.03	18359.00	17535.26	18017.83	8932.25
coinbase-btc-usd-spot	2020-11-30	18202.02	19713.93	19873.23	18201.47	19173.64	27293.48
coinbase-btc-usd-spot	2020-12-01	19713.94	18782.97	19915.14	18109.00	19122.08	30442.87
coinbase-btc-usd-spot	2020-12-02	18778.18	19225.63	19340.00	18335.00	18908.35	16227.14
coinbase-btc-usd-spot	2020-12-03	19222.45	19448.64	19625.64	18885.00	19304.86	14648.24

Column definitions:

- **market**: The id of the market. Market ids use the following naming convention: exchangeName-baseAsset-quoteAsset-spot for spot markets and exchangeName-futuresSymbol-future for futures markets.

- **time**: The time at the beginning of the candle's time interval in ISO 8601 date-time format.

- **price_open**: The opening price of the candle.

- **price_high**: The high price of the candle.

- **price_low**: The low price of the candle.

- **price_close**: The closing price of the candle.

- **vwap**: The volume-weighted average price of the candle.

- **volume**: The volume of the candle in units of the base asset.

2.2.3 Coverage Universe

Coin Metrics produces candles at the following time granularities:

- 5 minutes

- 10 minutes

- 15 minutes

- 30 minutes

- 1 hour

- 4 hours

- 1 day

Coin Metrics derives candles directly from trades. Candles are only generated if there are trades in the underlying interval. Therefore, gaps in candles data through time are normal and to be expected. To construct gapless candles, the user should fill forward candles through time, setting the open, high, low, and close to the close of the previous candle, setting the vwap to the vwap of the previous candle, and setting the volume to zero. Forward filling in this manner allows windowing functions to be applied to the data.

Since candles are derived from trades, the coverage universe of assets, exchanges, spot markets, and futures markets for candles is identical to the coverage universe of trades described in Section 2.1.3.

2.3 Quotes

2.3.1 Conceptual Definition

Quotes consist of the best bid and the best ask for a market at a given point in time. The best bid represents the highest price that a buyer is willing to pay and the number of units of the base asset for a spot market or number of contracts for a derivatives market. The best ask is conceptually identical but represents the lowest price that a seller is willing to sell.

2.3.2 Data Sample

A sample of the quotes data from Coinbase's Bitcoin-U.S. Dollar spot market is provided below.

market	time	coin_metrics_id	ask_price	ask_size	bid_price	bid_size
coinbase-btc-usd-spot	2020-12-04 22:49:16	1607055442485455-17881693	18837.92	0.0042154	18837.68	0.0296887
coinbase-btc-usd-spot	2020-12-04 22:49:25	1607047141955063-19974715	18801.43	0.0452408	18797.46	0.1500000
coinbase-btc-usd-spot	2020-12-04 22:49:26	1607055442485455-17886038	18794.29	1.1000000	18794.28	0.0400000
coinbase-btc-usd-spot	2020-12-04 22:49:35	1607047141955063-19978727	18778.68	1.0764502	18777.62	0.0400000
coinbase-btc-usd-spot	2020-12-04 22:49:36	1607055442485455-17889974	18775.56	0.5400000	18773.97	0.0067570

Column definitions:

- **market**: The id of the market. Market ids use the following naming convention: exchangeName-baseAsset-quoteAsset-spot for spot markets and exchangeName-futuresSymbol-future for futures markets.

- **time**: The exchange-reported time in ISO 8601 date-time format.

- **coin_metrics_id**: Unique identifier of the quotes snapshot.

- **ask_price**: The limit price of the top ask on the order book.

- **ask_size**: The size of the top ask on the order book in units of the base asset for a spot market or number of contracts for a derivatives market.

- **bid_price**: The limit price of the top bid on the order book.

- **bid_size**: The size of the top bid on the order book in units of the base asset for a spot market or number of contracts for a derivatives market.

2.3.3 Coverage Universe

Coin Metrics stores historical quotes snapshots approximately every 10 seconds for the following 19 markets.

Exchange Name	Market ID	Start Date
binance.us	binance.us-btc-usd-spot	2020-01-27
bitfinex	bitfinex-btc-usd-spot	2019-03-25
bitfinex	bitfinex-eth-usd-spot	2019-03-25
bitflyer	bitflyer-btc-usd-spot	2019-12-06
bitstamp	bitstamp-btc-usd-spot	2019-03-25
bitstamp	bitstamp-eth-usd-spot	2019-03-25
bittrex	bittrex-btc-usd-spot	2019-03-25
bittrex	bittrex-eth-usd-spot	2019-03-25
cex.io	cex.io-btc-usd-spot	2019-12-06
coinbase	coinbase-btc-usd-spot	2019-03-25
coinbase	coinbase-eth-usd-spot	2019-03-25
gemini	gemini-btc-usd-spot	2019-03-25
gemini	gemini-eth-usd-spot	2019-03-25
itbit	itbit-btc-usd-spot	2019-03-25
itbit	itbit-eth-usd-spot	2019-03-25
kraken	kraken-btc-usd-spot	2019-03-25
kraken	kraken-eth-usd-spot	2019-03-25
liquid	liquid-btc-usd-spot	2019-03-25
liquid	liquid-eth-usd-spot	2019-03-25

2.4 Order Books

2.4.1 Conceptual Definition

An order book represents the list of buy orders and the list of sell orders for a given market organized by price level. In this context, a buy order or sell order indicates the amount of the base asset that a buyer or seller wishes to trade for a spot market or the amount of contracts for a derivatives market. By using the order book, a trader is able to observe the amount that other traders are willing to buy or sell at given price levels.

The price and amount that a trader is willing to buy is referred to as the bid. The price and amount that a trader is willing to sell is referred to as the ask. When a trade is executed between a buyer and a seller, an order is removed from the order book. While an order book is constantly updated in real-time as

traders post new orders and as orders are matched, this data concept represents a snapshot of the order book at a given moment in time.

2.4.2 Data Sample

A sample of the order book data from Coinbase's Bitcoin-U.S. Dollar spot market is provided below. The bid side of the order book and the ask side of the order book are displayed in separate tables.

market	time	coin_metrics_id	bids_price	bids_size
coinbase-btc-usd-spot	2020-12-04 22:49:26	1607055442485455-17886038	18794.28	0.040000
coinbase-btc-usd-spot	2020-12-04 22:49:26	1607055442485455-17886038	18792.65	2.678000
coinbase-btc-usd-spot	2020-12-04 22:49:26	1607055442485455-17886038	18791.01	0.048252
coinbase-btc-usd-spot	2020-12-04 22:49:26	1607055442485455-17886038	18791.00	0.001332
coinbase-btc-usd-spot	2020-12-04 22:49:26	1607055442485455-17886038	18790.40	0.005313

market	time	coin_metrics_id	asks_price	asks_size
coinbase-btc-usd-spot	2020-12-04 22:49:26	1607055442485455-17886038	18794.29	1.100
coinbase-btc-usd-spot	2020-12-04 22:49:26	1607055442485455-17886038	18797.45	0.159
coinbase-btc-usd-spot	2020-12-04 22:49:26	1607055442485455-17886038	18799.93	0.200
coinbase-btc-usd-spot	2020-12-04 22:49:26	1607055442485455-17886038	18800.14	0.797
coinbase-btc-usd-spot	2020-12-04 22:49:26	1607055442485455-17886038	18800.47	0.250

Column definitions:

- **market**: The id of the market. Market ids use the following naming convention: exchangeName-baseAsset-quoteAsset-spot for spot markets and exchangeName-futuresSymbol-future for futures markets.

- **time**: The time of the order book snapshot in ISO 8601 date-time format.

- **coin_metrics_id**: Unique identifier of object.

- **asks_price**: The limit price of the ask order on the order book.

- **asks_size**: The size of the ask order on the order book in units of the base asset.

- **bids_price**: The limit price of the bid order on the order book.

- **bids_size**: The size of the bid order on the order book in units of the base asset.

2.4.3 Coverage Universe

Coin Metrics stores historical order book snapshots approximately every 10 seconds. The snapshots consist of the top 100 bids and top 100 asks. The coverage universe for order books is identical to the coverage universe for quotes described in section 2.3.3.

2.5 Futures Contract Specifications

2.5.1 Conceptual Definition

A futures contract is a financial derivative traded on an exchange that allows a buyer and seller to enter into a legal agreement to buy or sell an underlying asset. The term futures contract refers to both traditional futures contracts which specify a defined time when the futures contract expires and perpetual futures which simulate a traditional futures contract with the exception that it never expires.

Futures contracts can be described by their contract specifications which describe the underlying asset, how it is quoted, the date of expiration, the size of the contract, and other specifications necessary for market participants to enter into the contract. Each futures contract traded with the same symbol on a specified exchange are standardized, however, differences between contracts on the same exchange and between contracts on different exchanges exist.

2.5.2 Data Sample

market	type	min_time	max_time	base	quote	symbol
bitmex-XBTH20-future	future	2019-09-13 08:32:45	2020-03-27 12:00:00	btc	usd	XBTH20
bitmex-XBTM20-future	future	2019-12-13 08:30:53	2020-06-26 12:00:00	btc	usd	XBTM20
bitmex-XBTU20-future	future	2020-03-13 08:31:06	2020-09-25 12:00:00	btc	usd	XBTU20
bitmex-XBTZ20-future	future	2020-06-12 08:00:27	2020-12-04 22:49:23	btc	usd	XBTZ20
bitmex-XBTUSD-future	future	2015-09-25 12:34:25	2020-12-04 22:49:25	btc	usd	XBTUSD

market	size_asset	margin_asset	contract_size	tick_size	listing	expiration
bitmex-XBTH20-future	usd	btc	1	0.5	2019-09-13 08:00:00	2020-03-27 12:00:00
bitmex-XBTM20-future	usd	btc	1	0.5	2019-12-13 08:00:00	2020-06-26 12:00:00
bitmex-XBTU20-future	usd	btc	1	0.5	2020-03-13 08:00:00	2020-09-25 12:00:00
bitmex-XBTZ20-future	usd	btc	1	0.5	2020-06-12 08:00:00	2020-12-25 12:00:00
bitmex-XBTUSD-future	usd	btc	1	0.5	2016-05-13 12:00:00	NA

Column definitions:

- **market**: The id of the market. Market ids use the following naming convention: exchangeName-baseAsset-quoteAsset-spot for spot markets and exchangeName-futuresSymbol-future for futures markets.

- **type**: The type of the market. Can take values spot or future.

- **min_time**: Minimal available time for data from this market.

- **max_time**: Maximal available time for data from this market.

- **base**: The unique name of the contract's underlying asset.

- **quote**: The unique name of the contract's asset that the underlying asset is quoted in.

- **symbol**: The exchange-reported contract symbol.

- **size_asset**: The unique name of the asset that the contract's size is denominated in.

- **margin_asset**: The unique name of the asset that the contract's margin is demoninated in.

- **contract_size**: The number of units of **size_asset** that one contract represents.

- **tick_size**: The minimum price increment of the contract's price.

- **listing**: The timestamp that the contract first became available for trading.

- **expiration**: The timestamp that the contract expires. Equals null if contract is a perpetual future that never expires.

2.5.3 Coverage Universe

The coverage universe for futures contract specification includes all 2,013 futures markets that are described in the coverage universe for trades described in section 2.1.3.

2.6 Futures Open Interest

2.6.1 Conceptual Definition

Open interest represents the number of futures contracts that are currently outstanding and not settled. Each contract has a specified contract value that can be described by the size asset and contract size. Information about contract values can be found in the futures contract specifications. For instance, one contract of BitMEX's XBTUSD perpetual futures contract allows for notional exposure worth 1 USD. Other exchanges have their own contract specifications. In addition to representing open interest as the number of contracts, we also offer open interest converted to U.S. dollars using the available prices on each exchange.

2.6.2 Harmonization Discussion

Certain exchanges follow an integer contract size convention – buyers and sellers buy or sell a specified integer number of contracts and transacting in fractional contracts are not possible. However, some exchanges's perpetual futures contracts do not follow the integer contract size convention. Instead, they allow traders to trade these futures contracts much like how spot markets trade. Instead of buying and selling a specified integer number of contracts, traders can buy or sell a specified exposure in fractional units of the base asset. Therefore, certain exchanges report their open interest in fractional amounts.

All exchanges with the exception of Binance offer open interest that changes in real-time. Binance updates their open interest roughly once every 15 minutes.

2.6.3 Data Sample

market	time	contract_count	value_usd	database_time	exchange_time
bitmex-XBTUSD-future	2020-12-04 22:49:00	458166165	458166165	2020-12-04 22:49:00	2020-12-04 22:48:55
bitmex-XBTUSD-future	2020-12-04 22:49:54	457681660	457681660	2020-12-04 22:49:55	2020-12-04 22:49:53
bitmex-XBTUSD-future	2020-12-04 22:50:00	457672932	457672932	2020-12-04 22:50:00	2020-12-04 22:50:00
bitmex-XBTUSD-future	2020-12-04 22:50:54	457838562	457838562	2020-12-04 22:50:55	2020-12-04 22:50:51
bitmex-XBTUSD-future	2020-12-04 22:51:00	457839702	457839702	2020-12-04 22:51:00	2020-12-04 22:50:55

Column definitions:

- **market**: The id of the market. Market ids use the following naming convention: exchangeName-baseAsset-quoteAsset-spot for spot markets and exchangeName-futuresSymbol-future for futures markets.

- **time**: The time at which Coin Metrics queried the open interest data from an exchange in ISO 8601 date-time format.

- **contract_count**: The open interest denominated in number of contracts.

- **value_usd**: The open interest denominated in U.S. dollars.

- **database_time**: The timestamp when the data was saved in the database in ISO 8601 date-time format with nanoseconds precision.

- **exchange_time**: The timestamp reported by the exchange. Can be NULL if the exchange does not report.

2.6.4 Coverage Universe

Open interest is sampled roughly once a minute for every futures contract in our coverage universe. The coverage universe for open interest includes all 2,013 futures markets that are described in the coverage universe for trades described in section 2.1.3.

2.7 Futures Liquidations

2.7.1 Conceptual Definition

Futures contracts enable market participants to trade with leverage – that is, market participants are allowed to have a position with notional value greater than the amount of money they have in their account. This raises the possibility that market participants can lose more money than have in their account. To address this possibility, exchanges which offer futures products have a liquidation system that will attempt to close a market participant's position before the point at which the market participant begins to owe more than what is in his account.

A simplified example illustrates the process. Suppose a trader deposits $100 into an exchange and buys $10,000 worth of Bitcoin perpetual contracts resulting in a leverage of 100x. Also, suppose the current price of Bitcoin is $10,000. If the price declines to $9,900 (the "bankruptcy price"), the trader would be bankrupt. Therefore, the exchange sets the liquidation price for this trader's position at $9,925 (the "liquidation price"). If the price declines to this liquidation price, the exchange will forcibly initiate a sell liquidation order to attempt to close the trader's position.

2.7.2 Harmonization Discussion

Our liquidation data harmonizes liquidations data across various exchanges. Here we discuss some differences in how various exchanges report their liquidations data.

- **Liquidation orders versus liquidation trades:** Some exchanges report "liquidations orders" in which they will report the creation of a liquidation order when a trader's position initially enters liquidation. When a trader's position enters liquidation, an exchange will typically enter a limit order at the price at which the trader will be bankruptcy price. The liquidation orders will show the amount of the position that is being liquidated and the liquidation price, but will not represent the matched trades that are executed as a result of the liquidation. Other exchanges will report "liquidation trades" which represent the actual matched trades as a result of a liquidation order but will not report liquidation orders. Some exchanges will report both liquidation orders and liquidation trades.

- **Aggregated liquidation trades versus individual liquidation trades:** For the exchanges that report liquidation trades, the exchange can report it in aggregated or individual format. Exchanges that report liquidation trades in aggregated format means that even if the liquidation involved several matched trades, the exchange will report it as one aggregated trade representing the sum of the amount liquidated and the

average price of the liquidations. Other exchanges report liquidation trades in individual trade format such that one liquidation can be reported via multiple observations representing the multiple matched trades.

- **With original position data versus without original position data:** Some exchanges report data about the position that is liquidated such as the original quantity and the original price that the position was entered into while others do not.

- **With history versus without history:** Similar to trades data, certain exchanges allow us to query historical liquidation data while others do not.

To deal with the differences described above, here we harmonize the data in the following way:

- If an exchange reports both liquidation orders and liquidation trades, we store both types of observations and differentiate the two types with the `type` column.

2.7.3 Data Sample

market	time	coin_metrics_id	amount	price	type	database_time	side
bitmex-XBTUSD-future	2020-12-04 21:29:45	69821901259791240251768097561934561280	20000	18853.5	order	2020-12-04 21:29:45	sell
bitmex-XBTUSD-future	2020-12-04 21:29:59	208007914544160744201282257083569274880	500	18850.0	order	2020-12-04 21:29:59	sell
bitmex-XBTUSD-future	2020-12-04 21:46:45	175362762191571835180014168837109841920	27100	18843.5	order	2020-12-04 21:46:45	sell
bitmex-XBTUSD-future	2020-12-04 21:47:11	336175735440166310899147381109931638784	1000	18832.5	order	2020-12-04 21:47:11	sell
bitmex-XBTUSD-future	2020-12-04 21:52:54	333062415486069146742385345605169840128	7332	18772.5	order	2020-12-04 21:52:54	sell

Column definitions:

- `market`: The id of the market. Market ids use the following naming convention: exchangeName-baseAsset-quoteAsset-spot for spot markets and exchangeName-futuresSymbol-future for futures markets.

- `time`: The time at which Coin Metrics queried the open interest data from an exchange in ISO 8601 date-time format.

- `coin_metrics_id`: The id of a liquidation (unique per exchange). We are using exchange reported value if exchange reports a numeric liquidation id, otherwise we convert to numeric using Bijective mapping from exchange reported liquidation id's string.

- `amount`: The amount of the base asset liquidated.

- `price`: The price of the base asset quoted in the quote asset that the liquidation was executed at.

14

- **side**: The market order side. "buy" means that an ask was removed from the book by an incoming buy order, "sell" means that a bid was removed from the book by an incoming sell order.

- **type**: The liquidation type. "trade" means that liquidation was executed, "order" means that the order was placed for the liquidation at the timestamp of the data entry but it wasn't necessarily executed yet.

- **database_time**: The timestamp when the data was saved in the database in ISO 8601 date-time format with nanoseconds precision.

2.7.4   Coverage Universe

The coverage universe for open interest includes all 2,013 futures markets that are described in the coverage universe for trades described in section 2.1.3.

2.8   Futures Funding Rates

2.8.1   Conceptual Definition

Traditional futures contracts expire at a specified date in the future. At expiration, traditional futures contracts will settle at a price based on the futures contract underlying's spot price. This causes the futures contract's price to converge to the underlying's spot price at expiration.

Perpetual futures contracts are similar to traditional futures contracts except that they never expire. To ensure that the perpetual futures contracts trade a price that is close to the underlying's spot price, exchanges created a mechanism called the funding rate. Under this mechanism, there are periodic funding payments between long position holders and short position holders depending on whether the perpetual future's price is higher or lower than the underlying's spot price.

While the formula for how the funding rate is calculated varies by exchange, the general principle is that the funding rate is positive if the perpetual futures's price is higher than the underlying's spot price and negative if the perpetual futures's price is lower than the underlying's spot price.

If the funding rate is positive, long position holders will pay the funding payment to short position holders. If the funding rate is negative, short position holders will pay the funding payment to long position holders. Therefore, the funding rate mechanism encourages traders to take positions that keep perpetual futures's prices in line with the underlying's spot price.

2.8.2   Harmonization Discussion

Exchanges differ in their funding rate mechanism design and how they report the data through their API. This section will discuss the key differences between exchanges and our approach to creating a harmonized data model.

- **Realized funding rate versus predicted funding rate:** Many exchanges report two different funding rates. The realized funding rate represents the actual funding rate calculated over the previous funding interval that is used in determining the funding payment. The predicted funding rate is the current estimate of what the funding rate will be at the end of the current funding interval. Some exchanges refer to this as the real-time funding rate or the next funding rate. While the predicted funding rate could be important to certain users, in this data concept we are concerned about the realized funding rate. Any references to the term "funding rate" in this document refer to the realized funding rate.

- **Funding rate period:** Interest rates represent the change over a defined period of time. Many interest rates we encounter in daily life are reported on an annualized basis (a period of one year) because it is a logical period of time. But exchanges can differ on the funding rate period that they use. For many exchanges, the funding rate represents an 8 hour interest rate, so the funding rate period is 8 hours, but not all exchanges report their funding rate with the same funding rate period. We store the funding rate period as a separate column described below. With this information, a user can compare funding rates between exchanges that have different funding rate periods by converting the funding rates to a common funding period.

- **Funding interval:** The funding interval represents how often the funding rate and funding payments are calculated. For many exchanges, a funding rate is produced every 8 hours and it is calculated based on the difference between the futures's price and the spot's price over the previous 8 hours. In this case, the funding interval is 8 hours. For some exchanges, the funding rate and funding payments are calculated on a continuous basis, so the funding interval is set to 1 millisecond by convention.

- **Exchange-reported timestamp:** Exchanges differ in the how they report the timestamp associated with funding rates. Many exchanges report the funding rate as a timeseries, that is, a series of data points with timestamps that are equally spaced through time. The timestamps represent the time when the funding rate and funding payments are calculated. Other exchanges report the funding rate as a snapshot in time (similar to order book snapshots) and the exchange-reported timestamp represents the timestamp of the query. This method of reporting the funding rate requires some transformation to convert it to a timeseries. Regardless of

how the exchanges report the timestamp, we store the funding rates as a timeseries, with one observation at the end of every funding interval.

2.8.3 Data Sample

market	time	database_time	rate	period	interval
bitmex-XBTUSD-future	2020-12-03 12:00:00	2020-12-03 12:00:09	0.0001	08:00:00	08:00:00
bitmex-XBTUSD-future	2020-12-03 20:00:00	2020-12-03 20:00:05	0.0001	08:00:00	08:00:00
bitmex-XBTUSD-future	2020-12-04 04:00:00	2020-12-04 04:00:06	0.0001	08:00:00	08:00:00
bitmex-XBTUSD-future	2020-12-04 12:00:00	2020-12-04 12:00:06	0.0001	08:00:00	08:00:00
bitmex-XBTUSD-future	2020-12-04 20:00:00	2020-12-04 20:00:05	0.0001	08:00:00	08:00:00

2.8.4 Coverage Universe

The coverage universe for funding rates includes all 350 perpetual futures markets that are described in the coverage universe for trades described in section 2.1.3.

Column definitions:

- `market`: The id of the market. Market ids use the following naming convention: exchangeName-baseAsset-quoteAsset-spot for spot markets and exchangeName-futuresSymbol-future for futures markets.

- `time`: The time at which Coin Metrics queried the open interest data from an exchange in ISO 8601 date-time format.

- `database_time`: The timestamp when the data was saved in the database in ISO 8601 date-time format with nanoseconds precision.

- `rate`: The funding rate expressed as a percentage over the period For example, if the funding rate is 0.10%, expressed as an 8 hour rate and calculated continuously, the rate is 0.0010.

- `period`: The periodicity of the funding rate. Using the above example, the period is 08:00:00.

- `interval`: The interval over which the funding rate is calculated. Using the above example, the interval is set to 00:00:00.001 or 1 millisecond to represent the continuous funding interval.

2.9 Reference Rates

2.9.1 Conceptual Definition

The Reference Rates are designed to represent the price of a cryptoasset in an arms length transaction between a willing buyer and willing seller. It is

designed to represent the price where the majority of trades took place for a given cryptoasset using multiple markets as input data sources. A systematic framework evaluates and selects a unique set of constituent markets for each cryptoasset and the methodology utilizes volume-weighted median and time-weighted average price techniques. The Reference Rates utilizes a 61-minute window to calculate prices once an hour, every hour, including on weekends and holidays. The Reference Rates can be used for portfolio accounting, as settlement prices for financial derivative contracts, and as closing prices for investment products.

For more information on the Reference Rates, please consult the Coin Metrics Data Coverage file.

2.9.2 Data Sample

A sample of the reference rates data for Bitcoin is provided below.

asset	time	ReferenceRate
btc	2020-12-04 18:00:00	18990.62
btc	2020-12-04 19:00:00	19029.67
btc	2020-12-04 20:00:00	19045.05
btc	2020-12-04 21:00:00	18971.31
btc	2020-12-04 22:00:00	18856.24

Column definitions:

- **asset**: The id of the asset.

- **time**: The reference time in ISO 8601 date-time format.

- **ReferenceRate**: The reference rate value.

2.9.3 Coverage Universe

Reference rates are generated for 306 assets. For the full list of assets in the reference rates coverage universe, please consult the Coin Metrics Reference Rates Methodology document.

2.10 Real-Time Reference Rates

2.10.1 Conceptual Definition

Similar to the Reference Rates described in section 2.5.1, the Real-Time Reference Rates are designed to represent the price of a cryptoasset in an arms

length transaction between a willing buyer and willing seller. Rather than being calculated once an hour, the Real-Time Reference Rates utilize a separate methodology that utilizes volume-weighted median and inverse price variance weighting techniques to calculate prices once a second, every second, including on weekends and holidays.

2.10.2   Data Sample

A sample of the real-time reference rates data for Bitcoin is provided below.

asset	time	ReferenceRate
btc	2020-12-04 22:54:33	18731.41
btc	2020-12-04 22:54:34	18737.09
btc	2020-12-04 22:54:35	18745.18
btc	2020-12-04 22:54:36	18745.17
btc	2020-12-04 22:54:37	18747.75

Column definitions:

- **asset**: The id of the asset.

- **time**: The reference time in ISO 8601 date-time format.

- **ReferenceRate**: The reference rate value.

2.10.3   Coverage Universe

The coverage universe for the Real-Time Reference Rates is identical to the coverage universe for the Reference Rates described in section 2.5.3.

2.11   Index Levels

2.11.1   Conceptual Definition

Index levels represent the level of an index. For more information on the various indexes and what the various index levels represent, please consult the CMBI Single Asset Methodology document, the CMBI Market Cap Weighted Index Methodology document, and the CMBI Bitcoin Hash Rate Index Methodology document.

2.11.2   Data Sample

A sample of the index levels data for the CMBI 10 index is provided below.

index	time	level
CMBI10	2020-11-30	1808.336
CMBI10	2020-12-01	1951.183
CMBI10	2020-12-02	1861.554
CMBI10	2020-12-03	1903.023
CMBI10	2020-12-04	1930.421

Column definitions:

- **index**: The id of the index.

- **time**: The reference time in ISO 8601 date-time format.

- **level**: The index value.

2.11.3   Coverage Universe

The coverage universe for index levels consist of 10 indexes.

Index	Description
CMBI10	An index consisting of the 10 largest cryptoassets, weighted by their free float market capitalization.
CMBI10E	An index consisting of the 10 largest cryptoassets, weighted evenly at the start of each month.
CMBI10EX	An index consisting of the 9 largest non-Bitcoin cryptoassets, weighted by their free float market capitalization.
CMBIBE	An index consisting of Bitcoin and Ethereum, weighted by their free float market capitalization.
CMBIBTC	A single asset index measuring the performance an investor would expect from purchasing and holding Bitcoin.
CMBIBTCT	A single asset index measuring the performance an investor would expect from purchasing and holding Bitcoin as well as liquidati
CMBIETH	A single asset index measuring the performance an investor would expect from purchasing and holding Ethereum.
CMBIETHT	A single asset index measuring the performance an investor would expect from purchasing and holding Ethereum as well as liquid
CMBIHASH	Measure of the amount of hash rate being contributed to mining Bitcoin blocks.
CMBIWORK	Measure of the amount of mining activity being conducted on the Bitcoin Network thoughout a 24 hour period.

2.12   Index Constituents

2.12.1   Conceptual Definition

Certain indexes consist of multiple index constituents. These indexes weight the index constituents by one or more factors to calculate the index. For instance, market capitalization weighted indexes weight index constituents by adjusted free float market capitalization. For each index that utilizes this approach, the index constituents data concept lists the index constituents and their weights at regular intervals.

2.12.2 Data Sample

A sample of the index constituents data for the CMBI 10 index is provided below.

index	time	asset	weight
CMBI10	2020-12-04 18:00:00	ada	0.0110607
CMBI10	2020-12-04 18:00:00	bch	0.0093283
CMBI10	2020-12-04 18:00:00	bsv	0.0051981
CMBI10	2020-12-04 18:00:00	btc	0.7031517
CMBI10	2020-12-04 18:00:00	dot	0.0116246

Column definitions:

- `index`: The id of the index.

- `time`: The reference time in ISO 8601 date-time format.

- `asset`: The id of the index constituent.

- `weight`: The index constituent weight.

2.12.3 Coverage Universe

The coverage universe for the index constituents is identical to the coverage universe for the index levels described in section 2.7.3. Index constituents and weights are calculated once an hour, every hour, including on weekends and holidays.

3 Change Log

1. **Version 1.0.0 on May 5, 2020**: Initial publication of Market Data Documentation Overview.

2. **Version 1.0.1 on May 18, 2020**: Revise data samples to match format in most recent API version 4 specification.

3. **Version 1.0.2 on June 12, 2020**: Revise data samples to match format in most recent API version 4 specification.

4. **Version 1.0.3 on August 19, 2020**: Add futures contract specification and futures open interest data.

5. **Version 1.0.4 on December 4, 2020**: Add futures liquidations and funding rates data.