

CF Bitcoin Volatility Index Settlement Rate (BVXS)

Methodology Guide

Version: 1.1

Version Date: 23rd April 2024

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1 Version History

Version	Date Issued	Summary of Change	Owner
v1.0	9 April 2024	N/A	CF Benchmarks Management
v1.1	23 April 2024	Updated Potentially Erroneous Data criteria	CF Benchmarks Management

2 Overview

The CF Bitcoin Volatility Index Settlement Rate (BVXS) represents a daily measure of implied volatility in the CME Bitcoin Options market. It is a forward-looking measure, indicating how dispersed price movements in the underlying asset may be over a given time horizon. Volatility indices in this class are often referred to as fear gauges given how they capture the stress embedded in options markets based on what market participants price into options contracts.

The BVXS is constructed using published CF Bitcoin Volatility Real Time Index (BVX) data and is published once a day.

The design and implementation of the BVXS lends itself to be used as a settlement rate for derived financial instruments such as volatility futures and options.

Underlying Economic Reality

The CF Bitcoin Volatility Index is intended to measure the underlying economic reality of creating a weighted portfolio of CME Bitcoin options contracts with a view to replicating the payoff of a Bitcoin volatility swap. A volatility swap is an OTC traded financial instrument that allows an investor to gain direct linear exposure to Bitcoin volatility over a given time horizon, priced relative to a fair volatility strike defined at inception of the trade. The fair volatility strike is calculated by combining option contracts of different strike prices to produce a constant vega (volatility) exposure in the overall portfolio. This calculation is accomplished by the use of order input data from the CME that facilitate the trading of said options contracts.

3 Definitions

API: Application programming interface.

Front Contract: CME Bitcoin Futures contract which is closest to its expiry date.

Next Contract: CME Bitcoin Futures contract with expiry date after the Front Contract expiry date.

Next+1 Contract: CME Bitcoin Futures contract with expiry date immediately following the Next Contract expiry date.

Expiry Day: The last Friday of the Front Contract's month. If this is not either a UK or a U.S. business day, the contract expiry day will take place on the immediately preceding business day which is either a UK or a U.S. business day.

Expiry Datetime: 4:00 pm London on the Expiry Day.

Retrieval Time: One minute after the end of the TWAP Period on a given Calculation Day, as given by the server clock of the Calculation Agent.

TWAP Period: A period of time equal to the TWAP Period Length leading up to the Effective Time, as defined in Section 7.

Relevant Real Time Index Data: CF Bitcoin Volatility Real Time Index data (values and volumes) retrieved on or before the Retrieval Time

4 Methodology

4.1 Qualitative Description

The CF Bitcoin Volatility Index Settlement Rate is calculated based on CF BVX Real Time Index values (see Real Time Index Methodology [here](#)) calculated and published during the TWAP Period as specified in Section 7. The calculation steps are as follows:

1. All Relevant CF BVX Real Time Index values and associate volumes are added to a joint list.
2. The list of CF BVX Real Time Index values is partitioned¹ into a number of equally-sized time intervals, also specified in Section 7.
3. For each partition separately, the volume-weighted average index value is calculated from the Real Time Index values and volumes.
4. The CF Bitcoin Volatility Index Settlement Rate is then given by the equally-weighted average of the volume-weighted averages of all partitions.

4.2 Mathematical Representation

The following table shows the symbols used in the mathematical representation of the CF Bitcoin Volatility Index Settlement Rate.

Symbol	Name	Description	Type
t	Effective time	The time as of which a CF Bitcoin Volatility Index Settlement Rate is calculated	Parameter, see section 7
τ	TWAP period length	The length of the time-period prior to the effective time during which CF BVX Real Time Index data is collected	Parameter, see Section 7
$\hat{\tau}$ with $\hat{\tau} \leq \tau$ and $\hat{\tau} \tau$	Partition length	The length of the time periods into which the TWAP period length is partitioned	Parameter, see Section 7
K	Number of partitions	The number of partitions, given by $K = \tau / \hat{\tau}$	Output

¹ CF BVX Real Time Index values are added to a partition exclusive of partition start time and inclusive of partition end time when truncated to millisecond precision.

k with $k \in (1, \dots, K)$	Partition	The k th partition	Output
X_k for $k \in (1, \dots, K)$	TWAP period Index data	The collection of BVX Real Time Index value / volume data pairs observed in the k th partition, i.e. between times $T_1 - \tau + (k - 1)$ and $T_1 - \tau + k$	Input
I_k	TWAP period data count	The number of data points in the k th partition	Output
$x_{k,i}$ with $x_{k,i} = (p_{k,i}, s_{k,i})$ and $x_{k,i} \in X_k$	TWAP period trade	The i th BVX Real Time Index value / volume data pair of the k th partition	Input
$p_{k,i}$	TWAP period CF BVX Real Time Index value	The CF BVX Real Time Index value of the i th index / volume data pair of the k th partition	Input
$s_{k,i}$	TWAP period CF BVX Real Time Index volume	The volume of the i th index/volume data pair of the k th partition. The volume per CF BVX Real Time Index publication is calculated as a 30-day interpolated measure calculated based on the per expiration date equally-weighted average of the calculated utilized depth (as implied by parameter D) figures associated with each relevant option strike used in the respective CF BVX Real Time Index calculation. See here for more details on utilized depth calculation for Spot Rates.	Input
$VolSpread_{k,i}$	Volatility spread	The top of book, mid-ask implied volatility spread of the ATM (at the money) option strike associated with the i th index/volume data pair of the k th partition. Calculated as the difference between the ask implied volatility and the mid implied volatility for the relevant ATM option strike.	Input
$DVOLfilter_{k,i}$	DVOL filter	The DVOL filter is set to zero if $VolSpread_{k,i} > DVOL$ and is set to 1 otherwise.	Output
VWA_k	Volume-weighted average	The volume-weighted average index value of the k th partition	Output

$BVXS_t$	BVXS	The CF Bitcoin Volatility Index Settlement Rate at time t	Output
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For each partition k , the volume-weighted average index values VWA_k is calculated as:

$VWA_k = \frac{\sum_{i=1}^{I_k} p_{k,i} \cdot s_{k,t} \cdot DVOLfilter_{k,i}}{\sum_{i=1}^{I_k} s_{k,t} \cdot DVOLfilter_{k,i}}$	Eq. 1
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The CF Bitcoin Volatility Index Settlement Rate as of the effective time t , $BVXS_t$, is then given by:

$BVXS_t = \frac{1}{K} \sum_{k=1}^K VWA_k$	Eq. 2
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5 Contingency Calculation Rules

5.1 Delayed Data and Missing Data

Delayed data and missing data are treated according to the following rules:

1. Any Relevant Real Time Index Data for a given Calculation Day that is not available by the Retrieval Time is disregarded in the calculation of the CF Bitcoin Volatility Index Settlement Rate for that Calculation Day.
2. If, for any of the K partitions of the TWAP Period, no Relevant Real Time Index Data is available or one or more Relevant Real Time Index Data points are available but for any reason cannot be retrieved by the Calculation Agent, the partition remains empty and will be disregarded in the calculation of the CF Bitcoin Volatility Index Settlement Rate for that Calculation Day. The denominator in Eq. 2 will then be decremented by the number of empty partitions.
3. If one or more Relevant Real Time Index Data points occur but for any reason no Relevant Real Time Index Data can be retrieved by the Calculation Agent, a CF Bitcoin Volatility Index Settlement Rate calculation failure occurs for that Calculation Day (see Section 5.6).
4. If no Relevant Real Time Index Data is available on a given Calculation Day then a CF Bitcoin Volatility Index Settlement Rate calculation failure occurs for that Calculation Day (see Section 5.6).

5.2 Erroneous Data

All Relevant Real Time Index Data retrieved by the Calculation Agent for a given Calculation Day are subject to an automated screening for erroneous data according to the following rules:

1. If any Relevant Real Time Index Data shows a non-numeric or non-positive index value or index volume, it is flagged as erroneous.
2. If any Relevant Real Time Index Data is reported in a format that deviates from the expected format such that it cannot be parsed, it is flagged as erroneous.

Relevant Real Time Index Data flagged as erroneous for a given Calculation Day is disregarded in the calculation of the CF Bitcoin Volatility Index Settlement Rate for that Calculation Day.

If all Relevant Real Time Index Data of all Constituent Exchanges is flagged as erroneous for a given Calculation Day, a CF Bitcoin Volatility Index Settlement Rate calculation failure occurs for that Calculation Day (see Section 5.6).

5.3 Potentially Erroneous Data

All Relevant Real Time Index Data retrieved by the Administrator for a given Calculation Day is subject to automated screening for potentially erroneous data according to the following rules:

1. The first two BVX Real Time Index values in any partition are marked as potentially erroneous if either of those index values differ by more than the Potentially Erroneous Data Threshold from the median of the two index values. In that event, the first index value is discarded and the next index value in the partition is evaluated until a first viable index value pair is found. The index value immediately following the first viable index value pair is potentially erroneous if it is further away from the second index value in that pair than the Potentially Erroneous Data Threshold.
2. Beyond the first viable index value pair in a partition, an index value that differs from the previous index value by more than the Potentially Erroneous Data Threshold is flagged as erroneous. Any index value that triggers the provisions of this rule 5.3 will be discarded from consideration in assessing any subsequent Relevant Real Time Index values for this rule 5.3.

Relevant Real Time Index Data flagged as potentially erroneous for a given Calculation Day are disregarded in the calculation of the CF Bitcoin Volatility Index Settlement Rate for that Calculation Day. The occurrence of any such flag is reported to the Oversight Function.

If all Relevant Real Time Index Data are flagged as potentially erroneous for a given Calculation Day, a CF Bitcoin Volatility Index Settlement Rate calculation failure occurs for that Calculation Day (see Section 5.6).

5.4 Delayed Calculation & Publication

Where for any reason the Administrator is not able to calculate and publish a CF Bitcoin Volatility Index Settlement Rate within the Dissemination Time on any given Calculation Day then the Administrator shall publish a notification on its website at blog.cfbenchmarks.com informing index users that calculation and publication has been delayed. The Administrator will seek to publish the CF Bitcoin Volatility Index Settlement Rate for that Calculation Day as soon as it is able to. Should the Administrator not be able to calculate and publish a CF Bitcoin Volatility Index Settlement Rate by 23:59:59 London time then the provisions of Rule 5.6 shall come into effect.

5.5 Expert Judgement

The Administrator does not utilise Expert Judgement in the day-to-day calculation of the Reference Rates. In extraordinary circumstances Expert Judgement may be exercised by the Administrator in accordance with its codified policies and processes which are available upon request.

5.6 Calculation Failure

If a CF Bitcoin Volatility Index Settlement Rate cannot be calculated for a given Calculation Day before 23:59:59 London time, for instance because:

- no Relevant Real Time Index Data is published on that Calculation Day, or
- Relevant Real Time Index Data is published but for any reason cannot be retrieved by the Calculation Agent, or
- all Relevant Real Time Index Data retrieved by the Calculation Agent are flagged as erroneous or potentially erroneous (see Section 5.2); or any other reason or circumstance that prevents the orderly calculation of a CF Bitcoin Volatility Index Settlement Rate,

then the CF Bitcoin Volatility Index Settlement Rate for that Calculation Day is given by the CF Bitcoin Volatility Index Settlement Rate published on the previous Calculation Day and this Reference Rate value shall be published with a marker of (*)

The occurrence of any CF Bitcoin Volatility Index Settlement Rate calculation failure is reported to the Oversight Function and announced at blog.cfbenchmarks.com

6 Restatement & Republishing

The Administrator may restate and republish the index value where the published value is found to be incorrect. This will only occur if both the below conditions are met:

1. Timeliness – where the Administrator can RESTATE and REPUBLISH the index value before 23:59:59 of the given Calculation Day.
2. Materiality – where the RESTATED Index value has an absolute variance greater than 0.20% for the Index for the given Calculation Day

Example:

- The index on a given Calculation Day is published as 1234.56
 - The index will only be RESTATED if it is:
 - Greater than 1237.03
- OR
- Less than 1232.09

Where the above conditions are met the Administrator shall announce on its website that a restatement and republishing of the Index will take place for that Calculation Day.

The Administrator shall restate the index as soon as possible and shall do so by overwriting the previously published index value. This restated index value will carry no mark when published and will be final and not subject to any further change or republication.

7 Parameters

Rounding	2 decimals
Effective Time (t)	4:00 pm London Time
Publication Time	Between 4:00pm and 4:30 pm London Time on all CME Trading Days
TWAP Period Length (τ)	30 Minutes
TWAP Period	3:30pm to 4:00 pm London Time
Partition length ($\hat{\tau}$)	5 minutes
Number of Partitions (K)	6
Volatility Spread (DVOL)	0.05 (also known as 5 implied vols)
Potentially Erroneous Data Threshold	10%

Contact Information

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