

CF Bitcoin Volatility Index Settlement Rate (BVXS)

Methodology Guide

Version:

1.3

Version Date:

07th April 2025

Contents

| | | |
|-----|---|----|
| 1 | Version History | 3 |
| 2 | Overview | 4 |
| 3 | Definitions | 5 |
| 4 | Methodology | 6 |
| 4.1 | Qualitative Description | 6 |
| 4.2 | Mathematical Representation | 6 |
| 5 | Contingency Calculation Rules | 9 |
| 5.1 | Delayed Data and Missing Data | 9 |
| 5.2 | Erroneous Data | 9 |
| 5.3 | Potentially Erroneous Data | 10 |
| 5.4 | Delayed Calculation & Publication | 10 |
| 5.5 | Expert Judgement..... | 10 |
| 5.6 | Calculation Failure | 11 |
| 6 | Restatement & Republishing | 12 |
| 7 | Parameters | 13 |
| 8 | Methodology Review and Changes | 14 |

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 |
| v1.2 | 16 May 2024 | <p>Updated naming conventions</p> <p>Updated the Administrator communication procedures for Delayed Calculation & Publication; Calculation Failure; Restatement & Republishing and Market Failure Events</p> <p>Added section 8 methodology Review and Changes</p> <p>Updated Notice and Disclaimer</p> | CF Benchmarks Compliance |
| v1.3 | 23 April 2025 | Section 6 updated to the Restatement & Republishing example | 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 Bitcoin Volatility 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 Bitcoin Volatility Real Time Index values and associate volumes are added to a joint list.
2. The list of CF Bitcoin Volatility 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 Bitcoin Volatility 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 |
| k | Partition | The k th partition | Output |

¹ CF Bitcoin Volatility 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.

| | | | |
|---|---|--|--------|
| with $k \in (1, \dots, K)$ | | | |
| for X_k $k \in (1, \dots, K)$ | 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 Bitcoin Volatility Real Time Index value | The CF Bitcoin Volatility Real Time Index value of the i th index / volume data pair of the k th partition | Input |
| $s_{k,i}$ | TWAP period CF Bitcoin Volatility Real Time Index volume | The volume of the i th index/volume data pair of the k th partition. The volume per CF Bitcoin Volatility 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 Bitcoin Volatility 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 |
|----------------------------|------|---|--------|

For each partition k , the volume-weighted average index values VWA_k is calculated as:

| | |
|---|-------|
| $VWA_k = \frac{\sum_{i=1}^{I_k} p_{k,i} \cdot s_{k,i} \cdot DVOLfilter_{k,i}}{\sum_{i=1}^{I_k} s_{k,i} \cdot DVOLfilter_{k,i}}$ | Eq. 1 |
|---|-------|

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 |
|---|-------|

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 clearly communicate to all licensees via Statuspage 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. Any Calculation Failure events will be clearly communicated to all licensees via Statuspage.

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 **50%**
 - The index will only be **RESTATED** if it is:
 - Greater than **50.21%**
- OR
- Less than **49.79%**

Where the above conditions are met the Administrator shall clearly communicate to all licensees via Statuspage 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% |

8 Methodology Review and Changes

This methodology is subject to internal review by the Administrator and the CF Cryptocurrency Index Family Oversight Function ("**Oversight Function**") at least annually.

Any changes to this methodology are overseen by the Oversight Function, and in accordance with UK BMR Article 13.

All material changes to the methodology shall only be implemented after a consultation process with users and relevant stakeholders that shall be conducted according to the Administrator's policies and overseen by the Oversight Function.

Should the Administrator deem it necessary to cease providing the Index it shall only do so after a consultation process with users and relevant stakeholders that shall be conducted according to the Administrator's policies and overseen by the Oversight Function.

Contact Information

CF Benchmarks Ltd

| Address | Contact |
|--|---|
| <p>CF Benchmarks Ltd 6th Floor One London Wall London EC2Y 5EB</p> | <p>Web: https://www.cfbenchmarks.com Phone: +44 20 8164 9900 Email: contact@cfbenchmarks.com</p> <hr/> <p>Formal complaints or concerns regarding any CF Digital Asset Index Family products must be submitted by Email: complaints@cfbenchmarks.com</p> <p>Further details can be found on https://blog.cfbenchmarks.com/about/</p> |

Notice & Disclaimer

No part of this publication may be reproduced, distributed, or transmitted in any form or by any means, including photocopying, recording, or other electronic or mechanical methods, without the prior written permission of the publisher, except in the case of brief quotations embodied in critical reviews and certain other non-commercial uses permitted by copyright law. For permission requests, write to the publisher, addressed "Attention: Permissions Coordinator," at the address below.

CF Benchmarks Ltd is registered in England with registered number 11654816 and registered office at 6th Floor, One London Wall, London EC2Y 5EB, United Kingdom. CF Benchmarks is authorised by the UK Financial Conduct Authority as a registered Benchmark Administrator (FRN 847100).

This document and all of the information contained in it, including without limitation all methods, processes, concepts, text, data, graphs, charts (collectively, the "Information") is the property of CF Benchmarks Ltd or its licensors, direct or indirect suppliers or any third party involved in making or compiling any Information (collectively, with CF Benchmarks Ltd, the "Information Providers") and is provided for informational purposes only. The Information may not be reproduced or disseminated in whole or in part without prior written consent from CF Benchmarks Ltd.

The Information may not be used to create derivative works or to verify or correct other data or information without prior written consent from CF Benchmarks Ltd. For example (but without limitation), the Information may not be used to create indices, databases, risk models, analytics, software, or in connection with the issuing, offering, sponsoring, managing or marketing of any securities, portfolios, financial products or other investment vehicles utilizing or based on, linked to, tracking or otherwise derived from the Information or any other CF Benchmarks Ltd data, information, products or services.

The user of the Information assumes the entire risk of any use it may make or permit to be made of the Information. CF BENCHMARKS SOFR NOT MAKE ANY EXPRESS OR IMPLIED WARRANTIES OR REPRESENTATIONS WITH RESPECT TO THE INFORMATION (OR THE RESULTS TO BE OBTAINED BY THE USE THEREOF), AND TO THE MAXIMUM EXTENT PERMITTED BY APPLICABLE LAW, IT EXPRESSLY DISCLAIMS ALL IMPLIED WARRANTIES (INCLUDING, WITHOUT LIMITATION, ANY IMPLIED WARRANTIES OF ORIGINALITY, ACCURACY, TIMELINESS, NON-INFRINGEMENT, COMPLETENESS, MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE) WITH RESPECT TO ANY OF THE INFORMATION.

Without limiting any of the foregoing and to the maximum extent permitted by applicable law, in no event shall CF Benchmarks have any liability regarding any of the Information for any direct, indirect, special, punitive, consequential (including lost profits) or any other damages even if notified of the possibility of such damages. The foregoing shall not exclude or limit any liability that may not by applicable law be excluded or limited, including without limitation (as applicable), any liability for death or personal injury to the extent that such injury results from the negligence or wilful default of itself, its servants, agents or sub-contractors.

None of CF Benchmarks Ltd's products or services recommends, endorses, approves or otherwise expresses any opinion regarding any issuer, securities, financial products or instruments or trading strategies and none of CF Benchmarks Ltd's products or services is intended to constitute investment advice or a recommendation to make (or refrain from making) any kind of investment decision and may not be relied on as such.

The Information has not been submitted to, nor received approval from, the United Kingdom Financial Conduct Authority, the United States Securities and Exchange Commission or any other regulatory body.

CF Benchmarks is a member of the Crypto Facilities group of companies which is in turn a member of the Payward, Inc. group of companies.

- Payward, Inc. is the owner and operator of the Kraken Exchange, a venue that facilitates the trading of cryptocurrencies. The Kraken Exchange is a source of input data for certain CF Benchmarks indices.
- Payward, Inc. is the owner and operator of the Staked, a venue that operates the block production nodes for decentralized PoS protocols on behalf of institutional investors. Staked.us is a source of input data for certain CF Benchmarks indices.

Please refer to the individual product family documentation for more information about applicable input data sources.

Any use of or access to products, services or information of CF Benchmarks Ltd requires a license from CF Benchmarks Ltd.

CF Benchmarks is a registered trademark of Crypto Facilities Ltd.

CME Group and CME are trademarks of Chicago Mercantile Exchange Inc., used here with permission. All other trademarks are the property of their respective owners.

CME Group and CME are trademarks of Chicago Mercantile Exchange Inc., used here with permission. All other trademarks are the property of their respective owners.

Secured Overnight Financing Rate (SOFR) Disclaimer

The Secured Overnight Financing Rate (SOFR) is subject to the Terms of Use posted at [newyorkfed.org](https://www.newyorkfed.org). The New York Fed is not responsible for publication of the CF Bitcoin Interest Rate Curve by CF Benchmarks Ltd, does not sanction or endorse any particular republication, and has no liability for your use.

CF Benchmarks Ltd is not affiliated with the New York Fed. The New York Fed does not sanction, endorse, or recommend any products or services offered by CF Benchmarks.

Daily Treasury Par Yield Curve Rates

Disclaimer

Daily Treasury Par Yield Curve Rates used by the CF Bitcoin Interest Rate Curve methodology are obtained from publicly available sources posted at [home.treasury.gov](https://www.treasury.gov). The U.S Department of the Treasury or any other government entity is not responsible for publication of the CF Bitcoin Interest Rate Curve by CF Benchmarks Ltd, does not sanction or endorse any particular republication, and has no liability for the use of the data.

CF Benchmarks Ltd is not affiliated with the U.S Department of the Treasury or any other government entity. The U.S Department of the Treasury or any other government entity does not sanction, endorse, or recommend any products or services offered by CF Benchmarks.