

**S&P Dow Jones
Indices**

A Division of **S&P Global**

S&P Twitter Sentiment Indices *Methodology*

November 2021

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Introduction

Index Objective and Highlights

The S&P Twitter Sentiment Indices measure the performance of a selection of constituents from an underlying index that have higher (relatively positive) sentiment scores, selected according to the processes defined in *Eligibility Criteria* and *Index Construction*. Index constituents are weighted according to the weighting schemes defined for each index.

Index Family

The index family includes:

- **S&P 500 Twitter Sentiment Index.** The index measures the performance of 200 S&P 500 companies with high sentiment scores. Index constituents are float-adjusted market capitalization (FMC) weighted, subject to a single company weight cap of 10%.
- **S&P 500 Twitter Sentiment Select Equal Weight Index.** The index measures the equal weighted performance of 50 S&P 500 companies with high sentiment scores.

For more information on the S&P 500, please refer to the S&P U.S. Indices Methodology, available at www.spdji.com.

Supporting Documents

This methodology is meant to be read in conjunction with supporting documents providing greater detail with respect to the policies, procedures and calculations described herein. References throughout the methodology direct the reader to the relevant supporting document for further information on a specific topic. The list of the main supplemental documents for this methodology and the hyperlinks to those documents is as follows:

Supporting Document	URL
S&P Dow Jones Indices' Equity Indices Policies & Practices Methodology	Equity Indices Policies & Practices
S&P Dow Jones Indices' Index Mathematics Methodology	Index Mathematics Methodology
S&P Dow Jones Indices' Float Adjustment Methodology	Float Adjustment Methodology

Collaboration

S&P Dow Jones Indices would like to acknowledge the assistance of Pluribus Labs in building models supporting the creation of Sentiment Scores used in the S&P Twitter Sentiment Indices.

Eligibility Criteria

Index Universe

At each rebalancing reference date, the following indices are constructed from an Eligible Universe consisting of the constituents of an underlying index, as defined below:

S&P Sentiment Indices	Underlying Index
S&P 500 Twitter Sentiment Index	S&P 500
S&P 500 Twitter Sentiment Select Equal Weight Index	S&P 500

Index Construction

Overview

The indices select constituents that have higher (relatively positive) sentiment scores over a fixed time-period. Sentiment scores are derived from an analysis of a daily feed of Tweets containing “cash-tags” that reference the equity symbol of a company. The Twitter feed is filtered to exclude Tweets identified as spam using the spam model detailed below. Other defined eligibility requirements further filter the Twitter feed to create a universe of sentiment Tweets. The universe is scored using a sentiment dictionary, which is constructed using the Sentiment Scoring Model defined below. Every day, including exchange holidays, the body of screened Tweets are analyzed for collective sentiment and scores are recorded in a database with each daily score starting at 4:00 PM ET and ending at 4:00 PM ET the following day. The daily scores for each underlying index constituent are then used at the rebalancing to determine the selection and weighting of the index constituents.

Sentiment Scoring Model

The sentiment scoring model uses a training database of bullish/bearish messages over a three-year time-period (2018 to 2020)¹ to construct a dictionary of unary and binary tokens used to calculate a sentiment score. The sentiment score of a token is calculated as follows:

$$PMI(token, bullish) - PMI(token, bearish)$$

where:

- PMI (i.e. pointwise mutual information) = $PMI(x,y) = \log(P(x,y)/P(x)P(y))$
- $P(x)$ = the probability of occurrence of phrase x in the training dataset
- $P(x,y)$ = the probability of both x and y occurring in the training dataset

The individual Tweet scores are a sum of the scores of the Tweet’s tokens. The stock symbol is scored based on an average of all the equity symbol’s Tweet scores.

Spam Filtering Model

The spam filtering model identifies spam (low-relevance Tweets) using a natural language processing (NLP) tool and excludes Tweets classified as spam from the sentiment universe.

Daily Sentiment Score Calculation Process

After gathering the relevant Tweets associated with cash-tags, S&P Dow Jones Indices attempts to capture the most relevant Tweets by imposing filters such as minimum account age, number of followers, minimum number of Tweets per day, and other criteria which may change based on the judgment of the Index Committee and market conditions.

After 4:00PM ET each calendar day, a daily average sentiment score is calculated for each constituent in the index universe based on derived sentiment of Tweets. This is done using the following formula:

$$Avg\ Score_{x,t} = \sum_{t-1_{close}}^{t_{close}} \frac{SCORE_{x,t}}{OBSERVATIONS_{x,t}}$$

¹ For more information on the backtest, please refer to the *Appendix*.

where:

$Avg\ Score_{x,t}$ = The average sentiment score for stock component x at time t .

$SCORE_{x,t}$ = The sentiment score associated with Tweets for stock component x at time t .

$OBSERVATIONS_{x,t}$ = The total number of Tweets for stock component x at time t .

Constituent Selection

At each rebalancing, each index selects companies from the index universe that have a higher sentiment over the preceding month prior to the reference date. Sentiment scores are derived from an analysis of a daily feed of Tweets containing “cash-tags” that reference the equity symbol of a company. The Twitter feed is filtered to exclude Tweets identified as spam using the spam model. Companies must have a minimum number of non-filtered Tweets per day over a minimum number of days per month to be included in the index.

Index constituents for each index are selected as follows:

1. Calculate the exponentially weighted average (EWA) of daily scores for companies according to the following formula:

$$EWA(x) = \sum_{t=1}^N \alpha_t * Avg\ Score(x,t)$$

where:

N = The number of calendar days in the preceding month.

α_t = Weight of day t in the short-term EWA calculation, calculated as follows:

$$\alpha_t = \lambda^{N-t}$$

λ = The decay factor used for exponential weighting, set to a value of 0.9. This determines the weight of each daily score in the calculation of the average.

2. Compute the z-scores across the basket of EWA scores.

$$Z - score = \frac{Score - Mean_{EWA}}{Std_{EWA}}$$

3. Transform the z-scores to make them all positive.

$$AWF = \begin{cases} 1 + z, & z \geq 0 \\ \frac{1}{1-z}, & z < 0 \end{cases}$$

4. Finally, each index selects a specific number of constituents:
 - a. **S&P 500 Twitter Sentiment Index.** The index selects 200 companies with the highest z-score.
 - b. **S&P 500 Twitter Sentiment Select Equal Weight Index.** The index selects 50 companies with the highest z-score.

Constituent Weighting

S&P 500 Twitter Sentiment Index. At each rebalancing, the index is FMC weighted, subject to a single company cap of 10%. Any excess weight is proportionally redistributed to uncapped constituents. The process proceeds iteratively until no constituent breaches the 10% weight cap constraint.

S&P 500 Twitter Sentiment Select Equal Weight Index. At each rebalancing, the index is equal weighted.

Index Calculations

The indices calculate by means of the divisor methodology used in all S&P Dow Jones Indices' equity indices.

For more information on the index calculation methodology, please refer to the Market Capitalization Weighted Indices and Equal Weighted Indices sections, respectively, of S&P Dow Jones Indices' Index Mathematics Methodology.

Index Maintenance

Rebalancing

The indices rebalance monthly, effective after the market close of the fourth business day of each month, with the rebalancing reference date after the close of the market on the last calendar day of the prior month.

Additions and Deletions

Additions. Except for spin-offs, no stocks are added to the indices between rebalancings.

Spin-offs. A spin-off company remains a constituent of the respective S&P Twitter Sentiment Index until the subsequent rebalancing, when the spin-off is evaluated for continued index inclusion.

Deletions. If a stock is dropped from an underlying index, it is also removed from the respective index simultaneously. Between rebalancings, a stock can be deleted from an index due to corporate events such as mergers, takeovers, delistings, suspensions, spin-offs/demergers, or bankruptcies.

Corporate Actions

For more information on corporate actions, please refer to S&P Dow Jones Indices' Equity Indices Policies & Practices Methodology.

Currency of Calculation and Additional Index Return Series

The indices calculate in U.S. dollars.

In addition to the indices detailed in this methodology, additional return series versions of the indices may be available, including, but not limited to: currency, currency hedged, decrement, fair value, inverse, leveraged, and risk control versions. For a list of available indices, please refer to the [S&P DJI Methodology & Regulatory Status Database](#).

For information on various index calculations, please refer to S&P Dow Jones Indices' Index Mathematics Methodology.

For the inputs necessary to calculate certain types of indices, including decrement, dynamic hedged, fair value, and risk control indices, please refer to the Parameters documents available at www.spdji.com.

Base Date and History Availability

Index history availability, base date, and base value are shown in the table below.

Index	Launch Date	First Value Date	Base Date	Base Value
S&P 500 Twitter Sentiment Index	11/18/2021	02/06/2018	02/06/2018	100
S&P 500 Twitter Sentiment Select Equal Weight Index	11/18/2021	02/06/2018	02/06/2018	100

Index Governance

Index Committee

An S&P Dow Jones Indices' Index Committee maintains the index. The Committee meets regularly. At each meeting, the Committee reviews matters that may affect index constituents, statistics comparing the composition of the index to the market, and any significant market events. In addition, the Index Committee may revise index policy covering rules for selecting constituents, treatment of dividends, share counts or other matters.

S&P Dow Jones Indices' considers information about changes to its indices and related matters to be potentially market moving and material. Therefore, all Index Committee discussions are confidential.

For information on Quality Assurance and Internal Reviews of Methodology, please refer to S&P Dow Jones Indices' Equity Indices Policies & Practices Methodology.

Index Policy

Announcements

All index constituents are evaluated daily for data needed to calculate index levels and returns. All events affecting the daily index calculation are typically announced in advance via the Index Corporate Events report (SDE), delivered daily to all clients. Any unusual treatment of a corporate action or short notice of an event may be communicated via email to clients.

For more information, please refer to the Announcements section of S&P Dow Jones Indices' Equity Indices Policies & Practices Methodology.

Pro-forma Files

In addition to the corporate events file (.SDE), S&P Dow Jones Indices provides constituent pro-forma files each time the indices rebalance. The pro-forma file is typically provided daily in advance of the rebalancing date and contains all constituents and their corresponding weights and index shares effective for the upcoming rebalancing. Since index shares are assigned based on reference prices prior to the rebalancing, the actual weight of each stock at the rebalancing differs from these weights due to market movements.

Please visit www.spdji.com for a complete schedule of rebalancing timelines and pro-forma delivery times.

Holiday Schedule

The index is calculated on all business days.

A complete holiday schedule for the year is available at www.spdji.com.

Rebalancing

The Index Committee may change the date of a given rebalancing for reasons including market holidays occurring on or around the scheduled rebalancing date. Any such change will be announced with proper advance notice where possible.

Unexpected Exchange Closures

For information on Unexpected Exchange Closures, please refer to S&P Dow Jones Indices' Equity Indices Policies & Practices Methodology.

Recalculation Policy

For information on the recalculation policy, please refer to S&P Dow Jones Indices' Equity Indices Policies & Practices Methodology.

For information on Calculations and Pricing Disruptions, Expert Judgment and Data Hierarchy, please refer to S&P Dow Jones Indices' Equity Indices Policies & Practices document located on our Web site, www.spdji.com.

Index Dissemination

Index levels are available through S&P Dow Jones Indices' Web site at www.spdji.com, major quote vendors (see codes below), numerous investment-oriented Web sites, and various print and electronic media.

Tickers

The table below lists headline indices covered by this document. All versions of the below indices that may exist are also covered by this document. Please refer to the [S&P DJI Methodology & Regulatory Status Database](#) for a complete list of indices covered by this document.

Index	Return Type	Bloomberg
S&P 500 Twitter Sentiment Index (USD)	Price Return	SPSNTUP
	Total Return	SPSNTUT
	Net Total Return	SPSNTUN
S&P 500 Twitter Sentiment Select Equal Weight Index (USD)	Price Return	SPSSEUP
	Total Return	SPSSEUT
	Net Total Return	SPSSEUN

Index Data

Daily constituent and index level data are available via subscription.

For product information, please contact S&P Dow Jones Indices, www.spdji.com/contact-us.

Web site

For further information, please refer to S&P Dow Jones Indices' Web site at www.spdji.com.

Appendix

Back-Test Details

The back-test for the S&P Twitter Sentiment Indices is calculated for the period January 2018 to October 2021. S&P Dow Jones Indices designed the sentiment scoring model using data from approximately the same time range. The sentiment scoring model is a natural language processing tool based on linguistic classification of the degree to which a Tweet is likely to be positive or negative.

Back-test Dates	Sentiment Model Training Data
01/2018 – 12/2018	01/2018 – 12/2020
01/2019 – 12/2019	01/2018 – 12/2020
01/2020 – 12/2020	01/2018 – 12/2020
01/2021 – 10/2021	01/2018 – 12/2020

Disclaimer

Performance Disclosure/Back-Tested Data

S&P Dow Jones Indices defines various dates to assist our clients in providing transparency. The First Value Date is the first day for which there is a calculated value (either live or back-tested) for a given index. The Base Date is the date at which the index is set to a fixed value for calculation purposes. The Launch Date designates the date when the values of an index are first considered live: index values provided for any date or time period prior to the index's Launch Date are considered back-tested. S&P Dow Jones Indices defines the Launch Date as the date by which the values of an index are known to have been released to the public, for example via the company's public website or its data feed to external parties. For Dow Jones-branded indices introduced prior to May 31, 2013, the Launch Date (which prior to May 31, 2013, was termed "Date of introduction") is set at a date upon which no further changes were permitted to be made to the index methodology, but that may have been prior to the Index's public release date.

Please refer to the methodology for the Index for more details about the index, including the manner in which it is rebalanced, the timing of such rebalancing, criteria for additions and deletions, as well as all index calculations.

Information presented prior to an index's launch date is hypothetical back-tested performance, not actual performance, and is based on the index methodology in effect on the launch date. However, when creating back-tested history for periods of market anomalies or other periods that do not reflect the general current market environment, index methodology rules may be relaxed to capture a large enough universe of securities to simulate the target market the index is designed to measure or strategy the index is designed to capture. For example, market capitalization and liquidity thresholds may be reduced. Back-tested performance reflects application of an index methodology and selection of index constituents with the benefit of hindsight and knowledge of factors that may have positively affected its performance, cannot account for all financial risk that may affect results and may be considered to reflect survivor/look ahead bias. Actual returns may differ significantly from, and be lower than, back-tested returns. Past performance is not an indication or guarantee of future results.

Typically, when S&P DJI creates back-tested index data, S&P DJI uses actual historical constituent-level data (e.g., historical price, market capitalization, and corporate action data) in its calculations. Certain datapoints used to calculate S&P DJI's indices may not be available for the entire desired period of back-tested history. In cases when actual data is not available for all relevant historical periods, S&P DJI may employ a process of using "Backward Data Assumption" (or pulling back) of data for the calculation of back-tested historical performance. "Backward Data Assumption" is a process that applies the earliest actual live data point available for an index constituent company to all prior historical instances in the index performance. For example, Backward Data Assumption inherently assumes that companies currently not involved in a specific business activity (also known as "product involvement") were never involved historically and similarly also assumes that companies currently involved in a specific business activity were involved historically too. The Backward Data Assumption allows the hypothetical back-test to be extended over more historical years than would be feasible using only actual data. The methodology and factsheets of any index that employs backward assumption in the back-tested history will explicitly state so. The methodology will include an Appendix with a table setting forth the specific data points and relevant time period for which backward projected data was used.

Index returns shown do not represent the results of actual trading of investable assets/securities. S&P Dow Jones Indices maintains the index and calculates the index levels and performance shown or discussed but does not manage actual assets. Index returns do not reflect payment of any sales charges or fees an investor may pay to purchase the securities underlying the Index or investment funds that are

intended to track the performance of the Index. The imposition of these fees and charges would cause actual and back-tested performance of the securities/fund to be lower than the Index performance shown. As a simple example, if an index returned 10% on a US \$100,000 investment for a 12-month period (or US \$10,000) and an actual asset-based fee of 1.5% was imposed at the end of the period on the investment plus accrued interest (or US \$1,650), the net return would be 8.35% (or US \$8,350) for the year. Over a three-year period, an annual 1.5% fee taken at year end with an assumed 10% return per year would result in a cumulative gross return of 33.10%, a total fee of US \$5,375, and a cumulative net return of 27.2% (or US \$27,200).

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