# VecViz Aggregate Analytics Performance Summary Report

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1 April 2025

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## Introduction

Here we summarize the out of sample performance of VecViz's investment analytics. We do so at a high level, in terms of percentage of objectives met, in aggregate, across horizons and lookback periods.

All of VecViz's analytic metrics are derived from its Vector Model of price probability. The primary purpose of this report is of course to guage how well the metrics are meeting their objectives. A secondary but also important objective is to help the reader determine if the performance of the metrics across horizons and lookback periods is reasonably consistent. This serves as an important check on both the metrics themselves and their respective evaluation methodologies.

Please see the "Important Considerations" section of this report for disclosure of at least some of the many ways this report likely falls short of its objective, and other important disclosures.

## VecViz Analytic Metrics Assessed

1) Value at Risk (the 95th and 99th percentile downward)
2) Opportunity at Risk (the 95th and 99th percentile upward)
3) Expected Up and Down Body (the expected value between the current price and the forecasted 95th percentile price upward and downward, respectively)
4) Option Fair Values
5) V-Score rankings of expected forward price returns

Full Report Cards for each of these metrics can be found in the Appendix to this report. Charts, ticker level detail, and explanatory material supporting those Report Cards can be found in the metric specific Reports these report cards were excerpted from, which can be found in the "Reports" page of vecviz.com.

## Assessment Criteria Overview

This report presents summary statistics that represent the % of objectives met for each of the metrics listed above. Each metric has 7 or more objectives, and each objective is evaluated across 16 horizon / lookback period combinations, utilizing ticker-model date level granularity, to a significant extent. The evaluation of most metrics in this report includes: 1) comparison to Gaussian / normal distribution based Sigma, as implemented by VecViz to reflect exponential time decay of observation weightings. The V-Score is an exception here - it is evaluated on

the basis of the consistency of its rankings with forward returns. 2) accuracy related metrics, such as mean absolute error. For example, we measure how close the actual breakage rate of 95% VaR forecasts was to the targeted 5.00% level. 3) the returns of metric oriented strategies. For example, we measure the impact of setting position sizes using Vector Model VaR instead of Sigma VaR on investment performance. The

Though the results are not incorporated into the Aggregate Summary report card presented in the section that follows, we also evaluate VaR and OaR on the basis of their Kupiec and Christoferson statistics, which are well established statistical tests of the consistency of their breakage rate with targeted levels and the independence of breakage events. The results of those tests are included in the Appendix of this document.

## Vector Model Overview

The Vector Model uses systematic price channel identification and scoring in conjunction with machine learning to provide investors with volatility forecasts that reflect the asymmetric, jumpy, clustering, and price dependent behavior of realized and option implied volatility in the financial markets.

The sole input to Vector Model and the Sigma Model out of sample analytics are daily closing prices obtained from QuoteMedia.

The Vector Model was trained upon ~ 60,000 ticker model dates (TMD's) representing ~550 tickers (including equities, currencies, and commodities) and ~ 120 model dates spanning from March 9, 2002 to February 3, 2021. The Out of Sample period starts on 1/31/2022, nearly a full one year from the last model date included in the training data. All analytics discussed in this report are for model dates beyond January 31, 2022, making them fully out of sample.

This report includes Vector Model and Sigma model results for ~150 tickers. Only about twenty of these tickers were included in the Vector Model training data set discussed above. These tickers were selected using the following criteria at the time of selection: Top and Bottom 25 S&P 500 performers, Largest 25 publicly traded issuers in the LQD and HYG etf's, constituents of the Metals and Pharmaceuticals sector within the LQD and HYG etf's, and any other tickers that at the time drew significant financial media attention (Mag 7, meme-related stocks, bitcoin related stocks). We also included several major equity and debt-oriented ETF's. The complete Vector Model coverage universe discussed in this report includes the following tickers:

AA, AAP, AAPL, ABBV, ACGL, ADBE, AMAT, AMC, AMD, AMGN, AMZN, AVGO, AZN, AZO, BA, BAC, BALL, BBY, BHC, BHP, BIIB, BMY, BUD, BXP, CAH, CCL, CDNS, CHTR, CITI, CLF, CMA, CMCSA, CMG, CNC, COST, CPRT, CSCO, CSTM, CTLT, CVS, CYH, CZR, DHI, ELAN, EMB, ETRN, EXPE, FCX, FIS, FITB, FRA, FRCB, FSUGY, GBTC, GE, GILD, GLD, GME, GNRC, GOLD, GOOGL, GS, GSK, GT, GWW, HCA, HD, HLT, HON, HSBC, HYG, IEP, INTC, INTU, IRM, ISRG, JAZZ, JPM, KALU, KEY, KHC, LEN,

LLY, LNC, LQD, LUMN, LVS, LW, META, MNST, MOS, MRK, MS, MSFT, MSI, MSTR, MU, MUB, NAVI, NEM, NFLX, NVDA, NVS, NWL, ON, ORCL, ORLY, OXY, PCG, PEP, PHM, POST, PRGO, PWR, QCOM, QQQ, RIO, SBNY, SBUX, SIVBQ, SLV, SNY, SPY, T, TDG, TEVA, TFC, THC, TLT, TMUS, TRGP, TSLA, TXN, UAA, UNH, USB, VCSH, VFC, VICI, VNO, VST, VZ, WDC, WFC, WRK, WYNN, X, XOM, ZION, ZTS.

The Vector Model is described further in the FAQ and Blog of vecviz.com.

## Sigma Overview

The core of Sigma, as presented alongside Vector Model output by VecViz, is the standard deviation of price-based returns that very likely gets discussed in any introductory book on risk or portfolio management. This is the same definition of volatility that is utilized in the Black Scholes option pricing formula.

Sigma's flaws as an estimate of forward volatility are well documented. Nevertheless, it remains perhaps the most popular metric for "risk" when it comes to investments, likely because of its simplicity and familiarity.

We present Sigma based on daily logarithmic price returns (akin to % changes in price), and a lookback period of two years. To enhance Sigma's accuracy, we apply a 6-month half-life rate of decay to the weightings applied to the daily returns used to calculate Sigma. This weighting scheme causes the most recent 6-month period to be weighted 8x the least recent 6-month period in the 2 year look back period.

Sigma is converted to probabilities by applying multipliers associated with the standard normal (i.e. Gaussian) distribution with a mean of 0 and sigma of 1.00. Thus, 95% OaR is assumed to be -1.645 sigma's lower than the current price and 99% OaR is presumed to be -2.326 sigma's lower than the current price.

Sigma based probability percentiles for longer time horizons are obtained by multiplying Sigma calculated from daily closing prices by the square root of the number of trading days in the given horizon. In doing so, we are assuming daily returns are independent and identically distributed. So, for example, the multiplier that converts daily horizon sigma to 1 year horizon sigma is the square root of 252 (~15.9).

All calculations for Sigma are based on the same pricing data obtained from QuoteMedia data used to calculate Vector Model OaR.

All Sigma estimates discussed in this report are for dates beyond January 31, 2022, the end of the training period for the Vector Model.

Please see the Expected Body Performance Report for how Expected Body analytics are calculated for Sigma, and the Option Fair Value Performance Report for how option fair values are calculated using Sigma in conjunction with the Black Scholes option pricing model. Both reports can be found in the "Reports" section of vecviz.com.

**Important considerations about the analytics and performance metrics presented in this report:**

1) Past performance is no guarantee of future results. None of the content in this report is investment advice or an offer to buy or sell securities. VecViz is not an SEC investment advisor or broker-dealer. The staff of VecViz actively transacts in securities tied to many of the tickers discussed in this report. See VecViz's Terms and Conditions for more context and detail at https://vecviz.com/termsand- conditions/

2) Read ""Let me warn you…" of the limitations of VecViz's Analytics.", a blog entry on vecviz.com (https://vecviz.com/let-me-warn-you-of-the-limitations-of-vecvizsanalytics/)

3) Given that VecViz's Vector model is a novel, non-parametric approach to probability, with the exception of the Kupiec and Christoferson tests we feel it is important that performance for every model date is reflected in this report, so that the behavior of Vector Model analytics can be as well understood as possible. That said, doing so clearly results in overlapping horizons beyond 1d in duration, and that results in understated volatility metrics and skewed values of metrics that incorporate volatiltiy (such as Information Ratio and p-values for intercepts and slopes, i.e. Alpha and Beta). Thus please note that volatility oriented evaluation metrics should not be used for anything beyond comparison to similarly calculated evaluation metrics for other models, such as Sigma, or benchmarks, such as the SPY etf. Please also know that the data used for the Christoferson and Kupiec test was a subset of the overall dataset that was selected to have as many non-overlapping periods as possible from the start of the out of sample period on 1/31/2022 for each horizon.

4) We are not considering any incremental transaction costs that VecViz analytics may cause an investor to occur beyond what they would incur utilizing Sigma analytics for the same objectives.

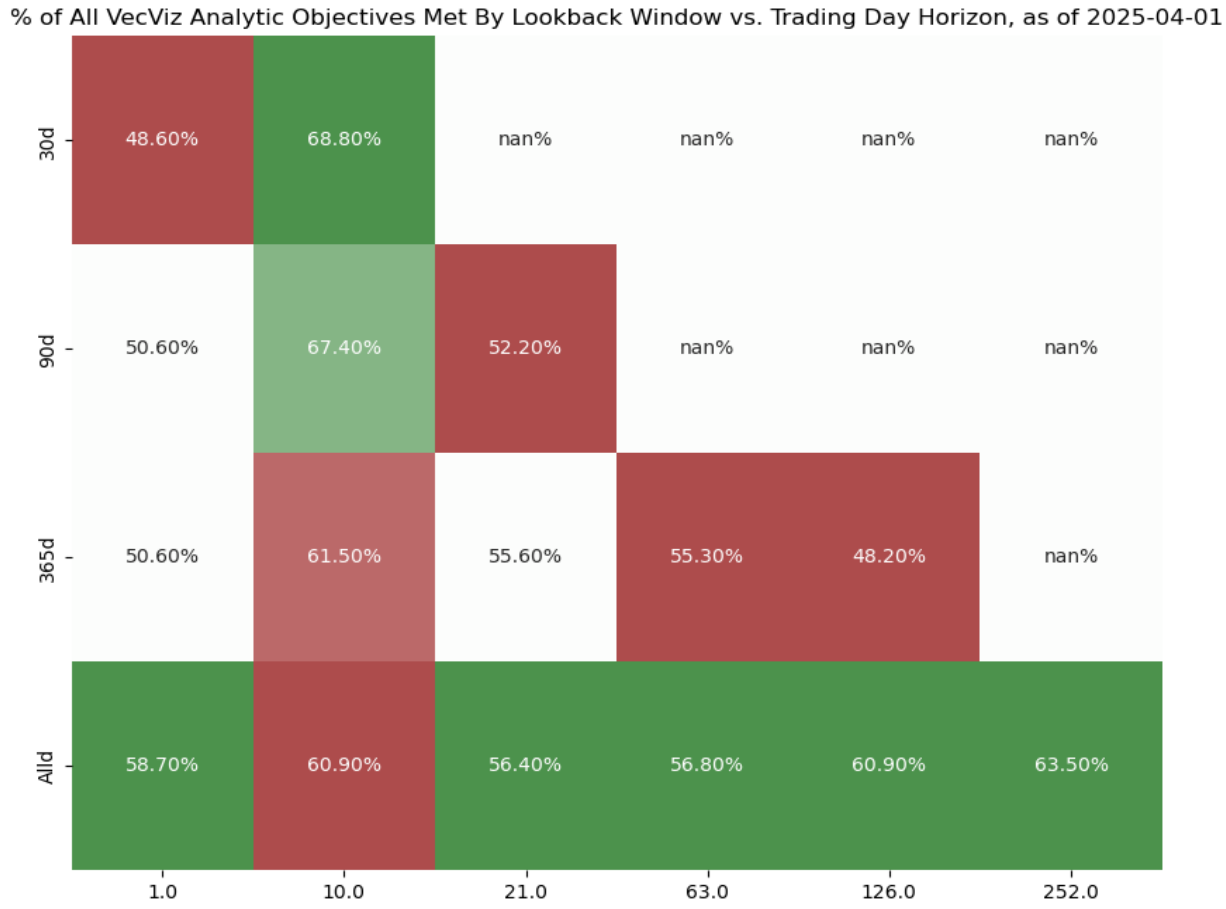
5) We are not incorporating any borrowing charges or repo credits or margin related costs for implied levered long or "short" positions in any of the return related metrics.

6) All analytics presented in this report assumes that prices are floored at $0.01. Since the coverage universe for this report includes only listed equities, that assumption is appropriate. However, if the Vector Model were applied to commodities or perhaps other potentially illiquid securities we would likely have to remove that floor for such tickers, and the resulting impact on model performance for such tickers has not yet been researched.

Thus, in summary, all metrics presented in this report are presented and are to be considered on a comparative basis. Do the bullish V-Score grouping outperform the bearish V-Score grouping? Do they outperform the benchmarks? How does their volatility and information ratio (IR = mean return / std dev) compare? These are the questions this report is structured to answer.

## Aggregate VecViz Analytics "Report Card"

Encompasses VecViz's VaR, OaR, Expected Body, Option Fair Value, and V-Score metrics:




### % of Each Metric's Performance Objectives Met by Lookback Period Across All Applicable Horizons

| Window | VaR | OaR | ExpBody | OptionFV | V-Score | AggScore | AsOfDate |
|---|---|---|---|---|---|---|---|
| 30 | 60.71 | 71.43 | 81.25 | 60 | 20 | 58.68 | 2025-04-01 |
| 90 | 64.29 | 78.57 | 70.83 | 60 | 10 | 56.74 | 2025-04-01 |
| 365 | 68.57 | 75.71 | 45 | 56 | 26 | 54.26 | 2025-04-01 |
| All | 44.05 | 71.43 | 43.75 | 56.67 | 81.67 | 59.51 | 2025-04-01 |

## % of Each Metric's Performance Objectives Met by Horizon Across All Applicable Lookback Periods

| Horizon | VaR | OaR | ExpBody | OptionFV | V-Score | AggScore | AsOfDate |
|---|---|---|---|---|---|---|---|
| 1 | 55.36 | 69.64 | 53.12 | 55 | 27.5 | 52.12 | 2025-04-01 |
| 10 | 75 | 80.36 | 70.31 | 52.5 | 45 | 64.63 | 2025-04-01 |
| 21 | 59.52 | 76.19 | 47.92 | 50 | 40 | 54.73 | 2025-04-01 |
| 63 | 46.43 | 75 | 43.75 | 70 | 45 | 56.04 | 2025-04-01 |
| 126 | 39.29 | 67.86 | 40.62 | 70 | 55 | 54.55 | 2025-04-01 |
| 252 | 50 | 71.43 | 56.25 | 60 | 80 | 63.54 | 2025-04-01 |

## % of Each Metric's Performance Objectives Met Across All Horizons and Lookback Periods

| Metric | % of Objectives Met | AsOfDate |
|---|---|---|
| VaR | 57.59 | 2025-04-01 |
| OaR | 74.11 | 2025-04-01 |
| ExpBody | 53.91 | 2025-04-01 |
| OptionFV | 57.5 | 2025-04-01 |
| V-Score | 43.12 | 2025-04-01 |
| AggScore | 57.25 | 2025-04-01 |

Observations as of 2025-03-28:

1. VecViz's analytics in aggregate achieved 59.5% of their objectives on an equally weighted objective / horizon / lookback period basis (excluding the Christoferson and Kupiec tests for VaR and OaR).

2. Aggregate performance across all analytics for the 10d horizon has improved strongly in the last 30 and 90 day periods. In contrast, performance for the 1d horizon has been lackluster for the 365 days, including the last 30 and 90, relative to the average for the entire period.

3. OaR has been the strongest performer overall, with VaR and Option Fair Value closely tied for second place.

4. While the V-Score has the strongest "All" lookback period performance of any metric, it has been the worst performer over the last year, 90 days, and 30 days. The other metrics comprise many of the inputs to the V-Score. We are planning to implement a refresh

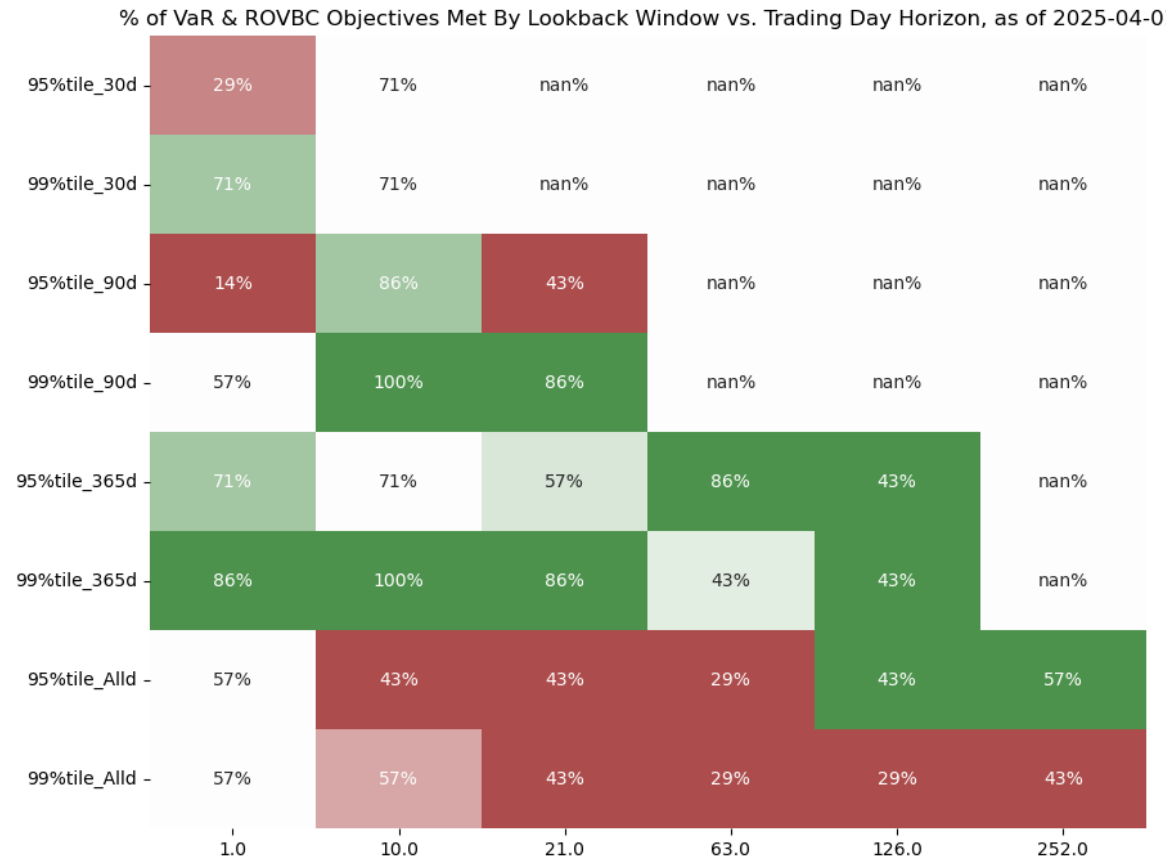
of its training data to include more recent observations. V-Score training data presently includes no model dates beyond 1/31/2021.

5. Expected Body has been on average the weakest performer, but still met 44% of its objectives, and it has been the strongest performer over the prior 30 days. We note that there is a trade-off from an accuracy perspective between Expected Up Body and OaR and between Expected Down Body and VaR that is contemplated in only some of the Expected Body evaluation criteria. See the Expected Body report for further discussion and details on metrics that adjust for this issue.

## Appendix 1: VaR Report Card Detail

Period examined: AllD = 2022-01-31 through 2025-03-28 while 365D /90D/ 30D include the 365/90/30 days ended 2025-03-28, respectively.

### Sigma Comparison Report Card:




### Vector Model Statistical Testing Report Card:

The Kupiec Proportion of Failures test statistic (listed as VaR_kStat in the table below), and its probability (VaR_pValK) are used to test the null hypothesis that the Vector Model's VaR breakage rate is consistent with expectations. The test statistic is calculated by comparing the number of VaR breaks experienced to the expected number of breaks given the total number of observations and the specified probability level. Breakage is measured at the individual ticker-model date level. The probability of the Kupiec statistic occurring is obtained from the

chi-squared distribution. The lower the Kupiec statistic, the higher the p-Value, and the more likely that the Vector Model's VaR breakage rate is consistent with expectations.

The Christoferson VaR Violation Independence test statistic (listed as VaR_chrStat in the table below) and its probability (VaR_pValChr) are used to test the null hypothesis that the VaR model violations are independent. The test statistic focuses on consecutive breakages over time. We measure breakage at the portfolio level, with portfolio breakage for a given period defined as equally weighted ticker level breakage for that period being beyond expectation given the specified probability level. The probability of the Christoferson statistic occurring is obtained from the chi-squared distribution. The lower the Christoferson statistic, the higher the p-Value, and the more likely that the Vector Model's VaR breakage is independent.

Kupiec and Christoferson test results for Sigma VaR can be found in the Appendix.

Period examined: 2022-01-31 through 2025-03-28. Note that for horizon periods greater than 1d we exclude enough model dates to assure no overlap between observation periods.

| Model | Pctile | Horizon | VaR_kStat | VaR_pValK | VaR_chrStat | VaR_pValChr |
|---|---|---|---|---|---|---|
| Vector | 95 | 1 | 4.82 | 0.03 | 11.56 | 0 |
| Vector | 95 | 10 | 17.5 | 0 | 0.09 | 0.77 |
| Vector | 95 | 21 | 2.16 | 0.14 | 0.68 | 0.41 |
| Vector | 95 | 63 | 0.97 | 0.32 | 0.01 | 0.92 |
| Vector | 95 | 126 | 0.2 | 0.65 | 0.37 | 0.54 |
| Vector | 95 | 252 | 0.01 | 0.92 | nan | 0 |
| Vector | 99 | 1 | 38.46 | 0 | 19.16 | 0 |
| Vector | 99 | 10 | 16.82 | 0 | 0.17 | 0.68 |
| Vector | 99 | 21 | 5.93 | 0.01 | 0.12 | 0.73 |
| Vector | 99 | 63 | 1.25 | 0.26 | 0.01 | 0.92 |
| Vector | 99 | 126 | 0.64 | 0.42 | nan | 0 |
| Vector | 99 | 252 | 7.4 | 0.01 | nan | 0 |

## Combined Summary Report Card By Objective:

Here we summarize the results by objective, starting with the Sigma comparison-based objectives, for which a sub-total is provided. Each lookback period, horizon and specified percentile receives equal weighting in these calculations.

Then summary results for the statistical tests are provided, with success defined as a p-value for the corresponding test statistic $> 0.05$, and each horizon and specified percentile receiving equal weighting.")

Period examined: 2022-01-31 through 2025-03-28.

| VaR and ROVBC Criteria | Average Score(%) |
|---|---|
| 1. Closer to Target VaR Breakage Than Sigma (i.e., smaller MAE) | 62.5 |
| 2. Less Volatile VaR Breakage Across Model Dates Than Sigma | 68.75 |
| 3. Less Volatile VaR Breakage Across Tickers Than Sigma | 28.12 |
| 4. Higher ROVBC Than Sigma | 53.12 |
| 5. Higher ROVBC Than Sigma, Adj. for Avg. VM-Sigma VaR Diff. | 81.25 |
| 6. Alpha of ROVBC vs Sigma >0, Across Tickers and Model Dates | 40.62 |
| 7. Alpha of ROVBC vs Sigma >0, By Ticker, Across Model Dates | 68.75 |
| Overall Comparison to Sigma Average | 57.59 |
| Kupiec Test of VaR Proximity to Target | 50 |
| Christoferson Test of VaR Date Independence | 58.3333 |

Observations as of 2025-03-28

1. The Vector Model compared favorably to Sigma in 59.8% of all VaR and ROVBC evaluation criteria, on average, across all 16 lookback periods and forward time horizons, supportive of investor consideration of Vector Model VaR alongside or perhaps in place of Sigma VaR.

2. Performance relative to Sigma has generally improved over time, with the 90-day lookback period stronger than the 365d lookback period, which is stronger than the entire ("Alld") lookback period.
3. 99% VaR criteria scores have outperformed 95% VaR criteria stores over the last 90 days.
4. Accuracy related (Breakage rate) scores were strong, but Return related (ROVBC) scores were even stronger.

5. ROVBC alpha across model dates was much stronger than alpha across tickers and model dates, suggesting weakness at generating alpha from ticker selection.

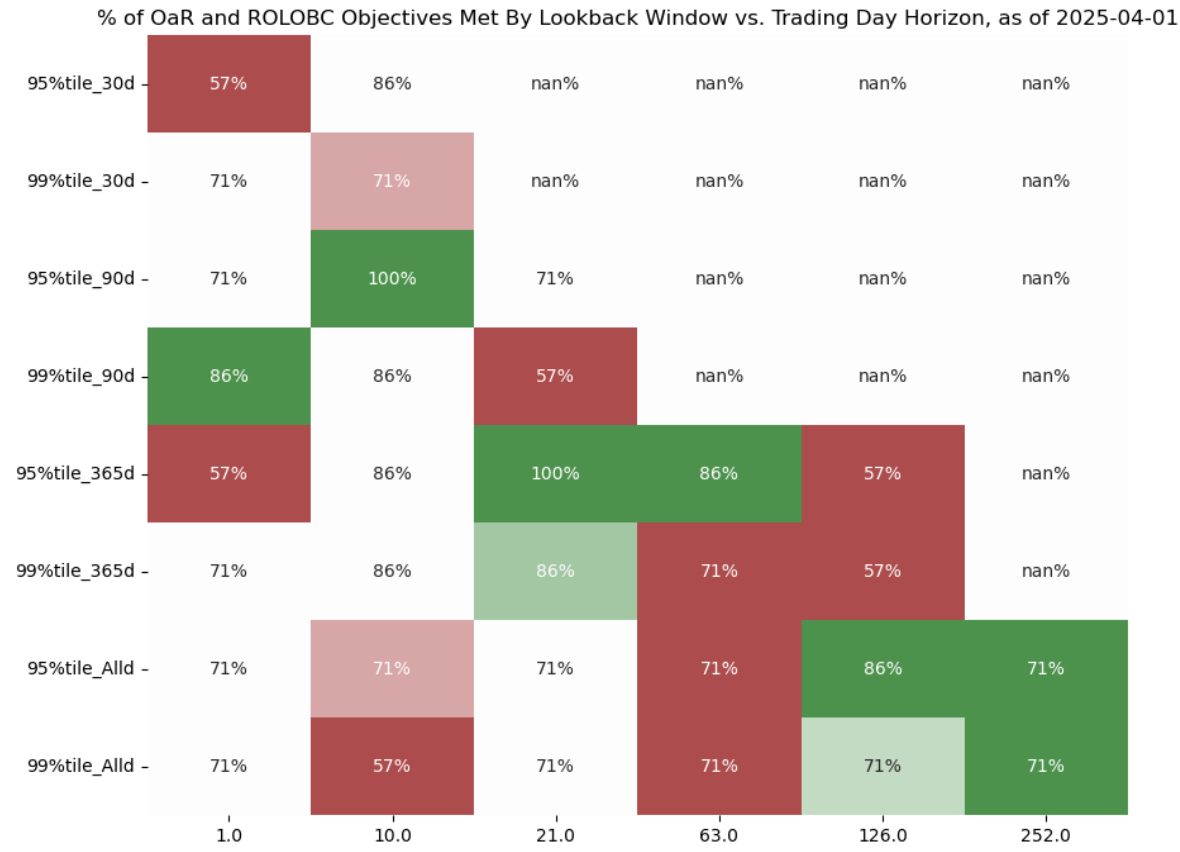
6. The Kupiec Test indicates that Vector Model VaR breakage was consistent with expectations, with 95% certainty, in 50% of the horizon and percentile combinations studied. The 95th percentile VaR was well specified at horizons fom 21d to 252d, while the 99th percentile VaR was well specified for only the 63d and 126d horizons.

7. The Christoferson Test indicates that Vector Model VaR breakage was independent across model dates, with 95% certainty, in 58% of the horizon and percentile combinations studied. The 10d through 63d time horizons were found to have independent VaR breakage for both the 95th and 99th percentiles.

## Appendix 2: OaR Report Card Detail

Period examined: AllD = 2022-01-31 through 2025-03-28 while 365D /90D/ 30D include the 365/90/30 days ended 2025-03-28, respectively.

### Sigma Comparison Report Card:




### Vector Model Statistical Testing Report Card:

The Kupiec Proportion of Failures test statistic (listed as OaR_kStat in the table below), and its probability (OaR_pValK) are used to test the null hypothesis that the Vector Model's OaR breakage rate is consistent with expectations. The test statistic is calculated by comparing the number of OaR breaks experienced to the expected number of breaks given the total number of observations and the specified probability level. Breakage is measured at the individual ticker-model date level. The probability of the Kupiec statistic occurring is obtained from the

chi-squared distribution. The lower the Kupiec statistic, the higher the p-Value, and the more likely that the Vector Model's OaR breakage rate is consistent with expectations.

The Christoferson OaR Violation Independence test statistic (listed as OaR_chrStat in the table below) and its probability (OaR_pValChr) are used to test the null hypothesis that the OaR model violations are independent. The test statistic focuses on consecutive breakages over time. We measure breakage at the portfolio level, with portfolio breakage for a given period defined as equally weighted ticker level breakage for that period being beyond expectation given the specified probability level. The probability of the Christoferson statistic occurring is obtained from the chi-squared distribution. The lower the Christoferson statistic, the higher the p-Value, and the more likely that Vector Model OaR breakage is independent.

Kupiec and Christoferson test results for Sigma OaR can be found in the Appendix.

Period examined: 2022-01-31 through 2025-03-28. Note that for horizon periods greater than 1d we exclude enough model dates to assure no overlap between observation periods.

| Model | Pctile | Horizon | OaR_kStat | OaR_pValK | OaR_chrStat | OaR_pValChr |
|---|---|---|---|---|---|---|
| Vector | 95 | 1 | 124 | 0 | 0.34 | 0.56 |
| Vector | 95 | 10 | 15.84 | 0 | 1.32 | 0.25 |
| Vector | 95 | 21 | 14.35 | 0 | 0.24 | 0.62 |
| Vector | 95 | 63 | 0.31 | 0.58 | 0.17 | 0.68 |
| Vector | 95 | 126 | 6.14 | 0.01 | nan | 0 |
| Vector | 95 | 252 | 0.01 | 0.9 | nan | 0 |
| Vector | 99 | 1 | 8.54 | 0 | 1.81 | 0.18 |
| Vector | 99 | 10 | 21.91 | 0 | 0.81 | 0.37 |
| Vector | 99 | 21 | 8.55 | 0 | 5.8 | 0.02 |
| Vector | 99 | 63 | 0.8 | 0.37 | 1.19 | 0.27 |
| Vector | 99 | 126 | 2 | 0.16 | nan | 0 |
| Vector | 99 | 252 | 2.58 | 0.11 | nan | 0 |

## Combined Summary Report Card By Objective:

Here we summarize the results by objective, starting with the Sigma comparison-based objectives, for which a sub-total is provided. Each lookback period, horizon and specified percentile receives equal weighting in these calculations.

Then summary results for the statistical tests are provided, with success defined as a p-value for the corresponding test statistic $> 0.05$, and each horizon and specified percentile receiving equal weighting.")

Period examined: 2022-01-31 through 2025-03-28.

| OaR and ROLOBC Criteria | Average Score(%) |
|---|---|
| 1. Closer to Target OaR Breakage Than Sigma | 81.25 |
| 2. Less Volatile OaR Breakage Across Model Dates Than Sigma | 100 |
| 3. Less Volatile OaR Breakage Across Tickers Than Sigma | 53.12 |
| 4. Higher ROLOBC Than Sigma | 84.38 |
| 5. Higher ROLOBC Than Sigma, Adj. for Avg. VM-Sigma OaR Diff. | 46.88 |
| 6. Alpha of ROLOBC vs Sigma >0, Across Tickers and Model Dates | 84.38 |
| 7. Alpha of ROLOBC vs Sigma >0, By Ticker, Across Model Dates | 68.75 |
| Overall Comparison to Sigma Average | 74.11 |
| Kupiec Test of VaR Proximity to Target | 41.6667 |
| Christoferson Test of OaR Date Independence | 58.3333 |

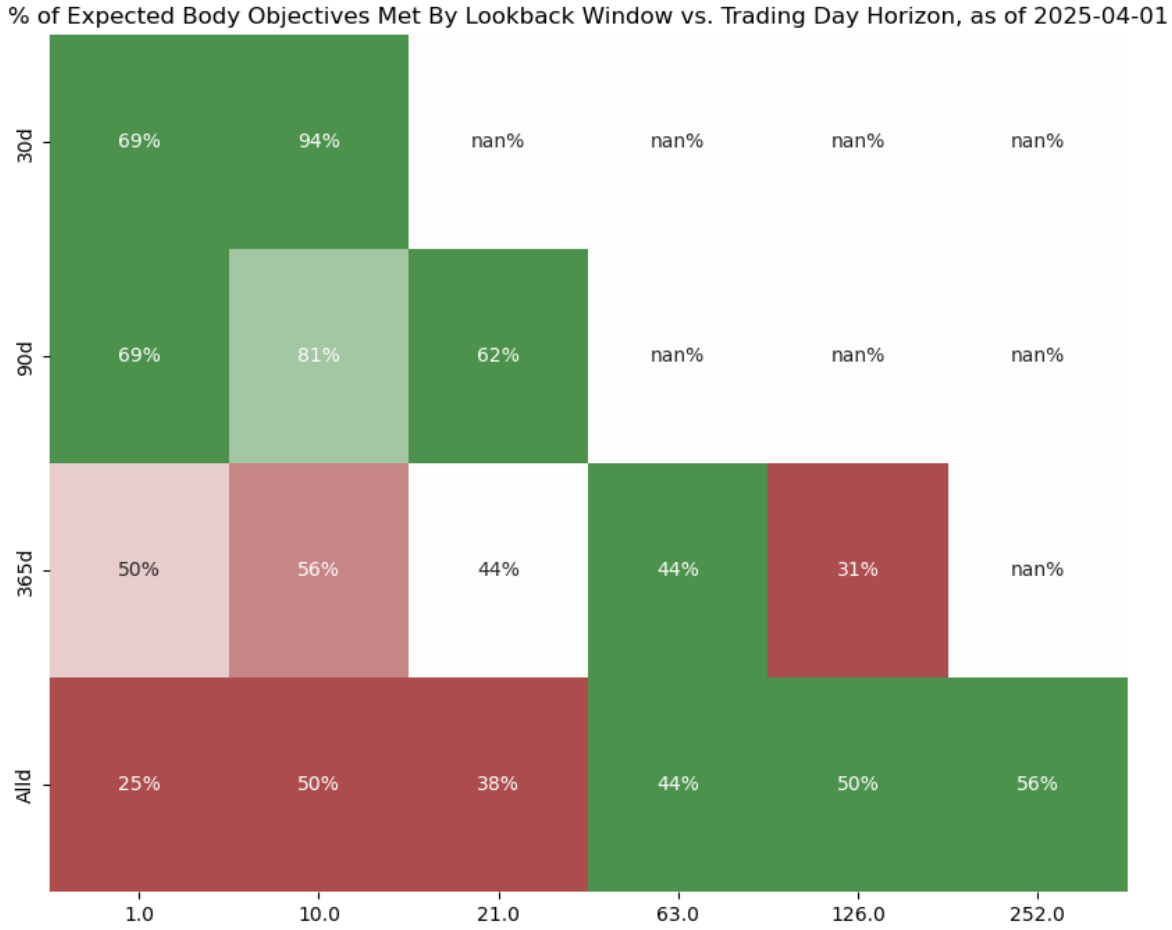
Observations as of 2025-03-28

1. The Vector Model compared favorably to Sigma in 58.3% of all OaR and ROLOBC evaluation criteria, on average, across all 16 lookback periods and forward time horizons, supportive of investor consideration of Vector Model OaR alongside or perhaps in place of Sigma OaR.

2. Performance relative to Sigma has modestly deteriorated in the last 90 days relative to the prior 365 days but is starting to rebound in the prior 30 days.
3. 95th and 99%tile OaR criteria scores performed similarly over the last year, though 95%tile OaR scores have outperformed 99%tile scores longer term.
4. Scores for return related criteria (ROLOBC) are strong, but accuracy related scores (breakage) are even stronger.
5. ROLOBC alpha across model dates was moderately stronger than alpha across tickers and model dates, suggesting moderate weakness at generating alpha from ticker selection.
6. The Kupiec Test indicates that Vector Model OaR breakage was consistent with expectations, with 95% certainty, in 42% of the horizon and percentile combinations studied. The 63d and 252d horizon was well specified at both the 95 and 99 percentile level, whereas the 126d was found to be well specified at only the 99% level.
7. The Christoferson Test indicates that Vector Model OaR breakage was independent across model dates, with 95% certainty, in 58% of the horizon and percentile combinations studied. The 1d through 63d time horizons were found to have independent VaR breakage for both the 95th and 99th percentiles, with the exception of the 21d horizon for the 99%tile, which just missed the 0.05 p-value threshold (with a p-value of 0.03).

## Appendix 3: Expected Body Report Card Detail

Period examined: AllD = 2022-01-31 through 2025-03-28 while 365D /90D/ 30D include the 365/90/30 days ended 2025-03-28, respectively.




| EB Criteria | Average Score(%) |
|---|---|
| 1. Smaller EUB MAE (mean absolute error) | 6.25 |
| 2. Smaller EUB MAE after 95%tile adjustment | 25 |
| 3. Less adjusted EUB MAE Variability across dates | 37.5 |
| 4. Less adjusted EUB MAE Variability across tickers | 31.25 |
| 5. Smaller EDB MAE | 25 |
| 6. Smaller EDB MAE after 95%tile adjustment | 50 |
| 7. Less adjusted EDB MAE Variability across dates | 37.5 |
| 8. Less adjusted EDB MAE Variability across tickers | 37.5 |
| 9. Greater ROEUB | 93.75 |

| EB Criteria | Average Score(%) |
|---|---|
| 10. Greater ROEUB after adjusting for EUB magnitude | 100 |
| 11. ROEUB alpha across tickers and dates $> 0$ | 87.5 |
| 12. ROEUB alpha across dates $> 0$ | 75 |
| 13. Greater ROEDB | 56.25 |
| 14. Greater ROEDB after adjusting for EDB magnitude | 50 |
| 15. ROEDB alpha across tickers and dates $> 0$ | 62.5 |
| 16. ROEDB alpha across dates $> 0$ | 87.5 |
| Overall Average | 53.91 |

See the prior page for associated definitions of the criteria.

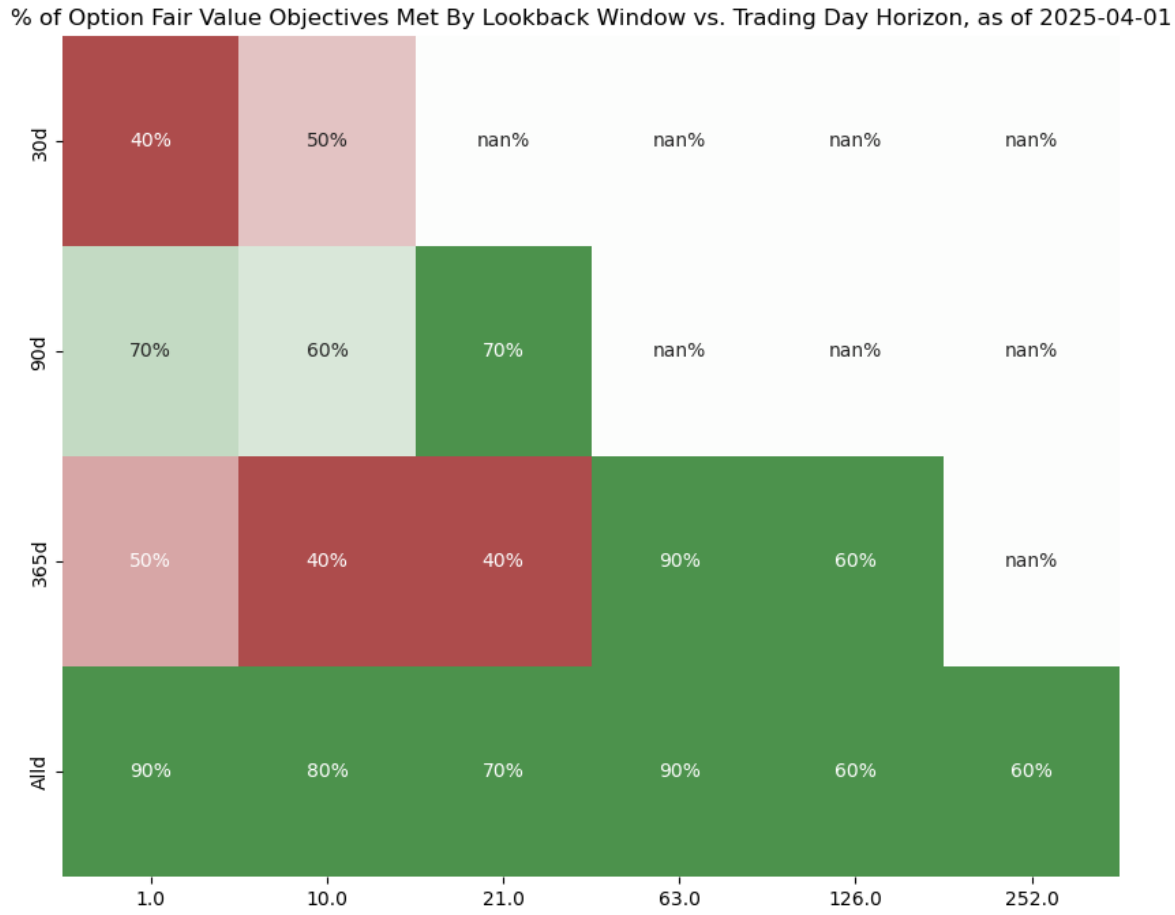
Observations as of 2025-03-28

1. Expected Body accuracy and return oriented metrics met 44% of their objectives.
2. Performance has been strong over the last 30 and 90 days after lagging earlier in the prior 365 day period relative to the prior 2 years.

3. Return oriented metrics scored much higher than the accuracy related metrics
4. Alpha across dates was stronger than alpha across tickers and dates for both ROEDB and ROEUB, suggesting these metrics have more to offer fronm a returns impact perspective in terms of timing of exposures than ticker selection.
5. EDB based metrics outperformed EUB based metrics in terms of both accuracy (EDB MAE outperformed EDB MAE) and returns (ROEDB outperformed ROEUB).

## Appendix 4: Option Fair Value Report Card Detail

Period examined: AllD = 2022-01-31 through 2025-03-28




| OFV Criteria | Average Score(%) |
|---|---|
| 1. Closer RFR Proximity: NTM | 43.75 |
| 2. Closer RFR Proximity: DOOTM | 25 |
| 3. Smaller Max Loss By Date: NTM | 87.5 |
| 4. Smaller Max Loss By Date:: DOOTM | 100 |
| 5. Avg Excess P&L >Excess Max Loss By Date (if any):NTM | 93.75 |
| 6. Avg Excess P&L >Excess Max Loss By Date (if any):DOOTM | 100 |
| 7. Smaller Max Loss By Ticker: NTM | 31.25 |
| 8. Smaller Max Loss By Ticker: DOOTM | 56.25 |
| 9. Avg Excess P&L >Excess Max Loss By Ticker (if any):NTM | 37.5 |
| 10.Avg Excess P&L >Excess Max Loss By Ticker (if any):DOOTM | 62.5 |
| Overall Average | 63.75 |

| OFV Criteria | Average Score(%) |
|---|---|

Observations as of 2025-03-28

1. Vector Model OFV achieved its objectives in 57% of instances on an equally weighted Objective / Lookback Period / Horizon basis.

2. Performance in the last 30 and 90 days is much improved relative to the prior year and the overall out of sample period for the 1d/10d/21d horizon (to extent applicable).

3. With the exception of RFR proximity, Vector Model performance tends to be better for DOOTM (even numbered criteria) than NTM (odd numbered criteria).
4. Vector Model average option selling profit tends to be further from the RFR than Sigma's
5. Vector Model option selling tends to experience less adverse max losses by date than Sigma, but more severe losses by ticker (particularly for NTM).
6. Average excess P&L vs. Sigma tends to be greater than any excess max loss vs. Sigma, including on a "by ticker" basis.

## Appendix 5: V-Score Report Card Detail

Here we summarize the results to be found in the section that follows, "Historic Average Performance By V-Score Grouping". We present here the % of the maximum score that can be obtained by applying the following criteria to the Average Returns and Information Ratios we calculate for each V-Score grouping / Model Date Lookback Period / Forward Time Horizon.

Average Price Return:

1. Positive V-Scores > Avg Ticker > NegV-Scores
2. Positive VaR Adjusted V-Scores >Avg Ticker > Negative VaR Adjusted V-Scores
3. Positive V-Score Rank Order corresponds to Price Returns
4. Negative V-Score Rank Order corresponds to Price Returns
5. The differential between Positive and Negative V-Scores is greater on a VaR adjusted basis than on an unadjusted basis.

Information Ratio (+1 if met):

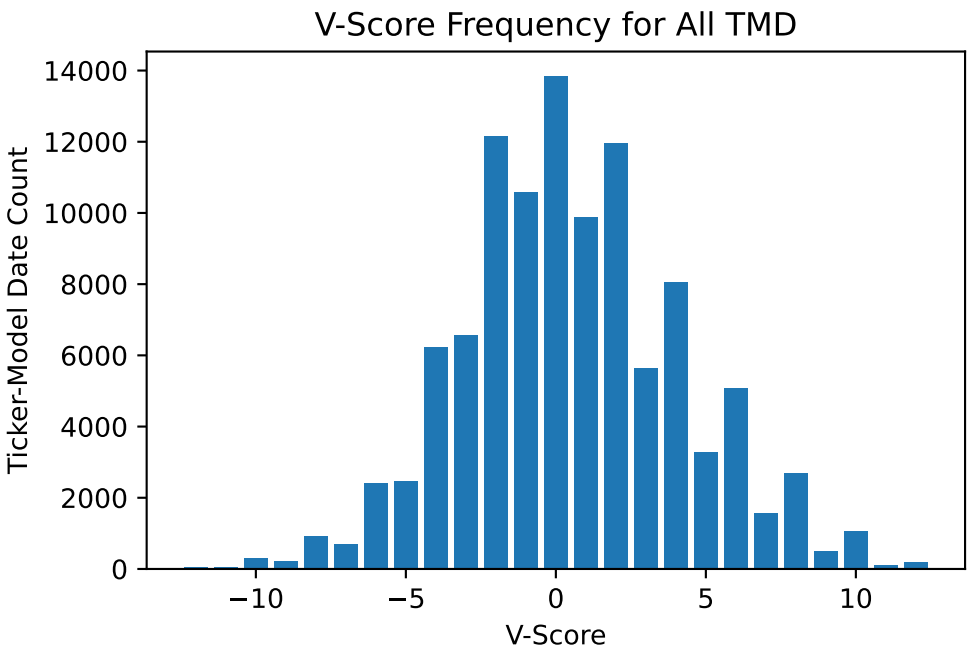
1. Positive VaR Adjusted V-Scores > All Positve V-Scores
2. Negative VaR Adjusted V-Scores < All Negative V-Scores
3. Positive VaR Adjusted V-Scores> Avg Ticker
4. Negative VaR Adjusted V-Scores < Avg Ticker
5. Positive VaR Adjusted V-Scores > "SPY" etf

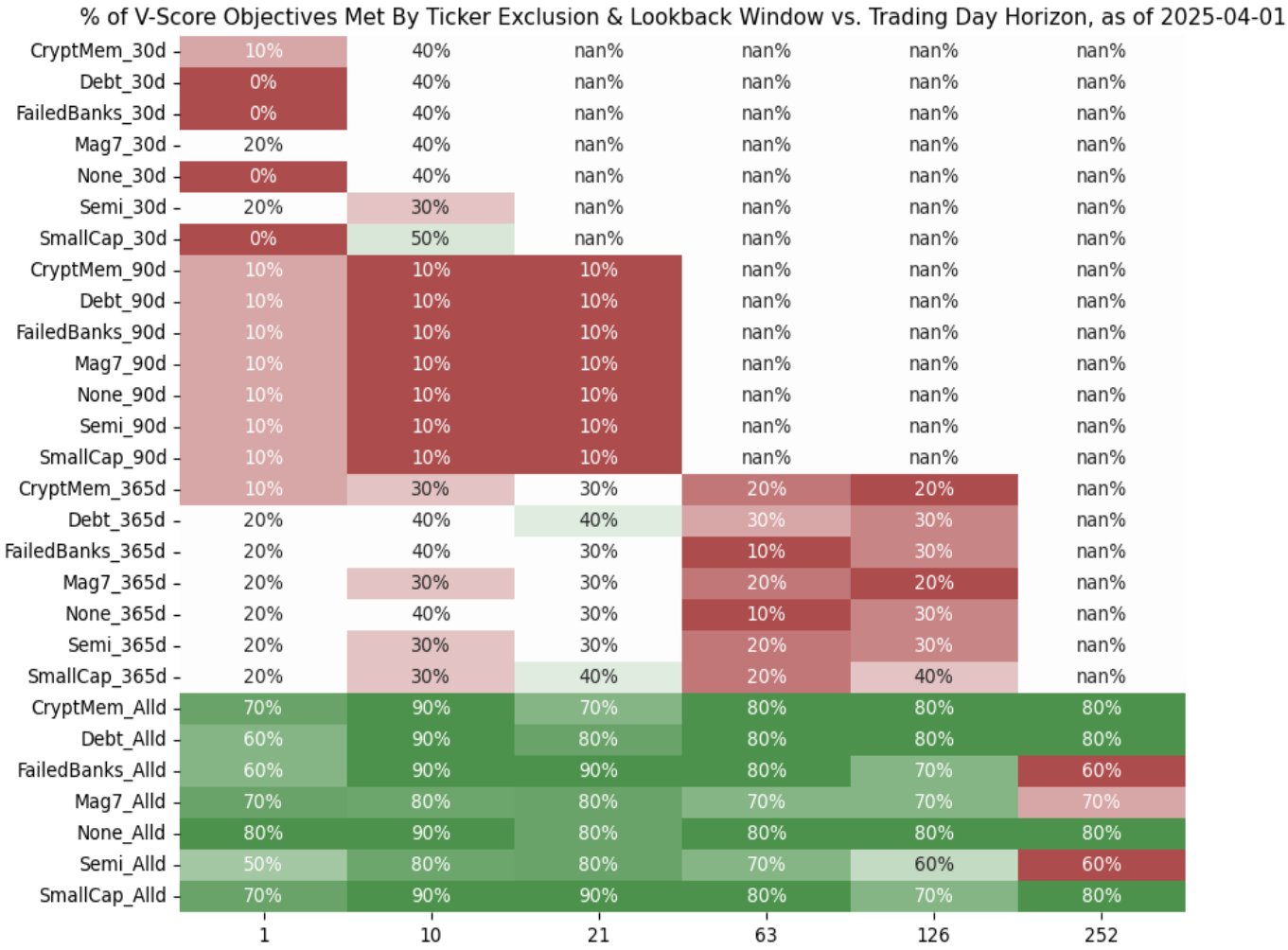
Ticker Exclusion Groupings:

1. None: all ~150 tickers covered included, none excluded
2. CryptMem: excludes MSTR, GBTC, AMC, GME
3. FailedBanks: excludes SIVBQ, SBNY, FRCB
4. SmallCap: excludes NAVI, LUMN, CYH, NWL, KALU, IEP, POST, GT, BHC
5. Mag7: excludes NVDA, NFLX, MSFT, AMZN, GOOGL, META, TSLA
6. Semi: excludes NVDA, AMD, AVGO, MU, AMAT, CDNS, TXN, ON, QCOM, INTC, WDC
7. Debt: excludes TLT, LQD, MUB, VCSH, HYG, EMB, FRA

Finally, an understanding of the relative frequency of each V-Score is key to understanding the V-Score's performance and to its interpretation:

Period examined: All model dates from 2022-01-31 through 2025-03-28


V-Score Frequency for All TMD
Ticker-Model Date Count
14000
12000
10000
8000
6000
4000
2000
0
−10
−5
0
5
10
V-Score




| V-Score Criteria | Average Score(%) |
|---|---|
| 1. PxRet: PosVS > AvgTicker > NegVS | 41.96 |
| 2. PxRet: VaRAdjPosVS > AvgTicker > VaRAdjNegVS | 37.5 |
| 3. PxRet: PosVS Rank Order | 30.36 |
| 4. PxRet: NegVS Rank Order | 11.61 |
| 5. PxRet: VaRAdj_PosNegVSDiff > PosNegVSDiff | 57.14 |
| 6. IR: VaRAdjPosVS > PosVS | 40.18 |
| 7. IR: VaRAdjNegVS < NegVS | 86.61 |
| 8. IR: VaRAdjPosVS > AvgTicker | 32.14 |
| 9. IR: VaRAdjNegVS < AvgTicker | 64.29 |
| 10. IR: VaRAdjPosVS > SPY | 15.18 |
| Overall Average | 41.7 |

Observations as of 2025-03-28

1. The V-Score achieved 45% of its objectives on an equally weighted objective / horizon / ticker exclusion grouping / lookback period basis.

2. Performance has degraded over the last 365 days relative to the "Alld" (prior 3 year) period, seemingly concentrated in the last 90days. Perhaps the November 2024 election and its aftermath was disruptive.

3. No exclusion grouping has a significant impact on the reported results. Results tend to benefit a bit when Small Caps or Crypto / Meme stocks are excluded, and they tend to do a bit worse when Semi's are excluded, but material impacts are hard to find.

4. Prior to the last 90 days the 10 day horizon was distinguishing itself as the strongest horizon. The 21d horizon also performs relatively well.

5. NegVSRank Order is the worse performing criteria (aside from those relating to SPY), as deeply negative V-Scores have actually performed quite well. Fortunately, these are a small fraction of all tickers.

6. VaRAdjNegVS is among the best performing criteria, underperforming most anything it is compared to, in line with expectations.

## Appendix 6: Sigma Kupiec and Christoferson VaR tests.

The Kupiec Proportion of Failures test statistic (listed as VaR_kStat in the table below), and its probability (VaR_pValK) are used to test the null hypothesis that the VaR model breakage is consistent with expectations. The test statistic is calculated by comparing the number of VaR breaks experienced to the expected number of breaks given the total number of observations and the specified probability level. Breakage was measured at the individual ticker-model date level. The probabilty of the Kupiec statistic occuring is obtained from the chi-squared distribution. The lower the statitic, the higher the p-Value, and the more likely that Sigma's VaR breakage is consistent with expectations.

The Christoferson VaR Violation Indepence test statistic (listed as VaR_chrStat in the table below) and its probabilty (VaR_pValChr) are used to test the null hypothesis that the VaR model violations are independent. The test statistic focuses on consecutive breakages over time. We measure breakage at the portfolio level, with portfolio breakage for a given period defined as equally weighted ticker level breakage for that period being beyond expecataion given the specified probability level. The probabilty of the Christoferson statistic occuring is obtained from the chi-squared distribution. The lower the statitic, the higher the p-Value, and the more likely that Sigma VaR breakage is independent.

Kupiec and Christoferson results for the Vector Model can be found in the Report Card section.

Period examined: 2022-01-31 through 2025-03-28. Note that for horizon periods greater than 1d we exclude enough model dates to assure no overlap between observation periods.

| Model | Pctile | Horizon | VaR_kStat | VaR_pValK | VaR_chrStat | VaR_pValChr |
|---|---|---|---|---|---|---|
| Sigma | 95 | 1 | 180.27 | 0 | 8.91 | 0 |
| Sigma | 95 | 10 | 1.5 | 0.22 | 0.07 | 0.8 |
| Sigma | 95 | 21 | 29.9 | 0 | 0.25 | 0.61 |
| Sigma | 95 | 63 | 12.46 | 0 | nan | 0 |
| Sigma | 95 | 126 | 19.23 | 0 | nan | 0 |
| Sigma | 95 | 252 | 13.73 | 0 | nan | 0 |
| Sigma | 99 | 1 | 261.69 | 0 | 29.13 | 0 |
| Sigma | 99 | 10 | 34.79 | 0 | 0.44 | 0.51 |
| Sigma | 99 | 21 | 0 | 0.98 | 1.67 | 0.2 |
| Sigma | 99 | 63 | 0 | 0.96 | 0.73 | 0.39 |
| Sigma | 99 | 126 | 0.31 | 0.58 | nan | 0 |
| Sigma | 99 | 252 | 0.44 | 0.51 | nan | 0 |

## Appendix 7: Sigma Kupiec and Christoferson OaR tests.

The Kupiec Proportion of Failures test statistic (listed as OaR_kStat in the table below), and its probability (OaR_pValK) are used to test the null hypothesis that OaR model breakage is consistent with expectations. The test statistic is calculated by comparing the number of OaR breaks experienced to the expected number of breaks given the total number of observations and the specified probability level. Breakage was measured at the individual ticker-model date level. The probabilty of the Kupiec statistic occuring is obtained from the chi-squared distribution. The lower the statitic, the higher the p-Value, and the more likely that Sigma OaR breakage is consistent wtih expectations.

The Christoferson OaR Violation Indepence test statistic (listed as OaR_chrStat in the table below) and its probabilty (OaR_pValChr) are used to test the null hypothesis that the OaR model violations are independent. The test statistic focuses on consecutive breakages over time. We measure breakage at the portfolio level, with portfolio breakage for a given period defined as equally weighted ticker level breakage for that period being beyond expecataion given the specified probability level. The probabilty of the Christoferson statistic occuring is obtained from the chi-squared distribution. The lower the statitic, the higher the p-Value, and the more likely that Sigma OaR breakage is independent.

Kupiec and Christoferson results for the Vector Model can be found in the Report Card section.

Period examined: 2022-01-31 through 2025-03-28. Note that for horizon periods greater than 1d we exclude enough model dates to assure no overlap between observation periods.

| Model | Pctile | Horizon | OaR_kStat | OaR_pValK | OaR_chrStat | OaR_pValChr |
|---|---|---|---|---|---|---|
| Sigma | 95 | 1 | 219.82 | 0 | 5.26 | 0.02 |
| Sigma | 95 | 10 | 1.1 | 0.29 | 1.72 | 0.19 |
| Sigma | 95 | 21 | 13.48 | 0 | 0.12 | 0.73 |
| Sigma | 95 | 63 | 10.02 | 0 | 0.34 | 0.56 |
| Sigma | 95 | 126 | 0.11 | 0.74 | -0 | 1 |
| Sigma | 95 | 252 | 11.04 | 0 | nan | 0 |
| Sigma | 99 | 1 | 134.05 | 0 | 10.43 | 0 |
| Sigma | 99 | 10 | 31.1 | 0 | 0.08 | 0.77 |
| Sigma | 99 | 21 | 21.99 | 0 | 0.1 | 0.76 |
| Sigma | 99 | 63 | 20.56 | 0 | nan | 0 |
| Sigma | 99 | 126 | 9.52 | 0 | nan | 0 |
| Sigma | 99 | 252 | 21.78 | 0 | nan | 0 |