

LightGBM Volatility Crash Gate

Gradient-boosted volatility-stress diagnostics across liquid macro exposures.

FAMILY Volatility overlay design	UNIVERSE Liquid macro ETF and index proxy panel	RESEARCH HORIZON 21d risk horizon
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Executive Summary

LightGBM Volatility Crash Gate is evaluated as a secondary overlay diagnostic.
The 21d stress-label AUC is 0.711, with 0.462 rank correlation to forward volatility.

Research horizon	21d risk horizon
Stress-label AUC	0.711
Forward-vol rank corr.	0.462
Forward-vol spread	7.51%
Risk-off fraction	20.06%

Observations

1. The diagnostic is strongest when higher scores line up with later volatility stress.
2. The design is an overlay research component, not a standalone allocation product.
3. Model comparison matters because the family contains several related scoring approaches.

Data and Research Setup

The setup evaluates volatility-stress scoring designs on a liquid macro proxy panel with walk-forward scoring.

UNIVERSE

Liquid macro ETF and index proxy panel. Current holdings and live trade lists are not shown.

INPUTS

Historical prices, volatility, credit and macro-stress fields are aligned to a dated research panel.

EVALUATION TARGET

Scores are compared against later volatility, drawdown and stress labels over a 21d research window.

OUTPUT BOUNDARY

The figures are historical diagnostics. They do not present current positions or instrument rankings.

Signal Methodology

Without disclosing the exact functional, the construction proceeds along three conceptual steps.

STEP 1

Risk-state scoring

The design assigns a dated risk score from prior market and macro stress information.

STEP 2

Forward stress comparison

Higher-score observations are compared with lower-score observations over the later risk window.

STEP 3

Model comparison

Related scoring families are compared on the same dates and evaluation targets.

The description is intentionally conceptual. Formula details, exact construction rules and implementation parameters are not disclosed.

Results and Diagnostic Context

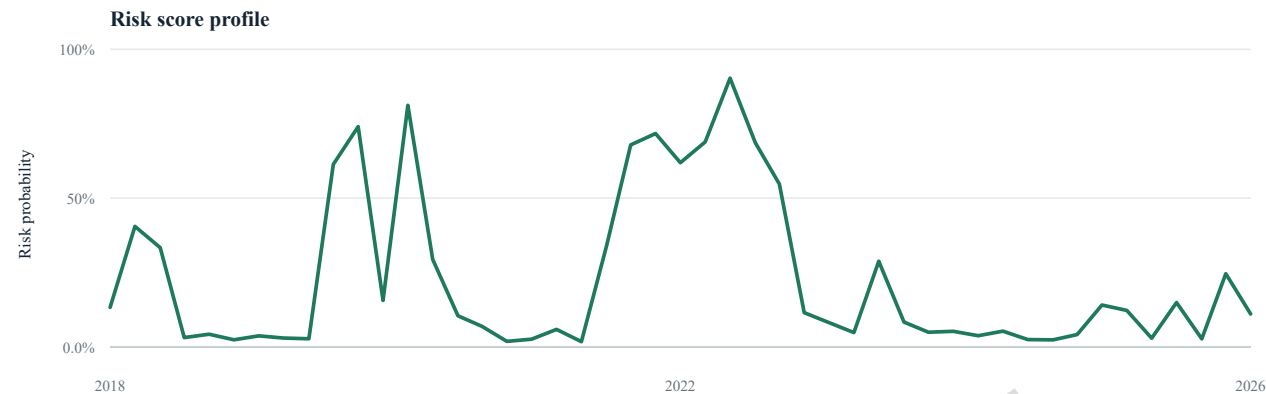


Figure 1. Monthly average risk-score profile for the component. The vertical scale is anchored at zero, and the series should be read as a stress diagnostic rather than a standalone return path.

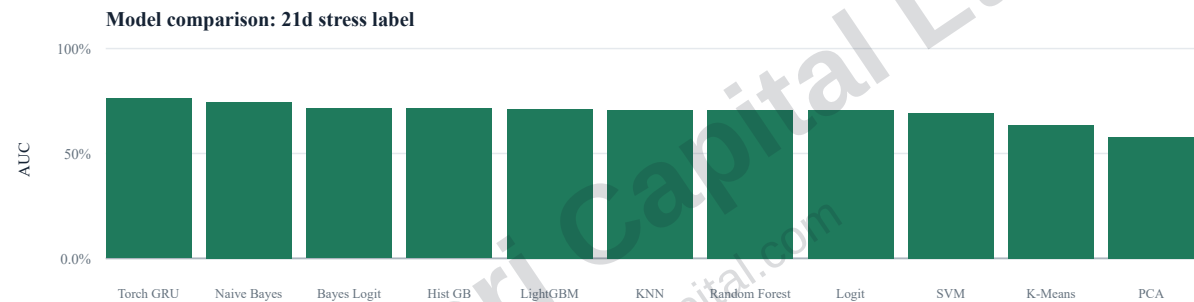


Figure 2. Stress-label AUC across related volatility-stress scoring designs.

Model	AUC	Vol rank corr.	Forward-vol spread	Risk-off fraction
Torch Gru Sequence Classifier	0.762	0.287	4.18%	20.07%
Gaussian Naive Bayes	0.745	0.405	6.66%	20.06%
Bayesian Logistic Laplace Shrinkage	0.715	0.429	6.80%	20.06%
Hist Gradient Boosting Classifier	0.714	0.474	8.29%	20.06%
Lightgbm Classifier	0.711	0.462	7.51%	20.06%
Knn Classifier	0.707	0.444	6.93%	20.06%
Random Forest Classifier	0.706	0.437	7.43%	20.06%
Logistic Regression	0.706	0.421	6.93%	20.06%
Support Vector Machine Rbf	0.693	0.471	6.30%	20.06%
Kmeans Regime Crash Rate	0.636	0.360	6.85%	21.09%
Pca Reconstruction Anomaly	0.580	0.246	5.49%	20.06%

Stability and Robustness

Stability is assessed from the yearly score profile and from comparison against related model families.

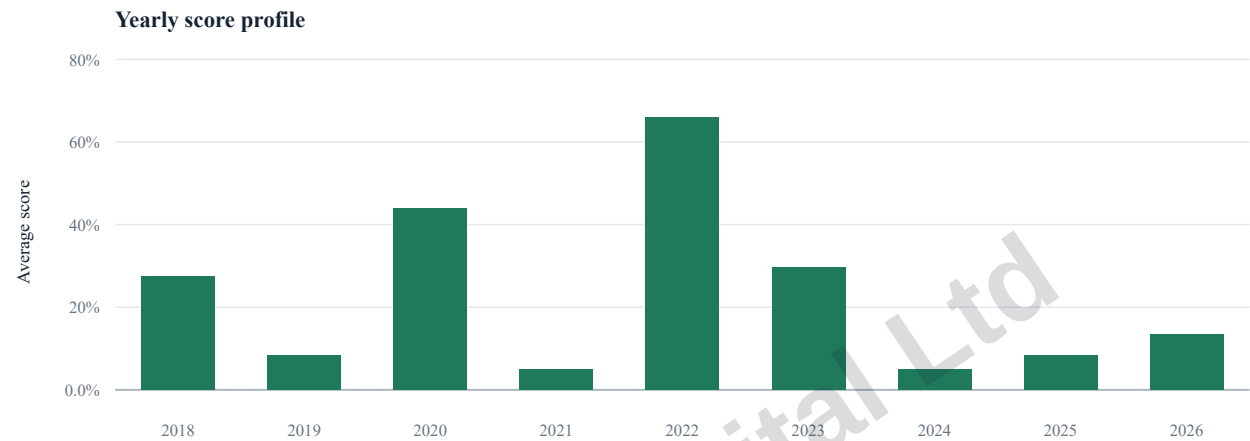


Figure 3. Yearly average risk score for the component. The vertical scale is anchored at zero.

Year	Average score
2018	27.56%
2019	8.29%
2020	43.83%
2021	4.86%
2022	66.09%
2023	29.73%
2024	5.00%
2025	8.41%
2026	13.46%

The yearly profile is diagnostic evidence only; it should be read alongside the model comparison table.

Research Interpretation

The design is retained as a secondary overlay diagnostic within the research library.

ROLE

Secondary overlay diagnostic.

CAPTURES

Stress-state ranking evidence across liquid macro exposures.

USE

Risk-state comparison component inside broader systematic allocation research.

LIMITATIONS

The note does not disclose construction details, model parameters, execution assumptions or product suitability.