Gaussian mixture regimes on SPY

> **Strategy evaluated** · **Nivel de evidencia** Histórico · Development · Sample 2020-03-17 20:00:00+00:00 to 2024-12-31 21:00:00+00:00

N/A marks an undefined or missing value. Return and risk fractions are shown as percentages. The JSON evidence preserves the original precision of the results.

Assessment limits

Survivorship bias. Not assessed. Historical universe membership is missing (SURVIVORSHIP_BIAS_NOT_CONTROLLED).

Look-ahead bias. Not assessed. The report does not verify when signals became available.

Multiple testing. DSR and PBO cannot be assessed from the evidence supplied.

Costs and execution. Gross and net returns were reconciled with recorded costs. Cost sensitivity and actual execution were not assessed.

Use of AI. The evidence does not say whether Strateva used AI in the review.

Advice. This report does not constitute investment advice.

Performance and risk

Absolute performance · Strategy and benchmark

Metric	Strategy	Benchmark
Observations `n_obs`	1207	1207
Periods per year `annualization`	252	252
Annual risk-free rate `risk_free_annual`	2%	2%
Cumulative return `total_return`	107.012%	120.349%
Annualized compound return (CAGR) `cagr`	16.4057%	17.933%
Annualized arithmetic return `annual_return_arithmetic`	15.958%	18.1303%
Annualized volatility `annual_volatility`	12.3599%	18.0877%
Sharpe `sharpe`	1.130887	0.8928702
Sortino `sortino`	1.742394	1.32179
Maximum drawdown `max_drawdown`	-14.6782%	-26.9036%
Periods to the maximum drawdown trough `max_drawdown_underwater_periods`	56	233
Periods from the previous peak to recovery `max_drawdown_recovery_periods`	253	564
Calmar `calmar`	1.117689	0.6665638
Share of positive periods `positive_period_rate`	19.884%	54.5153%
Alias for the share of positive periods `hit_rate`	19.884%	54.5153%

Absolute performance · Strategy and benchmark		
Metric	**Strategy**	**Benchmark**
Skewness `skewness`	0.2010143	0.3170986
Excess kurtosis `excess_kurtosis`	12.71989	6.382907

Active performance · Strategy versus benchmark	
Field	**Value**
Observations `n_obs`	1207
Periods per year `annualization`	252
Annual risk-free rate `risk_free_annual`	2%
Annualized active return `active_return_annual`	-2.17234%
Annualized tracking error `tracking_error_annual`	13.943%
Information ratio `information_ratio`	-0.1558018
Correlation with the benchmark `correlation`	0.6385815
Beta `beta`	0.4363623
Annualized regression alpha `regression_alpha_annual`	8.04659%
Annualized Jensen alpha `jensen_alpha_annual`	6.93039%
Strategy Sharpe ratio `strategy_sharpe`	1.130887
Benchmark Sharpe ratio `benchmark_sharpe`	0.8928702

Statistical uncertainty

Strategy · Mean excess return · HAC	
Field	**Value**
Status `status`	evaluated
Observations `n_obs`	1207
Lags `lags`	6
Weighting kernel `kernel`	bartlett
Estimate per period `estimate`	0.0554668%
Annualized estimate `annualized_estimate`	13.9776%
Standard error `standard_error`	0.0216275%
Annualized standard error `annualized_standard_error`	5.45014%

Strategy · Mean excess return · HAC	
Field	**Value**
t-statistic `t_stat`	2.56464
Two-sided p-value (normal) `p_value_two_sided_normal`	0.0103283

Strategy · Sharpe ratio interval · block bootstrap	
Field	**Value**
Observations `n_obs`	1207
Block length `block_length`	11
Replications `repetitions`	1000
Seed `seed`	20261116
Confidence level `confidence`	95%
Lower-tail probability `lower_probability`	2.5%
Upper-tail probability `upper_probability`	97.5%
Replications attempted `attempted_repetitions`	1000
Valid replications `valid_repetitions`	1000
Replications with no defined estimate `undefined_repetitions`	0
Status `status`	evaluated
Point estimate `point_estimate`	1.130887
Standard error `standard_error`	0.4172153
Lower interval bound `ci_lower`	0.2938014
Upper interval bound `ci_upper`	1.895945

Benchmark · No uncertainty estimate supplied.

Active performance · Mean active return · HAC	
Field	**Value**
Status `status`	evaluated
Observations `n_obs`	1207
Lags `lags`	6
Weighting kernel `kernel`	bartlett
Estimate per period `estimate`	-0.0086204%

Active performance · Mean active return · HAC	
Field	**Value**
Annualized estimate `annualized_estimate`	-2.17234%
Standard error `standard_error`	0.0232713%
Annualized standard error `annualized_standard_error`	5.86436%
t-statistic `t_stat`	-0.3704313
Two-sided p-value (normal) `p_value_two_sided_normal`	0.7110612

Active performance · Information ratio interval · block bootstrap	
Field	**Value**
Observations `n_obs`	1207
Block length `block_length`	11
Replications `repetitions`	1000
Seed `seed`	20261116
Confidence level `confidence`	95%
Lower-tail probability `lower_probability`	2.5%
Upper-tail probability `upper_probability`	97.5%
Replications attempted `attempted_repetitions`	1000
Valid replications `valid_repetitions`	1000
Replications with no defined estimate `undefined_repetitions`	0
Status `status`	evaluated
Point estimate `point_estimate`	-0.1558018
Standard error `standard_error`	0.4310964
Lower interval bound `ci_lower`	-0.9389098
Upper interval bound `ci_upper`	0.7702364

Subperiods and robustness

Additional metrics · No evidence supplied.

Verification and configuration

Engine checks	
Field	**Value**
Schemas valid `schema_valid`	Yes
Evidence hash valid `hash_valid`	Yes
Signature verified `signature_verified`	No
Confirmatory provenance verified `confirmatory_provenance_verified`	No
`reconciliation.tolerance`	1e-09
Status `reconciliation.status`	reconciled
Metric paths checked `reconciliation.checkedPathCount`	96
Hash bindings valid `hash_bindings_valid`	Yes
Metrics reconciled `metrics_reconciled`	Yes
Simulations reproduced `simulations_reproduced`	Yes
`kernelVersion`	1.1.0

Decision thresholds · No evidence supplied.

Engine configuration	
Field	**Value**
Periods per year `annualization`	252
Annualization method `annualizationMethod`	declared by StrategyTrace.frequency.periodsPerYear
Annual risk-free rate `riskFreeAnnual`	2%
`allowPositional`	No
`timezone`	UTC
`calendar`	XNYS
Confidence level `uncertainty.confidence`	95%
`uncertainty.hacLagPolicy.kind`	sample-size-bartlett-v1
`uncertainty.timeBasis.kind`	session-grid
Expected calendar hash `uncertainty.timeBasis.expectedEndsHash`	`76485e0c373b3cdd091d333cede5db7cbe94c3fc9c73bee0da88138152e06677`
Block length `uncertainty.blockLength`	11
Replications `uncertainty.repetitions`	1000
Seed `uncertainty.seed`	20261116

Monte Carlo

Observed path

Field	Value
Terminal wealth (multiple) `terminalWealth`	2.07012
Cumulative return `totalReturn`	107.012%
Maximum drawdown magnitude `maximumDrawdown`	14.6782%
Longest stretch below the peak (periods) `longestUnderwaterStreakPeriods`	252
Share of periods below the peak `timeUnderWaterFraction`	83.5957%
Longest losing streak (periods) `longestLosingStreak`	6
Ruin threshold reached `ruined`	No

Circular block bootstrap

Metric	Minimum	Mean	Maximum	Quantiles
Terminal wealth (multiple) `terminalWealth`	0.9578423	2.106498	4.562851	5% = 1.339359 · 50% = 2.043153 · 95% = 3.065394
Cumulative return `totalReturn`	-4.21577%	110.65%	356.285%	5% = 33.9359% · 50% = 104.315% · 95% = 206.539%
Maximum drawdown magnitude `maximumDrawdown`	5.65638%	14.3491%	37.3331%	5% = 7.89078% · 50% = 13.586% · 95% = 23.2649%
Longest stretch below the peak (periods) `longestUnderwaterStreakPeriods`	59	265.846	1100	5% = 106 · 50% = 225 · 95% = 568
Share of periods below the peak `timeUnderWaterFraction`	47.3902%	79.6445%	98.5087%	5% = 66.2759% · 50% = 79.8674% · 95% = 92.0505%
Longest losing streak (periods) `longestLosingStreak`	4	5.961	12	5% = 5 · 50% = 6 · 95% = 8
Probability of reaching the ruin threshold `ruinProbability`		0%		

Return-order permutation

Metric	Minimum	Mean	Maximum	Quantiles
Maximum drawdown magnitude `maximumDrawdown`	7.57775%	13.8479%	32.2474%	5% = 9.44919% · 50% = 13.2578% · 95% = 20.1568%
Longest stretch below the peak (periods) `longestUnderwaterStreakPeriods`	89	249.751	671	5% = 129.95 · 50% = 232 · 95% = 434.15
Share of periods below the peak `timeUnderWaterFraction`	70.3397%	80.8273%	88.1524%	5% = 76.802% · 50% = 80.8616% · 95% = 84.4242%
Longest losing streak (periods) `longestLosingStreak`	2	3.535	7	5% = 3 · 50% = 3 · 95% = 5
Probability of reaching the ruin threshold `ruinProbability`		0%		

Simulation settings and bindings

Field	Value
`simulationSchemaVersion`	strateva-simulation-evidence/v2
`engineVersion`	0.9.0

Simulation settings and bindings	
Field	**Value**
`kernelVersion`	1.1.0
`observationCount`	1207
`strategyTraceHash`	`4a385789d6348e9df4be4aad303167c3ead87c1ce7b7e121ae9f4bf5df2cecad`
`contentHash`	`15532206487c4f40f50ac1b1189bffb5e1295324c88f398b376a69690c103972`
Replications `configuration.repetitions`	1000
Seed `configuration.seed`	20261116
Block length `configuration.blockLength`	11
Initial wealth `configuration.initialWealth`	1
Ruin threshold (share of initial wealth) `configuration.ruinWealthFraction`	50%
`configuration.quantiles`	5% · 50% · 95%
`classic.method`	CIRCULAR_MOVING_BLOCK_BOOTSTRAP
`classic.sampling`	WITH_REPLACEMENT
`permuted.method`	FISHER_YATES_RETURN_ORDER_PERMUTATION
`permuted.sampling`	WITHOUT_REPLACEMENT
Terminal wealth invariant `permuted.terminalWealthInvariant`	Yes
Terminal wealth (multiple) `permuted.terminalWealth`	2.07012

Provenance and traceability

Evidence and input hashes	
Field	**Value**
`bundleSchemaVersion`	strateva-evidence-bundle/v3
`artifactId`	`urn:strateva:strategy-trace:4a385789d6348e9df4be4aad303167c3ead87c1ce7b7e121ae9f4bf5df2cecad`
`engineVersion`	0.9.0
`kernelVersion`	1.1.0
`generatedAt`	2026-11-17T16:51:09Z
`contentHash`	`39d3c6a8be132c4ba6762e2d3750d7c9fae0209c0d9f8f101c5a3d5f1929c25f`
Strategy return series hash `inputHashes.strategyReturns`	58544972744603ed49a2ea521c9e869c4e6562cca20008ae511868a9d5a07c55
Benchmark return series hash `inputHashes.benchmarkReturns`	2fae3fe671293602f201b96bfced816b0de6a58c7df1ae74128896784cfe14bb

Evidence and input hashes	
Field	**Value**
`lineage`	strategyTrace:4a385789d6348e9df4be4aad303167c3ead87c1ce7b7e121ae9f4bf5df2cecad · scope:4cb394c26cd35eae65b9f8c46a967b2cfe802ad6f1e699a2cc3edf13ed60f9f0 · artifact:69157325756ef27a4e8c3ee5179a0b3f15b8369a23e3cdb69cce75e88ce09472 · data:72f4cea1fee8555b873b6a7efe2b633f4f0cb1f27b768324931d21343d610969

Provenance statement	
Field	**Value**
`claim`	development
`runId`	N/A
`freezeHash`	N/A
`engineCommit`	N/A
`containerImageDigest`	N/A

Evidence signature · No evidence supplied.

StrategyTrace · Identity, frequency, conventions and benchmark	
Field	**Value**
`traceSchemaVersion`	strateva-strategy-trace/v1
`engagementId`	eng-61eaefdd
`runId`	gmm-regimes-evidence
`generatedAt`	2026-11-17T16:51:09Z
`scopeContentHash`	`4cb394c26cd35eae65b9f8c46a967b2cfe802ad6f1e699a2cc3edf13ed60f9f0`
`artifactContentHash`	`69157325756ef27a4e8c3ee5179a0b3f15b8369a23e3cdb69cce75e88ce09472`
`dataContentHash`	`72f4cea1fee8555b873b6a7efe2b633f4f0cb1f27b768324931d21343d610969`
`frequency.barInterval`	1d
Periods per year `frequency.periodsPerYear`	252
`frequency.calendar`	XNYS
`frequency.sourceTimezone`	America/New_York
`conventions.returnType`	SIMPLE
`conventions.returnUnit`	FRACTION
`conventions.timestampMeaning`	UTC_PERIOD_END
`conventions.turnover`	SUM_ABSOLUTE_POSITION_CHANGES
`conventions.exposure`	FRACTION_OF_EQUITY
`conventions.costs`	RETURN_FRACTION
`benchmark.kind`	SERIES
`benchmark.symbol`	URTH
`contentHash`	`4a385789d6348e9df4be4aad303167c3ead87c1ce7b7e121ae9f4bf5df2cecad`

Notes included in the evidence	
Field	**Value**
`disclosures`	The engine recomputed the metrics from verified StrategyTrace net returns. · Monte Carlo has its own hash. It affects criteria only if preregistered for that purpose.