Monte Carlo Portfolio Risk Analysis
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Table 1: Simulation Parameters

Parameter	Value
N (assets)	2
Tickers	SPY, AGG
Portfolio weights (w_i)	[0.5, 0.5]
Time step (Δt)	1 trading day
Horizon (H)	10 days
Number of paths (N_paths)	100,000
Random seed	42
Confidence levels (α)	[0.95, 0.99]

Estimated Parameters from Historical Data

Data period: 2019-01-01 to 2023-12-31

Daily mean returns (μ_i):
  SPY: 0.000576 (14.50% annualized)
  AGG: 0.000040 (1.01% annualized)

Daily volatilities (σ_i):
  SPY: 0.013281 (21.08% annualized)
  AGG: 0.004132 (6.56% annualized)

Correlation matrix (R):
  SPY: 1.0000 0.1605
  AGG: 0.1605 1.0000

Section 5: Results

Risk Metrics

- VaR_95: $1.01
- ES_95: $1.28
- VaR_99: $1.44
- ES_99: $1.65

Loss Distribution Statistics

- Mean loss: $-0.00
- Median loss: $-0.00
- Std deviation: $0.62
- Min loss: $-2.94
- Max loss: $2.72

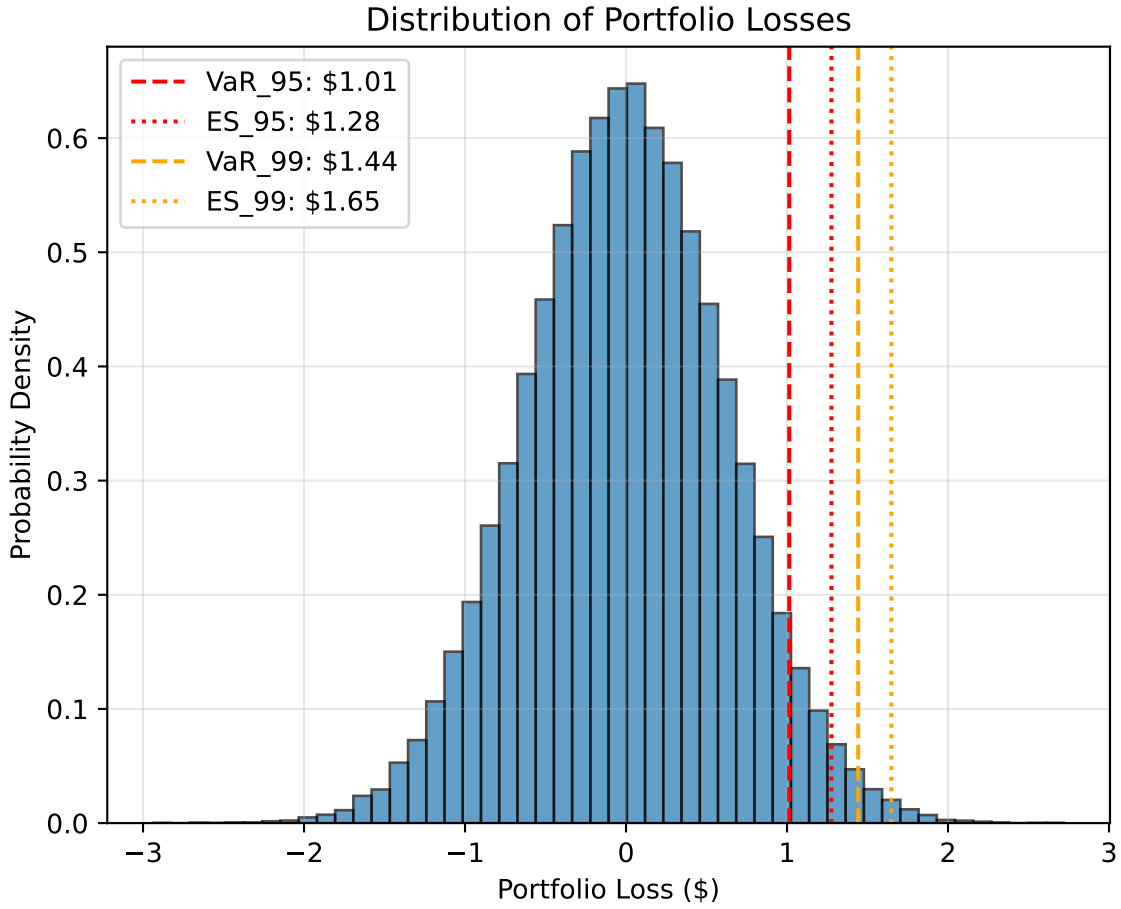
Interpretation

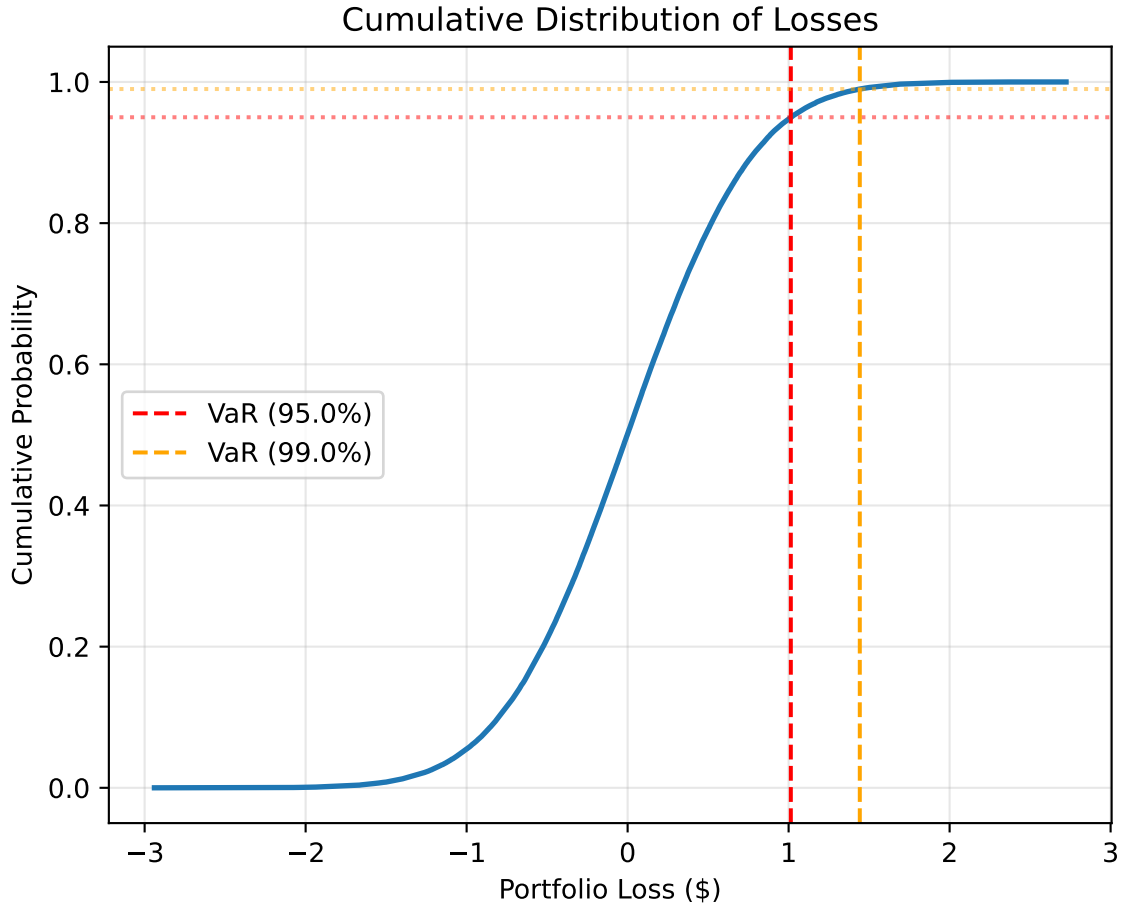
The 95% Value at Risk (VaR) of $1.01 indicates that with 95% confidence, the portfolio loss will not exceed this amount over the 10-day horizon.

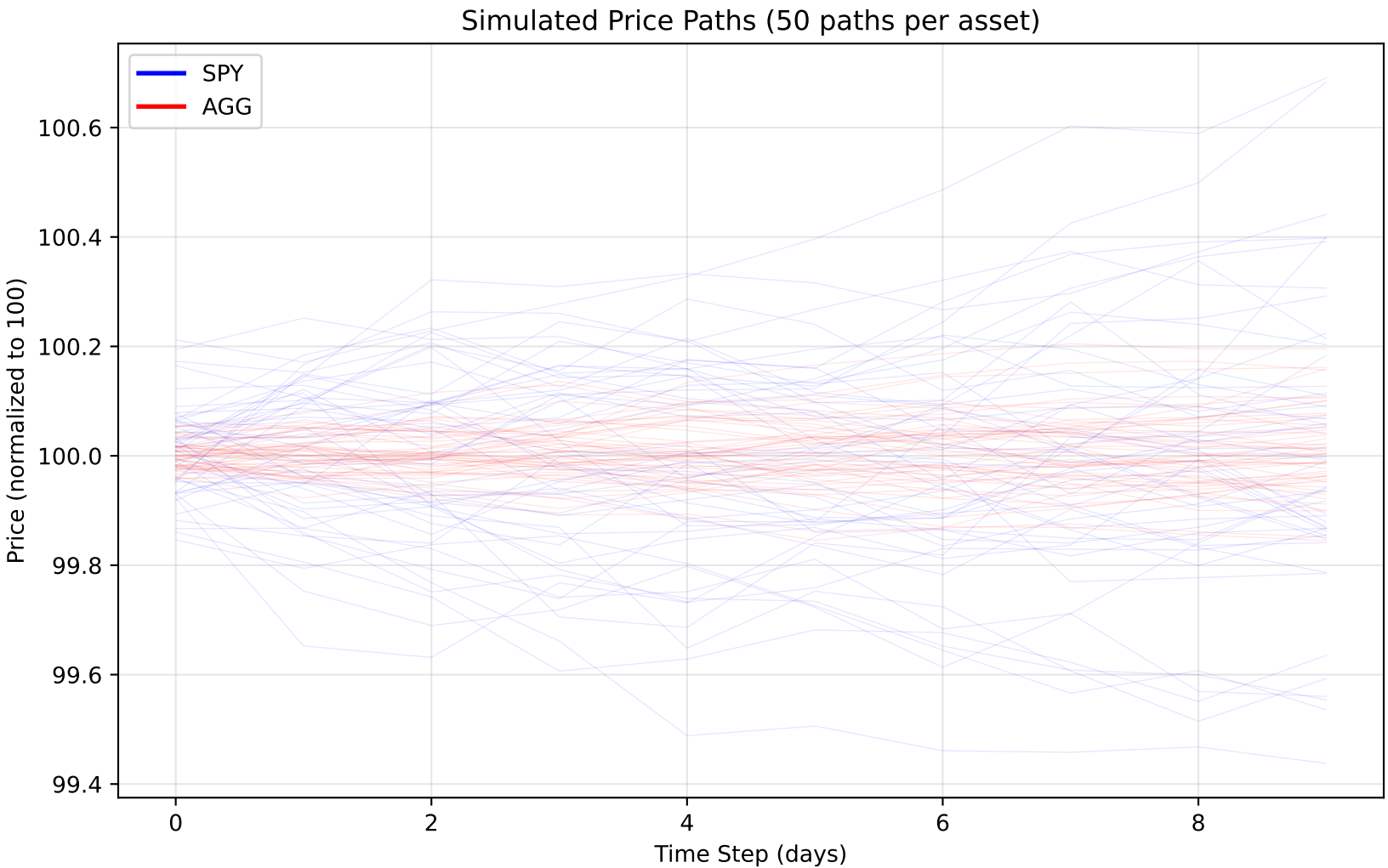
The 95% Expected Shortfall (ES) of $1.28 represents the average loss in the worst 5% of scenarios, providing insight into tail risk beyond the VaR threshold.

Portfolio Composition

- SPY: weight=50.0%, last price=$463.84
- AGG: weight=50.0%, last price=$91.97


Distribution of Portfolio Losses
VaR_95: $1.01
ES_95: $1.28
VaR_99: $1.44
ES_99: $1.65
Probability Density
Portfolio Loss ($)


Cumulative Distribution of Losses
VaR (95.0%)
VaR (99.0%)
Cumulative Probability
Portfolio Loss ($)


Simulated Price Paths (50 paths per asset)
SPY
AGG
Price (normalized to 100)
100.6
100.4
100.2
100.0
99.8
99.6
99.4
0
2
4
6
8
Time Step (days)