



Risk Management Report

LIS - Lisbon Investment Society

January, 2026

Analysts:

Cristina Lin

Duarte Gomes

Miguel Gomes

Raul Vasconcelos

Vaishnavi Nyayadhish

Portfolio Risk Summary

Scope and Objective

This note summarises the risk profile of a four-stock equity portfolio composed of:

AAPL (30%), MSFT (30%), KO (25%), AMD (15%),

using daily and monthly data. This report will give a concise view of:

- short-horizon downside risk (1-day VaR and ES at 99%);
- where that risk comes from (single-name tails and common factors);
- how effective diversification currently is.

Executive Summary

The portfolio has a **concentrated but broadly controlled risk profile**. One-day 99% VaR and Expected Shortfall from Monte Carlo simulations remain in the **low single-digit percentages** of portfolio value, with temporary spikes in more volatile periods. Bootstrap Monte Carlo systematically yields higher VaR/ES than the normal-based model, showing that the empirical distribution has **heavier left tails** and that pure Gaussian assumptions would understate tail risk.

On a medium-term horizon, **risk is clearly dominated by a technology factor**, while KO plays a meaningful stabilising role. Tech names are strongly correlated (MSFT-AMD and MSFT-AAPL), whereas KO is only weakly correlated with AMD, which **supports diversification**. PCA confirms that two intuitive factors explain most of the variance (market/tech plus a growth-defensive tilt). The diversification ratio of about 1.34 implies roughly a **25% reduction in volatility** versus holding the names independently.

1. Short-Horizon Risk

Method

- Daily returns are simulated under two models:
 - **Parametric Monte Carlo**: multivariate normal with sample mean and covariance;
 - **Bootstrap Monte Carlo**: resampling from historical returns to keep empirical skewness and fat tails.
- For each day, we generate a distribution of 1-day portfolio P&L and compute:
 - 99% **Value at Risk (VaR)**: loss exceeded in 1 out of 100 days;
 - 99% **Expected Shortfall (ES)**: average loss conditional on being in that worst 1% tail.

Key Findings

- The simulated 1-day P&L distribution (Figure 1) is centred close to zero, but exhibits a visibly heavy left tail.
- At the 99% level, both VaR and ES are in the **low single-digit percentages** of portfolio value. Daily losses of that magnitude are rare but plausible.

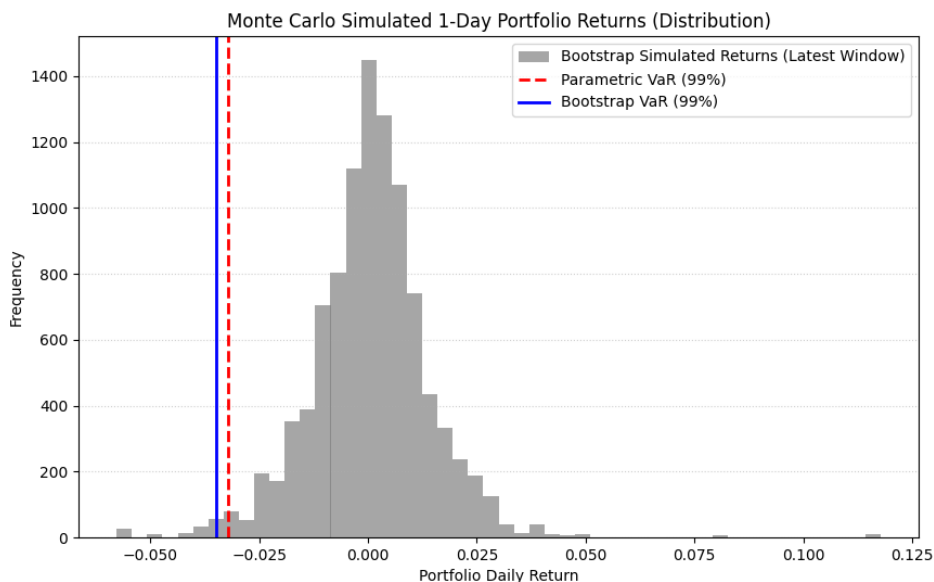


Figure 1: Simulated 1-day portfolio returns with 99% VaR (parametric vs bootstrap).

- **Bootstrap VaR is consistently more conservative** than parametric VaR (its 99% cut-off lies further to the left), indicating that a normal model would *underestimate* tail risk for this portfolio.

- ES is systematically above VaR, quantifying the severity of losses once the VaR threshold has been breached.
- Over time (Figure 2), all four series (VaR/ES, parametric/bootstrap) fluctuate with market volatility; there are clear episodes of elevated risk where both measures spike.

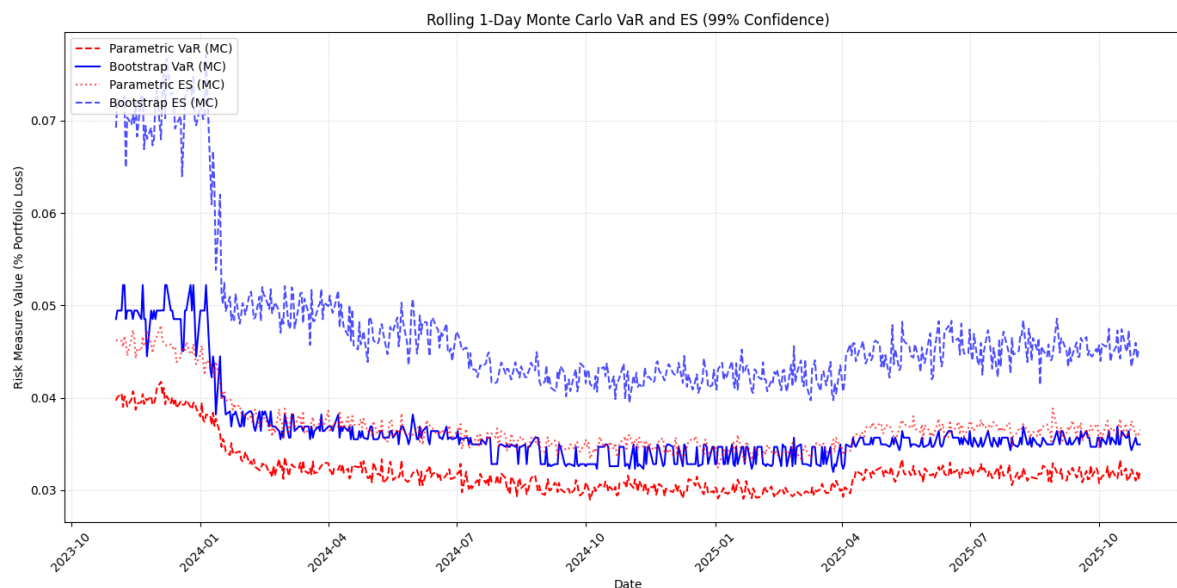


Figure 2: Rolling 1-day VaR and ES (99% confidence)- parametric vs bootstrap.

Operationally, we would recommend using **bootstrap 99% VaR and ES as the reference metrics** for daily risk limits, with the parametric figures as a quick benchmark and model-risk cross-check.

2. Single-Name Tail Risk

To complement portfolio-level metrics, the tail behaviour of key holdings is analyzed. For AAPL, the empirical distribution of daily returns and associated historical VaR levels are shown in Figure 3.

From this distribution:

- 95% 1-day historical VaR for a pure AAPL position is about **2.66%**;
- 97% 1-day historical VaR is about **3.32%**.

This illustrates that individual names, especially large growth holdings, can experience sizable one-day moves. The portfolio context reduces this risk, but concentration in such names remains a key driver of tail behaviour.

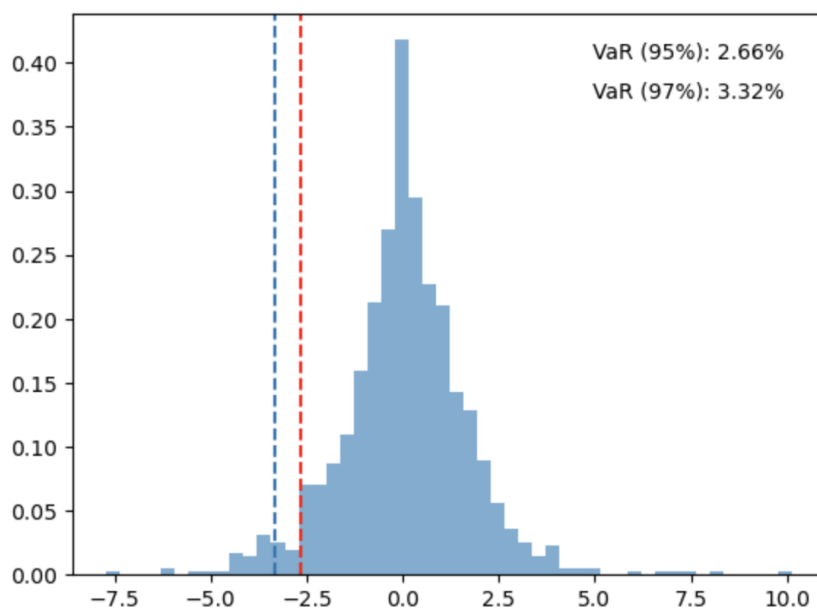


Figure 3: Historical daily returns for AAPL with VaR levels marked.

3. Diversification and Factor Structure (Monthly Horizon)

Using monthly log returns, we assess how much of the portfolio risk is diversified versus driven by common factors.

Correlation and PCA

- Technology names are strongly correlated:
 - MSFT-AMD correlation ≈ 0.66 ;
 - MSFT-AAPL correlation ≈ 0.49 .
- KO provides genuine diversification, especially versus AMD (KO-AMD correlation ≈ 0.07).
- Principal Component Analysis (PCA) on the four stocks yields:
 - PC1: eigenvalue 2.08, **52%** of total variance – broad "market/tech" factor dominated by AAPL and MSFT;
 - PC2: eigenvalue 1.01, **25%** of variance – relative movement between growth (tech) and defensive (KO);
 - PC3 and PC4: together **23%**, more idiosyncratic.
- Thus, **two intuitive factors explain about 77%** of the portfolio's volatility.

Diversification Ratio

With the stated weights, the monthly portfolio volatility is about **5.68%**. The **Diversification Ratio (DR)** is:

$$\text{DR} = \frac{\sum_i w_i \sigma_i}{\sigma_p} \approx \mathbf{1.34},$$

implying a risk reduction of roughly

$$1 - \frac{1}{\text{DR}} \approx \mathbf{25.4\%}$$

versus holding the same names independently.

A time series of DR shows:

- peaks around 1.34-1.35 when diversification is strongest (correlations relatively low);
- dips towards 1.18-1.22 when assets move more in sync and diversification weakens.

Overall, the portfolio is **moderately diversified**: KO plays a stabilising role, but risk remains dominated by a technology factor (AAPL, MSFT, AMD).

4. Conclusions

- **Risk Level:** Daily 99% VaR and ES are meaningful but controlled, staying in the low single-digit percentage range. Short-term risk is acceptable for a concentrated four-stock book, but not negligible.
- **Model Choice:** Bootstrap Monte Carlo better captures empirical tails than a normal model. For risk limits and stress monitoring, bootstrap VaR/ES should be the primary reference.
- **Concentration:** AAPL, MSFT and AMD form a highly correlated tech cluster and dominate the first principal component. Large increases in their volatility or sector-specific stress will quickly feed into portfolio risk.
- **Diversification:** KO materially improves diversification (low correlation, especially vs AMD) and supports a DR of 1.34. Reducing KO or adding another cyclical tech name would raise overall risk without adding much return diversification.
- **Monitoring:**
 - Track bootstrap VaR/ES and their day-on-day changes as part of the daily risk dashboard;
 - Monitor the Diversification Ratio and key correlations (MSFT–AMD, MSFT–AAPL, KO–AMD) monthly;
 - Review portfolio weights if DR falls persistently or if VaR/ES move above predefined comfort ranges.

In summary, the portfolio offers a **reasonable balance between growth exposure and diversification**. Risk is clearly driven by a small number of understandable factors, and can be monitored effectively using the proposed Monte Carlo and PCA-based reports.