Portfolio Risk Analysis using Monte Carlo Simulation (Value at Risk)

Objective

The objective of this project is to quantify potential downside risk of a diversified multi-asset portfolio using Monte Carlo simulation–based Value at Risk (VaR). The analysis aims to evaluate portfolio risk exposure and the impact of diversification on loss reduction.

Portfolio Composition

The portfolio consists of multiple asset classes including equities, fixed income, and gold proxies. Asset weights were assigned to achieve diversification and reduce overall volatility.

Methodology

Historical daily returns were used to estimate mean returns and the covariance matrix. A Monte Carlo simulation was performed by generating thousands of correlated return scenarios using a multivariate normal distribution. Portfolio returns were computed for each simulation to form a return distribution.

Risk Metrics

Value at Risk (VaR) was calculated at the 95% and 99% confidence levels. VaR represents the maximum expected loss over a one-day horizon under normal market conditions with a given confidence level.

Key Findings

The results indicated that portfolio diversification significantly reduced downside risk compared to single-asset exposure. Lower correlations between asset classes helped stabilize portfolio returns and reduce extreme losses.

Limitations & Future Enhancements

The model assumes normally distributed returns and stable correlations, which may underestimate tail risk. Future improvements include Expected Shortfall (CVaR), stress testing, and non-normal return distributions.

Tools Used: Python (NumPy, Pandas), Monte Carlo Simulation, Portfolio Theory