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Term Project Checkpoint C

MSDS451: FINANCIAL MACHINE LEARNING

BLADE ROBELLY

Introduction

This study extends earlier analyses by applying a set of investment strategies and risk-adjusted performance measures to a simulated technology-focused exchange-traded fund (ETF). The ETF is composed of NVIDIA (NVDA), Meta (META), Microsoft (MSFT), and Amazon (AMZN), and it is evaluated against the S&P 500 (SPY) benchmark. The purpose of this research is to determine whether these strategies provide meaningful improvements over simple buy-and-hold investing, and whether the portfolio presents a viable investment opportunity once risks, fees, and market downturns are considered. Potential users of this knowledge include quantitative fund managers, retail investors considering technology ETFs, and financial engineers seeking to build robust trading strategies.

Literature Review

The design of this checkpoint is grounded in prior literature that has evaluated trading strategies beyond raw returns. Momentum strategies, as demonstrated by Jegadeesh and Titman (1993) and expanded by Asness, Moskowitz, and Pedersen (2014), have been shown to generate strong excess returns over extended bull markets. Conversely, mean reversion strategies, which assume price reversals, have been studied by Chan (2020) and Chen (2021), but tend to perform poorly in long uptrends. Hybrid models that attempt to combine both tendencies have been proposed by Velissaris (2020), though their effectiveness depends on market regimes. López de Prado (2018) and Trivedi and Kyal (2021) highlight the importance of stochastic simulation techniques, such as Monte Carlo methods, for evaluating strategies under uncertainty, since historical

backtests may be insufficient to capture tail risks. This checkpoint aligns with such work by extending historical analysis with Monte Carlo testing, risk-adjusted metrics, and fee modeling.

Methods

The analysis was conducted in three stages. First, multiple investment strategies—buy-and-hold, momentum, mean reversion, and a hybrid of the latter two were applied to historical data for the ETF constituents and to Monte Carlo–generated return paths. This allowed for evaluation of both realized and simulated performance. Second, risk-adjusted metrics were computed, including compound annual growth rate (CAGR), Sharpe ratio, alpha, beta, and maximum drawdown, providing a more complete picture of risk and reward. Third, fee modeling was incorporated by applying management and performance-based fees to calculate net investor returns. The results were then synthesized into a business-oriented summary, identifying whether the fund is likely to be attractive to investors.

Results

The results reveal substantial variation in performance depending on strategy. The buy-and-hold portfolio generated a strong historical return on investment (ROI) of approximately 1,574 percent with a Sharpe ratio of 1.04, while the momentum strategy produced extreme gains of over 50,000 percent with a Sharpe ratio of 2.45. By contrast, the mean reversion and hybrid strategies performed disastrously, both generating losses of nearly 100 percent with negative Sharpe ratios. Monte Carlo simulations confirmed the

stability of these findings, as the mean simulated ROIs closely matched historical outcomes.

At the individual asset level, NVIDIA demonstrated the strongest risk-adjusted performance, with a Sharpe ratio above 1.1, a beta of 1.76, and a maximum drawdown of –1.1 percent. Microsoft and Amazon also showed positive but weaker Sharpe ratios of 0.88 and 0.78 respectively, while Meta underperformed with a Sharpe of just 0.56. In the portfolio-level business summary, the ETF achieved a CAGR of 0.32 percent, a Sharpe ratio of 1.04, an alpha close to zero, and a beta of 1.36. The maximum drawdown of –0.86 percent was modest, while the gross final portfolio value of 103.36 declined to 83.63 after fees. Despite this reduction, the investment was still classified as “viable,” since the portfolio maintained positive returns and acceptable risk-adjusted metrics.

Conclusions

The findings from Checkpoint C highlight the importance of strategy selection, risk-adjusted analysis, and realistic fee modeling in determining ETF viability. Momentum strategies, while delivering extraordinary returns in this dataset, may be overly optimistic and warrant further robustness testing. Buy-and-hold strategies appear reliable, generating strong returns with a reasonable Sharpe ratio, while mean reversion and hybrid approaches appear unsuitable in a technology-driven growth environment. Risk-adjusted analysis confirms that individual assets like NVIDIA provide outsized contributions to performance, though reliance on a single firm increases exposure to volatility. Finally, fee

modeling underscores that management and performance fees meaningfully erode investor gains, though the portfolio remains attractive net of fees.

In sum, this research suggests that a technology-focused ETF emphasizing buy-and-hold or momentum strategies can provide viable investment opportunities, though investors should be cautious about overfitting results and should account for the impact of fees on long-term outcomes.

References

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