BAYES BUSINESS SCHOOL
CITY ST GEORGE'S UNIVERSITY OF LONDON

Group Coursework Submission Form (PA)

Specialist Masters Programme

Please list all names of group members: (Surname, first name) 1. Ibrahim, Basil 2. Santos, José 3. So, Wing Sze	4. Stephenson, Nathaniel 5. **GROUP NUMBER:** 2
MSc in: Quantitative Finance	
Module Code: SMM265	
Module Title: Asset Pricing	
Lecturer: Dr Dirk Nitzsche	**Submission Date:** 25/11/2024

Declaration:

By submitting this work, we declare that this work is entirely our own except those parts duly identified and referenced in my submission. It complies with any specified word limits and the requirements and regulations detailed in the coursework instructions and any other relevant programme and module documentation. In submitting this work we acknowledge that we have read and understood the regulations and code regarding academic misconduct, including that relating to plagiarism, as specified in the Programme Handbook. We also acknowledge that this work will be subject to a variety of checks for academic misconduct.

We acknowledge that work submitted late without a granted extension will be subject to penalties, as outlined in the Programme Handbook. Penalties will be applied for a maximum of five days lateness, after which a mark of zero will be awarded.

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Once marked please refer to Moodle for your final coursework grade, including your Peer Assessment grade.

UK Stock Market Analysis

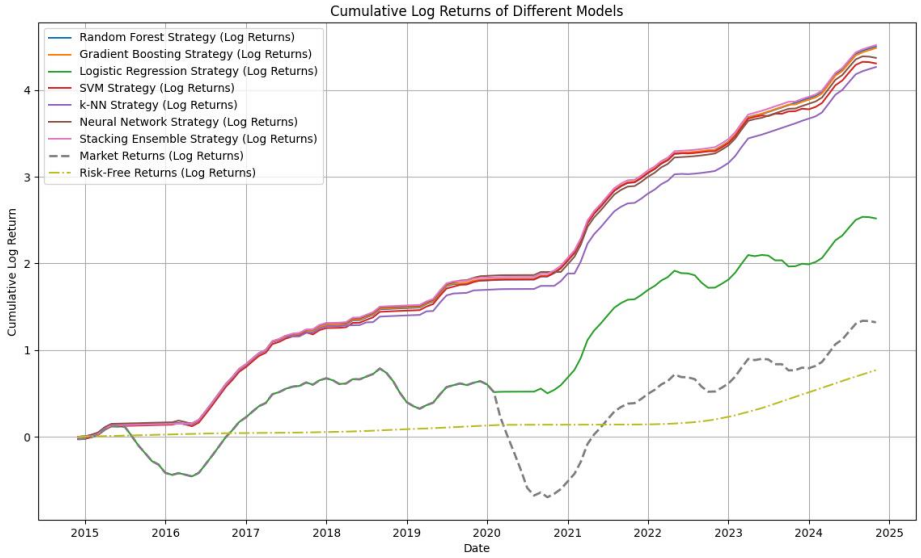
This report evaluates the potential of investing in the UK stock market by applying quantitative analysis and financial modelling. It aims to identify the best investment strategies by considering market returns, risk-free rates, and investor risk-return profiles.

The optimal market portfolio suits those seeking high returns with controlled risk, while the minimum variance portfolio offers stable returns with the lowest risk. Rebalancing helps manage portfolio risk by adapting to changing market conditions.

Forecasting Model Development

The initial phase of the analysis involved designing a forecasting model to guide capital allocation decisions between the FTSE100 index and 1-month UK Government Bonds. Multiple machine learning classifiers were deployed to produce investment signals biannually over the investment horizon. These models were trained using historical market data, spanning October 1995 to November 2024, enabling them to capture substantial market events exhibiting significant volatility and increasing robustness.

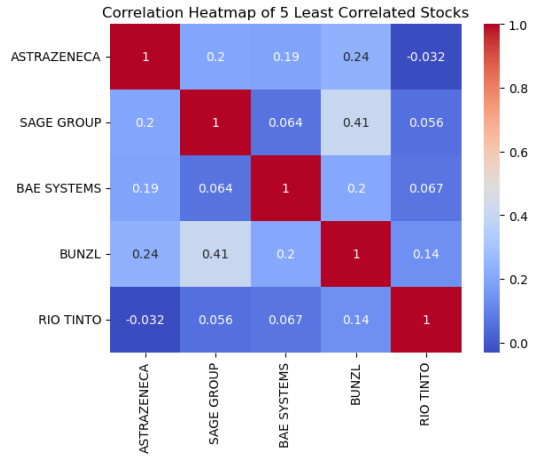
After training, the models were deployed to generate predictions for the investment period. All models outperformed baseline strategies, with many exceeding twice the returns (as illustrated in the graph below). The Ensemble strategy, combined the predictions from multiple models, demonstrated the highest cumulative returns and was selected to guide investment decisions. This systematic and data-driven approach maximised returns while mitigating risk.

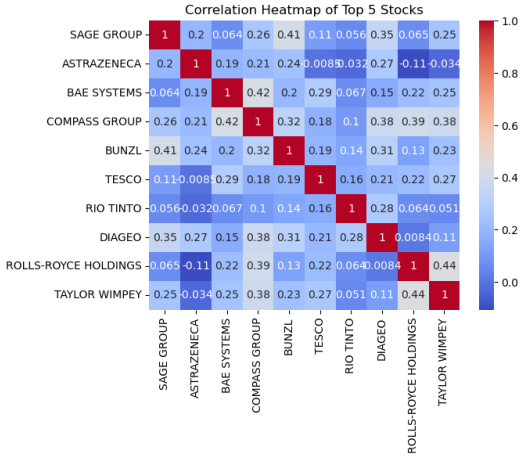


Portfolio Selection

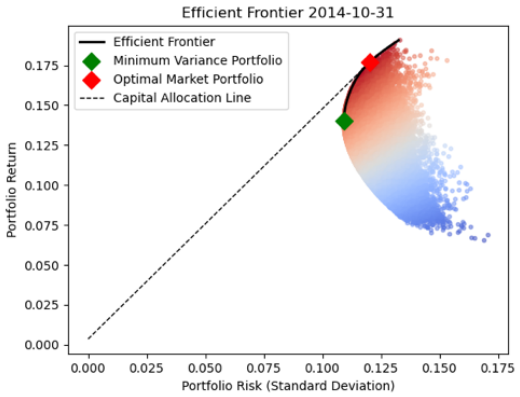
The goal in selecting the five stocks for the portfolio was to balance strong performance with risk diversification. The ten stocks with the highest Sharpe ratios are identified, which measure the relationship between risk and return for each investment. Additionally, the relationships between each stock are analysed through a correlation matrix. Combining these metrics, the final selection

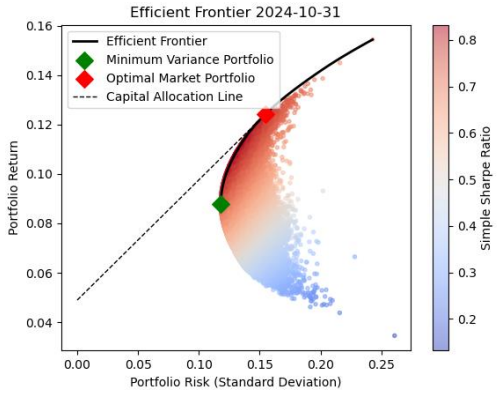
was AstraZeneca (Pharmaceuticals & Biotechnology), Sage Group (Software & Technology), BAE Systems (Aerospace & Defense), Bunzl (Food Distribution), and Rio Tinto (Mining & Metals).





By simulating randomly weighted portfolios, the efficient frontier is generated, representing the set of portfolios with the highest possible expected returns for a given level of risk. Two key portfolios can then be identified, the minimum-variance portfolio (the portfolio that offered the lowest risk) and the optimal market portfolio (with the highest Sharpe ratio adjusted to its risk-free rate). This process was repeated every six months until October 2024 to obtain the dynamic portfolio weights and efficient frontiers (see appendix).





Portfolio Analysis

The performance of each investment strategy was conducted through several scenario analyses on the five-stock portfolio. Starting with an initial investment of £1000 in October 2014, the table below summarises the performance metrics of each strategy:

	Portfolio Strategy	Terminal Wealth (£)	Annualised Return (%)	Annualised Volatility (%)
i	Market Portfolio (Static, No Rebalancing)	2,164.28	8.03	19.29
ii	Minimum Variance Portfolio (Static, No Rebalancing)	2,311.17	8.74	20.76
iii	Market Portfolio (Dynamic, Rebalanced Semi-Annually to Latest Market Weights)	1,614.31	4.91	13.28
iv	Minimum Variance Portfolio	2,125.56	7.83	11.34

	(Dynamic, Rebalanced Semi-Annually to Minimum Variance Weights)			
v	FTSE All Share Index (Market Benchmark)	1,264.99	2.38	12.19
vi	Risk-Free Rate	1,138.33	1.30	0.52
vii	Forecast-Based Dynamic Investment (On Market vs Bond Performance)	1,250.07	2.26	12.24

Key Insights

1. **Static Strategies Incur Higher Risk:** Both static portfolios achieved high returns but with significant volatility. While the static minimum variance portfolio achieved the highest terminal wealth, it also exposed investors to greater risk due to the lack of adjustments to changing market conditions.
2. **Dynamic Strategies Offer Lower Volatility:** The dynamic portfolios exhibited far lower volatility than the static alternatives. For the minimum variance portfolios, the terminal values were similar; however, the dynamic model offered significantly lower volatility. Semi-annual rebalancing ensured consistent portfolio diversification, avoiding overexposure to high-risk assets and preserving the balance of lower-risk assets. However, in practice, frequent rebalancing will result in high transaction costs, so it is advisable only to do so when necessary.
3. **Balanced vs Heavily Weighted Portfolios:** Minimum variance portfolios consistently outperformed market portfolios. Mean-variance optimisation suggests the market portfolio may allocate a heavy weight to certain stocks to maximise the Sharpe ratio, increasing the portfolio's vulnerability to significant losses during sudden market shocks. By contrast, the minimum variance approach avoids such concentrated exposures, resulting in a more stable performance during turbulent times.
4. **Forecast-Based Strategy Missed Growth Opportunities:** This strategy delivered one of the weakest performances in the analysis. The forecasting model correctly allocated capital at the risk-free rate during turbulent periods. However, the portfolio consistently outperformed the index, so this strategy did not capture this performance during those times. Additionally, frequent moves to risk-free assets during downturns led to missed opportunities to participate in market recovery and upward trends.

Investment Recommendations

- Risk-averse investors should consider the minimum variance portfolio or a portfolio on the capital allocation line, combining the market portfolio and the risk-free rate.
- Risk-tolerant investors should consider the optimal market portfolio. However, to mitigate the volatility, consider implementing constraints onto the portfolio to manage exposure and ensure diversification.
- Dynamic rebalancing is recommended for capturing market growth while managing risk, but care should be taken to minimise transaction costs.