Lisbon School of Economics & Management
Universidade de Lisboa

MASTER OF SCIENCE IN
FINANCE

MASTERS FINAL WORK
PROJECT

INVESTMENT POLICY STATEMENT:
RACHEL JONES

BÁRBARA CRISTINA DA SILVA ALBUQUERQUE FERNANDES

JUNE 2025

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Abstract

This Investment Policy Statement (IPS) outlines the investment strategy for Rachel Jones, a fictional U.S. based investor aiming to grow her initial capital of $500,000 to a final target of $1,125,000 ($1,364,735.39 adjusted for inflation) over a 10-year time horizon. This objective requires a minimum annualized return of 10.56%, accounting for inflation.

The portfolio is built around a passive value investing philosophy and consists entirely of Exchange Traded Products (ETPs). Rachel prefers U.S. dollar-denominated accumulation ETPs, with over 80% exposure to the U.S. market and 10% allocated to alternative assets. She avoids risk-free assets and complex strategies like short selling.

Using Mean-Variance Theory, the final portfolio was achieved by maximizing the Sharpe Ratio in Python and results in an expected annual return of 13.02% with a volatility of 11.07%. For risk analysis, parametric VaR, historical VaR, Monte Carlo VaR and Conditional Value at Risk (CVaR) were computed to assess downside risk.

The portfolio will be monitored regularly to ensure continued alignment with Rachel's investment objectives. Periodic reviews will allow for adjustments in response to significant deviations from expected performance, maintaining consistency with her long-term financial goals.

JEL classification:C6; G11

Keywords: Asset Management; IPS; Mean Variance Theory; Value Strategy; Risk Management

Resumo

Esta Declaração de Política de Investimento (DPI) descreve a estratégia de investimento para Rachel Jones, uma investidora fictícia sediada nos EUA que pretende fazer crescer o seu capital inicial de $500,000 para um objetivo final de $1,125,000 ($1,364,735.39 ajustado para a inflação) ao longo de um horizonte temporal de 10 anos. Este objetivo requer um retorno anual mínimo de 10.56%, já tendo em conta a inflação.

A carteira é construída com base numa filosofia de investimento passivo em valor e consiste inteiramente em Exchange Traded Products (ETPs). Rachel prefere ETPs de acumulação denominados em dólares americanos, com mais de 80% de exposição ao mercado dos EUA e 10% alocado a ativos alternativos. Ela evita ativos sem risco e estratégias complexas como a venda a descoberto.

Utilizando a Teoria Média-Variância, a carteira final foi alcançada maximizando o Índice de Sharpe no Python e resulta num retorno anual esperado de 13.02% com uma volatilidade de 11.07%. Para a análise do risco, foram calculados VaR paramétrico, VaR histórico, VaR Monte Carlo e Valor Condicional em Risco (CVaR) para avaliar o risco da perda.

A carteira será monitorizada regularmente para assegurar o alinhamento contínuo com os objetivos de investimento de Rachel. Revisões periódicas permitirão ajustes em resposta a desvios significativos do desempenho esperado, mantendo a consistência com os seus objeticos financeiros de longo prazo.

Classificação JEL: C6; G11

Palavras-Chave: Gestão de Ativos; DPI; Teoria Média-Variância; Estratégia de Valor; Gestão de Risco

Acknowledgements

The end of a chapter, and what a chapter! I couldn't be happier.

First of all, I would like to thank to my mum, my dad, and my brother for all your support throughout this phase and beyond. It was a stressful time, and I know I wasn't always easy to deal with, but you were always there for me. I can't express how grateful I am to have you by my side.

To my lovely boyfriend, with whom I have had the pleasure of sharing both bachelor's and masters' journey - you knew exactly how hard and stressful it was. Even during difficult moments, you were always there. Thank you for listening to me, even when I repeated myself for the thousandth time.

To my family – grandparents, aunts, and cousins – thank you for all believing in me and supporting me. Grandpa Manuel, I hope you are proud of me.

To my friends, thank you for always supporting me, even when I didn't have time to be with you. You have always been there, understanding and encouraging me. I am truly lucky to have all of you by my side.

To my professors, especially my supervisor, Pedro Rino Vieira, thank you for all the knowledge you have taught me. Thank you for always believing in my ideas, for your availability, and for valuable insights.

It has been a challenging but incredible journey… I can't wait for what's coming next!

Abbreviations

CFA – Chartered Financial Analyst

CVaR – Conditional Value at Risk

ECB – European Central Bank

ESG – Environmental, Social and Governance

ETCs – Exchange Traded Commodities

ETFs – Exchange Traded Funds

ETPs – Exchange Traded Products

FX – Foreign Exchange

GDP – Gross Domestic Product

GIPS – Global Investment Performance Standards

HICPX – Harmonized Index of Consumer Prices Excluding Energy and Unprocessed Food

IPS – Investment Policy Statement

MPT – Modern Portfolio Theory

NAV – Net Asset Value

OECD – Organization of Economic Co-operation and Development

P/B – Price-to-Book Ratio

P/E – Price-to-Earnings Ratio

REITs – Real Estate Investment Trusts

ROE – Return on Equity

SR – Sharpe Ratio

TER – Total Expense Ratio

U.S. – United States

VaR – Value at Risk

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1 Introduction

This Investment Policy Statement (IPS) is a structured approach for managing an investment portfolio. It serves as a foundational document that defines the investment strategy, risk tolerance, and time horizon, ensuring a disciplined and consistent approach to portfolio management.

The IPS focuses exclusively on Exchange-Traded Products (ETPs), selected for their ability to provide enhanced diversification, cost efficiency, and alignment with a long-term investment horizon. These factors make ETPs an ideal choice for building a balanced portfolio that efficiently captures broad market performance.

Risk management is a core component of this IPS, guiding decisions to mitigate potential losses and maintain portfolio stability. Most quantitative risk assessments and portfolio simulations were conducted using Python, providing precise and efficient analysis to support informed decision-making.

An IPS is essential for maintaining a clear investment strategy, establishing guidelines for making investment decisions, and providing a benchmark for evaluating portfolio performance over time. It also serves as a dynamic framework that allows ongoing monitoring and adjustments, ensuring the portfolio remains aligned with client's goals while minimizing unnecessary risks and costs.

2 Executive Summary

2.1 Scope and Purpose

This Investment Policy Statement (IPS) outlines the agreement between Bárbara Fernandes and her client, Rachel Jones, detailing the goals and objectives. Rachel plans to invest $500,000 over 10 years to fund her children's education and additional expenses. The advisor will manage the portfolio, update the IPS as needed, and provide quarterly risk assessment reports, adhering to CFA Institute standards.

2.2 Governance

The advisor is responsible for developing, implementing, and maintaining the IPS, ensuring alignment with the client's risk profile and long-term objectives. The portfolio is formally rebalanced annually, while quarterly performance reports are used to monitor asset allocation and risk exposure. Although risk is formally assessed using one-year VaR, quarterly reviews may support tactical adjustments based on observed deviations or market changes. Regular meetings with the client are conducted to assess any necessary adjustments to the strategy.

2.3 Investment Return and Risk

The IPS supports the client's long-term financial goals, targeting a minimum return of 10.56% over a 10-year period. With a moderately high-risk tolerance, the portfolio was optimized by maximizing the Sharpe Ratio within asset allocation limits guided by macroeconomic forecasts. The final portfolio targets an expected annual return of 13.02%, with a standard deviation of 11.07% and a Sharpe ratio of 0.77.

2.4 Risk Management

An effective investment strategy manages risk while aligning with the client's financial goals. Regular monitoring, clear communication, and periodic updates help the client stay informed about potential risks and necessary strategy adjustments, supporting long-term stability and wealth preservation.

3 Investment Policy Statement

3.1 Scope and Purpose

Mrs. Rachel Jones, a 35-year-old American attorney with a law degree, has a long-term investment horizon of 10 years. As a mother of two – a 5-year-old daughter and an 8-year-old son – her net annual salary of $150,000 is sufficient to cover all living and family expenses. In addition, she has $500,000 available for investment.

Her primary investment goal is to increase her portfolio to $1,125,000 over the next 10 years, ensuring sufficient funds for her children's education and additional expenses, such as traveling and maintaining a more comfortable lifestyle. ESG (Environment, Social, and Governance) considerations do not play a significant role in her investment decisions and she prefers investment products with an accumulative approach (reinvesting profits), rather than distributive ones (paying dividends or interest).

Mrs. Rachel has limited knowledge of financial markets. She expects to remain in her current job with a stable income. She does not plan to have more children and expects their eldest son to attend university in 10 years, when he turns 18.

3.2 Governance

To ensure effective portfolio management, this IPS clearly defines the responsibilities of both the financial advisor and Rachel Jones. The advisor is responsible for developing and implementing the IPS, overseeing portfolio performance, and recommending for adjustments when necessary.

An asset allocation strategy tailored to Rachel's financial objectives and risk profile will be designed, incorporating a diversified mix of equities, fixed income, and alternative investments. The portfolio will be reviewed and rebalanced annually, with any proposed changes subject to Rachel's approval. The advisor will maintain full transparency by providing regular performance updates, asset breakdowns, and analysis of risk and tax implications.

Quarterly performance reviews will assess the portfolio's progress, and the advisor will address any risk deviations to ensure the portfolio remains within Rachel's comfort zone. If the client's financial situation changes, her risk profile will be revisited to keep the IPS aligned with her long-term financial goals.

3.3 Investment, Return and Risk Objectives

3.3.1 Investment Objective

The primary objective of this investment is to accumulate $1,125,000 over a 10-year period to cover the future educational expenses of the client's children, along with providing additional financial security.

According to Hanson (2025), the average annual cost of a college education in the United States (U.S.) is $38,270, amounting to approximately $153,080 over four years (the typical duration of an undergraduate program). These values are an average of both public and private schools.

To fund the education expenses of her two children, the client aims to set aside around $325,000. In addition, Rachel wishes to accumulate an extra $300,000 to provide a financial cushion, allowing her to maintain a comfortable lifestyle and meet her unforeseen expenses. This brings a total required amount, before any inflation adjustments, to approximately $625,000.

3.3.2 Return, Distribution and Risk Requirements

The inflation rate is projected to trend around 2.40% in 2026 and 2.30% in 2027 (Trading Economics, 2025). However, with the tariffs implemented by Trump, it will have a high impact on markets, prices, and the living costs of people. According to J.P. Morgan (2025), U.S. business sentiment is likely to deteriorate significantly, potentially pushing the economy closer to a recession. While optimism was high earlier in the year, rising uncertainty due to increased tariffs and broader policy concerns under the Trump administration is now dampening confidence. This downturn in sentiment is expected to reduce business investment and hiring. This drop may intensify by midyear as tariff-related concerns grow.

According to Trading Economics (2025), in U.S. the average inflation rate from 1914 until 2025 was 3.29%. Taking this into account, it is prudent to assume a more conservative approach and account for the uncertainties that we are facing, so an average of 3,30% for the inflation rate will be assumed. The initial investment target of $1,125,000 has been adjusted to $1,364,735.39 to account for inflation, ensuring it will accurately cover anticipated expenses.

To achieve the minimum required annual return of 10.56%, the financial advisor will perform a thorough risk assessment to align the strategy with Rachel's goals. Modern Portfolio Theory (MPT) will be utilized to select a portfolio that optimally balances risk and return, aiming to maximize expected returns for a given level of risk.

3.3.3 Portfolio Policy

The asset allocation plan emphasizes transparency and involves regular collaborative reviews between the advisor and the client. The primary objective is to build a diversified portfolio by applying constraints on asset distribution across classes. Optimal allocations will be determined using a model that considers the client's profile, time horizon, and macroeconomic forecasts. To ensure flexibility, predefined maximum and minimum limits will be established for each ETP.

The advisor will ensure actual allocations stay within these ranges, with detailed quarterly reports provided to the client outlining current allocations and compliance. This ongoing monitoring process aims to align the investment strategy with the client's financial objectives and risk tolerance.

3.3.4 Investor's Risk Tolerance

The IPS, which highlights the value of capital preservation while pursuing growth, describes the client's financial profile. The client's confidence stems from her secure professional condition, allowing her to recover from losses and avoid immediate access to money over the investment horizon. This strong financial position indicates a high-risk capacity, as they are well-positioned to withstand market fluctuations.

The Charles Schwab survey (Figure A2) revealed a moderate risk tolerance, while the Vanguard assessment (Figure A1) suggested 60% stocks, and 40% fixed income. However, Rachel wanted to include alternative investments to increase potential growth and diversification across different sectors, thus some adjustments were made. Although her risk-taking capacity is high – supported by stable income and long investment horizon – the overall assessment of her risk profile is moderately high.

To incorporate a 10% allocation to alternatives while maintaining a fully invested portfolio, equal reductions were made from equity and fixed income – each lowered by 5%. This balanced reallocation preserves the overall risk profile and avoids disproportionate exposure to any asset class. The final allocation – 55% equity, 35%

fixed income, and 10% alternative – allows for diversity within each asset class. This diversified strategy balances the growth potential of equity, stability of fixed income, and additional diversity from alternatives, supporting the client's financial goals by balancing the willingness to take risk and the financial capacity to absorb losses.

3.3.5 Relevant Constraints

When constructing a well-diversified and optimized portfolio, it is essential to consider key constraints aligned with the investor's preferences and risk profile. Rachel, a U.S.-based investor, favors ETPs for their cost efficiency, transparency, and broad market exposure. She prefers ETPs denominated in U.S. dollars, with over 80% of the portfolio allocated to the U.S. market.

Rachel prefers accumulation ETPs that automatically reinvest, enabling her investment to grow more efficiently over time through compound returns. She requires an allocation of 10% to alternative investment – such as commodities or real estate – to further enhance portfolio diversification. Additionally, she has expressed a preference to exclude risk-free assets from her portfolio to pursue higher returns, accepting the associated increase in risk for potentially greater profitability.

Given her basic knowledge of financial markets, Rachel wishes to avoid complex strategies such as short selling. Her portfolio will be subject to a 15% capital gains tax rate, in accordance with current U.S. tax law (Parys, 2025).

3.4 Risk Management

To preserve portfolio stability, this strategic aligns with the client's risk tolerance and long-term goals. As the financial advisor, I will monitor performance and assess risk through parametric VaR, historical VaR, and Monte Carlo VaR, along with Conditional VaR – in accordance with the CFA' Institute's GIPS standards. Quarterly reports will detail performance metrics, update risk measures, and asset allocation reviews, with corrective actions and adjustments proposed and implemented upon client approval.

Currency risk is a core component of overall portfolio risk. This IPS excludes hedged ETPs. Since the investor is based in the United States with income and expenses in U.S dollars, ETPs focused on the U.S. market do not introduce currency risk. Exposure to non-U.S. markets will involve some currency risk, but hedging is avoided to keep costs low and maintain portfolio efficiency.

4 Investment Design

4.1 Investment Philosophy

An investment philosophy represents a structured approach to understanding the markets, their underlying mechanisms, and the behavioral tendencies that may create inefficiencies. An investment philosophy provides the foundation for guiding investment decisions, offering a stable framework that allows investors to adjust and develop new strategies when existing ones fall short. For instance, the common human tendency to follow the crowd, whether logical or not, can contribute to price momentum in the markets (Damodaran, 2003).

This IPS employs passive value investing, emphasizing the acquisition of stable securities priced below their intrinsic value. Valuation multiples such as Price-to-Earnings and Price-to-Book ratios have historically been central to value investing strategies. For value investors, focusing on Return on Equity can help identify companies with strong profitability and efficient capital utilization. While Dividend Yield may not directly influence firm value in all contexts, it remains a useful metric for assessing a company's financial health (Meyer, 2024).

Accordingly, this IPS follows passive investing principles – minimizing trading and tracking broad market indices – while applying a value strategy focused on long-term capital appreciation through cost-efficient investment in undervalued assets (Benedikt, 2025). By prioritizing stability and reducing turnover, this strategy aims to capture value over time while keeping costs low. Given the extended horizon, minimizing management fees and efficiency are key. Diversification across value-focused equity ETFs helps manage risk. Additionally, the long-term approach supports resilience during market volatility and helps benefit from undervalued opportunities.

4.2 Strategic Asset Allocation

Strategic asset allocation is a long-term investment strategy that sets target allocation across asset classes to align with an investor's risk tolerance, goals, and time horizon. It involves periodic rebalancing to restore the portfolio to its original asset allocation when market fluctuations cause deviations in asset weights. By diversifying investments across asset classes and sectors, this approach helps reduce the impact of market volatility on the overall portfolio over time (Campbell and Viceira, 2002).

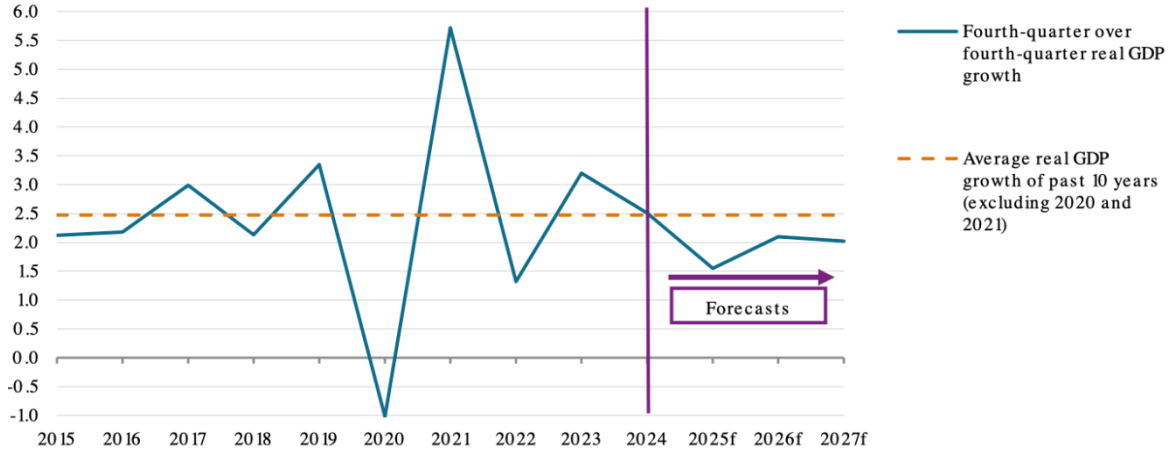
A robust strategic asset allocation framework typically begins with a macroeconomic review to assess economic trends, inflation expectations, interest rate movements, and global political developments. This foundation supports informed decisions about the expected performance of different asset classes and their contribution to the investor's long-term objectives. Continuous monitoring helps maintain alignment with these goals and reflects market conditions.

4.2.1 Macroeconomic overview

U.S. remains a dominant force in the global economy, accounting for a significant portion of global market capitalization. Given that over 80% of the portfolio is allocated to U.S. assets, it is essential to assess the country's macroeconomic fundamentals, monetary policy outlook, and political developments – particularly in the context of the 2024 presidential elections.

In 2025, the U.S. economy faces rising uncertainty. According to S&P Global Ratings (2025), annual real GDP growth is projected to slow to 1.9% in both 2025 and 2026, down from 2.9% in 2023 and 2.8% in 2024. This deceleration reflects the front-loading of regressive policies, including renewed tariffs and federal workforce reduction, which are disrupting economic momentum. One early sign of weakness was the 0.3% contraction in GDP in Q1 2025 – the first quarterly decline since early 2022 (Trading Economics, 2025). This downturn was driven by a surge in imports, soft consumer spending, and a sharp drop in government expenditures. A central contributor to current economic slowdown is the Trump administration's tariffs policy, aimed at reducing the national debt but expected to weigh on GDP and real wages by limiting trade openness and increasing borrowing costs (Penn Wharton Budget Model, 2025).

Figure 1 - U.S. real GDP growth



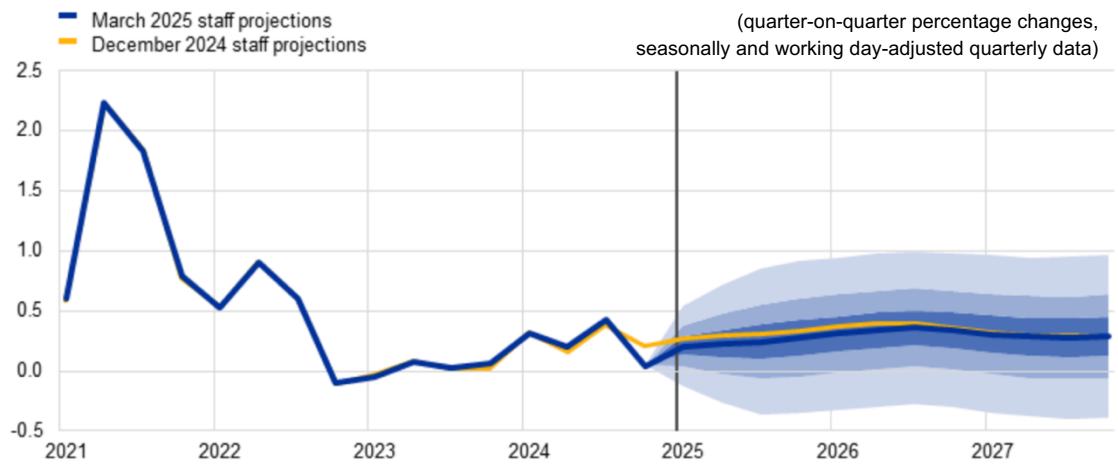
Source: S&P Global

Trade tensions have escalated sharply following the imposition of new tariffs – 25% on Canadian and Mexican imports and 10% on Chinese foods – framed by the administration as a response to illegal immigration and drug trafficking. In retaliation, all three countries have announced or are preparing countermeasures, threatening to dampen U.S. export growth and raise supply chain costs. Together, China, Mexico, and Canada account for over 40% of U.S. imports, heightening the risk of inflation and industry disruption (Sherman et al., 2025).

Inflation in the U.S. rose to 2.40% in May 2025, up from 2.30% in April, and it is expected to remain 2.40% in 2026 before easing slightly to 2.30% by 2027 (Trading Economics, 2025). The unemployment rate, currently at 4.10%, is projected to rise to 4.60% by mid-2026, reflecting a softening labor market amid tightening economic conditions (S&P Global, 2025). The federal funds rate stands at 4.50% (2025) and is expected to hold steady in the short term. Over the longer term, it is forecasted to gradually decline to 3.25% by 2027 (Trading Economics, 2025).

The Euro Area is projected to see moderate growth, with GDP rising 0.9% in 2025 and 1.2% in 2026, supported by consumption and investment. However, the growth outlook has been revised down by 0.2 percentage points for both years due to weaker exports, investment, and ongoing competitiveness challenges. Global trade tensions – especially from renewed U.S. tariffs under the Trump administration – add downside risks. While Europe is not directly targeted, it may suffer from weakened global demand and supply chain disruptions, given its export-oriented economy (ECB, 2025).

Figure 2 - Euro area real GDP growth



Source: BCE

Headline inflation, which includes volatile components like energy and food, is projected to decline from 2.3% in 2025 to 2.0% by 2027. Core inflation – measured by HICPX – which excludes energy and food, offers a clearer view of underlying price trends, and is expected to fall steadily from 2.2% in 2025 to 1.9% by 2027. While wage growth remains above historical averages due to tight labor markets, it is gradually declining as real wages recover and inflation pressures ease (ECB, 2025). On the fiscal front, the euro area is expected to slightly tighten in 2025, turning to a neutral position in 2026 and tightening again in 2027. However, depending on the scale of adverse spillovers from U.S. policy changes, additional fiscal support may be necessary to sustain growth momentum (ECB, 2025).

Real GDP growth in the Asia region is projected to slow to 3.9% in 2025 and 4.0% in 2026, down from 4.6% in 2024. This deceleration reflects the impact of U.S. trade policy – particularly new tariffs and retaliatory measures – along with softer external demand, a subdued tech cycle, and weak private consumption. The area remains vulnerable to global trade uncertainty, asset price volatility, and capital flow disruptions, highlighting the need for balanced policies that support near-term growth while ensuring fiscal and external stability (IMF, 2025).

While the global economy showed resilience in 2024, growth is expected to slow to 3.1% in 2025 amid persistent inflation, rising trade tensions, and policy uncertainty. Escalating protectionism – mainly due to U.S. tariffs – is raising costs and dampening trade, with spillover effects across Europe and Asia. In this context, maintaining open markets, fiscal discipline, and structural reforms will be crucial to sustaining long-term global stability and growth (OECD, 2025).

4.2.2 Asset Allocation

The strategic asset allocation aims to have a good balance between the client's return objective, risk tolerance and investment constraints. Since the client does not require immediate access to funds, there is no allocation to liquidity.

Based on Vanguard's risk tolerance framework, a 60% equity and 40% fixed income allocation was initially suggested for Rachel's financial profile. However, as said before, Rachel expressed interest to include alternative investments to enhance growth potential and diversification. As a result, the portfolio was adjusted as follows:

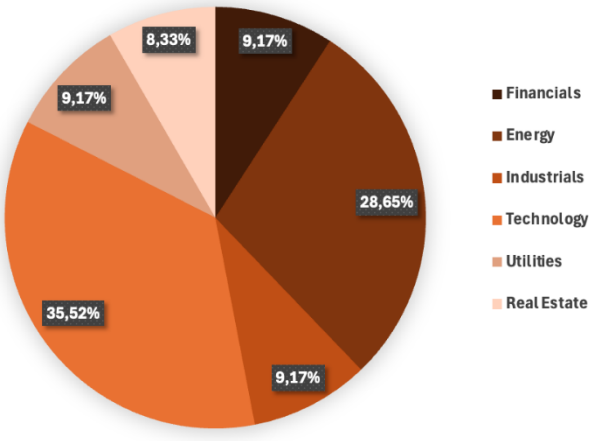
- Equity ETFs (55%) are selected to support Rachel's long-term financial goals with an emphasis on value-oriented strategies. The 5% reduction in equities reflects rising macroeconomic uncertainty, including slowing U.S. growth, trade tensions, and political instability following the 2024 election – all of which increase downside risks in equity markets and justify a more cautious allocation.
- Fixed income ETFs (35%) remain a core stabilizing component, but the 5% reduction reflects recalibration due to restrictive policy and only gradual expected rate cuts. While interest rates are projected to decline over the coming two years, they remain elevated in the near term compared to previous periods (Trading Economics, 2025), negatively impacting bond prices.
- Alternative investments (10%) provide broader diversification and help reduce portfolio volatility by including non-traditional assets that are less correlated with equities and fixed income. Given the current macroeconomic uncertainties – trade tensions, policy risks, and geopolitical instability – these instruments can help buffer the portfolio against shocks and improve risk management.

The sectors included in this IPS were not selected directly but came from a careful screening process based on specific constraints. Once the eligible ETPs were identified, the resulting sector exposures were reviewed considering the current macroeconomic environment. Below is a summary of the analysis of the sectors:

- Financials Sector: With the Federal Reserve maintaining rates at 4.50% and only a gradual decline expected, bank lending margins are expected to remain attractive, supporting profitability. Although economic growth is slowing (projected at 1.90% in 2025), and the labor market is softening (with unemployment rising to 4.60% by mid-2026), financial institutions benefit from diversified income streams, such as trading revenue, wealth management, and conservative lending models that limit credit risk (Githaiga, 2022).
- Energy Sector: The energy sector, which includes companies involved in oil and gas extraction and production, exhibits the highest sensitive beta to inflation among sectors and tends to perform well during inflationary periods (Bampinas & Panagiotidis, 2016). With inflation rising to 2.40% and trade disruptions pushing up input costs, commodity prices are likely to remain elevated due to restricted global supply chains and geopolitical tensions.

- Industrials Sector: U.S. real GDP is slowing, with Q1 2025 contracting by -0.3%, signaling weaker capital spending. The industrials sector — tied to economic activity via construction, transportation, and manufacturing — is sensitive to these trends. The growing interdependence within complex supply chains has intensified the spread of economic shocks, leading to higher levels of macroeconomic uncertainty. Research shows that companies more exposed to global trade networks tend to suffer greater financial losses during tariff shocks (Huang et al., 2023). To reduce this risk, the industrial ETF in this portfolio focus on U.S.-based companies, which are less vulnerable to global trade disruptions but still benefit from domestic investment and infrastructure demand.
- Technology Sector: While global growth is expected to slow to 3.1% in 2025, the U.S. remains a leader in technology, a sector characterized by innovation and scale (Mahajan, 2025). Though tighter financial conditions and trade uncertainty can weigh on valuations, the gradual decline in interest rates over the coming years (to 3.25% by 2027) provides a favorable long-term outlook. With slower growth in Asia, U.S. tech may continue to attract capital due to its resilience and global relevance. The sector offers exposure to durable themes like automation, digital infrastructure, and cloud computing — all critical in navigating periods of economic and geopolitical disruption.
- Utilities Sector: With persistent inflation (2.4% in 2025 and 2026) and rising unemployment, utilities offer stability through consistent cash flows and essential services (Maksy, 2023). The sector is less exposed to cyclical demand and international trade shocks, making it attractive amid slowing GDP growth and rising economic uncertainty. Utilities provide a natural hedge during market stress and declining consumer sentiment.
- Real Estate: The real estate sector is sensitive to interest rates, but with a projected gradual decline in the federal funds rate (from 4.50% in 2025 to 3.25% by 2027), the cost of borrowing is expected to ease. This supports property valuations and the performance of Real Estate Investment Trusts (REITs). Although short-term macro headwinds like soft consumer spending and rising inflation could pose challenges, real estate offers diversification and inflation protection through rental income (Muckenhaupt et al., 2024). With a muted global outlook and higher volatility in equities, REITs present an opportunity for steady cash flows and portfolio resilience.

Figure 3 – GICS Sectors Distribution



Source: Author

4.3 Security Selection

This IPS consists solely of ETPs, which provide access to a broad range of asset classes and offer key advantages such as liquidity, transparency, diversification, and cost-efficiency (Salimian et al., 2019). ETPs are financial instruments whose value is derived from the performance of underlying assets, allowing investors to gain market exposure without directly owning those assets (Prewysz-Kwinto, 2016). These instruments include various types such as Exchange-Traded Funds (ETFs), Exchange-Traded Commodities (ETCs), and Exchange Traded Notes (ETNs), which typically follow the performance of indices, stocks, or commodities (Cugia, 2015).

This IPS incorporates two ETP categories: ETFs and ETCs. ETFs are passive investments vehicles that allow individuals to invest in indexes, asset classes, or sectors with low costs and high transparency. Their popularity has surged — particularly in the U.S., where nearly 50% of investments come through ETFs (Joshi & Dash, 2024). In addition to their accessibility and cost effectiveness, ETFs are better at replicating benchmark indices, especially during market downturns, and offer better tracking efficiency. ETFs are also priced at a low average discount with some persistent deviations. These factors make ETFs a cost-effective option for targeted strategy, such as sector or regional investing (Afonso & Martins Cardoso, 2017).

In contrast, ETCs are instruments that allow investors to gain exposure to commodity markets without directly owning the physical commodities. This structure allows individuals to benefit from changes in commodity prices through a more liquid format (Dorfleitner et al., 2018).

The selected ETPs were carefully screened to ensure they align with the investor's objectives. The screening process included the following key criteria:

- Currency: all ETPs in the portfolio are denominated in U.S. dollars to simplify the investment process and align with the U.S. market. However, some international ETPs invest in non-U.S. currencies, exposing the portfolio to currency fluctuations that can affect investment value.
- Replication: Full or Optimized Sampling — The portfolio mainly uses ETPs employing either full or optimized replication to track a benchmark index. Optimized replication selects securities with the most significant impact on the index's performance. This method is preferred for larger or complex indices, as it reduces costs and minimizes tracking errors while still closely following the index. In full replication, the ETP holds all the securities in the index, matching their exact proportions. This method is chosen for its simplicity and ability to avoid unnecessary complexity or tracking errors (Vanguard, 2023). Only the real estate ETF employs a swap-based replication method, using swap agreements instead of direct holdings securities to replicate the index's performance. This approach helps avoid high transaction costs and market impact associated with trading numerous less liquid real estate securities, enabling more efficient index tracking (REIT Institute, n.d.).
- Accumulation method: Accumulation ETPs were selected since the investor prefers not to receive dividends directly. Instead, this approach allows dividends to be reinvested within the fund, promoting compound growth over time.
- Expense ratio: The average expense ratio for active ETFs is 0.71%, while for passive ETFs is 0.44% (Gamble, 2020). Since all the ETPs included in this IPS follow a passive investment strategy, a maximum expense ratio cap of 0.44% was established to avoid incurring unnecessary costs.
- ETP providers: To mitigate the risks associated with one single provider, the portfolio will be diversified across multiple ETP providers. No single provider will account for more than 50% of the total portfolio.

To select suitable options, each Equity ETF was evaluated based on key metrics – comparing the Price-to-Earnings ratio (P/E), Price-to-Book ratio (P/B), Return on Equity (ROE) and Dividend Yield against the respective sector benchmarks, previously discussed as key indicators for finding undervalued ETFs (Meyer, 2024).

- P/E ratio measures how much investors pay per dollar of earnings. A lower P/E suggests the ETF's holdings might be undervalued relative to their profits.
- P/B ratio compares the market price of the ETF's holdings to book value. A low P/B ratio may indicate the ETF holds stocks trading below their true asset value.
- Dividend Yield reflects the dividends distributed by the ETF's holdings as a percentage of its price. Higher dividend yields often indicate companies with healthier financials and more stable earnings.
- ROE measures how efficiently the companies in the ETF use equity to generate profits. High ROE indicates financially healthy and profitable companies.

A screening process using these four metrics identified undervalued equity ETFs. The data for both ETFs and sector benchmarks were sourced from Bloomberg.

Table 1 - Screens

ETFs	Financials	Energy	Industrials	Technology	Utilities
Price/Earnings	17.52	14.80	26.63	37.49	19.79
Price/Book	2.34	1.86	6.05	6.23	2.22
Dividend Yield	1.55	4.28	1.52	0.68	3.00
ROE	13.93	12.57	23.72	22.96	11.22

Sector	Financials	Energy	Industrials	Technology	Utilities
Price/Earnings	18.27	14.85	27.07	39.49	20.15
Price/Book	2.36	2.07	6.26	9.57	2.22
Dividend Yield	1.46	3.32	1.51	0.71	2.95
ROE	13.20	13.42	23.29	22.18	11.15

Source: Author

All selected equity ETFs had both P/E and P/B ratios below the sector average, as these are the two most fundamental metrics in value investing. A lower P/E and P/B indicate that the securities within the equity ETFs are undervalued relative to their sector peers, aligning with the value-based investment strategy (Meyer, 2024).

In addition to these key valuation metrics, dividend yield and ROE were also considered. These factors ensure that the ETFs not only exhibit strong value characteristics but also demonstrate financial stability and shareholder returns (Meyer, 2024). The ETFs selected either had dividend yield and ROE above the industry average or maintained values that did not significantly deviate, ensuring a balanced approach between undervaluation and fundamental strength.

Fixed-income ETF selection included inflation-linked government bonds to protect against rising U.S. inflation. With inflation projected at 2.4% in 2025 and 2026 due to

tariffs and supply chain disruptions, exposure to TIPS helps preserve purchasing power in an environment of persistent inflation risk.

For corporate bond ETFs, diversification across North America, Europe, and Asia helps reduce risk amid region-specific economic challenges such as slowing growth, trade tensions, and inflation. A focus on short-term duration bonds minimizes interest rate risk in a tightening monetary environment. While ESG factors are not the primary focus, their inclusion reflects growing market importance and tends to support stronger performance and resilience as ESG investing gains popularity (Pramitasari, 2024).

Diversification within fixed income helps reduce risk and stabilize the portfolio. High yield bonds offer higher income to balance lower returns from government and investment-grade bonds. Geographic diversification to regions like Europe and Asia is important given slowing growth forecasts and the inflationary, supply chain impacts of U.S. trade tensions, which increase risk premiums on lower-rated bonds.

The screening for alternative investments focused on real estate and gold to enhance diversification and serve as inflation hedges amid current inflationary pressures. These investments complement fixed income and equity holdings by mitigating inflation risk and increasing portfolio resilience in today's complex macroeconomic environment.

There was no hedge against currency exposure, as more than 80% of the final portfolio is focused on the U.S., which significantly minimizes the exposure to this risk. While some vulnerability remains due to ETPs focused on other regions and currencies outside the U.S. dollar, there is no hedge to maintain lower expense ratios.

4.4 Portfolio Composition

4.4.1 Modern Portfolio Theory and Mean-Variance Theory

Modern Portfolio Theory (MPT) will be integrated to determine the optimal allocation of weights for each ETP, aiming to maximize the SR. According to Markowitz (1952), the optimal portfolio is the one that offers the highest expected return for a level of risk.

MPT is based on the idea that diversification lowers the specific risk of an individual asset or asset class. By building a portfolio of securities that are not perfectly correlated, overall risk can be reduced without sacrificing returns (Markowitz, 1952).

ETPs are well-suited for this approach, providing broad market exposure, liquidity, and cost efficiency, making them an effective diversification tool (Salimian et al., 2019).

To achieve an optimal portfolio, expected returns, variances, and covariances of the selected ETPs were computed, allowing for the best possible balance between risk and reward. The efficient frontier represents the portfolios that provide the highest risk-reward balance. Portfolios that fall below the efficient frontier are considered suboptimal, as they either generate lower returns for the same level of risk or expose the investor to unnecessary risk for a given level of return. (Markowitz, 1952).

4.4.2 Methodology

The development of the optimized portfolio began with collecting historical monthly adjusted prices of the selected ETPs from Bloomberg Terminal from May 31, 2020, to January 31, 2025.

To ensure consistent comparisons across ETPs with different price levels, logarithmic monthly percentage returns were computed. Log returns are preferred because they make multi-period returns additive and provide a more accurate measure of continuous compounding (Hudson & Gregoriou, 2015). This approach standardizes the time series data, ensuring a uniform measure of returns. The formula used was:

$$R_i = \log\left(\frac{S_i(T)}{S_i(0)}\right) \quad (1)$$

Where $S_i(T)$ is the ETP's price at the end of the period, and $S_i(0)$ is its price at the start.

Following this, monthly returns and volatilities for each ETP were calculated and converted into equivalent yearly metrics. Using Python, a variance-covariance matrix was generated from the logarithmic monthly returns. This matrix quantified the relationship between ETP returns, facilitating a deeper understanding of diversification benefits and risk correlations within the portfolio.

The optimization phase involves maximizing SR, which measures the portfolio's risk-adjusted performance. The SR quantifies the excess return earned per unit of risk and is calculated as:

$$Sharpe\ Ratio = \frac{R_p - R_f}{\sigma_p} \quad (2)$$

Where Rp is the portfolio's return, Rf the risk-free rate, and σp is the portfolio's volatility.

As mentioned above, the final asset allocation is 55% to equity, 35% to fixed income, and 10% to alternative investments. Each ETP was constrained to a maximum of 50% and a minimum of 10% within its asset class. The 50% cap prevents any one ETP from dominating its asset class exposure, while the 10% floor ensures that each holding contributes meaningfully to overall performance.

Weight constraints can be seen as a discretion limits. According to Davies (2020), these limits help reduce agency conflicts by restricting biased advisors' recommendations, which can lead to suboptimal portfolios and unnecessary fees.

These constraints were applied individually, resulting in the following ETP limits:

$$5.50\% \leq Weight_{Equity\ ETF_i} \leq 27.50\%,\ \ i = 1, \ldots, 5 \quad (3)$$

$$3.50\% \leq Weight_{Bond\ ETF_j} \leq 17.50\%,\ \ j = 6, \ldots, 8 \quad (4)$$

$$1.00\% \leq Weight_{Alternative\ ETP_k} \leq 5.00\%,\ \ k = 9, 10 \quad (5)$$

$$\sum_{i=1}^{5} Weight_i = 55\% \quad (6)$$

$$\sum_{i=1}^{3} Weight_j = 35\% \quad (7)$$

$$\sum_{i=1}^{2} Weight_k = 10\% \quad (8)$$

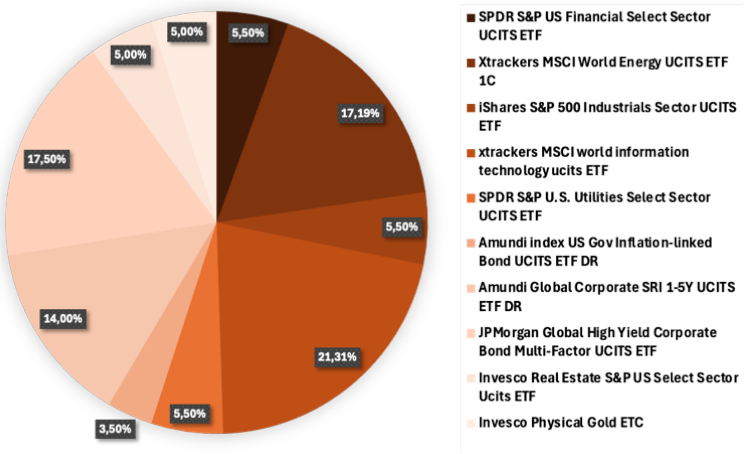
These limits maintain portfolio diversification while allowing flexible allocation across ETPs. Python was used to optimize asset weights to maximize SR, balancing return potential and risk within the allocation structure (Figure A5).

4.4.3 Portfolio Composition

Trackinsight (n.d.) suggests that a portfolio of 5 to 10 ETFs is optimal for achieving effective diversification. Similarly, ETF Central (n.d.) suggests that fewer than 10 ETFs can be sufficient to build a well-diversified portfolio.

In line with this, the final portfolio consists of 10 EPS: 9 ETFs – 5 equity, 3 fixed-income, and 1 alternative – and 1 ETC, leading to the following portfolio:

Figure 4 - Portfolio composition



Source: Author

The selected ETPs for the portfolio, adhering to the specified constraints, are as follows (Bloomberg):

- **SPDR S&P US Financial Select Sector UCITS ETF** (IE00BWBXM500): seeks to replicate the performance of the U.S. financial sector, represented by the S&P Financials Select Sector Index. Denominated in U.S. dollars, this ETF offers exposure to a range of large U.S. financial companies, including banks, insurers, and investment firms. It has an expense ratio of 0.15%.
- **Xtrackers MSCI world energy UCITS ETF 1C** (IE00BM67HM91): aims to replicate the MSCI World Energy Index, providing exposure to large and mid-cap companies within the global energy sector. Denominated in U.S. dollars and an expense ratio of 0.25%, this ETF covers a range of industries, including oil and gas, renewable energy, and energy equipment and services worldwide.
- **iShares S&P 500 Industrials Sector UCITS ETF** (IE00B4LN9N13) provides exposure to U.S.-based companies within the industrial sector by tracking the S&P 500 Industrials Sector Index. This ETF provides targeted exposure to industries such as aerospace, defence, machinery, and transportation. Denominated in U.S. dollars, the ETF offers investors a focus on large-cap U.S. companies in the industrials sector and it has an expense ratio of 0.15%.
- **Xtrackers MSCI world information technology UCITS ETF** (IE00BM67HT60) aims to replicate the MSCI World Information Technology Index, providing access to leading global technology companies. With an

expense ratio of 0.25%, it is denominated in U.S. dollars and offers exposure to the information technology sector across developed markets.

- **SPDR S&P US Utilities Select Sector UCITS ETF** (IE00BWBXMB69) seeks to follow the performance of the S&P Utilities Select Sector Index, which represents U.S.-based companies within the utilities sector, providing exposure to industries such as electric utilities, gas utilities, water utilities, and renewable energy companies. Denominated in U.S. dollars, the ETF focuses on large-cap U.S. companies within the utilities sector. It has an expense ratio of 0.15%.
- **Amundi index US Gov Inflation-linked Bond UCITS ETF DR** (LU1525419294) seeks to replicate the Bloomberg US Government Inflation-Linked Bond Index, providing exposure to U.S. Treasury Inflation-Protected Securities (TIPS). Denominated in U.S. dollar and having an expense ratio of 0.09%, it provides an exposure to investment in government bonds.
- **Amundi Global Corporate SRI 1-5Y UCITS ETF DR** (LU1525418726) focuses on short-term corporate bonds meeting strong (ESG) criteria. This ETF tracks the Bloomberg MSCI Global Corporate ESG Sustainability SRI 1-5 Year Index, offering exposure to global corporate bonds with maturities between 1 and 5 years. It has an expense ratio of 0.16%.
- **VanEck Global Fallen Angel High Yield Bond UCITS ETF** (IE00BF540Z61) tracks the ICE Global Fallen Angel High Yield 10% Constrained Index, including corporate bonds downgraded from investment grade. The ETF offers diversified exposure to global high yield bonds with an expense ratio of 0.40%.
- **Invesco US Real Estate Sector UCITS ETF** (IE00BYM8JD58) offers exposure to leading U.S. real estate companies denominated in U.S. dollars by tracking the S&P Select Sector Capped 20% Real Estate index where single stocks are limited to a maximum of 20%. It has an expense ratio of 0.14%.
- **Invesco Physical Gold ETC** (IE00B579F325) is designed to provide investors access to the gold market. Each unit is backed by physical gold, offering exposure to the price movements of gold. It has an expense ratio of 0.12%.

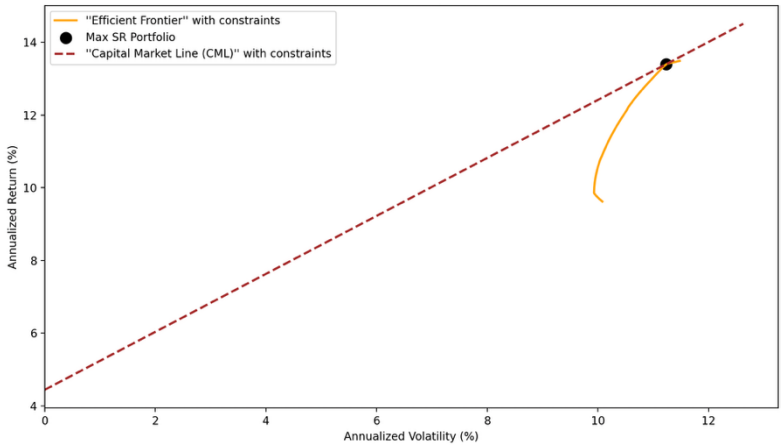
This list reflects the ETPs selected to meet Rachel's investment objectives and constraints. Additional details on the ETPs are provided in Table A2.

The risk-free rate of 4.44% was derived from the U.S. 10-Year Treasury bond (Bloomberg, 06 February 2025). This choice reflects the client's American domicile,

the dollar-denominated nature of all securities, significant exposure to the U.S. market in the portfolio, and the investment time horizon. Using U.S.-based securities aligns with the client's domicile and strategically focuses on mature, highly liquid market, helping to minimize currency risk (though not eliminate it) and reduce complexity.

The selected portfolio maximizes the SR and lies at the tangency point between the "efficient frontier" with constraints and "Capital Market Line (CML)" with constraints, offering the best risk-return trade-off among all feasible ETP combinations within the given constraints.

Figure 5 - Efficient frontier



Source: Author

4.5 Expected Performance

Based on the current allocations and market assumptions, the portfolio is projected to generate an annual return of 13.02%, with an expected volatility of 11.07%. A detailed breakdown of the expected performance is outlined in the table below.

Table 2 – Expected Performance of the Proposed Portfolio

Expected Return	13.02%
Variance	1.22%
Standard Deviation	11.07%
Risk Free Rate	4.44%
Sharpe Ratio	0.77
Reward/Risk	1.17

Source: Author

To analyse the portfolio's expected performance, a Monte Carlo Simulation was conducted. This widely recognized technique is used to forecast outcome probabilities by simulating numerous scenarios. The analysis required the following inputs:

- Initial investment: $500,000
- Expected return: 13.02%
- Expected volatility: 11.07%
- Time-horizon: 10 years

Using these parameters, random returns were generated based on the Geometric Brownian Motion (GBM) framework, which models asset prices as a continuous-time random walk with drift and volatility. This approach assumes that returns are normally distributed, and log prices follow a Brownian motion, capturing the compounding and randomness of market behaviour over time. A total of 100,000 Monte Carlo simulations were performed in Python to model a wide range of possible outcomes in the end of the 10 years. The GBM model was selected for its analytical simplicity and compatibility with long-term financial forecasting, as supported by Reddy & Clinton (2016) and Peng & Simon (2024). The simulation was based on the closed-form GBM formula, which models the portfolio value (V_t) as:

$$V_t = V_0 \times e^{\left(\mu - \frac{1}{2}\sigma^2\right)t + \sigma\sqrt{t}\mathrm{Z}} \quad (9)$$

Where V_0 is the initial investment; μ is the annual expected return; σ is the annual volatility; t is the time horizon (in years), and Z is a standard normal random variable.

Table 3 - Expected Performance (Monte Carlo)

Mean	$1,838,037.06
Median	$1,729,266.96
Standard Deviation	$662,881.92

Source: Author

The portfolio has the potential to grow from $500,000 to $1,838,037.06 in 10 years. However, the standard deviation of $662,881.92, indicates considerable variability around the expected outcome. At 95% confidence level – based on the 2.5th and 97.5th percentiles – the final portfolio value may range from $874,547.79 to $3,420,594.73.

Table 4 - Returns per Percentile

Percentile	Return
5%	$976,159.98
25%	$1,106,672.67
50%	$1,729,266.96
75%	$2,188,592.08
95%	$3,071,969.71

Source: Author

The table represents the expected portfolio returns at different percentiles. At the 95th percentile, there is a 95% probability that the portfolio's ending value will be at or below $3,071,969.71, and a 5% probability that it will exceed this value. Similar interpretations can be made for the other percentiles and their corresponding values.

To assess the portfolio's performance, a benchmark was established as a reference point. Given that the ETPs in this portfolio use full or optimized replication methods (except for the Real Estate ETF, which employs Swap-Based replication), a weighted benchmark approach was adopted. This method aggregates the historical monthly returns for each underlying index, adjusted by the respective ETP weights in the portfolio. To evaluate the portfolio's performance relative to the benchmark, Information Ratio and Tracking Error were calculated using the following formulas:

$$Tracking\ Error = \sqrt{\frac{\sum_{i=1}^{n}(R_p - R_b)^2}{N-1}} \tag{10}$$

$$Information\ Ratio = \frac{R_p - R_b}{Tracking\ Error} \tag{11}$$

Where R_p is the return of the portfolio; R_b is the return of the benchmark and N is the number return periods.

The tracking error quantifies the deviation between the portfolio's returns and the benchmark. The tracking error of 1.98% reflects how much the portfolio's performance fluctuates relative to the benchmark over time. A lower tracking error generally indicates that the ETPs are closely following their benchmark, with minimal deviation due to costs or inefficiencies. The information ratio measures the portfolio's excess return per unit of risk taken relative to the benchmark. An information ratio of 0.5 is considered good, as it shows the portfolio may beat the benchmark with lower volatility and more consistent performance over time (Schneider, 2009).

4.6 Risk Analysis

After analysing the expected performance, a risk analysis was conducted to evaluate potential downsides. Three Value at Risk methods were performed: parametric VaR, historical VaR, and Monte Carlo VaR. Additionally, Conditional VaR (CvaR) was also computed to provide a more comprehensive view of tail risk beyond the VaR threshold.

Pfau (2012) highlights that assessing portfolio risk over shorter intervals, such as one-year rolling periods, can offer more practical insights for long-term investors – particularly when comparing valuation-based strategy. In line with this, the VaR for each method was calculated using a one-year horizon, providing a clearer understanding of potential short-term risks within a long-term investment strategy.

4.6.1 Parametric VaR (Variance-Covariance VaR)

Parametric VaR estimates the maximum expected portfolio loss over a specific time frame and confidence level by assuming asset returns follow a normal distribution. This means returns are symmetrically distributed around the mean, with most outcomes concentrated near the average and fewer extreme values, allowing risk to be modeled using mean and standard deviation. While computationally efficient, this approach's reliance on normality may underestimate the risk of rare but severe market events, as real-world returns often display skewness and fat tails (Abad et al., 2014).

For the analysis, the following formula was used:

$$VaR_{\alpha} = \mu - Z_{\alpha} \times \sqrt{t} \times \sigma \times V_0 \quad (12)$$

Where μ is the annual expected return; Z_{α} is the Z-score corresponding to the confidence level α; t is the time horizon (in years); σ is the portfolio's standard deviation and V_0 is the initial investment.

The parametric VaR results are shown in the table below, indicating potential losses at various confidence levels and providing a clearer insight into possible outcomes.

Table 5 - Parametric VaR

Confidence Interval	Z_{α}	Parametric VaR ($)	Parametric VaR (%)
90%	1.282	5,821.96	1.16
95%	1.645	25,925.16	5.19
99%	2.326	63,635.42	12.73

Source: Author

At 95% confidence level, the portfolio may incur a loss of $25,925.16, which represents approximately 5.19% of the total portfolio value. This means that there is a 5% chance that the loss will exceed this amount.

4.6.2 Historical VaR (Non-parametric VaR)

Historical VaR assumes that past returns provide a reliable representation of the future return distribution. It uses historical performance data to estimate the potential range of future outcomes (Abad et al., 2014).

The historical VaR was computed based on log returns derived from monthly portfolio data. The method identifies the worst historical returns at specific confidence levels. The calculation in python followed the formula:

$$VaR_{\alpha} = \text{np.percentile}(\text{returns}, (1-\alpha) \times 100) \times \sqrt{t} \quad (13)$$

Where $\text{np.percentile}(\text{returns}, (1-\alpha) \times 100) \times \sqrt{t}$ gives the $(1-\alpha)$ percentile of historical returns and $\sqrt{t}$ is the square root of time (in months since the returns are monthly).

In the table below we can find the historical VaR given a specific confidence level:

Table 6 - Historical VaR

Confidence Interval	Z_{α}	Historical VaR ($)	Historical VaR (%)
90%	1.282	47,296.91	9.46
95%	1.645	72,175.97	14.44
99%	2.326	137,332.61	27.47

Source: Author

At the 95% confidence level, the VaR of $72,175.97 suggests a 95% probability that the portfolio's loss will not exceed this amount over the specified time horizon.

4.6.3 Monte Carlo VaR

Monte Carlo VaR was computed to estimate the potential portfolio value over a specific time frame under typical market conditions. Unlike traditional VaR techniques that rely on fixed distribution assumptions, this method uses stochastic processes to simulate numerous market outcomes. This approach provides a more dynamic risk assessment by capturing a wider range of possible market scenarios (Abad et al., 2014).

A one-year Monte Carlo simulation with 100,000 runs was performed in Python using the Geometric Brownian Motion model, which simulates asset price movements as continuous random changes driven by expected return and volatility. Each iteration involved generating a standard normal random variable Z_i ~ $N(0,1)$ scaled by portfolio's volatility and the square root of time (t). This method is widely recognized for its practical use in financial forecasting as highlighted by Reddy & Clinton (2016) and Peng & Simon (2024). The formula used was:

$$R_t = \left(\mu - \frac{1}{2}\sigma^2\right)t + \sigma\sqrt{t}\mathrm{Z} \tag{14}$$

Where μ is the annual expected return; σ is the annual volatility; t is the time horizon (in years) and Z is a standard normal random variable.

This produced a simulated return R_t for each scenario. The corresponding simulated portfolio value (V_t) and loss (L_t) were computed as:

$$V_t = V_0 \times e^{R_t} \tag{15}$$

$$L_t = V_0 - V_t \tag{16}$$

Where V_0 is the initial investment.

The Monte Carlo VaR was computed for each confidence level as:

$$VaR_\alpha = np.percentile(L_t\,, \alpha) \times 100 \tag{17}$$

We can find the Monte Carlo VaR in the table below for a specific confidence level:

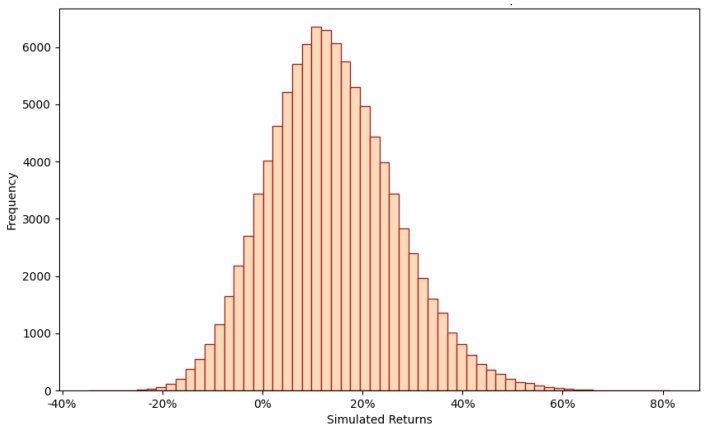
Table 7 - Monte Carlo VaR

Confidence Interval	Z-Stat	Monte Carlo VaR ($)	Monte Carlo VaR (%)
90%	1.282	8,789.73	1.76
95%	1.645	28,382.99	5.68
99%	2.326	63,093.25	12.62

Source: Author

At 95% confidence level, the VaR is $28,382.99, meaning there is 95% chance losses won't exceed this amount over one year, with 5% of scenarios showing greater losses.

Figure 6 - Distribution of simulated returns (1 year)



Source: Author

The bell curve shown in the histogram above illustrates the distribution of potential portfolio returns, with most of the simulated outcomes clustering around the expected return. However, the focus lies on the tail of the distribution, where extreme losses are observed. For a one-year period, the simulations suggest portfolio returns could range from approximately -20% to 60% within a year.

4.6.4 Conditional VaR (Expected shortfall)

Conditional VaR is a risk measure that captures the average loss that could occur in the worst-case scenarios – specifically, those beyond the VaR threshold. Unlike VaR, which only identifies the minimum loss at a certain confidence level, CvaR focuses on the severity of losses that exceed that level, making it particularly useful for understanding impact of rare but significant market downturns (Abad et al., 2014).

The formula used was the following:

$$ES_\alpha = \mathrm{E}[L_t \mid L_t > VaR_\alpha] \tag{18}$$

Where L_t is the loss variable and VaR_α is the α-quantile of the loss distribution.

The results of this computation were the following:

Table 8 - Conditional VaR

Confidence Interval	Z-Stat	Conditional VaR ($)	Conditional VaR (%)
90%	1.282	33,624.51	6.72
95%	1.645	49,544.03	9.91
99%	2.326	79,445.66	15.89

Source: Author

At 95% confidence level, the CVaR shows that if losses exceed the VaR threshold, the average loss is $49,544.03, representing 9.91% of the portfolio total value.

4.6.5 Risk Matrix

A risk matrix was constructed, with probability on the X-axis and impact on the Y-axis.

- Probability: the expected frequency or likelihood of the risk occurring.
- Impact: the severity of consequences on the portfolio if the risk materializes.

The following risks were identified in this IPS:

- Market risk (M): Market risk is particularly relevant in the current environment, as U.S. economic growth is decelerating amid restrictive monetary policy, persistent inflation, and heightened political uncertainty. The Q1 2025 GDP contraction and elevated interest rates underscore the sensitivity of fixed-income and equity markets to macroeconomic shifts. For this portfolio heavily concentrated in U.S. assets, this poses a high probability and high impact risk.
- Liquidity risk (L): The portfolio's focus on highly liquid U.S. helps minimizes liquidity risk (Salimian et al., 2019). However, ECB (2025) notes that liquidity problems can worsen during periods of market stress due to wider spreads and net asset values discounts. Given current market conditions, the probability of significant liquidity disruptions is medium, reflecting heightened uncertainty and volatility. The expected impact is also medium, as liquidity issues can lead to higher transaction costs, price deviations, increased redemption pressures, and potential spillover effects to underlying securities.
- Regulatory risk (R): Policy shifts under Trump administration have introduced renewed tariffs and workforce reductions that may affect some sectors. However, since the portfolio is exposed to multiple sectors, adverse effects in one area may be offset by stability or gains in others. While the probability of continued regulatory changes remains moderate, this sectoral diversification helps limit the overall impact to a low level.
- Credit risk (C): Credit risk primarily affects fixed-income, especially lower-rated corporate bonds, where rising borrowing costs and potential fiscal tightening could cause credit spreads to widen moderately. While exposure to high-quality government inflation-linked bonds helps reduce overall credit risk, the inclusion of corporate and high-yield bonds increases potential volatility. This balanced

approach keeps credit risk at a moderate probability and moderate impact level while supporting stable returns.

- Operational risk (O): The portfolio uses only ETPs traded on reputable platforms with transparent structures and robust regulation. No single provider holds more than 50% of the portfolio, further reducing operational risk. Therefore, the probability and impact of operational failures are low.
- Foreign-Exchange risk (F): Although the portfolio is primarily concentrated in U.S.-listed assets, foreign exchange risk arises from international ETPs and U.S. companies with significant foreign revenue. This risk is heightened by the notable weakening of the U.S. dollar in early 2025 – its sharpest drop since 2022 (CNBC, 2025) – driven by rising trade tensions, protectionism, and divergent global monetary policies (Schwab, 2025). Without currency hedging, the portfolio is directly exposed to valuation swings from dollar volatility. While FX exposure is not dominant, the lack of hedging and current macroeconomic context elevates this risk to a high probability with moderate impact.
- Tariff and Trade War risk (T): Tariff escalation – such as the 25% tariffs on Canadian and Mexican imports – has begun inflating costs and straining supply chains (Sherman et al., 2025). Given the portfolio's exposure to U.S. – listed multinationals and globally integrated companies, the risk of retaliatory measures and weakened trade flows is significant. Although certain holdings, like inflation-linked bonds, may offer partial protection, the broad economic implications make this a very high-probability, high-impact risk.

Figure 7 - Risk Matrix

Impact		Very low	Low	Medium	High	Very high
Probability	Very high				T	
	High			F	M	
	Medium		R	L; C		
	Low		O			
	Very low					

Low Risk
Moderate Risk
High Risk
Very High Risk

Source: Author

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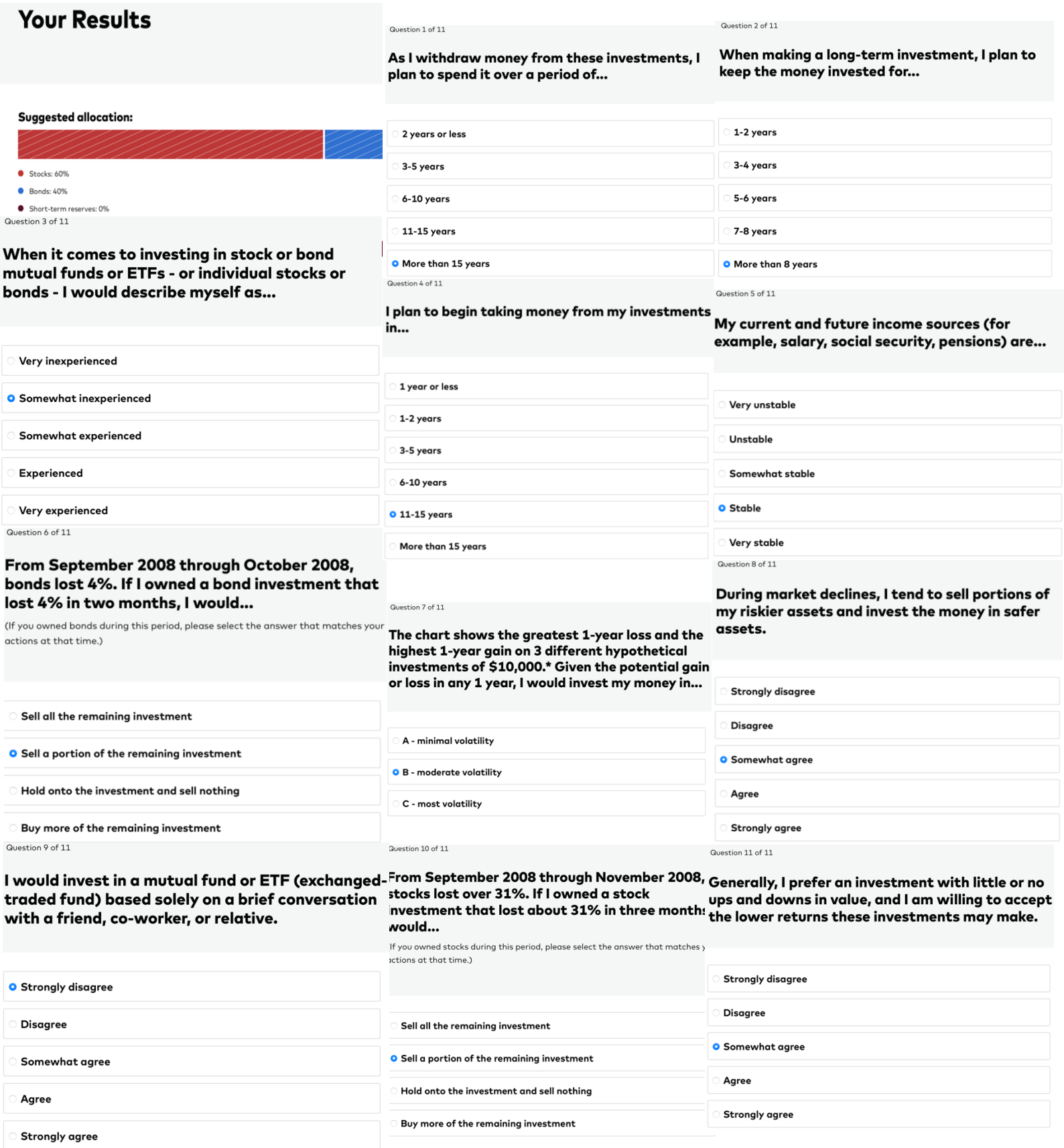
Appendix

Table A1 - Client's Profile

Name	Rachel Jones
Age	35 years-old
Children	5-year-old daughter and a 10-year-old son
Work	Attorney
Net Annual Wage	$150,000
Additional Information	Limited knowledge of financial markets
Investment Constraints	- Use of U.S. dollar-denominated ETPs. - Majority of investment focused on U.S. (more than 80%). - Allocation of 10% to alternative investments. - No risk-free asset. - No short selling. - Accumulating strategy.
Ability to Bear Risks / Willingness to Take on Risk	High / Moderate
Risk Profile	Moderately high
Capital to invest	$500,000
Investment Objective	$1,364,735.39
Time Horizon	10 years
Minimum Rate of return	10.56 %
Expected Average Annual Return (Portfolio)	13.02%
Standard Deviation (Portfolio)	11.07%

Source: Author

Figure A1 – Suggested Allocation



Source: Vanguard questionnaire

Figure A2 - Profiling Questionnaire

1. I plan to begin withdrawing money from my investments in:

Less than 3 years	1
3–5 years	3
6–10 years	7
11 years or more	10

2. Once I begin withdrawing funds from my investments, I plan to spend all of the funds in:

Less than 2 years	0
2–5 years	1
6–10 years	4
11 years or more	8

Enter the total points from questions 1 and 2. **Time Horizon Score:** 18

If your Time Horizon Score is less than 3, stop here. If your score is 3 or more, please continue to Risk Tolerance.

A score of less than 3 indicates a very short investment time horizon. For such a short time horizon, a relatively low-risk portfolio of 40% short-term (average maturity of five years or less) bonds or bond funds and 60% cash investments is suggested, as stock investments may be significantly more volatile in the short term.

RISK TOLERANCE

3. I would describe my knowledge of investments as:

None	0
Limited	2
Good	4
Extensive	6

4. What amount of financial risk are you willing to take when you invest?

Take lower than average risks expecting to earn lower than average returns	0
Take average risks expecting to earn average returns	4
Take above average risks expecting to earn above average returns	8

5. Select the investments you currently own or have owned:

Money market fund or cash investments	0
Bonds and/or bond funds	3
Stocks and/or stock funds	6
International securities and/or international funds	8

Example: You now own stock funds. In the past, you've purchased international securities. Your point score would be 8.

6. Consider this scenario:

Imagine that in the past three months, the overall stock market lost 25% of its value. An individual stock investment you own also lost 25% of its value. What would you do?

Sell all of my shares	0
Sell some of my shares	2
Do nothing	5
Buy more shares	8

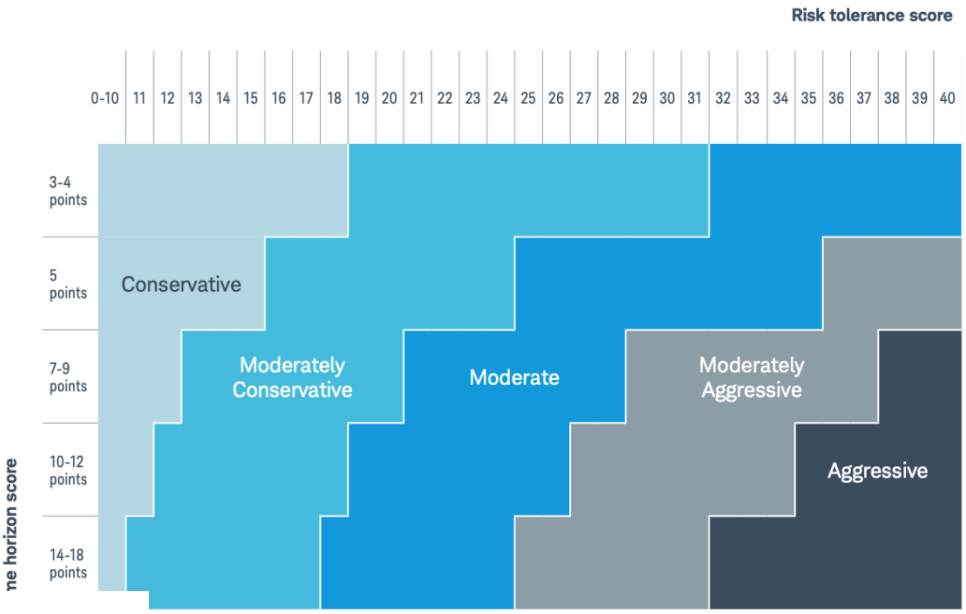
7. Review the chart below.

We've outlined the most likely best-case and worst-case annual returns of five hypothetical investment plans. Which range of possible outcomes is most acceptable to you?

The figures are hypothetical and do not represent the performance of any particular investment.

Plan	Average annual return	Best-case	Worst-case	Points
A	7.1%	22.8%	-9.5%	0
B	8.3%	27.0%	-13.3%	3
C	9.2%	30.9%	-20.9%	6
D	9.8%	34.4%	-29.5%	8
E	10.2%	39.9%	-36.0%	10

Enter the total points from questions 3 through 7. **Risk Tolerance Score:** 19



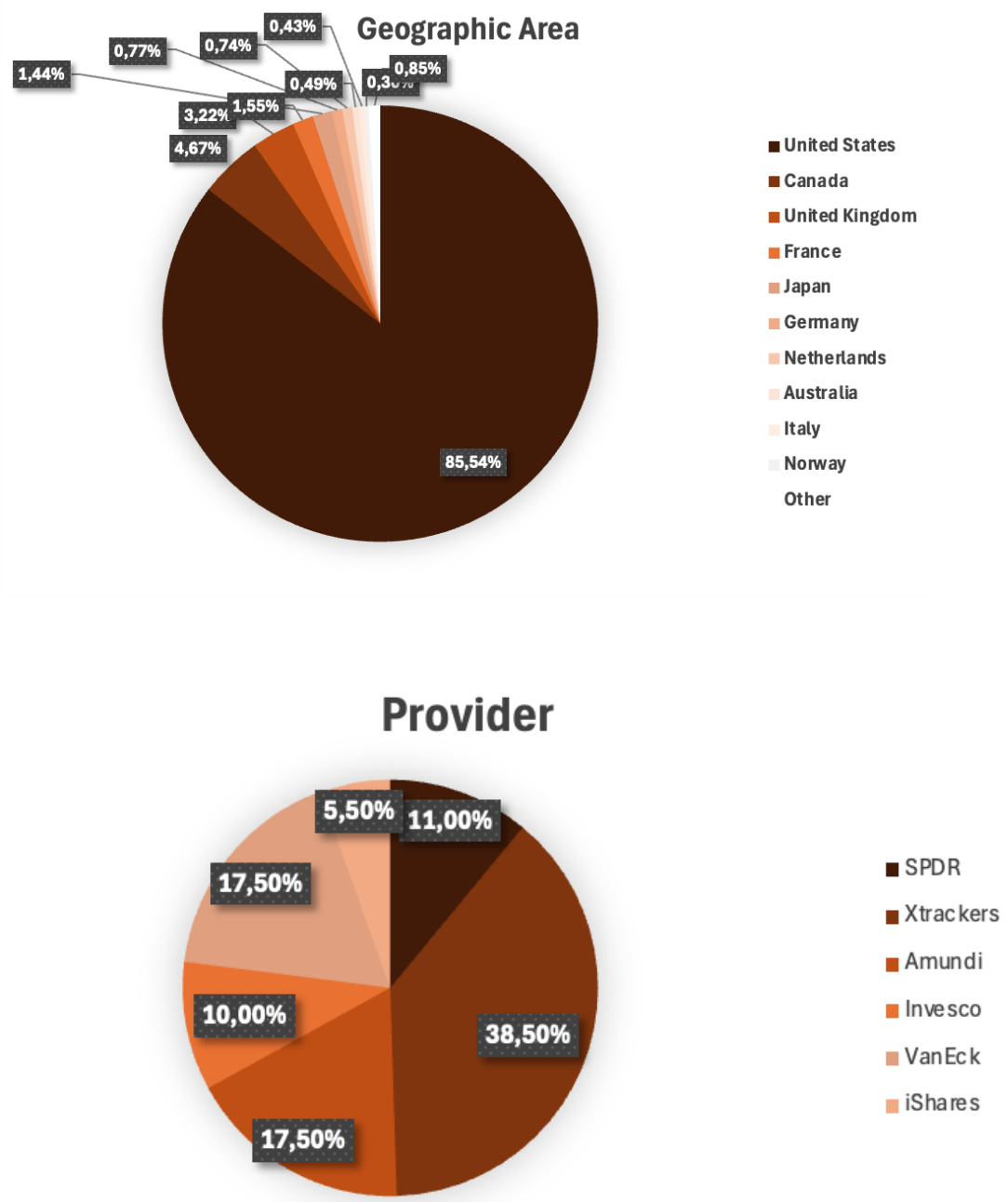
Source: Charles Schwab

Table A2 - ETPs Screens

ETP	Fund size	Index	Distribution Policy	Investment Focus	Replication Method	TER	Provider
SPDR S&P US Financial Select Sector UCITS ETF	$801M	S&P Financials Select Sector Daily Capped 35/20 Index	Accumulating	Equity, US, Financial	Full replication	0,15%	SPDR
Xtrackers MSCI World Energy UCITS ETF 1C	$802M	MSCI World Energy index	Accumulating	Equity, World, Energy	Full replication	0,25%	Xtrackers
iShares S&P 500 Industrials Sector UCITS ETF	$409M	S&P 500 Capped 35/20 Industrials index	Accumulating	Equity, US, Industrials	Full replication	0,15%	iShares
Xtrackers MSCI world information technology UCITS ETF	$4,21B	MSCI World Information Technology 20/35 Custom index	Accumulating	Equity, US, Information Technology	Full replication	0,25%	Xtrackers
SPDR S&P U.S. Utilities Select Sector UCITS ETF	$121M	S&P Utilities Select Sector Daily Capped 35/20 index	Accumulating	Equity, US, Utilities	Full replication	0,18%	SPDR
Amundi index US gov inflation-linked bond UCITS ETF DR	$11M	Bloomberg US Government Inflation-Linked Bond index	Accumulating	Bonds, US, government	Full replication	0,09%	Amundi
Amundi Global Corporate SRI 1-5Y UCITS ETF DR	$108M	Bloomberg MSCI Global Corporate ESG Sustainability SRI 1-5 Year Index	Accumulating	Bonds, US, Corporate	Optimized	0,20%	Amundi
VanEck Global Fallen Angel High Yield Bond UCITS ETF A USD	$62M	ICE Global Fallen Angel High Yield 10% Constrained index	Accumulating	Bonds, Global, High-yield Corporate	Full replication	0,40%	VanEck
Invesco real estate S&P US select sector UCITS ETF	$88M	S&P Select Sector Capped 20% Real Estate index	Accumulating	Alternative, US, Real Estate	Swap-based	0,14%	Invesco
Invesco physical gold ETC	$13,33B	Spot price of gold in US Dollar	Accumulating	Alternative, Gold	Full replication	0,12%	Invesco

Source: Author

Figure A3 - Portfolio Composition



Source: Author

Figure A4 - Portfolio Optimization Code

```python
import pandas as pd

import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import scipy.optimize as sco

# Load the data
file_path = "RT.xlsx"  # Adjust the path if needed
df = pd.read_excel(file_path, sheet_name="Sheet1")

# Extract returns (drop the Date column)
returns = df.iloc[:, 1:].copy()
etf_names = returns.columns

# Calculate expected returns and covariance matrix
mean_returns = returns.mean()  # Arithmetic mean monthly returns
cov_matrix = returns.cov()  # Covariance matrix

# Convert annual risk-free rate (4.44%) to monthly
rf_monthly = 0.0444 / 12
rf_annual = 0.0444  # Annual risk-free rate

# Number of ETFs
n = len(etf_names)

# Define constraints
bounds = [(0.055, 0.275)] * 5 + [(0.035, 0.175)] * 3 + [(0.01, 0.05)] * 2
group_constraints = [
    {"indices": range(0, 5), "target": 0.55},
    {"indices": range(5, 8), "target": 0.35},
    {"indices": range(8, 10), "target": 0.10},
]

# Define portfolio statistics
def portfolio_perf(weights, mean_returns, cov_matrix, rf):
    port_return = np.sum(weights * mean_returns)  # Expected monthly return
    port_volatility = np.sqrt(weights @ cov_matrix @ weights.T)  # Monthly volatility
    sharpe_ratio = (port_return - rf) / port_volatility
    return port_return, port_volatility, sharpe_ratio
# Objective function: maximize Sharpe Ratio
def neg_sharpe(weights, mean_returns, cov_matrix, rf):
    return -portfolio_perf(weights, mean_returns, cov_matrix, rf)[2]  # Negative Sharpe

# Constraints
constraints = [{"type": "eq", "fun": lambda w, idxs=g["indices"], t=g["target"]: np.sum(w[idxs]) - t} for g in group_constraints]

# Initial guess: Equal distribution in allowed ranges
x0 = np.array([b[0] for b in bounds])

# Optimize for maximum Sharpe ratio
opt_result = sco.minimize(
    neg_sharpe, x0, args=(mean_returns, cov_matrix, rf_monthly),
    method="SLSQP", bounds=bounds, constraints=constraints
)

# Optimal weights
opt_weights = opt_result.x
opt_return_monthly, opt_vol_monthly, opt_sharpe_monthly = portfolio_perf(opt_weights, mean_returns, cov_matrix, rf_monthly)

# Convert to annualized values
opt_return_annual = (1 + opt_return_monthly) ** 12 - 1
opt_vol_annual = opt_vol_monthly * np.sqrt(12)
opt_sharpe_annual = (opt_return_annual - rf_annual) / opt_vol_annual  # Annual Sharpe ratio

# Display results
print("\nOptimal Portfolio Allocation:")
for etf, weight in zip(etf_names, opt_weights):
    print(f"{etf}: {weight:.2%}")

print(f"\nAnnualized Expected Return: {opt_return_annual:.2%}")
print(f"Annualized Volatility: {opt_vol_annual:.2%}")
print(f"Annualized Sharpe Ratio: {opt_sharpe_annual:.2f}")
```

Source: Author

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