Investment Portfolio Management

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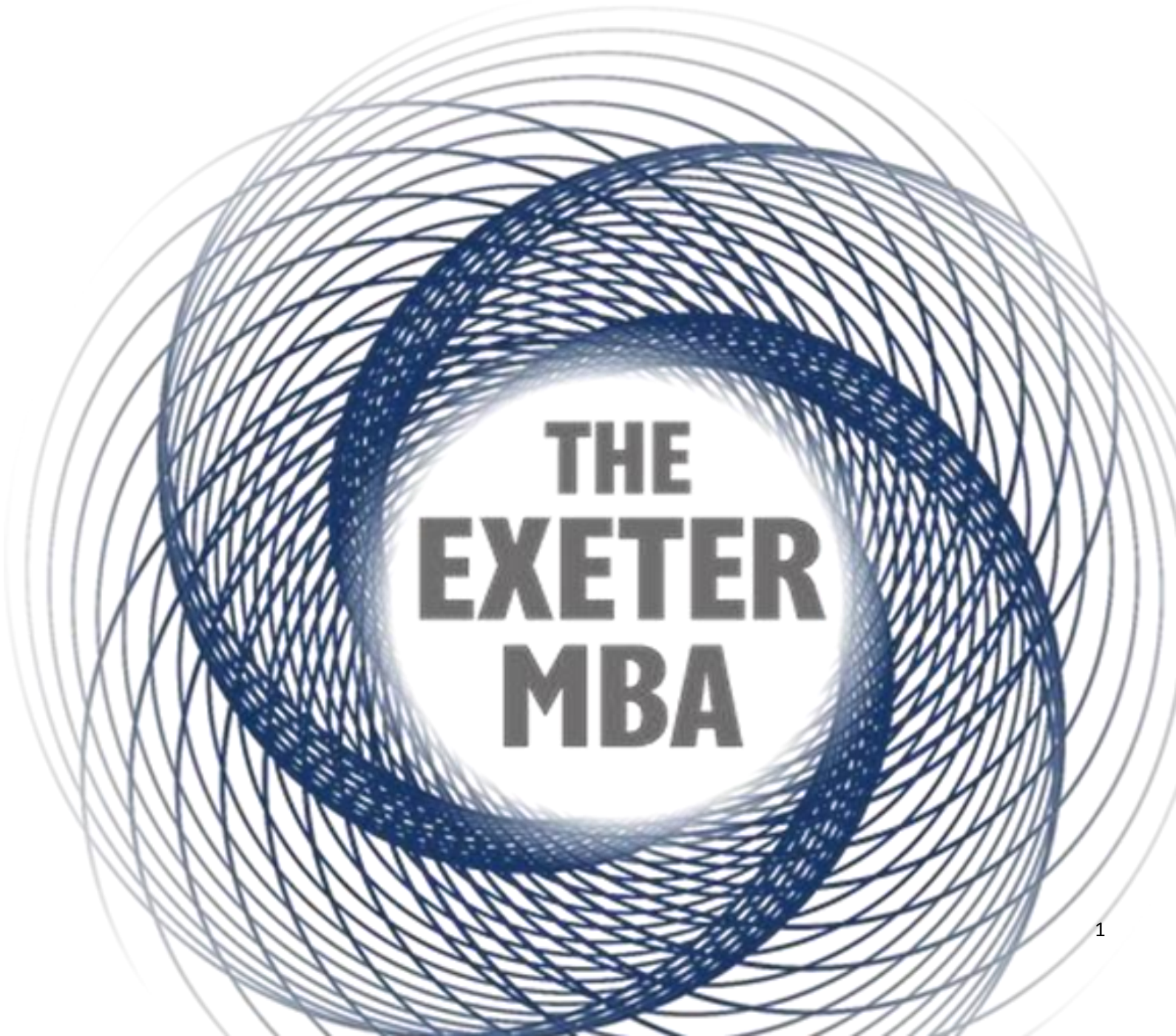

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1. Client Profile

1.1. Client Profile

The client is a middle-aged working professional with a decent understanding of financial investment.

1.2. Investment Notional

£100,000

1.3. Time horizon

A minimum of 1 year and up to a maximum of 3 years

1.4. Risk tolerance

Between 15 and 20%

Willingness to Take Risk	Ability to Bear Risk	
	Below Average	Above Average
Below Average	Below average risk tolerance	Resolution Needed
Above Average	Resolution Needed	Above average risk tolerance

1.5. Return Objectives

A return of 7.5%, that is approximately 2.5% higher than the annual return of the FTSE100 index.

1.6. Liquidity Requirements

Ability to withdraw 10% of the investments in the next 12 months on a rolling basis.

1.7. Measure of Equity Risk

Standard deviation and Value at risk (VaR)

1.8. Additional Constraints

Invest in ESG compliant Funds

2. Portfolio Construction

2.1. Approach

Though the client has a high-risk appetite, the time horizon is very short, and therefore I adopt a top-down approach that considers the ongoing macro-economic conditions (Concannon et al., p 90, chapter 51, CFA Level 1) when constructing the portfolio. Based on the current and forecasted economic conditions, a recession is almost eminent herein the UK, an analyst (Patterson, 2022) at Vanguard predicts that the UK is 50% likely to hit recession within the next 12 months and 60% likely to hit a recession in the coming 24 months. The next couple of years witnesses some of the major events which could be marked by high volatility (recently elected leadership followed by prime ministerial elections) and therefore I include defensive stocks (ABF, CCH, AVST, AVV, OCDO, and SBRY) that are constituents of major market indices (FTSE 100, ESG and MSCI ESG leader index) and exclude aggressive stocks that include financial and industrial stocks like HSBA, LLBA, NWG, and BARC.

To accommodate the client's ESG preferences, I apply (a) Best in class screening and include stocks that are within the first quartile of aggregate ESG (Environment, Social, and Governance) scores in their respective sectors followed by (b) exclusion-based investing and exclude BAT (British American Tobacco), though it is included in MSCI ESG index and pledges to reduce health impacts from its business. The client has not expressed preference towards a specific ESG issue and hence aggregate ESG scores are used as they reflect the overall ESG performance of a firm.

2.2. Strategic Asset Allocation

Considering the client's risk, return, and time horizon from the investment mandate, I split the portfolio into 1:4 with one quarter into risk-free UK government bonds which provide an annualized risk-free return of 3%, and the remaining three quarters into risky assets which include cautiously risky assets, for example, defensive UK stocks that are a constituent of major market indices.

Asset Class	**%Age allocated**	**GBP**	**Expected Return**	**Client Risk**	**Total Portfolio Return**
UK Stocks (FTSE-100)	75%	£ 75,000	9%	15-20%	7.5%
Govt. Bonds	25%	£ 25,000	3%	0%	

3. Security Selection

From the initial pool of defensive stocks that are a constituent of FTSE100, I further narrow down on the below 20 stocks with

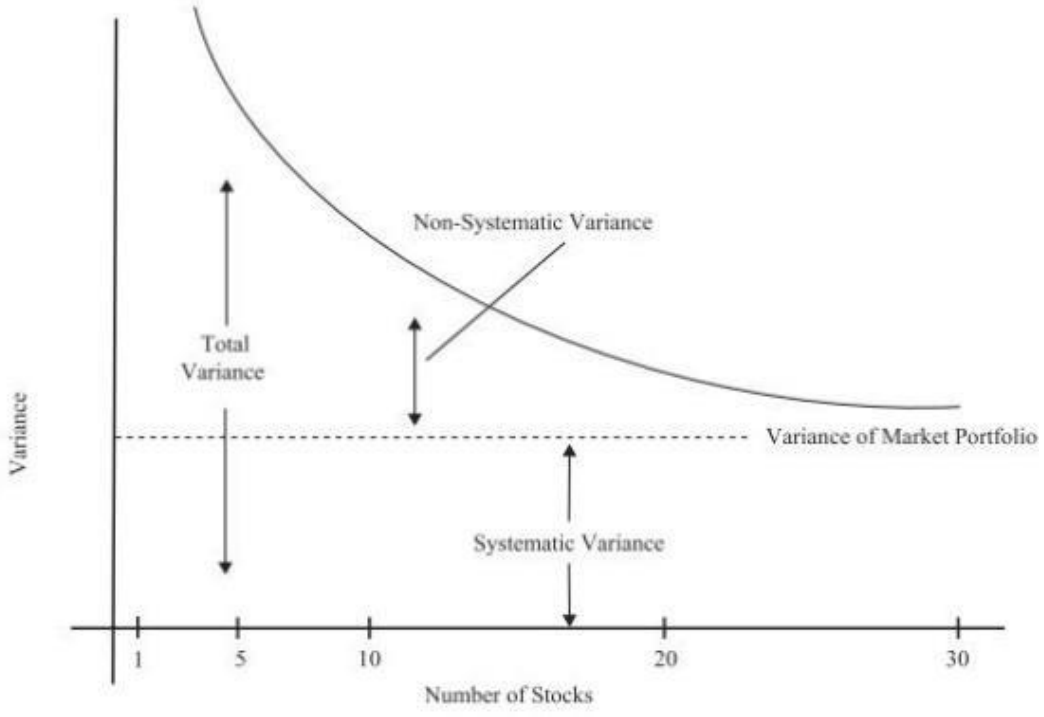
1. **High Beta Values**
   I. As per CAPM, the expected return of a stock is a function of a stock's Beta (Singal, Vijay, p213, chapter53, CFA Level 1)
   II. Higher Beta translates to a higher expected return (p211, chapter 53, CFA Level I)
2. **Highest five years average dividend yield.**
   III. Pay-out for holding the stock
3. **Stocks with low correlation.**
   I. Minimize unsystematic risk.

Code	Name	Market cap (m)	Beta	Dividend yield - 5Y Average %
RIO	RIO TINTO PLC ORD 10P	63031.33	0.88	10
VOD	VODAFONE GROUP PLC ORD USD0.20 20/21	32681.62	0.99	8.5
SHEL	SHELL PLC ORD EUR0.07	168833.67	1.27	8
IMB	IMPERIAL BRANDS PLC ORD 10P	17938.95	0.87	8
ULVR	UNILEVER PLC ORD 3 1/9P	100323.94	0.36	7.5
GSK	GSK PLC ORD 31 1/4P	57048.7	0.25	5.5
NG.	NATIONAL GRID PLC ORD 12 204/473P	42255.48	0.31	5
TSCO	TESCO PLC ORD 6 1/3P	19911.44	0.32	4.5
SBRY	SAINSBURY(J) PLC ORD 28 4/7P	5042.22	0.8	4.5
SSE	SSE PLC ORD 50P	19709.52	0.38	4.1
AHT	ASHTEAD GROUP PLC ORD 10P	19082.77	0.67	4.1
DGE	DIAGEO PLC ORD 28 101/108P	88244.53	0.71	4
CRH	CRH PLC ORD EUR 0.32 (CDI)	24163.24	1.15	4
FLTR	FLUTTER ENTERTAINMENT PLC ORD EUR0.09 (CDI)	19077.88	1.00	3
CCH	COCA-COLA HBC AG ORD CHF6.70 (CDI)	7420.05	0.33	2.8
RKT	RECKITT BENCKISER GROUP PLC ORD 10P	47186.27	1.32	2.75
AZN	ASTRAZENECA PLC ORD SHS $0.25	173511.82	0.33	2.5
EXPN	EXPERIAN PLC ORD USD0.10	25712.12	0.31	2
ABF	ASSOCIATED BRITISH FOODS PLC ORD 5 15/22P	12358.03	1.4	2
CPG	COMPASS GROUP PLC.	34777	1.3	

**The Beta values of individual stocks have been obtained from https://www.ft.com/, and additionally the calculation for Beta of a stock can befound in sections 49 through 53 of the code (link in reference)*

3.1. Diversification

Diversification enables contain unsystematic risk within the sector or firm, though it does not help address the risk of factors like inflation and political uncertainty which impact the market overall, also referred to as systematic risk (Singal,Vijay, p213, chapter 53, CFA Level 1). Studies conclude that the unsystematic risk of a portfolio starts to flatten out as the number of securities in the portfolio approaches 20, hence I have included 20 stocks in the portfolio (Singal, Vijay,p 231, chapter 53, CFA Level I).

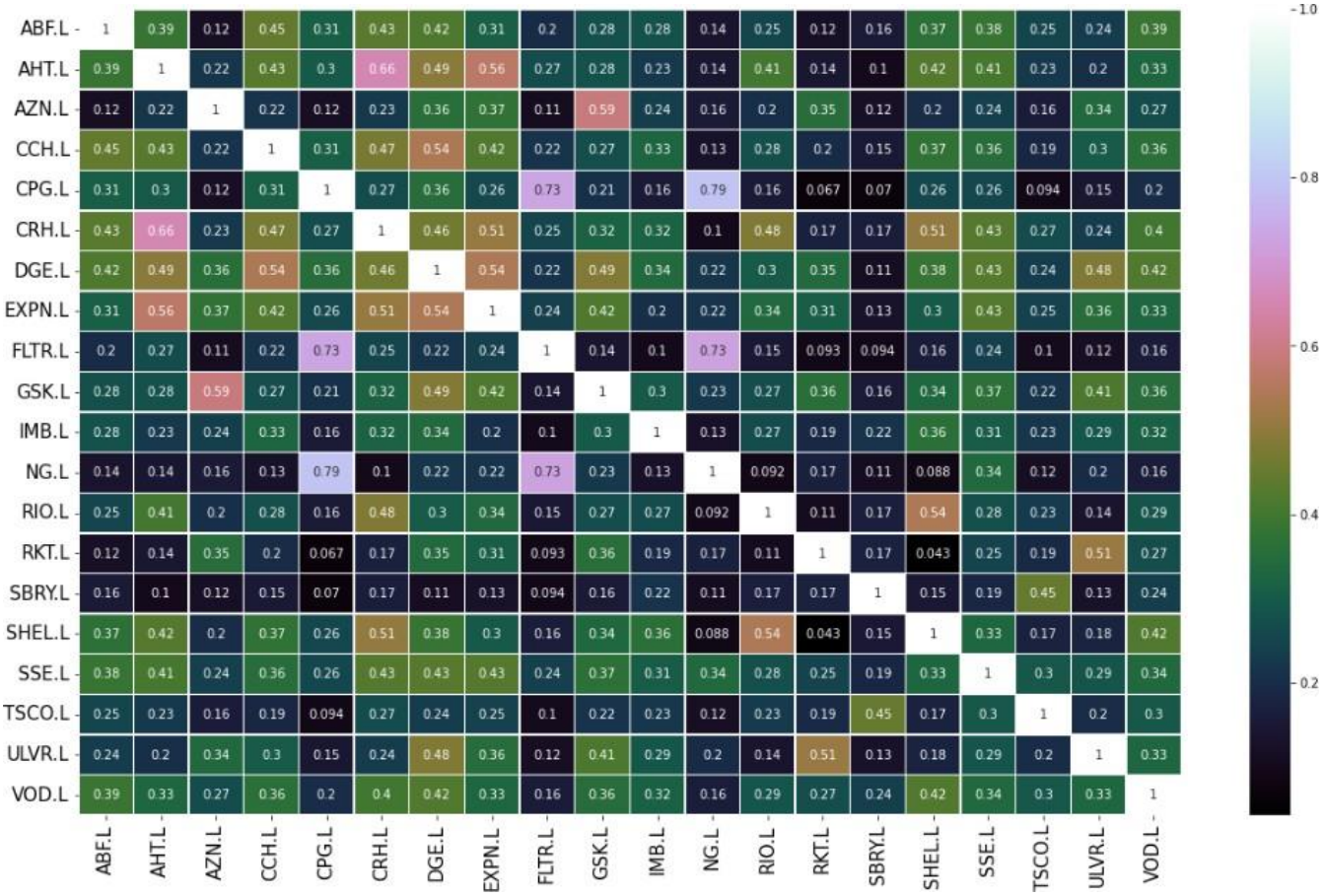


Chen, Linquan, Week2,Module BEAM036J

3.2. Correlation

The below heatmap has been plotted against the correlation of daily returns of the constituent stocks in the portfolio, the number in a box represents the correlation between the daily returns of any two stocks. The overall correlation is low, which represents a well-diversified portfolio, this in turn translates to low standard deviation (risk) and low unsystematic risk.

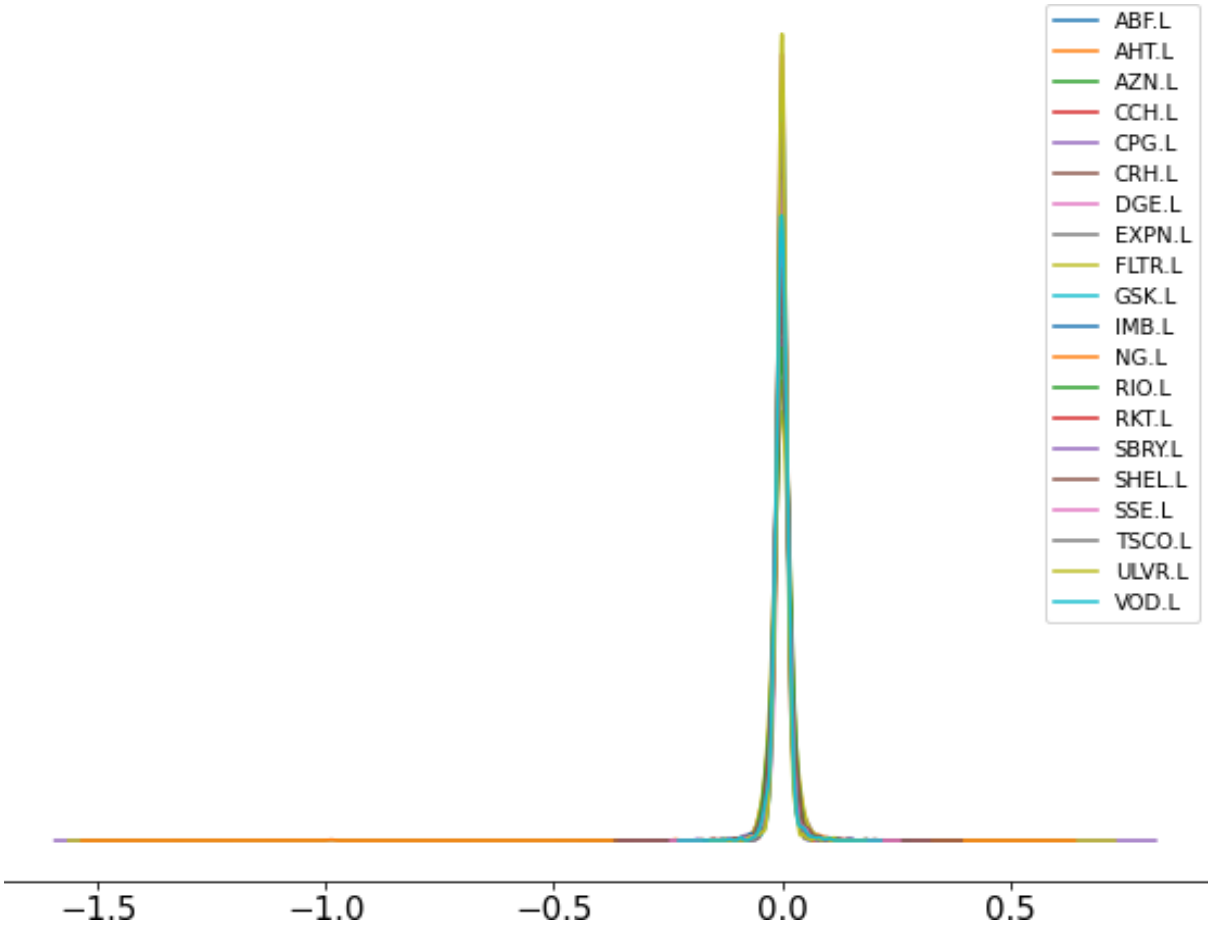
(Code, sections 4 through 7



3.3. Volatility

The below kernel density estimate (KDE) plot shows the distribution of daily returns for the stocks in the portfolio. The KDE resembles a normal distribution, the absence of kurtosis (fat tail) or skewness further implies that there is no abnormal return and that the stocks are not volatile.

(Code, section 8,9)



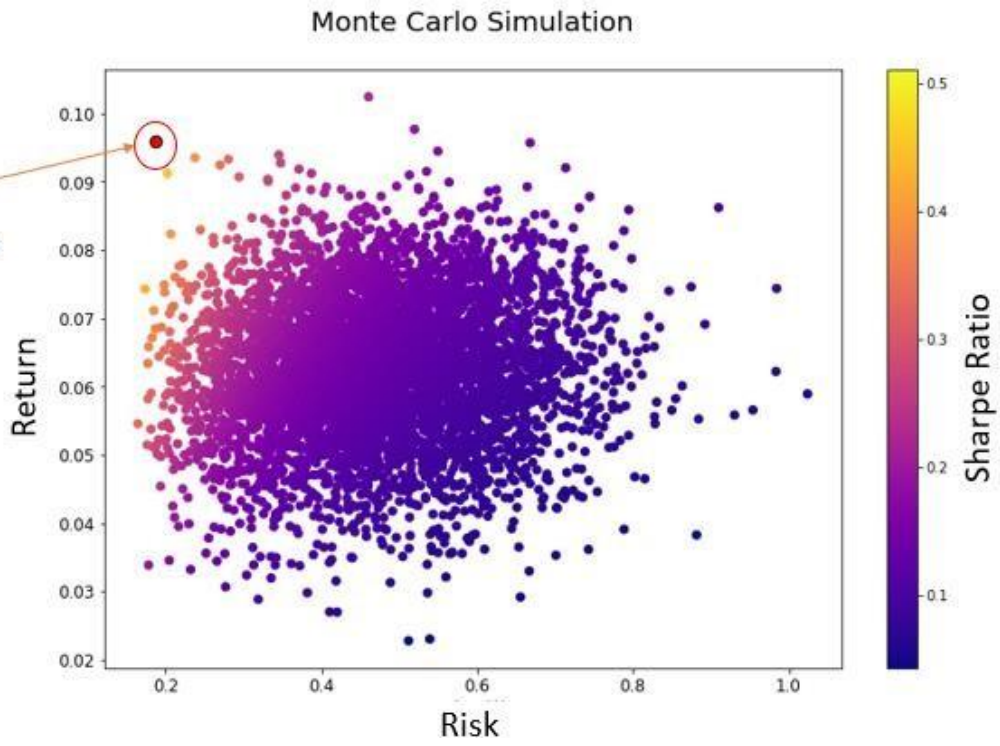
4. Asset Allocation

4.1. Monte Carlo Simulation

Now we are confident of the constituent stocks that make up the 75% of the portfolio. The next step involves optimizing the weights of the constituents to obtain the best risk-to-reward ratio (Sharpe Ratio).

To optimize weights, I use Monte Carlo simulation (Chen, Linquan, Video 4.4, Week 4). Monte Carlo simulation involves creating multiple random allocations for the portfolio and checking which allocation mix provides the best risk-to-return performance (Sharpe Ratio). To get the exact estimation, a log of daily returns and volatility is used in the calculation.
(Code, section 53)

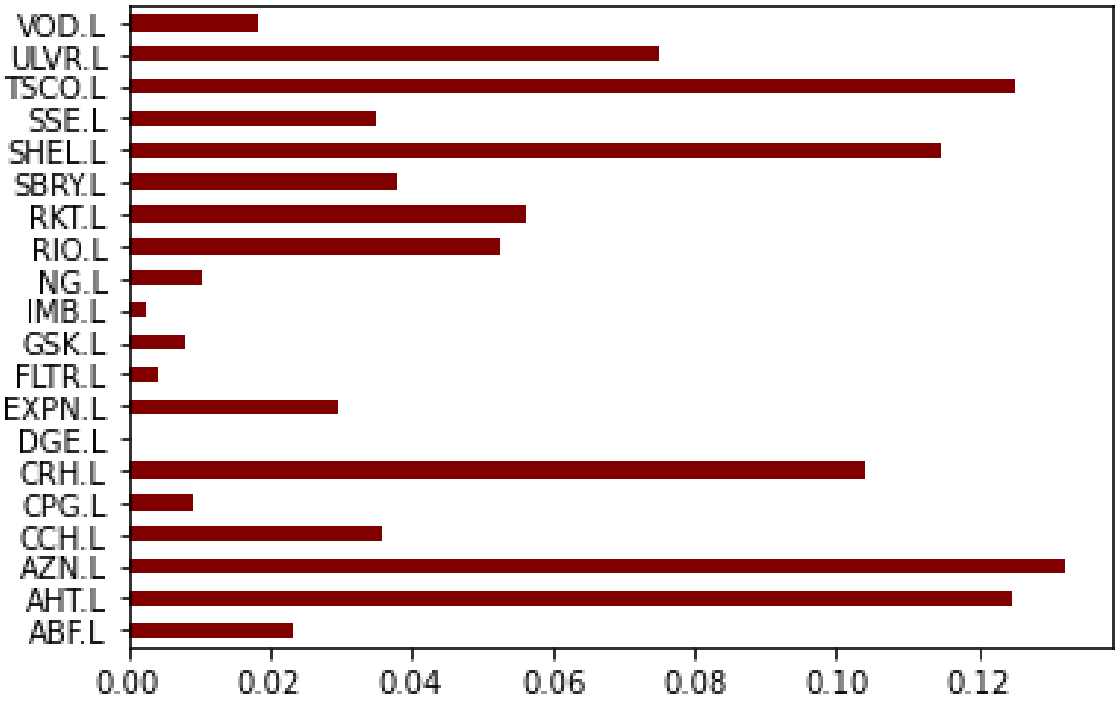
Return 9.6%
Risk (Standard Deviation) 18.7%



(Code, section 18)

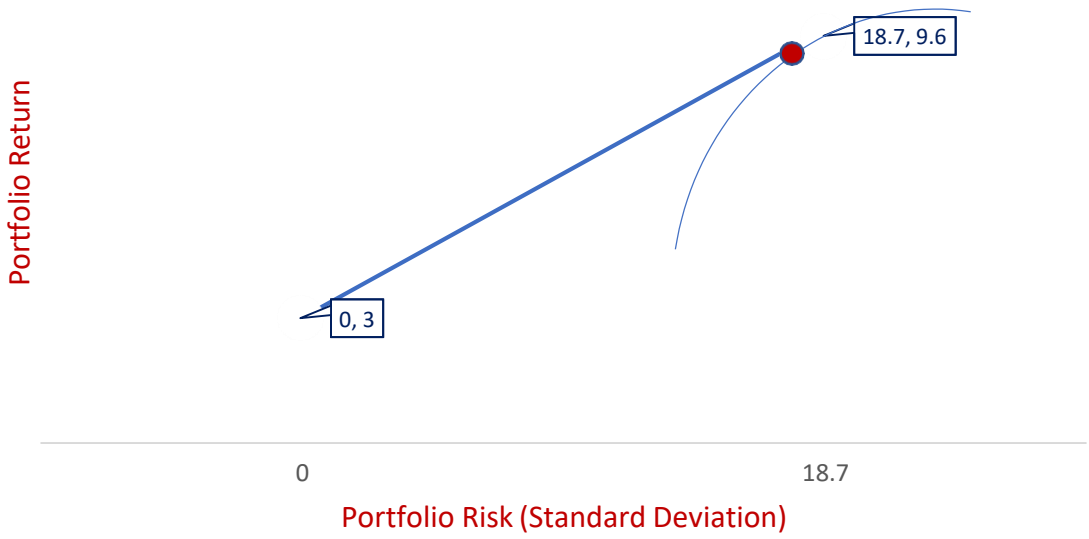
After performing 50k simulations, I arrive at the below best possible set of allocations that provides an annualized average return of 9.63% and an annualized risk (volatility) of 20.47. Assuming the risk-free rate of return is 0, we arrive at a Sharpe ratio of 0.51. The figure below shows the allocation of weights of different securities within the portfolio.

Monte Carlo simulation is good for handling multiple assets; however, it could get computationally intensive given the number of random allocations that are required before arriving at the most optimum set of allocations.



4.2. Capital Market Line

Govt. Bonds provide a risk-free return of 3% and the portfolio provides a return of 9.6% with a total risk of 18.7%.



5. Portfolio Benchmark

The return of the portfolio is measured against the return of the FTSE100 index + 2.5% (with the understanding that return of FTSE 100 in 2021 was 5%).

Index	Origin	Description
FTSE 100	UK	Market Capitalization weighted index of the 100 largest UK companies traded on the London Stock Exchanges.

The difference between the performance of an investment portfolio and the benchmark (returns of FTSE100+2.5%) is referred to as the tracking error. A positive tracking error implies that the portfolio outperforms the benchmark, and a negative value of tracking error means the portfolio underperforms in comparison to the benchmark returns.

6. Performance Appraisal

6.1. Sharpe Ratio

Sharpe Ratio is one of the most widely used portfolio efficiency ratios and can be estimated on a theoretical ex-ante basis based on readily available market data. Sharpe Ratio is easy to interpret

and conveys the reward-to-risk ratio. It is represented by the formula.

$$SR = \frac{R_i - R_f}{\sigma_i}$$

Ri is the Return on the investment portfolio.
Rf is the Risk-free Return
σi is the standard deviation of the investment portfolio and measures total risk.

Assuming the risk-free rate of return is 0, we arrive at a Sharpe ratio of 0.51 (Code, section 11,12). Sharpe Ratio, however, is not the best indication of portfolio performance, given the ratio considers the total risk of the investment and not the systematic risk.

Additionally, Sharpe Ratio does not convey much information by itself, for example, a value of 0.51 does not provide much information about the performance of a portfolio unless compared with the Sharpe ratio of another portfolio. Portfolios with a higher Sharpe Ratio provide a better risk-adjusted return and are thus preferred over ones with a lower Sharpe Ratio. If the value of the numerator in the equation is negative, the ratio will be less negative for riskier portfolios which may result in counterintuitive rankings (Chen, Linquan, week 2, slide 27/35, module BEAM036J).

6.2. Treynor Ratio

Treynor Ratio captures the excess return of a portfolio per unit of systematic risk. It is denoted by the formula.

$$TR = \frac{E(R_i) - R_f}{\beta_i}$$

E(Ri) is the expected return on the investment.
Rf is the return of a risk-free asset.
Bi is the systematic risk of the investment.

To calculate the expected return of the portfolio we calculate the expected return of individual securities using CAPM and weigh them as per the weights in optimum allocation as suggested by Monte Carlo simulation.

Code	Market Return	Risk free Rate	Stock Beta	Expected Return (CAPM)	Weight	Portfolio Return	Portfolio Beta
	5.5	0	0.88	4.84	5.26%	0.25480505	0.04632819
	5.5	0	0.98	5.41	1.85%	0.10012487	0.01813722
SHEL	5.5	0	1.3	7.15	11.49%	0.82157579	0.14937742
IMB	5.5	0	0.91	5.01	0.28%	0.01412864	0.00256628
ULVR	5.5	0	0.27	1.47	7.48%	0.11002734	0.0202091
GSK	5.5	0	0.52	2.86	0.81%	0.02322601	0.00422291
NG.	5.5	0	0.28	1.54	1.05%	0.01615301	0.00293691
TSCO	5.5	0	0.75	4.13	12.52%	0.51726603	0.09393451
SBRY	5.5	0	0.63	3.47	3.78%	0.13115729	0.02381242
SSE	5.5	0	0.68	3.74	3.49%	0.13055128	0.0237366
AHT	5.5	0	1.71	9.41	12.46%	1.17251798	0.21307181
DGE	5.5	0	0.72	3.96	0.01%	0.00032071	5.831E-05
CRH	5.5	0	1.15	6.33	10.39%	0.65746581	0.11944482
FLTR	5.5	0	1.09	6	0.44%	0.02654036	0.0048215
CCH	5.5	0	1.33	7.32	3.58%	0.26222676	0.04764503
RKT	5.5	0	0.23	1.27	5.62%	0.07131226	0.01291482
AZN	5.5	0	0.27	1.49	13.24%	0.19723796	0.03574111
EXPN	5.5	0	0.77	4.24	2.97%	0.12607035	0.02289485
ABF	5.5	0	1.33	7.32	2.32%	0.17010472	0.03090701
CPG	5.5	0	1.35	7.43	0.94%	0.06997923	0.01271493
Portfolio Expected Return using CAPM						4.87	
Portfolio Beta (weighted by allocation)							0.886

The values of individual stock Beta were obtained from https://www.ft.com/

Equating the values in the formula for Treynor Ratio (assuming the Risk-free rate is 0), we get TR = 5.5 [Expected Portfolio Return/Portfolio Beta = 4.87/0.88]

The higher the value of Treynor ratio, the better is the reward-to-risk ratio and is useful for comparing well-diversified portfolios that consider only the systematic risk.

6.3. Treynor Ratio versus Sharpe Ratio

Treynor Ratio is a portfolio's excess returns per unit of the portfolio's systematic risk whereas

Sharpe Ratio is the portfolio's excess return per unit of the Portfolio's total Risk. The total risk is made up of both systematic (or undiversified) and unsystematic risk. Examples of systematic risk include factors that impact the entire market like political turmoil, rise in inflation, etc., whereas examples of unsystematic risks include factors that impact a sector or firm, also referred to as idiosyncratic risks, for example, a change in the management of a firm impacts a single firm only likewise a new regulation concerning real estate impacts a single sector only.

6.4. Jensen's Alpha

Jensen's alpha is the portion of excess return that is not explained by systematic risk, in other words, it can also be explained as the difference between the actual return of the market portfolio and the theoretical return explained by CAPM.

$$\alpha = \mu - \{\boldsymbol{r_f} + \ Q(\boldsymbol{E}(\boldsymbol{r_m}) - \ \boldsymbol{r_f})\}$$

$\boldsymbol{r_f}$ is the risk-free return.
$\boldsymbol{E}(\boldsymbol{r_m})$ Is the expected return on the investment
$\boldsymbol{r_m}$ is the return of a risk-free asset.
Q is the systematic risk of the investment.

A positive value of alpha suggests overperformance while a lower value of alpha suggests underperformance.

Choosing the right ratio to measure the performance of a portfolio depends on the measure of risk i.e., total, or systematic risk. Sharpe Ratio and M square are used in cases where the portfolio is not well diversified. Treynor Ratio and Jensen's alpha are used for well-diversified portfolios (Chen, Linquan, Slide 33/35,

7. Risk Management

Given the micro and macroeconomic constraints, a portfolio is subject to various risks, so far, we have discussed the systematic and total risks to the portfolio through various ratios. Below we address various other risks to the portfolio including VaR which is commonly used for portfolio risk measurement and reporting purposes (Chen, Linquan, Week 4, Module BEAM036J).

7.1. Value at Risk (VaR)

As per Professor Linquan Chen at the University of Exeter Business School (Chen, Linquan, Slide 5/29, Week 4, BEAM036J), the Value of Risk (VaR) of a portfolio refers to a threshold that the portfolio loss will not exceed over a certain time horizon with a certain degree of confidence (level). Choosing a VaR threshold and time horizon requires sound judgment about the client's risk and liquidity requirements. Here, I calculate VaR from the past 5 years' historical data to arrive at the below figures, the allocation weights suggested by the Monte Carlo simulation were used for calculation.

Daily		
95% daily VaR	1.6%	There is a 95% chance that the average daily loss of a portfolio. should not exceed 1.6%
99% daily VaR	3.0%	There is a 99% chance that the average daily loss of the portfolio should not exceed 3%
30 days		
30 days 95% VaR	8.7%	There is a 95% chance that the total portfolio loss should not exceed 8.7% in the next 30 days
30 days 99% VaR	16%	There is a 99% chance that the total portfolio loss should not exceed 16 % in the next 30 days
90 days		
90 days 95% VaR	15.0%	There is a 99% chance that the total portfolio loss should not exceed 15% within the next quarter.
90 days 99% VaR	28.0%	There is a 99% chance that the total portfolio loss should not exceed 28% within the next quarter.

Link: https://tinyurl.com/mska76m7
The calculations for VaR of the portfolio can be found in the attached spreadsheet.

The above daily, 30 days, and 90 days VaR values imply a relatively stable portfolio. Given the calculation of VaR involves weighing the returns of the constituent stocks by their weight, it is safe to assume that the weights of the securities are optimally allocated.

This method of calculation is referred to as historical simulation, other methods include the parametric method and back testing.

7.2. Credit Risk

The portfolio comprises of UK Government bonds, the chances of the UK government defaulting in short term is negligible (close to 0) and the equity portion constitutes of stocks in a leading index weighted by market cap., therefore it is safe to assume that there is no risk of credit.

7.3. Liquidity Risk

A liquidity requirement of the client is to be able to withdraw 10% of the investments within 12 months rolling period. Given the stocks are a constituent of a leading index, and the bonds are highly liquid, there should be no liquidity risk to the portfolio in the short time horizon of one through three years.

8. Portfolio Rebalance

8.1. Need to Rebalance

Over time with movement in the market, it is expected that the portfolio will start to drift away from the initial 75/25 mix. For example, if market conditions are favorable, the equity portion could gain and the overall mix could become 85/15, this exposes the portfolio to additional market risk and gains must be realized i.e., stocks that performed well should be sold. Inability to realize gains could result in gains getting wiped out due to price fluctuations which is common in equity markets. Christy Gatien, portfolio manager at D.A. Davidson & Co says “As we rebalance, we’re trimming the areas that are doing well — selling high — and adding to the areas that are struggling — buying low. (Brown, 2017).

After the sell-off based on the ongoing macroeconomic conditions and client liquidity requirements, the portfolio manager could choose to continue to maintain the same asset mix of 75/25 or make the necessary adjustments. Additional profits in the form of dividend payments shall be reinvested back.

Research by Vanguard (McNamee et al., 2019) suggests the following benefits of rebalancing over a buy-and-hold strategy.

a. A rebalanced portfolio exhibits a tighter return distribution.
b. A non-rebalanced portfolio is more volatile.
c. A rebalanced portfolio usually produces more return per unit of risk.

8.2. Rebalancing Technique

The two commonly followed approaches for rebalancing a portfolio are (a) Threshold-based and (b) Schedule based. Schedule-based rebalancing involves rebalancing a portfolio based on certain rules (for example a calendar date) and does not require any judgment of performance, on the other hand, threshold-based rebalancing involves defining upper and lower bounds and rebalancing once the portfolio gains or losses move beyond the defined boundary (threshold).

The rebalancing technique adopted here is a hybrid of both time and threshold. The upper threshold is a 7% gain such that a rebalance is triggered when the portfolio mix changes to an 82/18 percent mix and a downward threshold of 5% such that a rebalance is triggered when the portfolio becomes a 70/30 percent equities/bonds mix. The time-frequency of the rebalance is every six months such that if the equity portion of portfolio does not move up by 7% or goes down by 5%, a term of 6 months should trigger the rebalance, and if any of the upper or lower thresholds are triggered that resets the clock and marks the beginning of a new term and therefore six months are calculated from that date.

8.3. Transaction Fees and Broker Selection

Engage with brokers that provide the most competitive transaction fees and comprehensive post-trade transaction cost analysis that aims to minimize transaction costs and improve execution quality.

9. Conclusion

Given the fixed time horizon is only a year, the idea of portfolio construction is to use the least correlated defensive stocks, this reduces the overall risk of the portfolio and guards the portfolio against shocks due to unsystematic risk. 25% investments in highly liquid government bonds ensure readily available risk-free liquidity. Though the time horizon is very short, screening based on ESG score provides another layer of safety net without compromising on short-term gains.

The 95% and 99% daily VaR levels are 1.6% and 3% respectively, and the lower rebalance threshold is set at 5%. A portfolio loss of below 5% should trigger a rebalance, in which case the portfolio manager could check for reasons and take corrective measures.

10. References

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