DA6701 – Assignment 1 – Portfolio Optimization using MPT – Report

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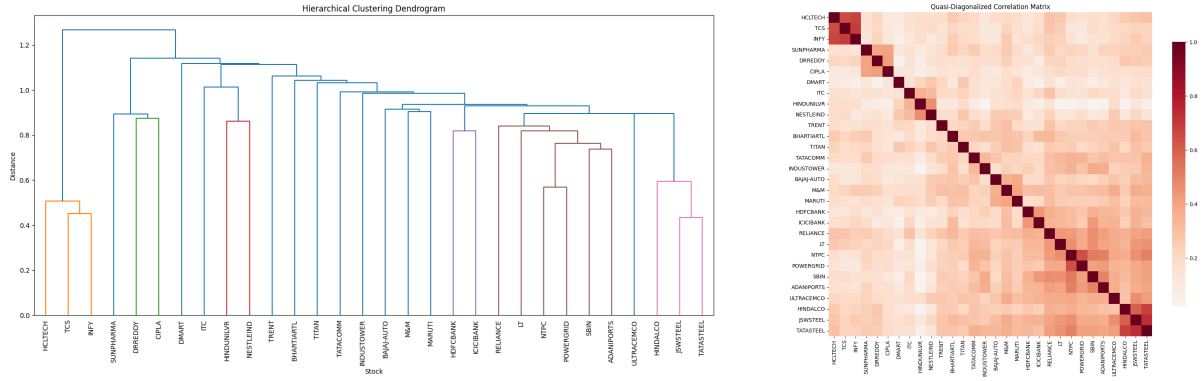
1 Selection

1.1 Hierarchical Risk Parity

We did hierarchical clustering using single linkage, to find out the optimal leaf ordering, and quasi diagonalization. We then, using recursive bisection to figure out the weights, and chose the highest from each of the ten given sectors.



(a) Hierarchical Clustering Dendrogram (b) Quasi-Diagonalized Matrix

Figure 1: Hierarchical Risk Parity

1.2 Sharpe Ratio Maximization

1.2.1 Portfolio = Market

We considered all thirty stocks as a part of our portfolio and found the weights of each which maximise the Sharpe ratio. Out of them, only **14 stocks** had significant weights, and we chose stocks corresponding to the ten highest weights, each from a different sector.

1.2.2 Portfolio = Sector

We considered ten portfolios, each consisting of three stocks from each category, and figured out the weights which maximise the Sharpe ratio in each category. We chose the stock with the highest weight out of each category.

2 Results

2.1 Portfolio Weights

	HRP		**Sharpe (Market)**		**Sharpe (Sector)**	
Category	Stock	Wt	Stock	Wt	Stock	Wt
Pharmaceuticals	SUNPHARMA	0.1569	SUNPHARMA	0.0601	SUNPHARMA	0.0863
Consumer Goods	NESTLEIND	0.1352	NESTLEIND	0.0149	NESTLEIND	0.0371
Banking & Finance	ICICIBANK	0.1328	SBIN	0.0774	SBIN	0.1358
Information Tech	HCLTECH	0.1031	HCLTECH	0.0398	HCLTECH	0.0435
Telecommunications	BHARTIARTL	0.1022	BHARTIARTL	0.2978	BHARTIARTL	0.3292
Energy & Power	RELIANCE	0.0908	NTPC	0.0531	NTPC	0.0768
Automobiles	MARUTI	0.0901	BAJAJ-AUTO	0.1801	BAJAJ-AUTO	0.2097
Retail/E-commerce	TITAN	0.0849	TRENT	0.0899	TITAN	0.0382
Construction/Infra	ULTRACEMCO	0.0594	ADANIPORTS	0.0131	ULTRACEMCO	0.0198
Metals & Mining	JSWSTEEL	0.0445	HINDALCO	0.0012	HINDALCO	0.0235

Table 1: Comparison of Stock Selection Across Different Allocation Strategies

2.2 Portfolio Performance

	HRP	Sharpe (Market)	Sharpe (Sector)
Expected Annual Return (%)	19.23	32.10	29.69
Annual Volatility (%)	11.17	14.20	13.47
Sharpe Ratio	1.72	2.26	2.20

Table 2: Comparison of Portfolio Performance Across Different Allocation Strategies

2.3 Inference

We observe that the strategy of maximizing Sharpe Ratio treating the market as our portfolio results in a better return-risk trade-off(according to MPT). **Choosing Sharpe (Market) strategy to choose 10 stocks**

3 Deliverables

3.1 Optimization Plot

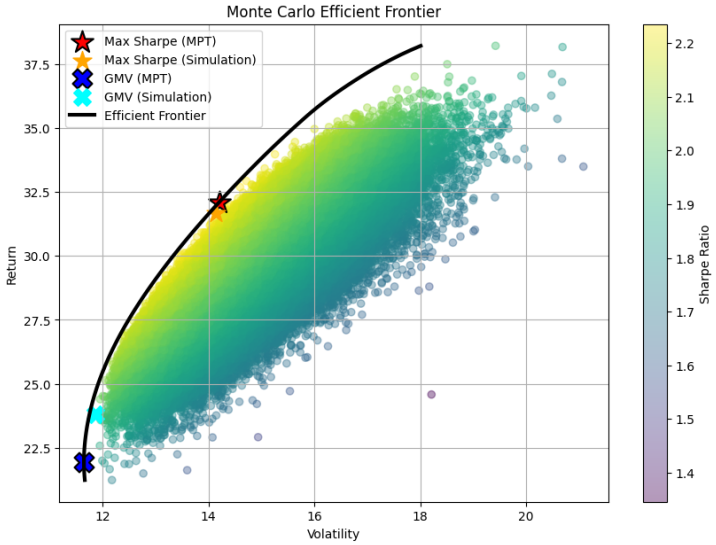


Figure 2: Monte Carlo Efficient Frontier

3.2 Correlation Matrix Heatmap

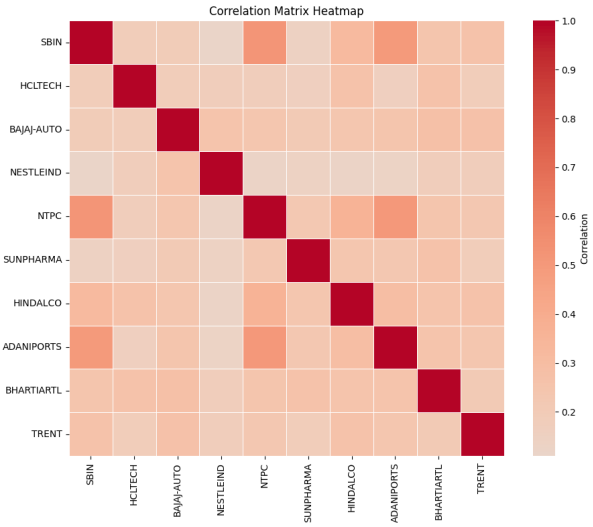


Figure 3: Correlation Matrix Heatmap of Portfolio Stocks

3.3 Weight Attribution

	Max Sharpe		GMV	
Stock	MC	MPT	MC	MPT
SBIN	0.1022	0.1116	0.1472	0.1326
HCLTECH	0.0868	0.0401	0.1409	0.1199
BAJAJ-AUTO	0.2363	0.1960	0.0813	0.0573
NESTLEIND	0.0446	0.0355	0.2044	0.2690
NTPC	0.0595	0.0680	0.0363	0.0254
SUNPHARMA	0.0660	0.0778	0.2115	0.2548
HINDALCO	0.0151	0.0109	0.0213	0.0064
ADANIPORTS	0.0310	0.0300	0.0120	0.0000
BHARTIARTL	0.2525	0.3325	0.1263	0.1347
TRENT	0.1060	0.0975	0.0187	0.0000

Table 3: MC vs MPT Weights at Max Sharpe and GMV