

# Portfolio Management & Optimization: Diversification, Backtesting & Multi-Asset Strategies

Summary of Work from Day 15 to Day 20

# Agenda (Week 3)

Day 15: Modern Portfolio Theory & Diversification

Day 16: Diversification Effect – Statistical Tests

Day 17: Mean-Variance Optimization (MVO) Backtest

Day 18: Multi-Asset GMV & Tangency Portfolios

Day 19: Sharpe vs Sortino Analysis

Day 20: Portfolio Ranking & Strategic Insights

Overall Conclusions

# Day 15: Diversification & MPT

Modern Portfolio Theory (Markowitz, 1952)

**Risk–Return Trade-off:** Maximize returns, minimize risk

Portfolio risk driven by **covariance**, not just averages

**Diversification reduces idiosyncratic risk** → Efficient Frontier

# Day 16: Statistical Tests of Diversification

Strategies tested: Equal-Weight, Min-Var, Max-Sharpe, HRP

Data: Nifty50, 3 years daily returns

## Performance:

- Max-Sharpe: Sharpe 1.70, Annual Return 42.9%
- Min-Var: Lower volatility, weakest return (Sharpe 0.64)

## Statistical Results:

- Max-Sharpe → significant outperformance ( $p < 0.05$ )
- Min-Var → borderline significance, weak effect
- HRP → no improvement

# Day 17: MVO Backtest Failure

MVO implemented via **CVXPY** vs PyPortfolioOpt

Training (2019–21): strong Sharpe (1.428), but highly concentrated

- INFY 37%, ASIANPAINT 30%

Testing (2022–25): Sharpe turned **negative**

- Equal-Weight outperformed (Sharpe 0.636)

**Issue:** Concentration risk & trend reversals

**Fixes:** Exposure caps, multi-asset diversification, rebalancing

# Day 18: Multi-Asset GMV & Tangency Portfolios

Universe: Equities, Debt ETFs, Gold ETFs, Intl Equity

## GMV Portfolio:

- Min vol = 3.63%
- Debt-heavy (EBBETF0430 = 85%)

**Insight:** Debt provides stability, Gold & equities add return

## Tangency Portfolio:

- Max Sharpe = 1.459
- Debt 63%, Gold 14%, Equity (INFY, ICICI Bank) for growth

# Day 19–20: Sharpe vs Sortino

**Sharpe Ratio:** return / total volatility

**Sortino Ratio:** return / downside volatility (ignores upside)

## Findings:

- Defensive assets (Debt, Gold) had higher Sortino
- Tangency ranked best by Sharpe (0.0903)
- GMV ranked best by Sortino (0.1999)

**Implication:** Sharpe = efficiency, Sortino = resilience

# Strategic Insights

- Tangency (Max Sharpe) → best in **growth/expansion phases**
- GMV (Sortino-optimal) → stronger in **volatile/risk-off periods**
- Adaptive framework: blend or switch between the two
- Multi-asset diversification (debt + gold + equity + global) is key



# Overall Conclusions

- ❖ Diversification reduces unsystematic risk → Efficient Frontier
- ❖ Max-Sharpe works in-sample, but fails without robust controls
- ❖ Multi-asset allocation improves stability and risk-adjusted returns
- ❖ Sortino adds critical perspective on downside risk
- ❖ Best strategy: **adaptive allocation** based on market regime