Contents

Efficient Frontier Portfolio Optimization Report

ECO 43000 — Quantitative Finance
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Executive Summary

The purpose of this project was to design a stock portfolio that **maximizes return while controlling risk**, using principles from Modern Portfolio Theory. I analyzed the performance of seven well-known U.S. companies from different industries and used simulation and machine-learning techniques to identify the best possible asset allocation.

I tested 50,000 different portfolio combinations using a Monte Carlo process and then used a regression model to draw the **Efficient Frontier**, which shows the portfolios that make the **smartest financial decisions**. The portfolio I selected is especially suitable for an **aggressive investor** who seeks high long-term growth and can tolerate short-term market fluctuations.

1️⃣ Objective

My goal was to find **the smartest possible portfolio**:

The most return for the lowest level of risk.

Every point that lies **below** the Efficient Frontier provides **less reward than what is possible** at that level of risk. Therefore, I focused on portfolios that lie directly on that curve.

2️⃣ Stocks I Chose

To ensure diversification, I selected companies from multiple U.S. industries:

Ticker	Sector
IBM	Technology
JPM	Banking & Finance
XOM	Energy
WMT	Consumer Retail
JNJ	Healthcare
KO	Consumer Staples

Ticker	Sector
T	Telecommunications

This variety helps protect the portfolio if one sector experiences trouble.

3️⃣ Methodology — How I Built the Portfolio

I followed a step-by-step analytical process:

1. **Collected historical price data** (or simulated when unavailable)
2. Calculated:
    - Daily returns
    - Annual return estimates
    - Risk (volatility)
    - Correlations (how differently stocks move)
3. Simulated **50,000 random portfolios**
4. Evaluated each portfolio using the **Sharpe Ratio**, which measures:

    "How much return do I get for every unit of risk I take?"

5. Used machine learning polynomial regression to draw a **smooth Efficient Frontier curve**.

✅ This ensures the portfolio is backed by data and smart mathematics — not guesswork.

4️⃣ Why Diversification Matters

I learned that building a strong portfolio is not about picking the **best single stock**.
It's about choosing **a team of stocks that support each other**.

If one stock falls, others may rise — reducing stress for the investor.

Diversification is like walking on **multiple legs instead of one**.
If one stumbles, you still stay standing.

Correlation analysis helped me confirm that combining these assets **reduces total portfolio risk**.

5️⃣ Results — The Best Portfolio for Growth

Here are the **optimal investment weights** that delivered the strongest results:

Company	Allocation
IBM	**41.09%**
JPM	**18.23%**
XOM	1.51%
WMT	**19.58%**
JNJ	1.33%
KO	0.37%
T	**17.90%**

✅ Heavy tilt toward IBM, JPM, WMT, and T
✅ Excellent performance relative to risk

Performance Summary

Metric	Value
Expected Annual Return	**32.41%**
Annual Volatility (risk)	**14.39%**
Sharpe Ratio	**1.97**

📌 Interpretation
→ **Outstanding return** for the level of uncertainty
→ Well-aligned with growth-seeking investment strategy

Why This Portfolio Is the Smart Choice

This portfolio lies on the **Efficient Frontier**, which means:

✅ It is mathematically impossible to get higher return
✅ Without also taking more risk

Any portfolio below the line is simply not a smart financial decision.

6️⃣ Final Investor Recommendation

This portfolio is ideal for an investor who:

✓ Wants high long-term returns
✓ Accepts market ups and downs
✓ Invests for retirement, wealth growth, or long horizons (5+ years)

This is **not** for someone seeking quick profits or risk-free stability.
For an aggressive growth investor, this portfolio is a **high-quality choice** supported by financial theory.

7️⃣ Limitations

To keep the model clean, I made a few assumptions:

- Stock behavior remains stable — real markets change suddenly
- Transaction fees and taxes are not included
- Returns follow a normal distribution (may not always be true)
- No bond or cash assets included in the mix

Even with these limitations, the results remain **strong and useful**.

References (APA 7 Style)

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