Albert Lee
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Term Project – Checkpoint B
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Introduction

With so many ETF's and Mutual Funds currently available, it's a massive market that many investors such as myself need to understand so that we can make our best judgement on which ones to invest in. It's no different then trying to buy a house and doing market comparisons and research on the house. According to ICI (Investment Company Institute) there are over 10,000 (Active and Index) Mutual Funds and ETF's with over $32,679 trillion of assets. With so many ETF's and Mutual funds, it's more important than ever to understand how they leverage modern day technologies to optimize portfolios, maximize returns, and reduce risks. Instead of going with the basic 5 assets as required by the assignment, I decided to expand my scope to 15 assets along a wide spectrum including index funds themselves. I also wanted to truly understand how our strategies that we're learning apply to modern day portfolios where it's a combination of equities, bonds, index funds, treasuries, etc. Most average investors gravitate towards the companies that make the news but there's still thousands of other assets that isn't in the news that help balance the ETF's and Mutual Funds.

Who else has conducted research like this?

While it would be any investors dream to invest in a company and hope that the company stock only goes up but that's not reality. As Markowitz (1952) points out that "if we ignore market imperfections the foregoing rule never implies that there is a diversified portfolio which is preferable to all non-diversified portfolios." Unfortunately, this is not reality. We've seen many downturns in the market that last days, weeks, months, and even years. According to Morningstar, from 1900's to 2000's there have been over 19 market crashes ranging from 19.6% to 79% decline. In Fundamental Indexation by Arnott, Hsu, and Moore (2005), they proved that their fundamental indexation strategy outperformed the S&P 500 by an average of 1.91% higher. Fundamental index investing is where a fund will re-balance the index fund portfolio based on financial measures of company size rather than stock price and serves as a complement to market-capitalization index strategies. Arnott, Hsu, and Moore re-balances their fund every year.

How are you conducting the research?

It's not just the portfolios we hear about that are well balanced. According to Brinson, Singer, and Beebower (1991) 82 pension plans all had asset class weights for equity, bonds, cash, and "other" from 1977 to 1987. Their portfolio allocation was about 605 equity and 40% fixed income. Even in my role overseeing the Treasury team for my company and talking with OCIO's about recommended investments for the company, they all recommended a diverse set of investments across equities, fixed income, cash, and alternatives. Looking at Morningstar's most well balanced US-Focused Mutual Funds all include a healthy mix of equity, fixed income, and some cash. Since my portfolio comprise of index funds. ETF's on the other hand are more equity based according to Morningstar's Q2 Top Performing ETF's. Since the hypothetical

portfolio and 15 assets chosen are all equities / ETF's, this portfolio operates more like a ETF. Within the portfolio, there are 7 traditional company stocks and 8 ETF's.

Ticker	Name
AAPL	Apple Inc.
JPM	JPMorgan Chase & Co.
HON	Honeywell International Inc.
NOC	Northrop Grumman Corporation
MSFT	Microsoft Corporation
JNJ	Johnson & Johnson
PG	The Procter & Gamble Company
SPY	SPDR S&P 500 ETF Trust (tracks the S&P 500 index)
IWM	iShares Russell 2000 ETF (tracks the Russell 2000 index)
QQQ	Invesco QQQ Trust (tracks the Nasdaq-100 Index)
ACWI	iShares MSCI ACWI ETF (All Country World Index)
TLT	iShares 20+ Year Treasury Bond ETF (tracks the US Treasury with remaining maturities greater than 20 years)
GLD	SPDR Gold Shares (tracks the price performance of gold bullion)
VNQ	Vanguard Real Estate ETF (invests in stocks issued by REIT's)
UUP	Invesco DB U.S. Dollar Index Bullish Fund (tracks US dollar)

The company equities cover a wide variety of industries that include technology, financial services, industries, defense, healthcare, and consumer products. The ETF's in the portfolio cover broad indexes.

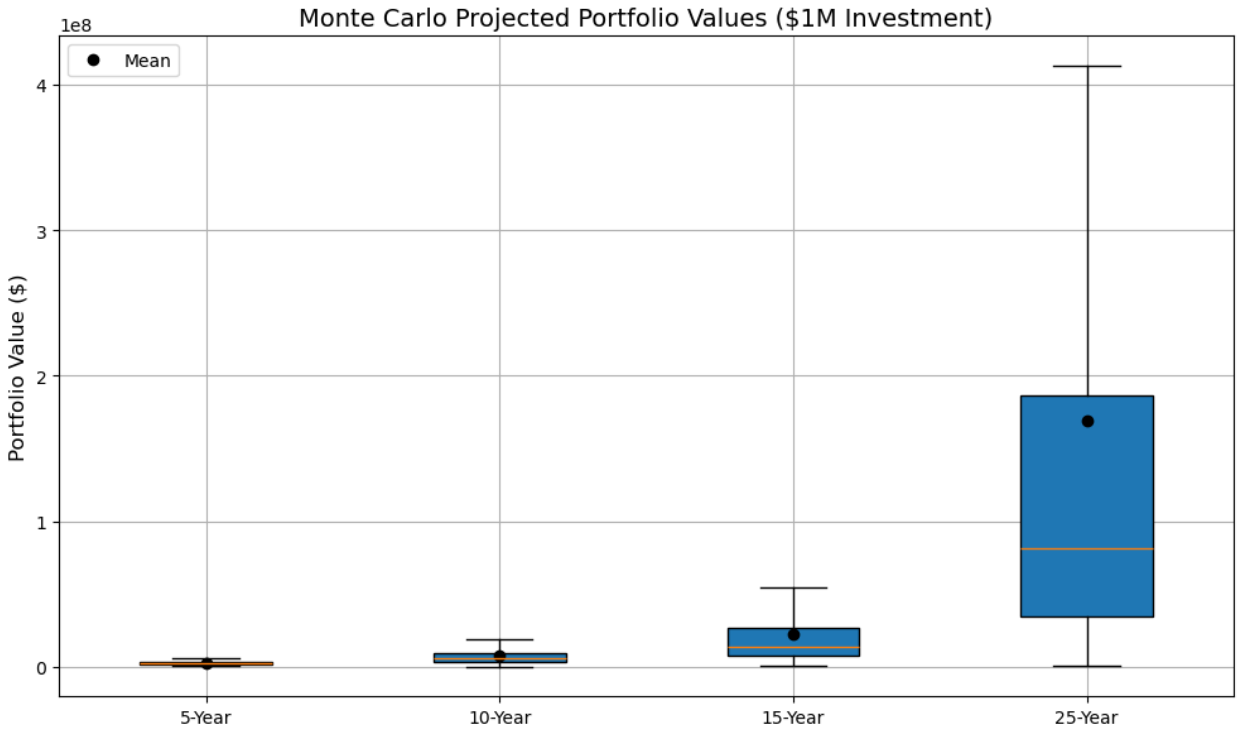
What did you learn from your research so far?

As I was modeling the different asset classes across 25 years, one of the biggest pain points that I encountered was trying to do portfolio optimization back all those years. The challenge was some of the ETF's were not available until mid to late 2000's. This created complexity since the data was not available. I could have gone the easy route and done equal-weighting portfolio methodology but that's not optimal to maximizing returns and reducing risks. According to Markowitz, investors "should diversify and that they should maximize expected returns." I was finally able to apply Monte Carlo Deterministic Optimization Technique to weighting the portfolio based on available historical data. I also realized that the method did not produce the best expected returns so I went with my original Monte Carlo Dirichlet Process instead.

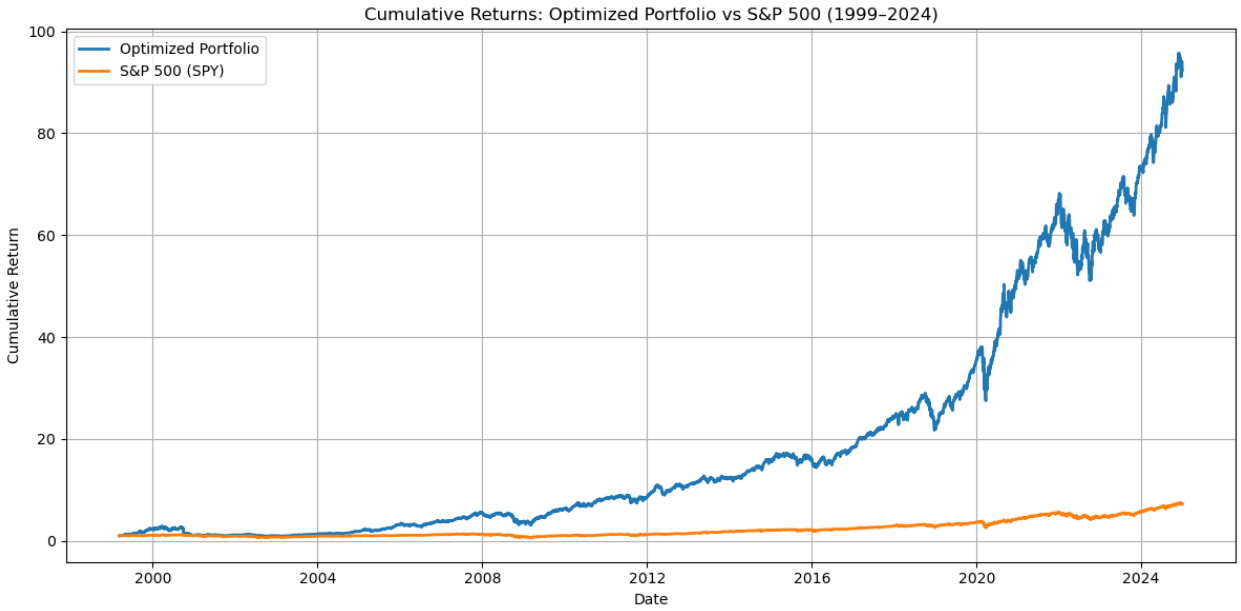
So, what does it all mean?

The modeling can still be perfected to get the best results and I hope to do that leading up to week 10. Using Monte Carlo portfolio optimization, I was able to generate a significant portfolio return against the S&P 500. This yielded in the following investment returns (assuming a $1M initial investment):

	Median ($)	Mean ($)	5th Percentile ($)	95th Percentile ($)
5-Year	2,401,455	2,797,163	972,502	6,005,665
10-Year	5,834,714	7,861,557	1,660,250	20,880,062
15-Year	14,041,935	21,964,063	2,876,952	66,967,099
25-Year	81,811,163	168,878,848	10,461,869	599,196,115



This shows that this portfolio has the potential possibility to outperform the S&P 500 in the future. Based on backtesting from 1999, this portfolio significantly beat the S&P 500 with significant returns.


Cumulative Returns: Optimized Portfolio vs S&P 500 (1999–2024)
Optimized Portfolio
S&P 500 (SPY)
Cumulative Return
Date
0
20
40
60
80
100
2000
2004
2008
2012
2016
2020
2024

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