Implementing Various Delta Hedging Strategies

Presentation Outline

- Introduction
- Concepts:
  - Delta Hedge
  - Monte Carlo Methods
- Methodology:
  - Hedging Strategies
- Performance Comparison
- Conclusion

Introduction

- The primary objective of our study is to empirically assess the effectiveness of different delta hedging strategies in managing risk and optimizing returns.

- Through the utilization of Monte Carlo simulations, we aim to simulate a diverse range of market scenarios and evaluate the performance of dynamic, static, and no hedging strategies.

- Ultimately, our goal is to provide investors and traders with actionable insights that can inform their decision-making processes and enhance their risk management capabilities in options trading.

Project Structure

Strategy and Concept Research → **Data Collection and Market Simulation** → **Delta Hedging Simulation** → **Results Analysis**

- Delta Hedge
- Monte Carlo Methods

- YahooFinance - SPY ETF

- Dynamic Hedge
- Static Hedge
- No Hedge

- Summary Statistics
- Performance Comparison

Concept: Delta Hedge

- Delta hedging is an options trading strategy aimed at reducing and/or eliminating the risk associated with changes in the price of the underlying asset.

- It involves adjusting the portfolio of options and the underlying asset in such a way that changes in the price of the underlying asset have minimal impact on the overall value of the portfolio.

Concept: Delta Hedge

Delta Hedge Equation:

$$\Delta(t,s) \doteq \frac{\partial}{\partial s} C(t,s)$$

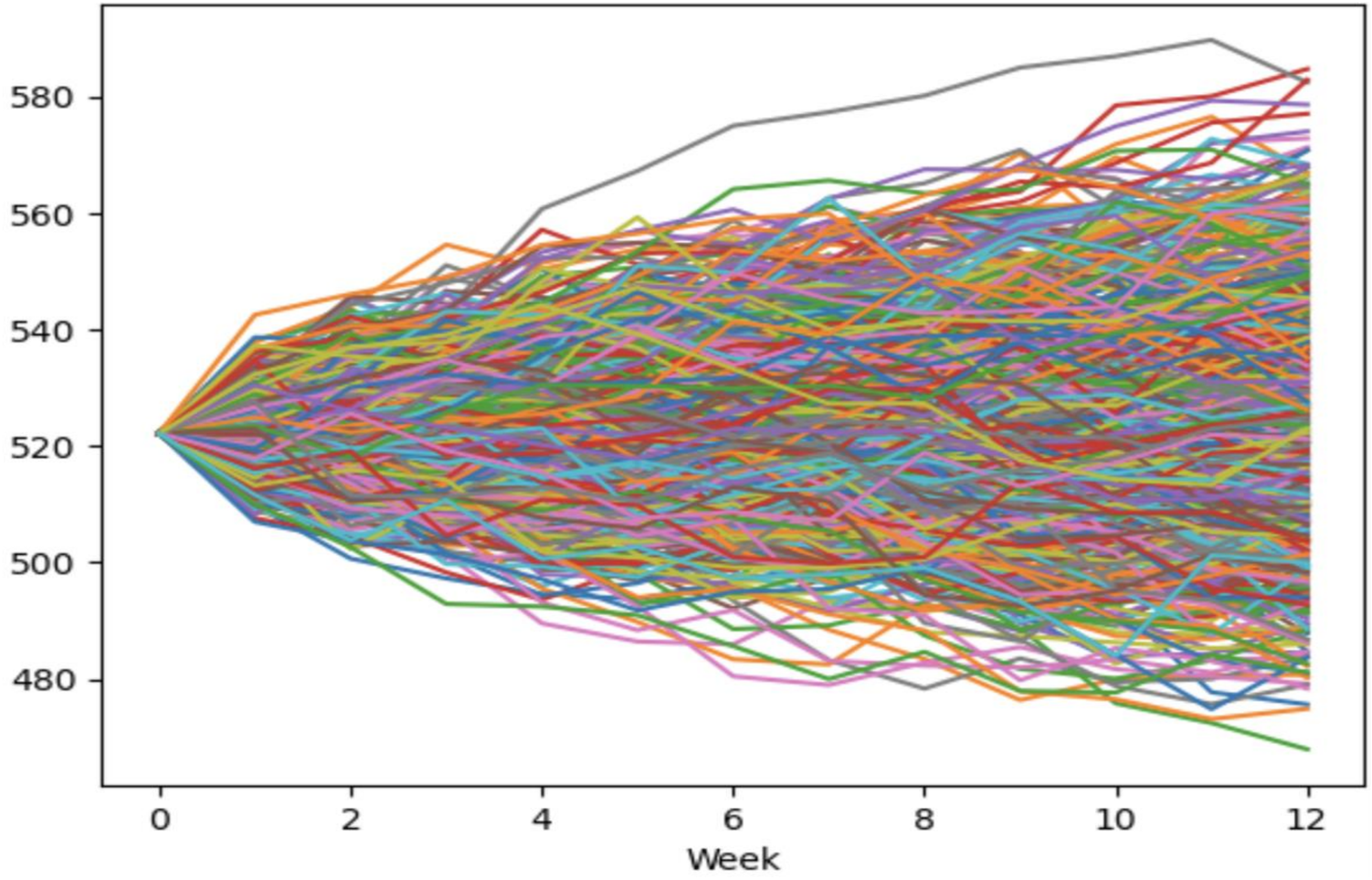
Δ(t,s) = Delta of the Option

δC(t,s) = Change in Option Price

δs = Change in Underlying Assets Price

Concept: Monte Carlo Simulation

- Monte Carlo Simulations are computational algorithms used to model the probability of different outcomes in a process that cannot easily be predicted due to the intervention of random variables.



Methodology: Strategies

Delta Hedging Strategy	Description	Adjustment	Goal
Dynamic Hedge	Adjusts hedge ratio continuously based on delta changes.	Weekly adjustments	Maintain delta-neutral position
Static Hedge	Establishes a fixed hedge ratio at outset.	No adjustments	Fixed hedge based on initial delta
No Hedge	Holds option without hedging against price changes.	None	Expose to full price risk

Dynamic Hedging Strategy (Example)

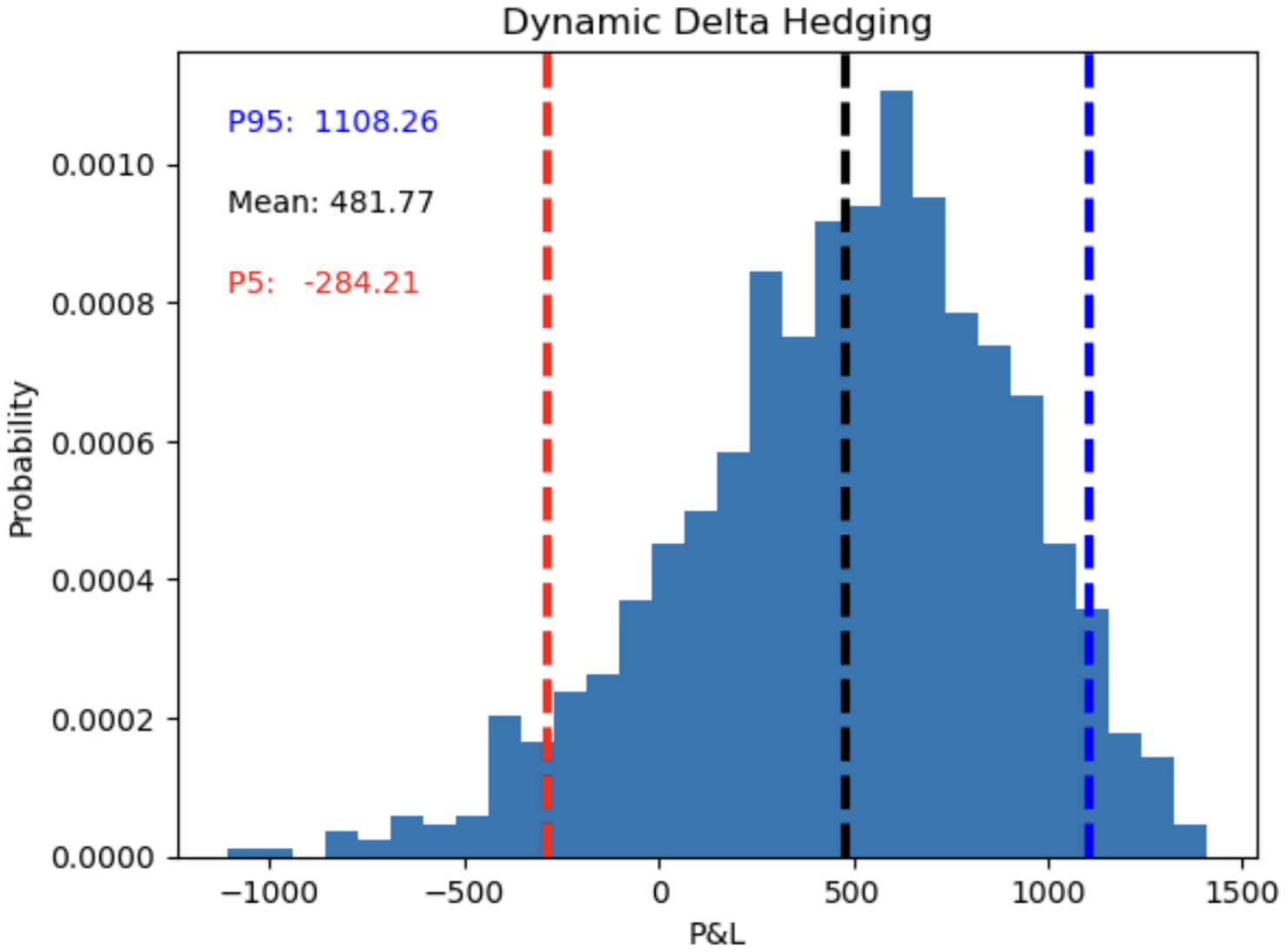
- Short 1 Contract of At-the-Money Call (Fixed)
- SPY Price = 520

Week	Price	Delta	Total Delta Position	Adjustment Shares	Total Adjustment
0	520	-54	0	NaN	NaN
1	518.01	**-51**	**3**	**Sell 3**	Short 3
. . .			. . .		
10	528.57	-84	-38	Buy 38	**Long 30**
11	523.52	NaN	NaN	**Sell 30**	NaN

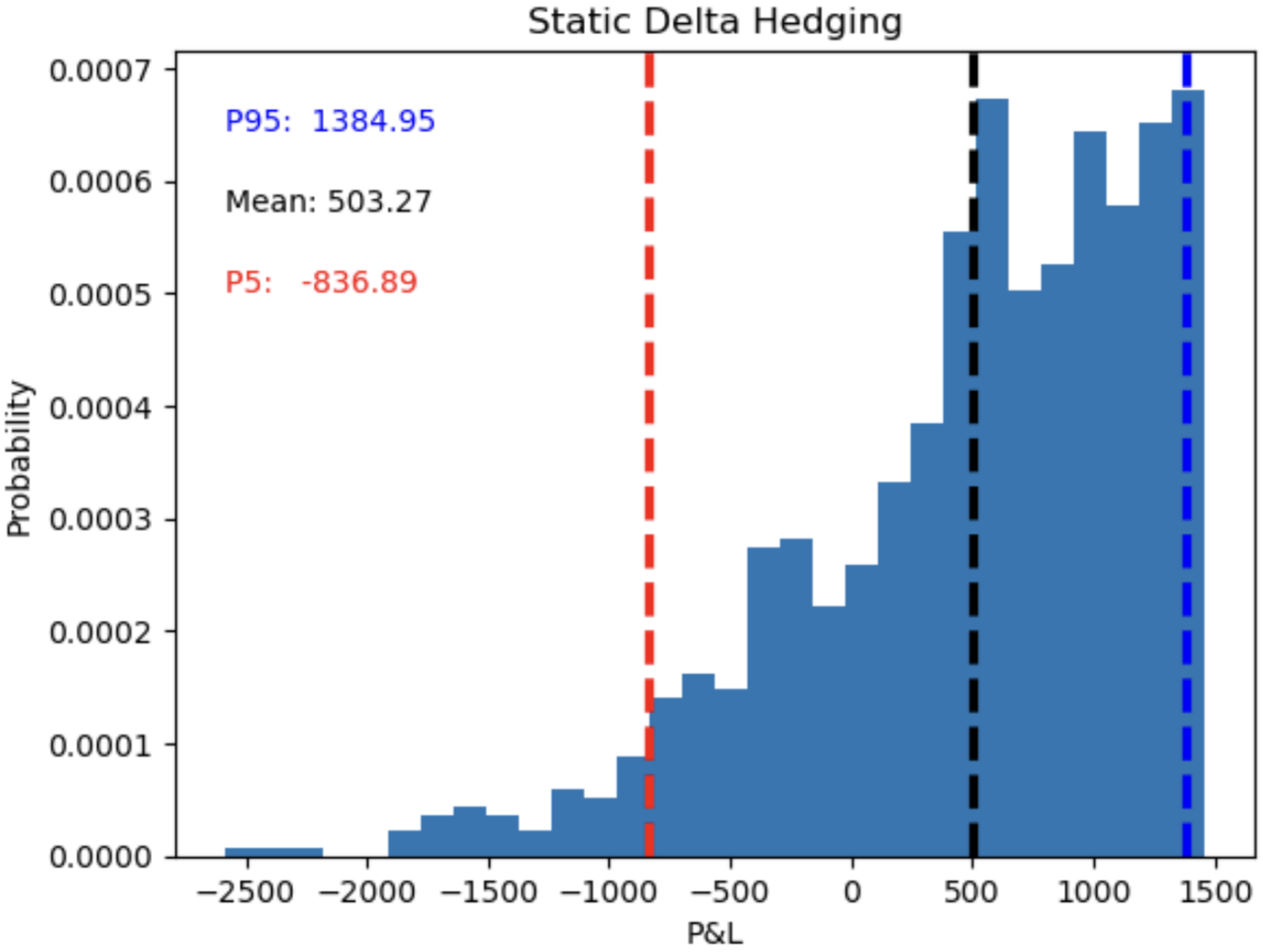
Dynamic Hedging Strategy (Example)

Dynamic hedging results	
Original Option P&L	$ 189.50
Original Stock P&L	$ 37.26
Adjustment P&L	$ -94.53
Carry (Interest) on Option	$ 1.07
Carry (Interest) on Stock	$ -22.93
Interest on Adjustments	$ 0.37
TOTAL CASH FLOW	**$ 110.74**

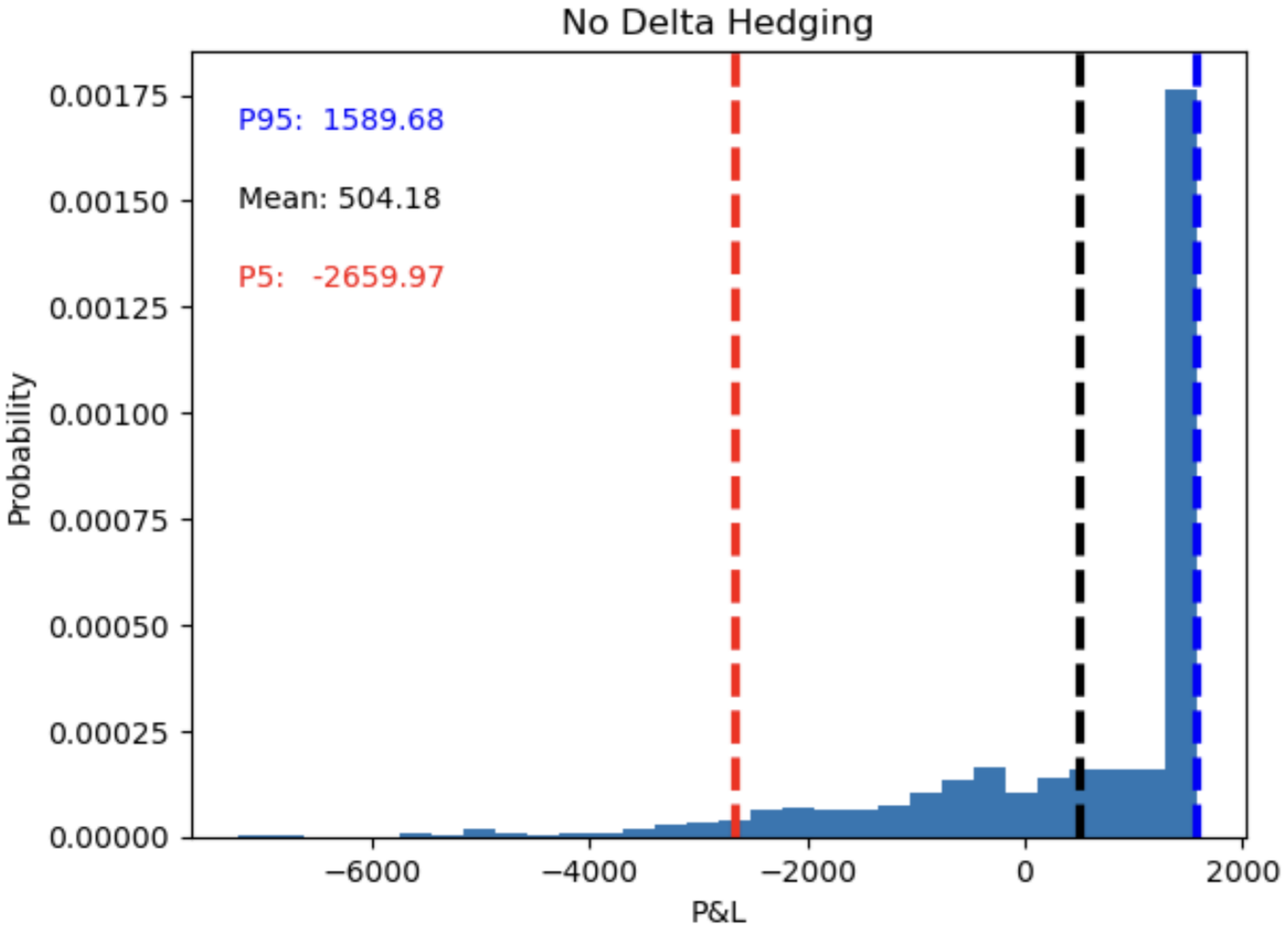
Dynamic Hedging Strategy



Static Hedging Strategy



No - Hedge Strategy



Performance of Strategies

- Short Call (Realized volatility = 0.11)

	P5	Mean	P95	P95 - P5 (90% Confidence Interval)
Dynamic Hedge	-284.21	481.77	1108.26	1392.47
Static Hedge	-836.89	503.27	1384.95	2221.84
No Hedge	**-2659.97**	504.18	1589.68	4249.65

Performance of Strategies

Realized Volatility	Dynamic Hedging		Static Hedging		No Hedging	
	P5	P95	P5	P95	P5	P95
0.02	1141.9	1365.04	1058.83	1412.38	631.58	1589.68
0.05	673.37	1285.63	328.69	1419.02	-650.42	1589.68
0.08	239.81	1212.7	-382.48	1381.45	-1706.57	1589.68
0.11	-284.21	1108.26	-836.89	1384.95	-2659.97	1589.68
0.14	-713.82	984.46	-1689.24	1362.36	-4281.42	1589.68
0.17	-1223.92	846.86	-2448.86	1340.83	-5388.37	1589.68
0.20	-1595.73	726.83	-2990.73	1316.93	-6528.77	1589.68

Performance of Strategies

- Short Put (Realized Volatility = 0.11)

	P5	Mean	P95	P95 - P5 (90%Confidence Interval)
Dynamic Hedge	-657.04	95.12	696.24	1353.28
Static Hedge	-1318.77	70.64	1021.32	2340.09
No Hedge	**-3034.52**	-9.43	994.18	4028.70

Performance of Strategies

Realized Volatility	Dynamic Hedging		Static Hedging		No Hedging	
	P5	P95	P5	P95	P5	P95
0.02	780.19	1002.79	647.67	1047.98	438.73	994.18
0.05	333.27	992.66	40.79	1053.95	-645.32	994.18
0.08	-131.76	822.93	-674.57	1051.16	-1649.67	994.18
0.11	-657.04	696.24	-1318.77	1021.32	-3034.52	994.18
0.14	-1073.36	636.37	-1957.01	985.07	-4077.17	994.18
0.17	-1592.99	476.04	-2868.27	978.24	-5253.62	994.18
0.20	-2074.05	338.83	-3502.7	955.75	-6148.17	994.18

Conclusion

Hedging Strategy	P95 - P5 (90% Range)	P5	P95	Risk Management
Dynamic Hedge	Lowest	Highest	Lowest	Effective risk management
Static Hedge	Higher than dynamic hedge	Lower than dynamic hedge	Higher than dynamic hedge	Less effective than dynamic
No Hedge	Highest	Lowest	Highest	Speculative, high risk

FUTURE WORK

- Dynamic Hedging Optimization:
  - Exploring different re-calibrating frequency
  - Adding market friction (example: transaction costs)

- Volatility Simulation:
  - Explore the feasibility of the hedging strategies in changing volatility conditions

- Backtest Strategy:
  - Test the effectiveness of the three different strategies using historical data

Thank You!