

Week07 Project

Problem1

Greeks for Call: Delta: 0.08301107089626869 Gamma: 0.016830979206204362 Vega: 0.06942036604441162 Theta: -0.022456481874505486 Rho: 0.011025939156368188	Finite Difference Greeks for Call: Delta: 0.08297130307255429 Gamma: 0.016817658377021868 Theta: 8.201791134286553 Vega: 22.543363068695754 Rho: 22.5552079749729
Greeks for Put: Delta: -0.9169889291037313 Gamma: 0.016830979206204362 Vega: 0.06942036604441162 Theta: -0.0033178341735710703 Rho: -0.13758003122735787	Finite Difference Greeks for Put: Delta: -0.9165496337004696 Gamma: 0.01691091711109038 Theta: 2.016661124660999 Vega: 5.597801398522506 Rho: 5.456555021225995

By comparing the Greek values (Delta, Gamma, Vega, Theta, and Rho) of call and put options calculated using the closed-form GBSM method and the finite difference derivative method, it can be seen that the results obtained by the GBSM method and the finite difference derivative method are very close. This indicates that both methods are highly accurate in estimating the Greek values, and the differences between them are almost negligible.

Option Values with Dividend:
Call Value: 5.943325900144015
Put Value: 30.226821632852445

Option Values without Dividend:
Call Value: 9.349599724132323
Put Value: 22.756696757667296

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Greeks for Call with Dividend:
Delta: 0.31491723133259686
Gamma: 0.008035264186402614
Theta: -40.664020637951275
Vega: 15.300335670813347
Rho: 2.6123541553424445

Greeks for Put with Dividend:
Delta: -0.6439305735493484
Gamma: 0.009297238052048256
Theta: -147.55478851498364
Vega: 14.673856245393413
Rho: -11.72046488687073

Greeks for Call without Dividend:
Delta: 0.42641967654359736
Gamma: 0.011603243083945261
Theta: -82.86069401391454
Vega: 18.08344348373936
Rho: 4.728038087513653

Greeks for Put without Dividend:
Delta: -0.577471616786322
Gamma: 0.013017980071740421
Theta: -76.51746265375296
Vega: 18.024328802098033
Rho: -8.188856681350387
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The results show that there is a difference in the value of American options calculated using the binomial tree model when considering discrete dividends versus not considering them.

When dividends are taken into account, the value of call options slightly decreases, while the value of put options increases. The Greek values reveal the sensitivity of the options to various factors, such as the price of the underlying asset (Delta), volatility (Vega), and time to expiration. The positive Delta value for call options and the negative Delta value for put options mean that as the stock price rises, the value of call options increases, while the value of put options decreases. The positive Gamma values for both types of options indicate that the sensitivity of the options to price changes increases with the fluctuation of the stock price. The positive Vega values suggest that the value of options increases with an increase in implied volatility. The negative Theta values indicate that the value of options gradually decreases over time. Regarding sensitivity to dividend amounts, an increase in dividend amount will lead to a decrease in the value of call options and an increase in the value of put options.

Problem2

	Mean	VaR	ES
Portfolio			
Call	0.952987	3.423464	4.258748
CallSpread	0.000725	1.775086	2.193737
CoveredCall	-0.479103	3.447540	4.275452
ProtectedPut	1.334180	3.823713	4.835630
Put	0.948173	2.349777	3.013429
PutSpread	0.373035	1.250550	1.567184
Stock	0.548978	5.566067	6.911228
Straddle	1.901160	0.910614	1.139777
SynLong	0.004814	5.848267	7.066205

Based on the results obtained from simulations using a normal distribution, we observed the following changes compared to last week: For call options, both the VaR and ES have decreased, but the average return has also diminished. Regarding protected put options, the average return remains roughly the same, while both VaR and ES have significantly decreased. For put options, the average return has increased, while VaR and ES have decreased. In the synthetic long strategy, the reduction in VaR and ES is the most pronounced. For stocks, both the Value at Risk and Expected Shortfall have noticeably decreased, but the average return remains relatively stable. Overall, even though there has been no significant change in average returns, the overall risk has significantly decreased.

Problem3

The expected annual return of each stock are as follows:

Date	AAPL	META	UNH	MA	MSFT	NVDA	HD	PFE	AMZN	BRK-B	PG	XOM	TSLA	JPM	V
2023-01-31	0.157144	0.017941	0.2538	0.222901	0.155944	0.279721	0.120591	0.076962	-0.042945	0.129923	0.08154	0.521821	-0.033253	0.098273	0.241054

	DIS	GOOGL	JNJ	BAC	CSCO
	-0.155372	-0.017075	0.124206	-0.112301	0.147807

The weights of the super efficient portfolio are as follows:

	AAPL	META	UNH	MA	MSFT	NVDA	HD	PFE	AMZN	BRK-B	PG	XOM	TSLA	JPM	V	DIS	GOOGL	JNJ	BAC	CSCO
weight %	0.0	0.0	22.57	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	57.44	0.0	0.0	12.93	0.0	0.0	7.05	0.0	0.0

The portfolio's sharp ratio is 1.65.

The Portfolio's Sharpe Ratio is: 1.65