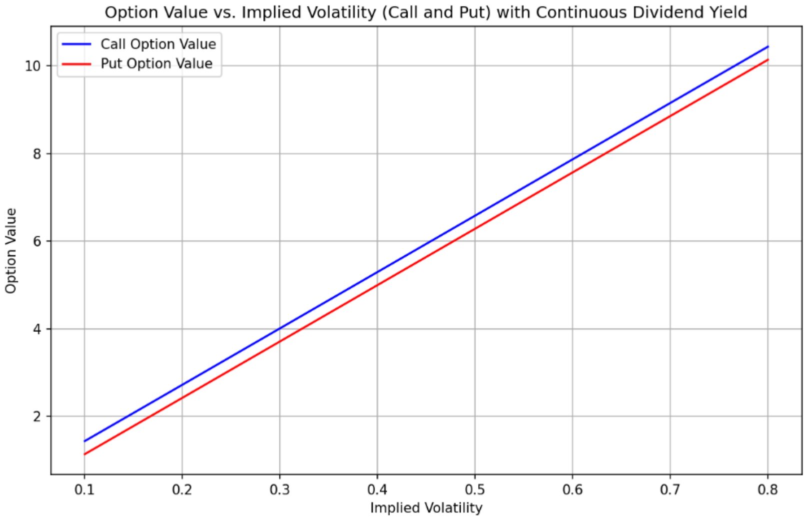
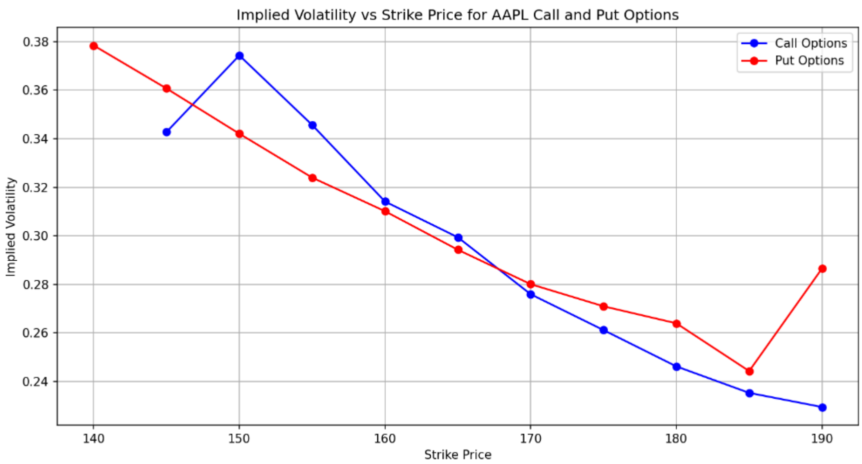
1.



This plot illustrates how the values of a call and a put option vary with changes in implied volatility for an at-the-money setup, where the strike price equals the current stock price. Both option values increase with implied volatility because higher volatility raises the probability that the option will end up in-the-money by expiration. The call option consistently shows a slightly higher value than the put option across the volatility range, due to the particular effects of interest rate and dividend yield in this scenario. This relationship demonstrates that option prices are sensitive to volatility, making implied volatility a crucial factor in their valuation.

Implied volatility itself is driven by market supply and demand dynamics. When demand for an option rises—perhaps due to expected price swings in the underlying asset—buyers are willing to pay more, leading to an increase in the option's market price. This higher price translates to increased implied volatility, as it's backed out from the observed option price using models like Black-Scholes. Conversely, when supply outweighs demand, such as when institutions sell options to hedge positions, the market price of options may decrease, reducing implied volatility. This dynamic makes implied volatility a real-time reflection of market sentiment and expectations for future price movements.

2.

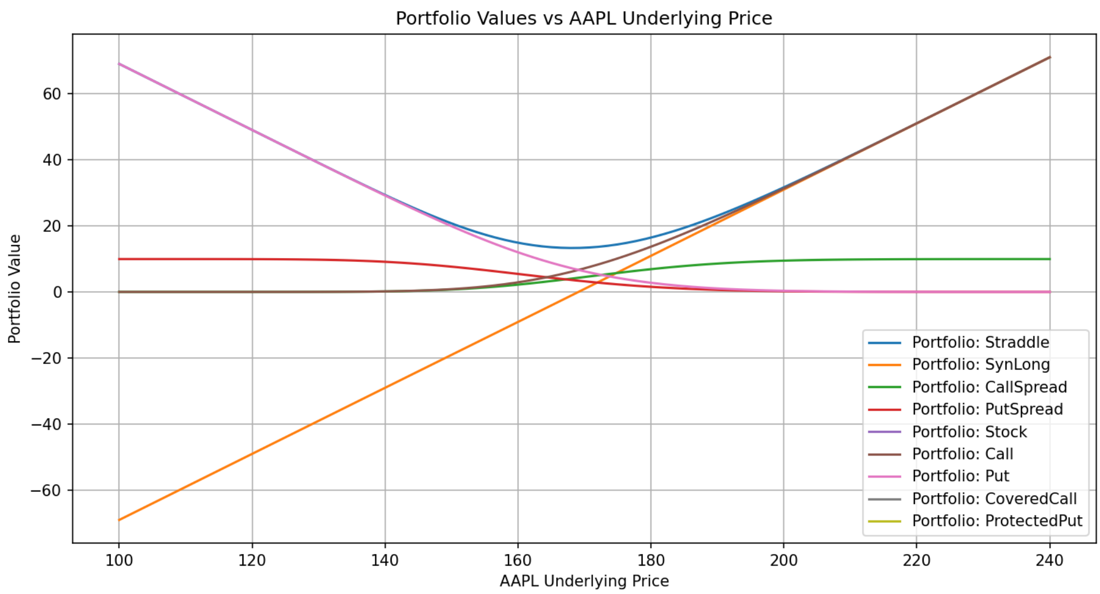


The graph shows implied volatility for AAPL call and put options across various strike prices, revealing a volatility skew where implied volatility generally decreases as the strike price increases. This pattern, common in equity options, reflects the market's asymmetric risk perception. Specifically, implied volatility is higher for lower-strike put options (out-of-the-money puts) and lower for higher-strike call options. This skew suggests that investors expect more downside risk than upside potential, leading to a higher demand for downside protection. Consequently, out-of-the-money puts are priced with a volatility premium, as investors often use them to hedge against potential market downturns.

Additionally, the graph shows slight bumps in implied volatility for calls around the 150 strike and puts around the 190 strike. These peaks could be driven by targeted demand for certain strikes due to speculative interest or hedging strategies. For instance, the high volatility for lower-strike calls might reflect demand from investors anticipating a price recovery after a decline, or as part of structured strategies where deep in-the-money options play a role. Similarly, higher implied volatility for higher-strike puts may be due to investors hedging against tail risks or significant downside events, where they are willing to pay a premium for protective options.

Overall, this volatility skew and the observed peaks at specific strikes capture the market's expectations of future price risks for AAPL. The higher implied volatility for downside strikes indicates a greater perceived likelihood or concern of a price drop, which is characteristic of cautious or bearish sentiment in the options market. This structure provides insight into how investors are positioning themselves, balancing their portfolios with protective puts and speculative or recovery-oriented calls based on anticipated market moves.

3.



The graph illustrates the payoff profiles of various AAPL option portfolios, each responding differently to changes in the underlying stock price. Portfolios like the "Straddle" exhibit a "V" shape, designed to profit from high volatility; it benefits from large price movements in either direction due to holding both a call and a put. In contrast, the “Call Spread” and “Put Spread” portfolios show capped gains, reflecting strategies that aim to profit from moderate price movements. These spreads involve buying and selling options at different strikes to limit both potential profit and loss.

The “Synthetic Long” position replicates the payoff of holding the stock itself, using a combination of a long call and a short put at the same strike. This aligns with put-call parity, which states that a stock position can be synthetically created by combining options. Similarly, the “Covered Call” involves holding the stock and selling a call, capping the upside while generating premium income—ideal for mildly bullish investors who want some income with limited risk. Overall, these portfolio shapes highlight different risk-return profiles, from aggressive bets on volatility to conservative, income-generating strategies, each tailored to specific market views and investor preferences.

Mean P&L: 7.942446790777595
VaR (95%): 1.2926874659703558
Expected Shortfall (95%): 1.09989030209303

The results from the AR(1) model simulation provide a snapshot of AAPL's potential short-term performance, with a Mean P&L of $7.94 suggesting a positive expected gain over the next 10 days. This indicates that the model is projecting a modestly bullish trend, as the average simulated price paths point toward an increase in AAPL's value. However, it's essential to consider that this is only an average outcome; actual results may vary depending on market conditions that the model might not capture, such as sudden news events or market shocks.

The Value at Risk (VaR) at the 95% level of $1.29 highlights the relatively low downside risk in this scenario, suggesting a 5% chance of incurring a loss greater than $1.29 over 10 days. The Expected Shortfall (ES) of $1.10 further refines this view, indicating that, on average, losses in the worst 5% of cases are unlikely to be significantly severe. The closeness of the ES to the VaR suggests that extreme losses, beyond typical fluctuations, are minimal under the model's assumptions, implying stability in AAPL’s price movements in the short term.

In summary, the positive Mean P&L combined with low VaR and ES values indicates a favorable outlook with limited downside risk for AAPL in this period. However, it’s important to recognize the limitations of an AR(1) model, which assumes that returns are only influenced by their most recent values. This approach may not fully capture the complexity of market dynamics, and therefore, it’s advisable to use additional models and analyses to form a comprehensive risk assessment.