Greek Hedging Code Explanation

# Basic Code Explanation

The provided Python code conducts a comprehensive analysis of delta hedging strategies for options trading. It begins by importing necessary libraries and fetching historical stock price data using Yahoo Finance API. After pre-processing the data, including calculating returns and volatility, the code defines functions for implied volatility calculation and delta hedging simulation. Implied volatility is computed using the Black-Scholes model, providing insight into the market's expectation of future volatility.

Next, the code simulates stock price movements over time using geometric Brownian motion, considering a specified number of simulations, and realized volatility. It then performs dynamic delta hedging simulation for each scenario. For each simulation, the code calculates delta values, determines adjustment actions, computes P&L components, and accumulates interest on adjustments. These steps allow for a comprehensive assessment of the effectiveness of dynamic delta hedging in managing risk associated with options trading.

The results of the simulations are visualized through histograms, showing the distribution of total cashflows for dynamic delta hedging, static delta hedging, and no hedging strategies. The mean, 5th percentile, and 95th percentile values are marked on the plots to provide insights into the performance of each strategy.

In summary, the code provides a robust framework for analyzing and optimizing options trading strategies. By employing quantitative techniques and simulation-based approaches, it offers valuable insights into the impact of delta hedging on option P&L and overall risk management. It serves as a powerful tool for traders and analysts seeking to enhance their understanding of options trading dynamics and optimize their hedging strategies in dynamic market conditions.

# Delta Hedging

Delta hedging is a risk management strategy commonly used in options trading to reduce or eliminate the exposure to changes in the price of the underlying asset. The strategy involves adjusting the portfolio's delta, which represents the sensitivity of the option's price to changes in the underlying asset's price. By continuously adjusting the portfolio's delta to offset changes in the option's price due to changes in the underlying asset's price, delta hedging aims to maintain a neutral position, thereby minimizing the impact of price movements on the portfolio's value.

**Theory:**

Delta, denoted by Δ, measures the rate of change of the option price with respect to changes in the price of the underlying asset. It represents the slope of the option price curve relative to changes in the underlying asset's price. Delta can be positive or negative, depending on whether the option is a call or put and whether the position is long or short.

The Black-Scholes model provides a formula for calculating the delta of a European call or put option:

For a European call option: Δ=N(d1)

For a European put option: Δ=N(d1)−1

Where:

* N(⋅)is the cumulative distribution function of the standard normal distribution.
* *d*1​ is the standardized risk-adjusted term in the Black-Scholes formula

**References:**

1. Black, F., & Scholes, M. (1973). The Pricing of Options and Corporate Liabilities. Journal of Political Economy, 81(3), 637–654. DOI: 10.1086/260062
2. Hull, J. C. (2018). Options, Futures, and Other Derivatives (10th Edition). Pearson.
3. McDonald, R. (2014). Derivatives Markets (3rd Edition). Pearson.

Delta hedging involves adjusting the delta of the option position by buying or selling the underlying asset to maintain a delta-neutral position. This strategy helps traders manage the risk associated with changes in the underlying asset's price and is a fundamental aspect of options trading.