Options Analysis

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https://github.com/toyess-37/Intro-Options-Hackathon

Contents

- We fetched the data from the Yahoofinance website for `GOOGL` options at: https://finance.yahoo.com/quote/GOOGL/options/?date=1771545600.
  - This **Call option** contract expires on **Feb 20, 2026**. The strike price of this contract is **$350.0** and option price is **$10.10** (as on 14 Jan, 2026). The current stock price (as of 14 Jan, 2026) is **$335.84**.
  - Each option contract gives us right to 100 shares of the underlying stock. And, the current risk-free rate of the US Treasury 10-yr bond is **4.14%**.

Criteria 1 of selection: Capital Efficiency

We chose an OTM option with a Delta of **0.28** (detailed explanation in future pages.) The benefit is that to hedge this position, we only need to short **28 shares** of `GOOGL` (vs 100 for an ITM option). This drastically reduces the **margin requirement** and hence allows us to invest cash somewhere else.

Criteria 2 of selection: Liquidity (Open Interest)

We ensured the contract had high **Open Interest (OI)**. If we buy an option with 0 or low Open Interest, we might get stuck with it. This choice of a *busy market* ensures tight “Bid-Ask Spreads” so that we don’t lose money on transaction costs.

Market Context: Cheap vs. Expensive

The current volatility (21 day rolling) is **18.9%**.

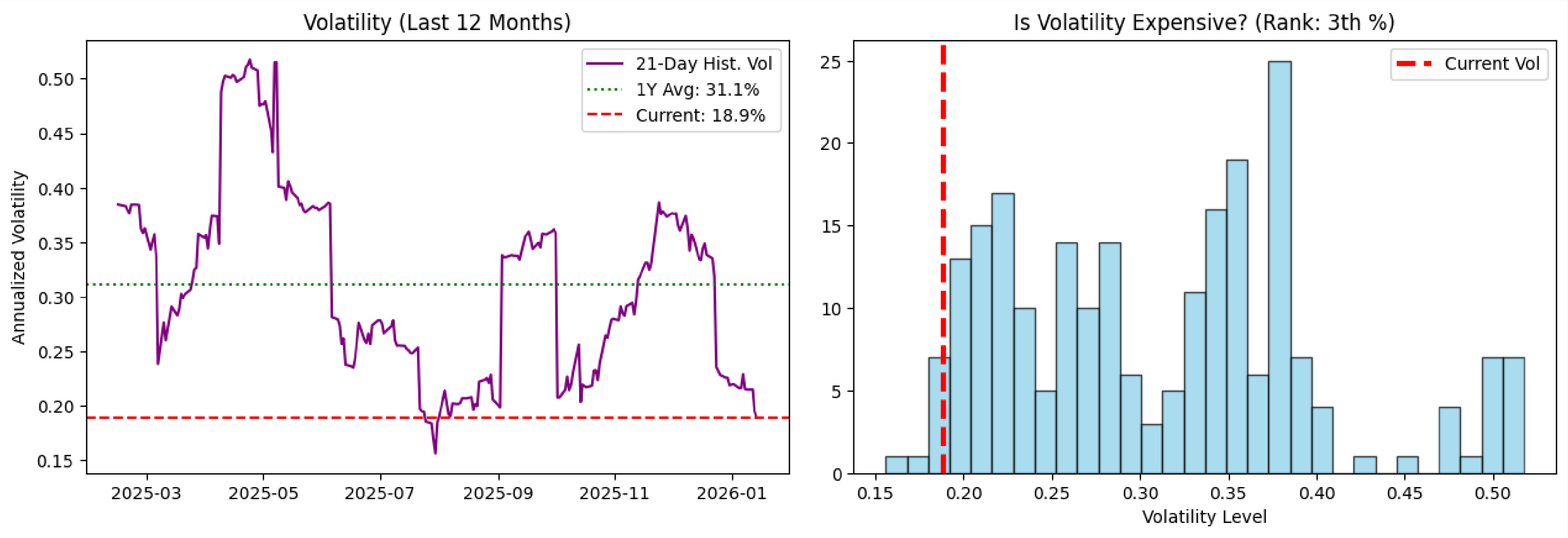
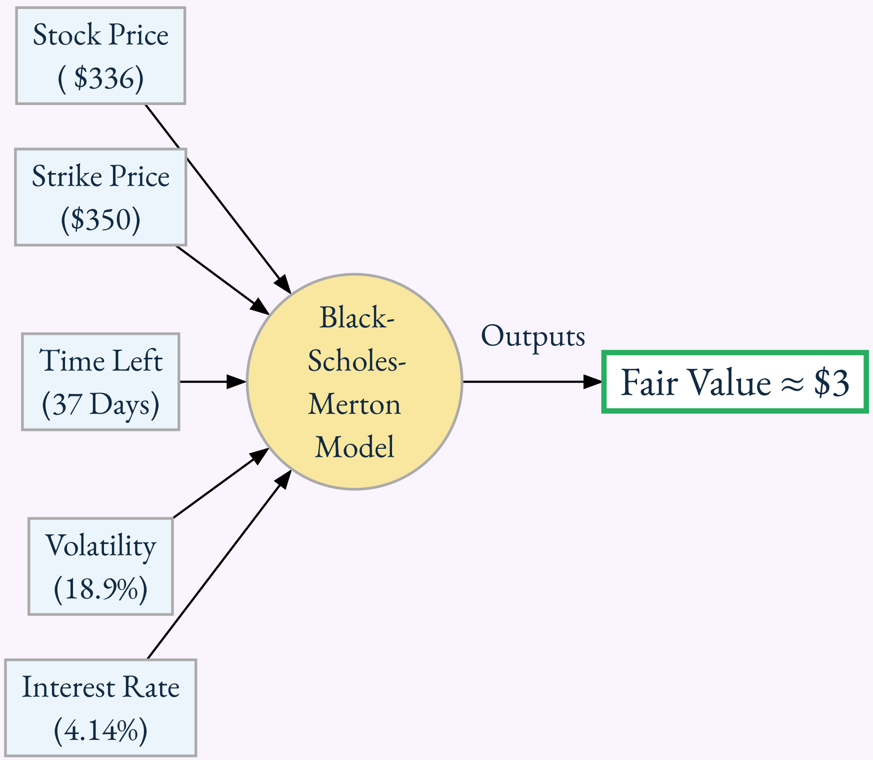


Figure 1: 21-day rolling Volatility of `GOOGL`

- It is very low as compared to the past 12 months data shown in Figure 1.
- It means that, the market is relatively calm.
- So, the *premium* will be relatively on the lower level.
- Hence this **option is cheap and favorable for buying**.

Fair Price of Option: Black-Scholes-Merton Model

To determine the **fair value** of the option contract, we used the **Black-Scholes-Merton (BSM)** model.



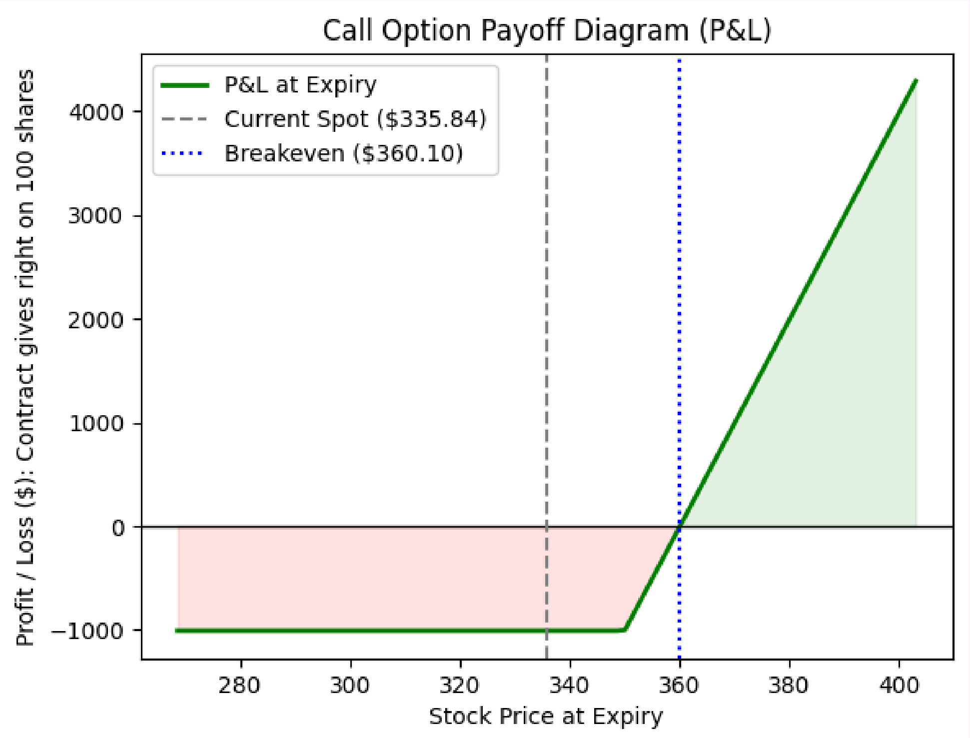


Figure 2: Simple Call Option Payoff. Currently, we're far from profitable region. So, we will hedge by buying shares

Is it really the *fair* value?

According to the model, the market price of **$10.10** is overvalued. But, the model was made for the *European options*. Since American options give more flexibility, hence the $10.10 may be close to *fair* (we have not done the exact calculations). This is one of the limitations of using this model.

Greeks and Risks

The Greeks are the sensitivity metrics that tell the response of our options to various market movements.

Delta (Δ)

Our Value: ≈ 0.275
Δ of 0.275 means our single option contract behaves like 27 shares of `GOOGL` stock. If `GOOGL` goes up \$1, our option goes up \$0.28.

Theta (Θ)

Our Value: ≈ -0.10
As expiration approaches, the *picture* of the final price becomes clearer, reducing the value of uncertainty. Θ measures an option's time decay, indicating how much its price is expected to decrease each day as it gets closer to its expiration date, assuming all other factors remain constant. This decay is good for sellers (who can buy back at a lower price) and bad for buyers (because the contract became cheaper).

Vega (ν)

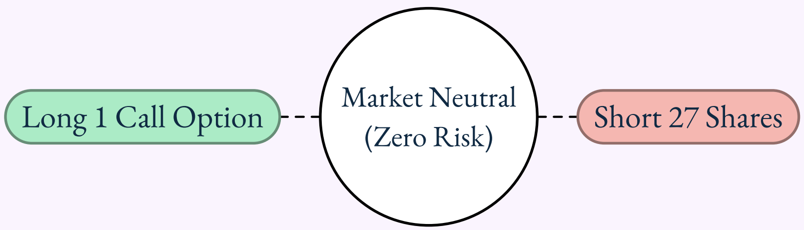
Our Value: ≈ 0.35
This measures sensitivity to panic (aka, volatility). If the market suddenly volatile, option prices usually rise. In our case, for every 1% rise in volatility, option price increases by \$0.35.

Hedging Strategy

Why are we buying options instead of the stock?

The simple reason is **Capital Efficiency**. Buying 100 shares of `GOOGL` requires ≈ \$33600 in capital. However, 1 Call option (for 100 shares) today at \$350 strike requires only ≈ \$1000 dollars. This gives us incredible profit, **ONLY IF** Google crosses \$350 on or before February 20, 2026.

However, the *IF* is a big bet in this case. We need to be correct in around 40 days to be profitable. It may happen that we are not that lucky in this bet. Holding this call option makes us vulnerable if `GOOGL` crashes. So, we need to hedge to protect ourselves.



We can execute a simple **Delta Neutral Hedge**.
Since our Delta is ≈ 0.275, we are effectively **Long on 27 Shares**. We will **Short Sell 28 Shares of `GOOGL` stock**. Now, we are as neutral as possible.

Why do this?

If we are perfectly hedged, we no longer care if the stock price moves. We now care about earning risk-free interest on our **saved** cash (the \$33600 − \$1000 computed earlier).

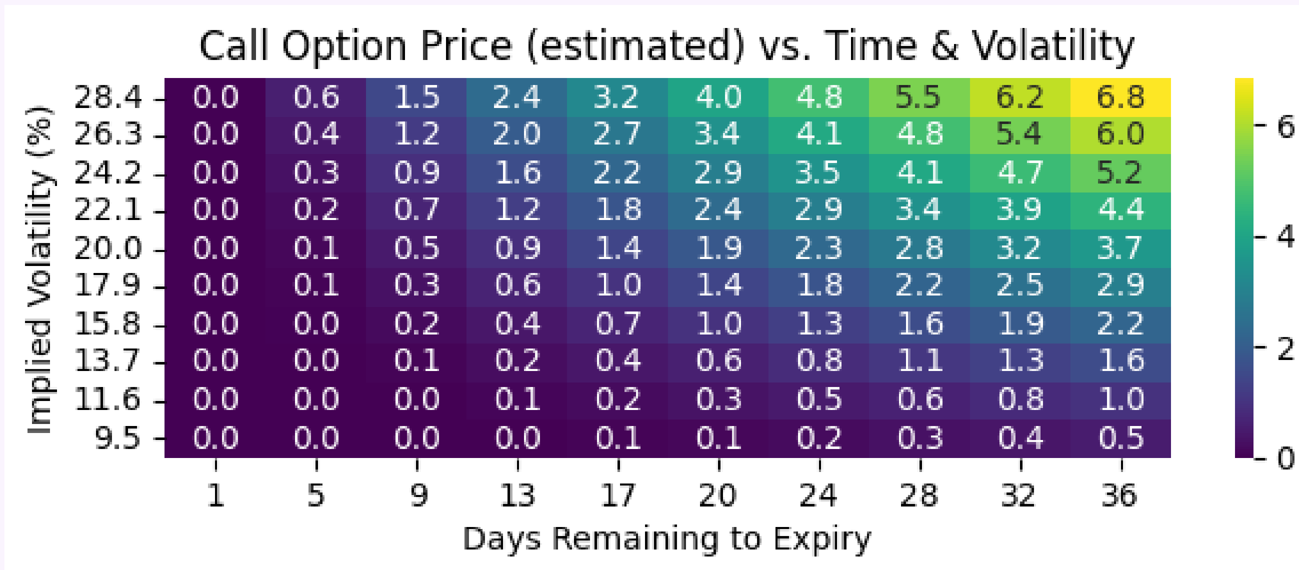


Figure 4: Volatility & Time effects on Call Option Price as per Black-Scholes-Merton Model.
Current prediction: $3.28 (but Market price is $10.10)

If Volatility rises: Note that the current option is priced for low volatility (according to Figure 1). The historical average volatility is around 31%, and current volatility is around 19%. So, we expect volatility to rise and hence, we expect the options price to rise too. We can sell our options and profit if that happens.

If Time decays: It is a loss for the call option as we're losing the race of reaching to $350.

Real-life Limitations of Simple Models

Limitations of our Models

1. Black-Scholes-Merton pricing model is an approximate model with the following limitations:
   - It is modelled for European options. But, we're dealing with American Options here.
   - Log-normal volatility assumption, which is not always the case.
   - Trading costs and other market friction are neglected in this model.
2. Our Δ is 0.28 now. If the price of `GOOGL` increases very rapidly to say \$360, then obviously Δ increases and we are no longer hedged appropriately. We will need very rapid re-hedging which will impose more transaction costs. This is a very rare case though.