Options & Volatility

Traders@SMU

September 24th, 2025

Agenda

- Brainteaser
- Options & Volatility Explained
  - Options 101
  - Volatility: Realized, Implied & Vol Surface
  - The Greeks
  - Strategy Identification Game

Brain Teaser

I give you a shuffled deck of 14 cards which contain exactly one card from each rank and a Joker. You win $100 if you flip over the King, Queen, & Jack but if at any point you have flipped over the Joker, the game ends and you win nothing.
How much would you be willing to pay, to play this game?

Answer

- The only cards that influence the outcome of the game are the King, Queen, Jack, & Joker so only these 4 cards need to be considered.
- You lose the game if the Joker comes before any one of these three royal cards, so the probability of you winning is the same as the probability the Joker is selected last among these cards. The probability any 1 of the 4 cards is last is 1/4 .
- Your expected earnings from playing this game is 1/4·100 so you should be willing to pay up until $25 dollars for this game.

Introduction to Derivatives

Definition

A derivative is a financial contract/agreement made between two parties that derives its value an underlying asset, index, currency, or interest rate.

Modeling: The most well-known model of Financial Derivatives is the Black-Scholes Model. Developed in 1973, the "BSM" calculates theoretical values given five input variables.

Market Analysis

In 2023, analysts place Derivatives market at over $1 Quadrillion (more than x10 Global GDP)

The Chicago Mercantile Exchange, is among the world's largest Derivatives exchanges, $206 Billion Total Assets

Options behave in an Over the Counter (OTC) Market type, this allows anonymity, loose customization & regulation

Spotlight Derivatives:

Options

A financial contract that gives the holder the right (but not the obligation) to buy or sell an underlying asset at a predetermined price on or before a specific date.

Two Types
- **Long:** Right to b/s
- **Short:** Obligation to b/s

Key Terms
- Strike Price, Underlying Asset, Premium, Expiration Date

Futures

A futures contract is a standardized agreement traded on an exchange to buy or sell an asset at a predetermined price on a specified date in the future.

Common Assets:
- Commodities
- Currencies

Key Terms
- Spot Price, Settlement, Basis Risk, Stack & Roll

Futures Basics

Buying a Futures Contract

Use case: Bullish outlook on an asset or to lock in a future purchase price.

Example

Buy a futures contract for crude oil at $80 per barrel. If the price rises to $90 by expiration, you profit $10 per barrel.

Selling a Futures Contract

Use case: Bearish outlook or hedging against falling prices.

Example

Sell a futures contract for corn at $100. If the market price drops to $90, you profit $10.

Long Futures Payoff

Unlimited upside potential, unlimited downside risk.

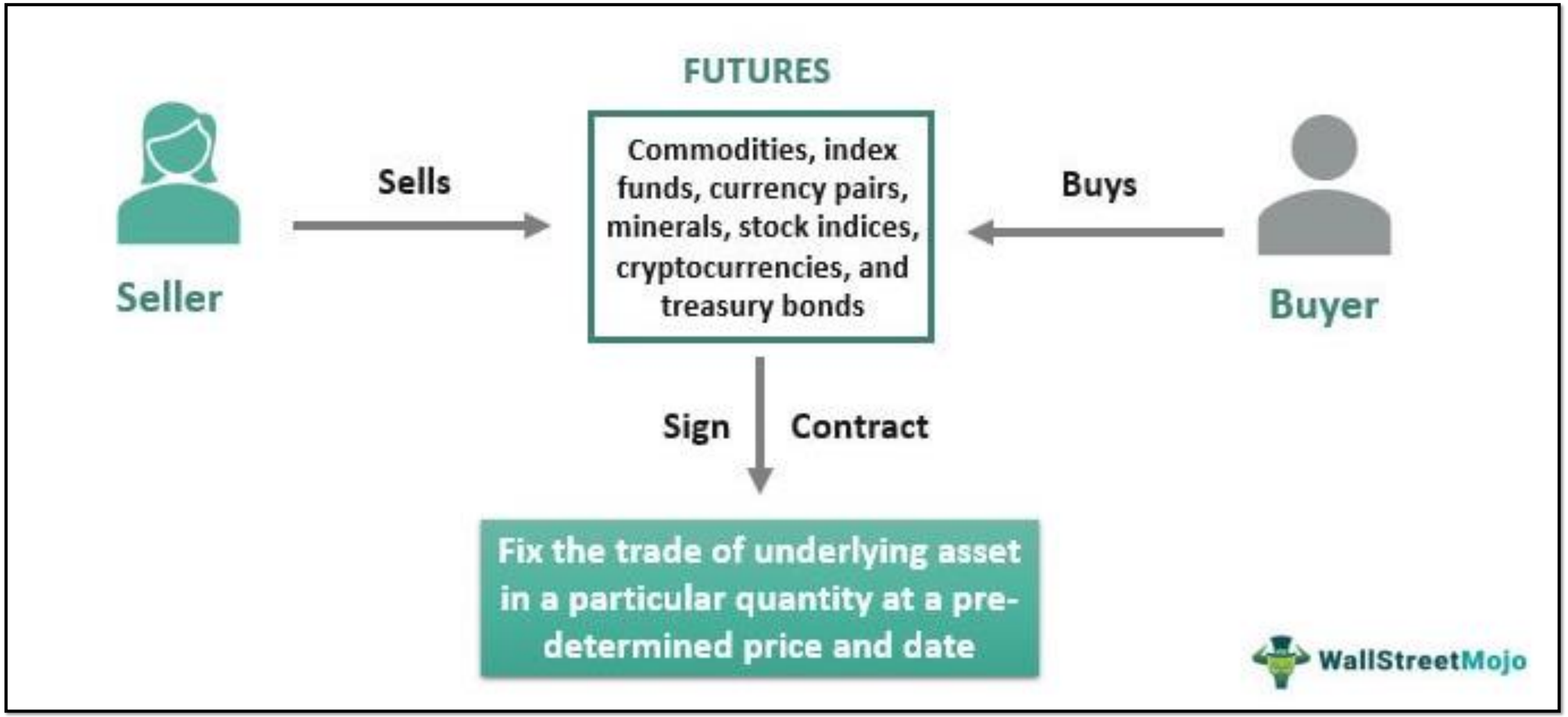
Short Futures Payoff

High reward if price drops, unlimited downside if price rises.

Using Futures as Risk Management

Lock in future purchase prices to hedge against rising input costs → Buyers hedge against price increases in essential goods
Lock in selling prices to hedge against falling product prices → Sellers hedge against price declines in their products

Futures



Options Basics

Buying a Call Option

Use case: Bullish outlook on an underlying asset.

Example

Buy a call option with a strike price of $100 for a $5 premium. If the asset rises to $110, the intrinsic value of the option is $10.

Buying a Put Option

Use case: Bearish outlook or hedging downside risk.

Example

Buy a put option with a strike price of $100 for a $5 premium. If the asset drops to $90, the intrinsic value is $10.

Call Option Payoff

Unlimited upside potential, limited downside (loss limited to the premium paid).

Put Option Payoff

High potential reward if the price drops significantly, limited downside (premium paid).

- **Options are a versatile financial instrument that can act as insurance, hedging, or speculative vehicles**
- **Understanding option Greeks helps traders manage risk and optimize their strategies**
- **Market-making firms like Akuna Capital trade options at high volumes to profit from bid/ask spreads**

Components of an Option

Underlying Asset

Equities (AAPL), Commodities (Oil), Crypto (XRP)

Option Type

Long Call, Long Put, Short Call, Short Put, Etc.

Expiration

A date in the future (can also trade options that expire same - day

Strike

Price level at which the Option is considered ITM or OTM

Call Option Example

Buy a **Call** option on **AAPL** with a **Week till Expiry** at a **Strike Price of $100** for a $5 premium. If the asset rises to $105, the intrinsic value is $5.

Put Option Example

Buy a **Put** option on **AAPL** with a **Week till Expiry** at a **Strike Price of $100** for a $5 premium. If the asset drops to $90, the intrinsic value is $10.

Basic Option Payoffs

Call Option Payoff	Put Option Payoff
Unlimited upside potential, limited downside (loss limited to the premium paid).	High potential reward if the price drops significantly, limited downside (premium paid).

Risk / Reward Asymmetry

- Options offer asymmetric upside with limited risk

Dive into Option Pricing

Two Factors in an Option Premium

Intrinsic Value (Moneyness)

- Difference between the asset price and the strike price (for ITM options)
- Represents the real, tangible value if exercised today

Extrinsic Value (Time Value)

- Portion of option that exceeds intrinsic value

Influenced by:

- Implied Volatility
- Interest Rates and Dividends

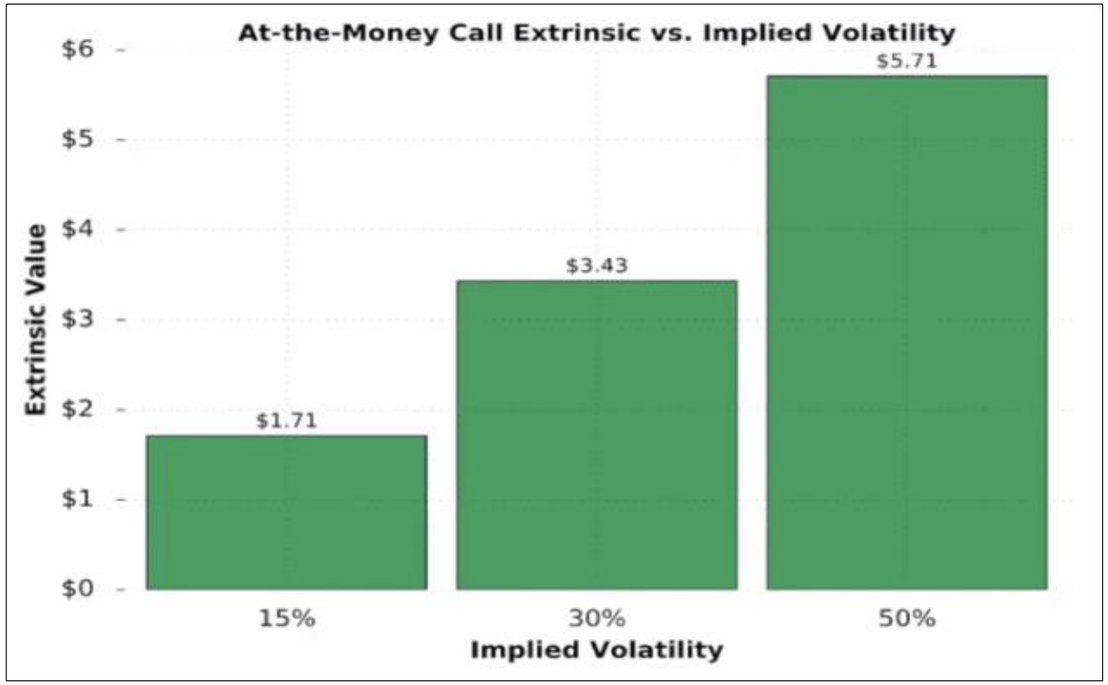
Total Option Premium

These Components make up the Option Premium Price

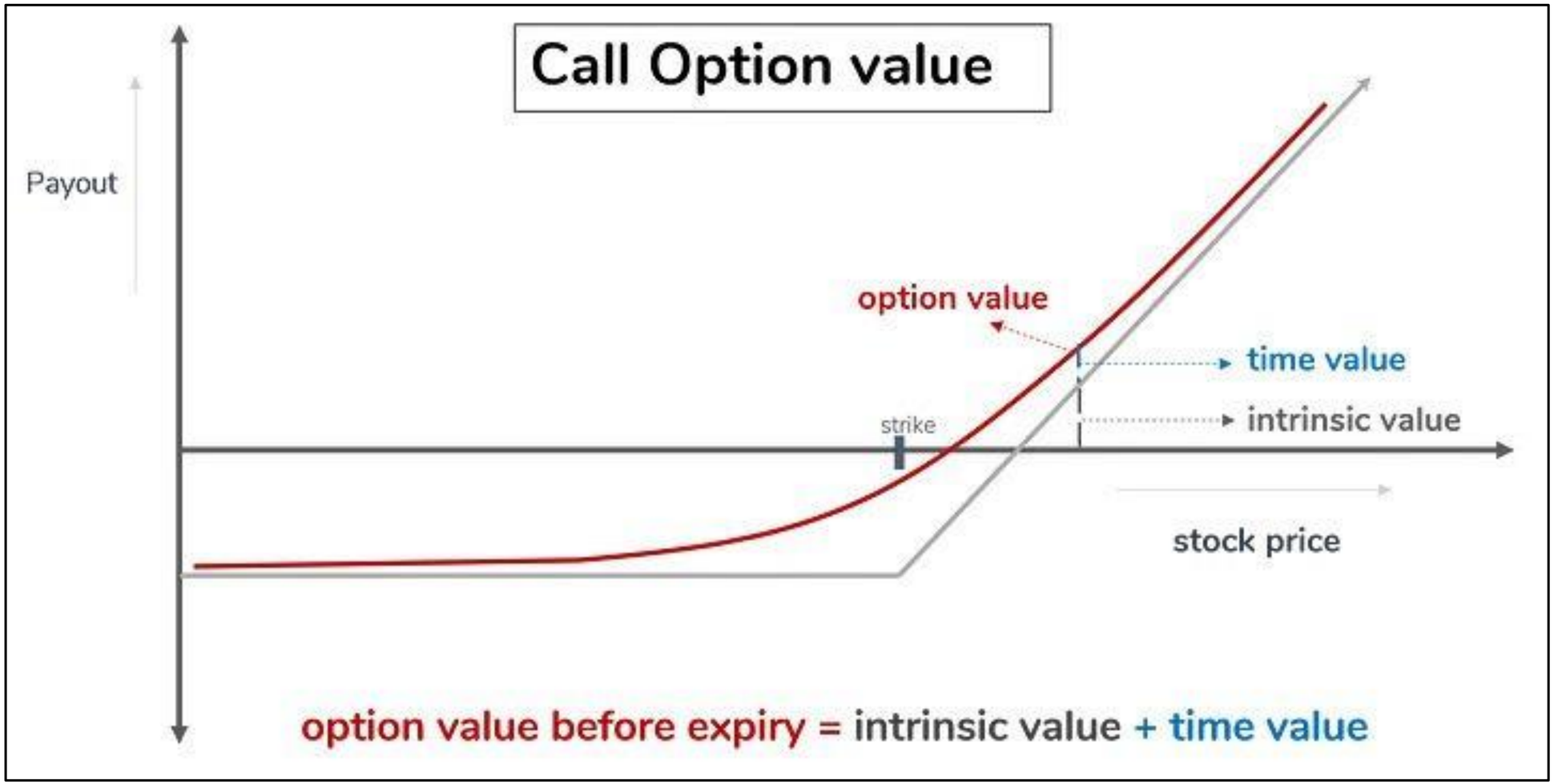
Implied Volatility

A measure of the market's expectation of future volatility in the underlying

- Increases in anticipation of events that can cause significant price swings
- Directly affects the extrinsic value
  - *Higher IV increases extrinsic value (more potential to move into profitability (ITM) before expiration)*



Option Payoff: Convexity



Realized, Implied, and Vol. Surface

Variations of Volatility

Realized (Historical): Backwards looking, measures how much an assets price *actually* fluctuated over a past period (ie 30 day). This is purely statistical and does not engage in market expectations.

Implied: Forward looking, represents the markets expectations and is derived from formulas such as the BSM. Not a direct forecast on returns, rather a gauge to risk and demand.

Volatility Smile and Surface

Vol. **Smile**: Implied Vol. vs Strike Price. Typically, U-Shaped and OTM puts/calls trade at higher IV than ATM Options

Vol. **Surface**: Extension of the smile across both strike **AND** maturity. 3-D view showing IV varies across strikes/exp

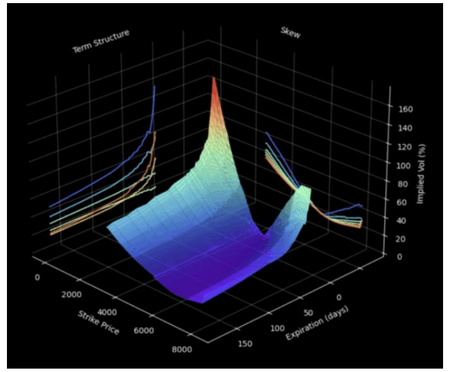
Interpreting Skew and Smile: reflects expectations of asymmetric outcomes (ie. OTM puts). Differs by Asset

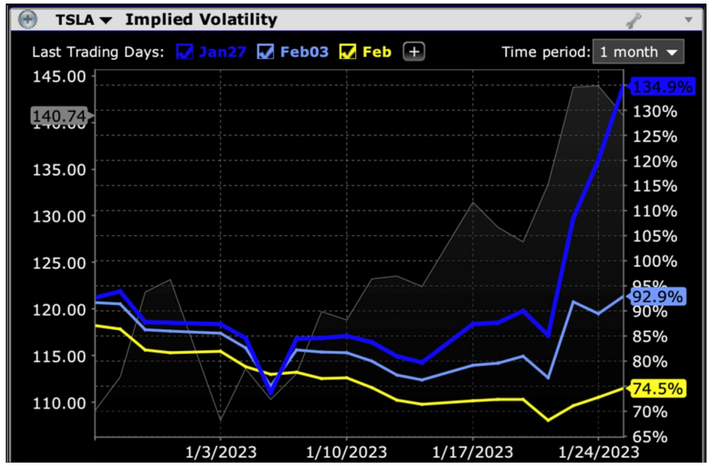
Spotlight SPX vs TSLA (Earnings)

SPX (S&P 500)
- Steady IV (FOMC)
- Diversified event risk

TSLA (Tesla)
- Drastic IV drops in Earnings
- Price in uncertainty

IV Models





Vol. Impact

- Volatility is the only **unobservable input**
- Higher IV -> Higher Premium

How can MM hedge risk and profit from the vol. Premiums?

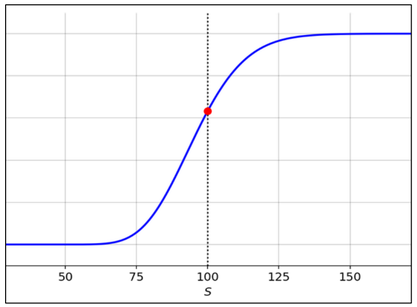
Overview: Why the Greeks Matter

What are Option Greeks

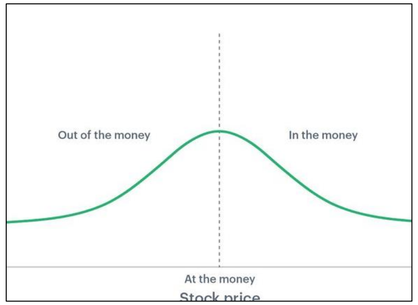
Option Greeks are risk metrics that describe how the price of an option is expected to change in response to different factors. They are essential tools for traders to understand **how sensitive an option's value is** to:

1st & 2nd Order Option Greeks

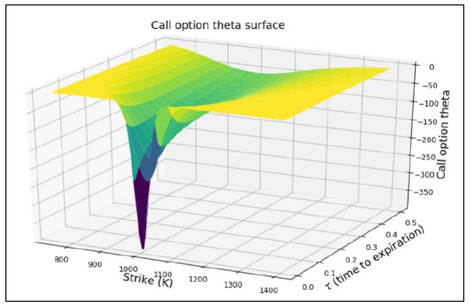
Delta (Δ)



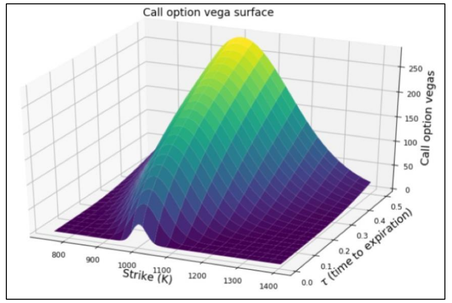
Gamma (Γ)



Theta (Θ)



Vega (v)



Price Changes
In the underlying asset

Volatility Shifts

Time Decay

Interest Rate Movements

Together, they help price options more accurately, manage portfolio risk, and design hedging strategies.

Greeks: Delta (Δ)

Sensitivity to Price Change

- Measures how much the option price changes for a $1 move in the underlying asset.
  - Also used to approximate the probability of the option finishing in the money.

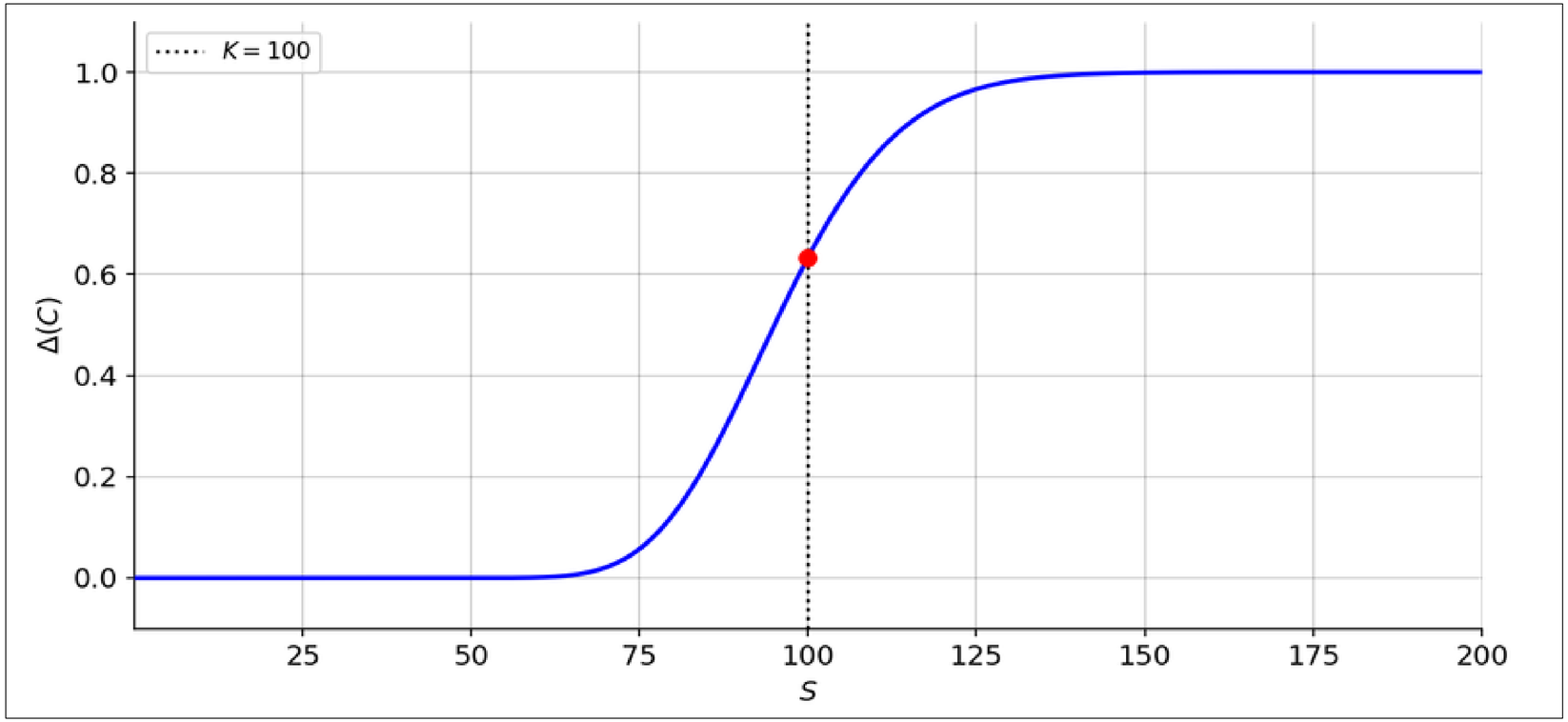
Calls

- Delta ranges from 0 to 1

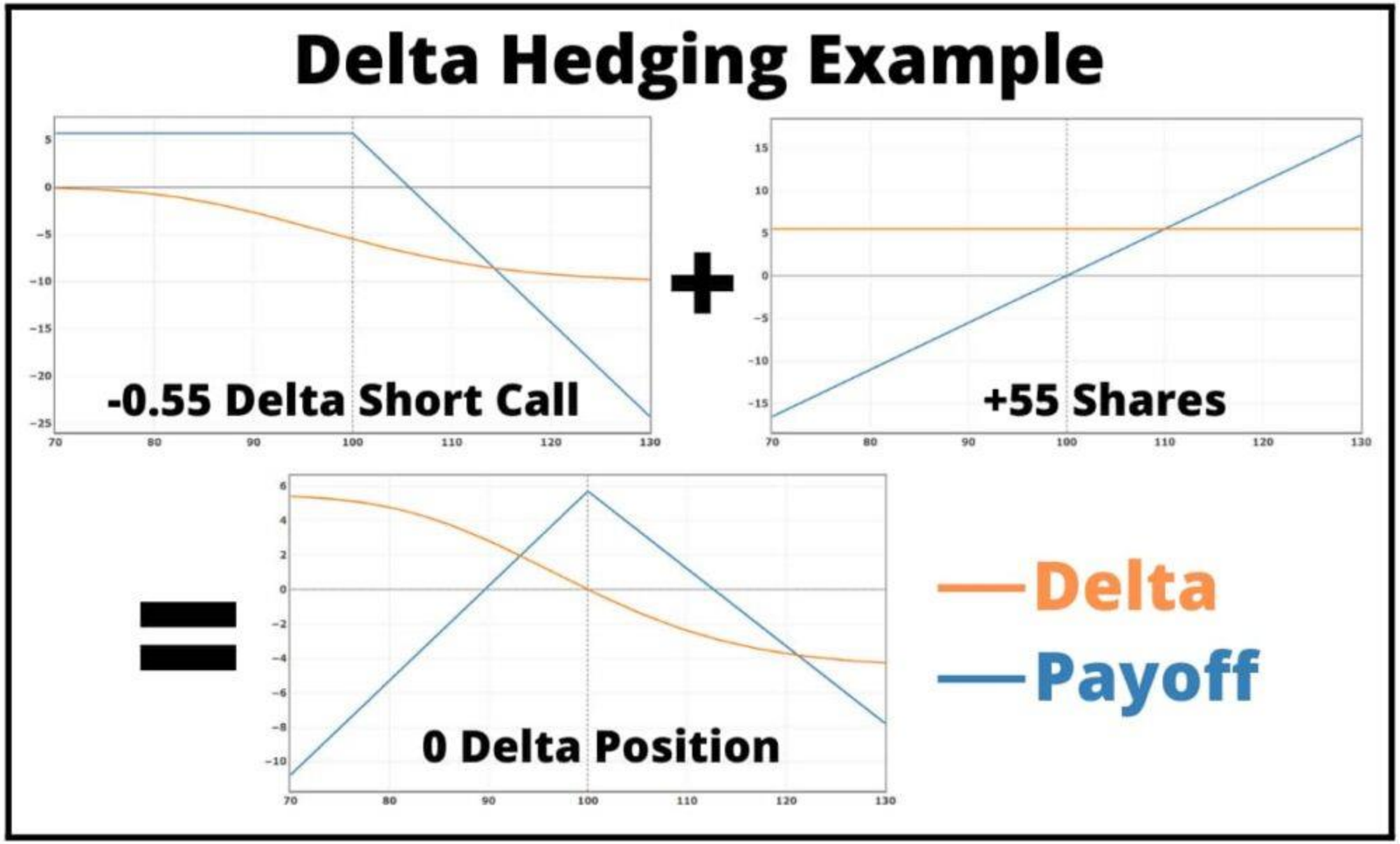
Puts

- Delta ranges from -1 to 0

Delta hedging is a strategy used to reduce directional risk by offsetting an option's delta with a position in the underlying asset. **For example**, if a trader is **long a call option** with a delta of **0.6**, they would short **60 shares** of the underlying to remain delta-neutral. As delta changes with price and time, the hedge must be frequently adjusted.



More Delta Hedging Examples



Greeks: Gamma (Γ) -> Measures sensitivity of Δ

- Measures how much **delta** changes when the underlying asset moves by $1.

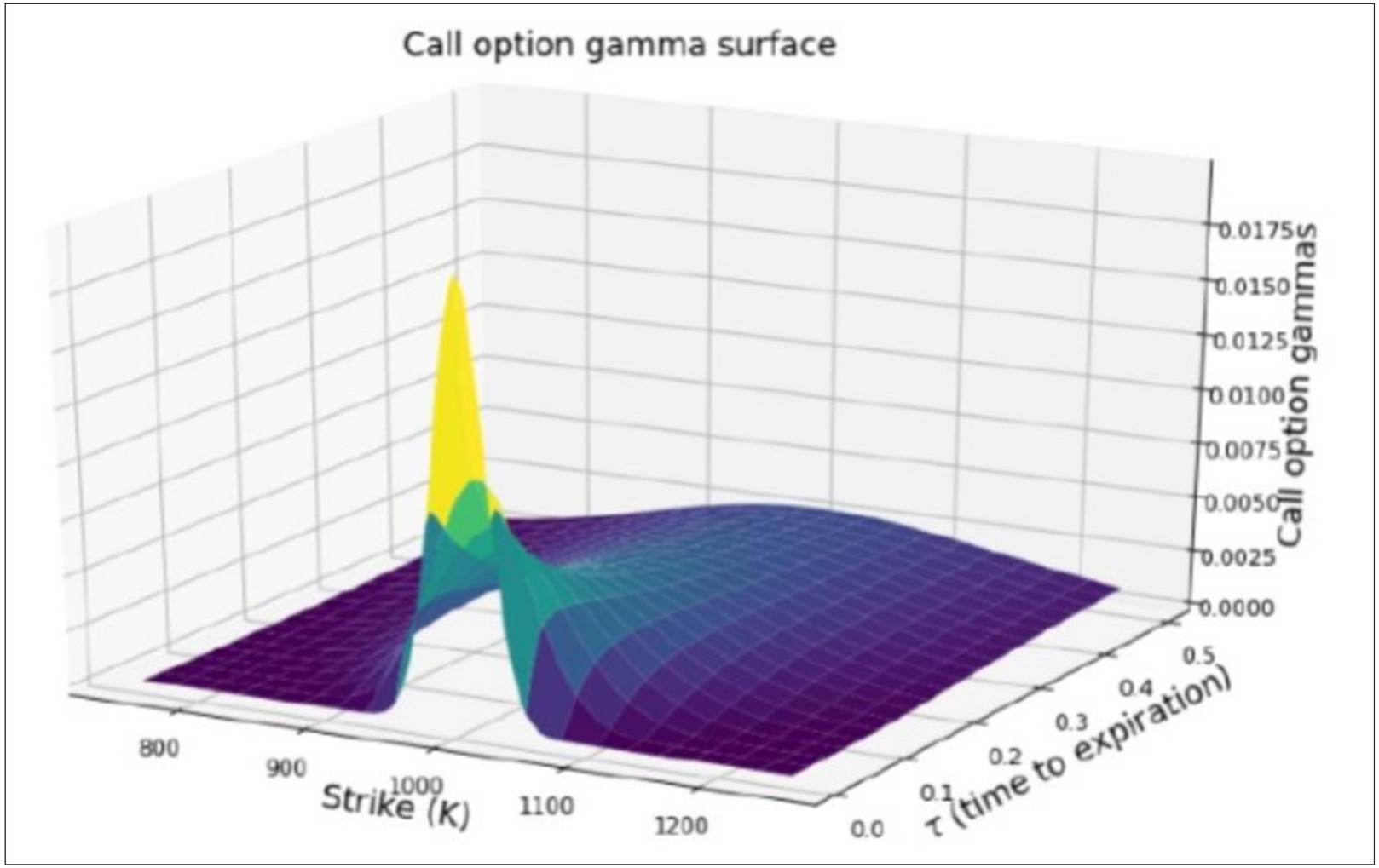
Highest for ATM Options

- Especially ones that are near expiration, as shown in the Gamma surface to the right.

Gamma Scalping

Exposure

- Important for managing risk
- Gamma changes as levels in Implied Volatility changes – which changes how an option behaves directionally



Example: Using Delta & Gamma Together

Question

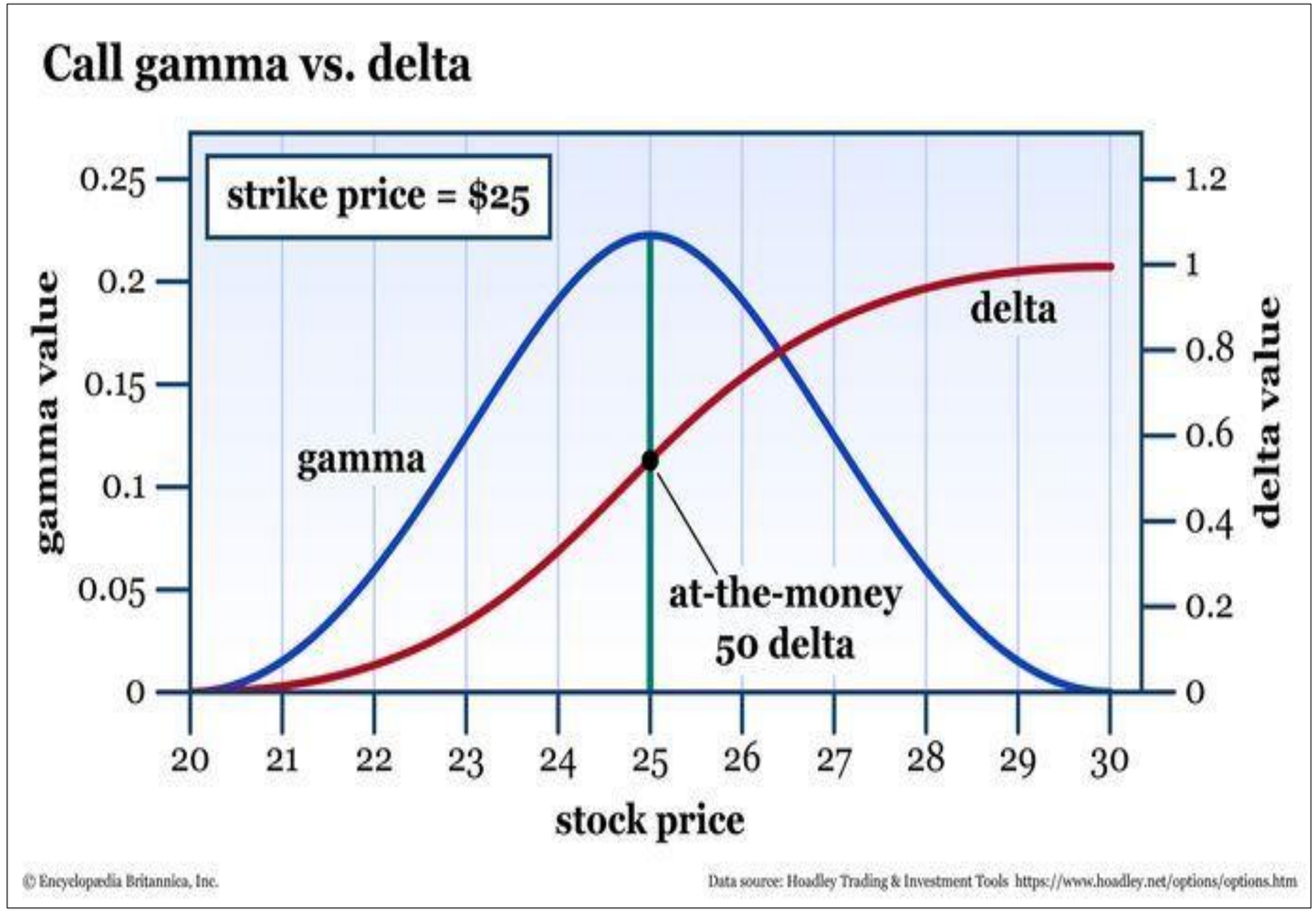
You buy a **call option** currently priced at **$6.00**.

Delta (Δ)
- The delta of the Option is .50

Gamma (Γ)
- The Gamma is 0.05

The underlying stock increases by $2

Q: What is the new option Premium?



Answer

Question

You buy a **call option** currently priced at **$6.00**.

Delta (Δ)
- The delta of the Option is .50

Gamma (Γ)
- The Gamma is 0.05

The underlying stock increases by $2

Q: What is the new option Premium?

Answer

Step 1: First $1 move
- Use current Delta = 0.50
- Premium increases by $0.50
- New Premium = 6.50
- New Delta = 0.50 + 0.05 = 0.55

Step 2: Second $1 move
- Use updated Delta = 0.55
- Premium increases by $0.55
- Final Premium = $6.50 + 0.55 = **7.05**

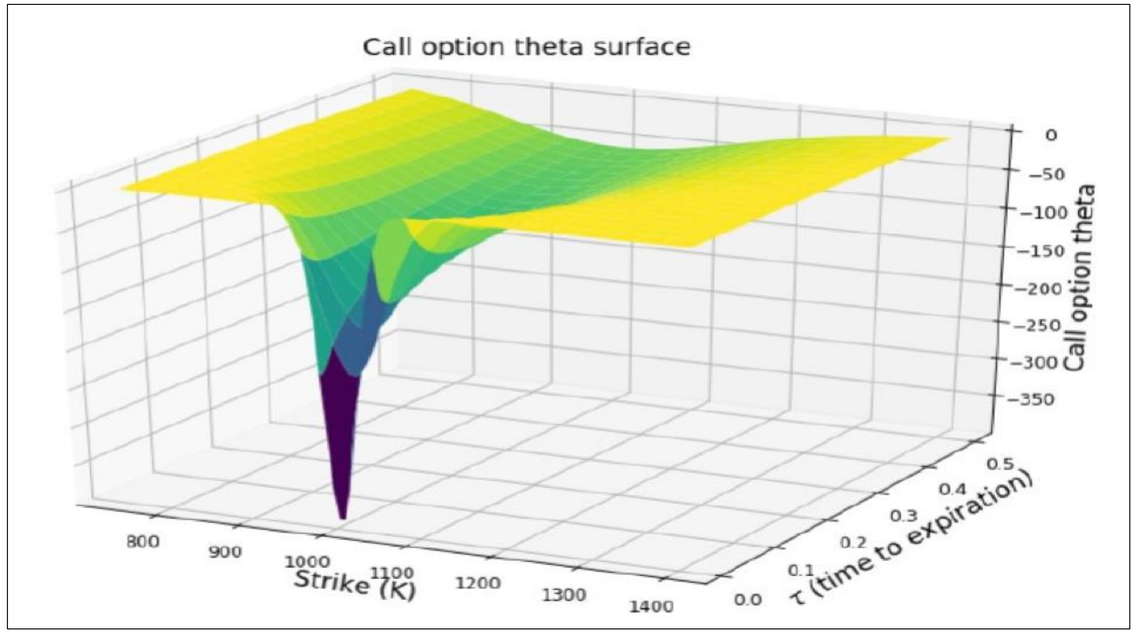
Theta (Θ)

Time Decay

- Measures the rate at which an option loses value as time passes, all else equal.

Negative for Long Options

- Accelerates as expiration approaches — especially for at-the-money options.



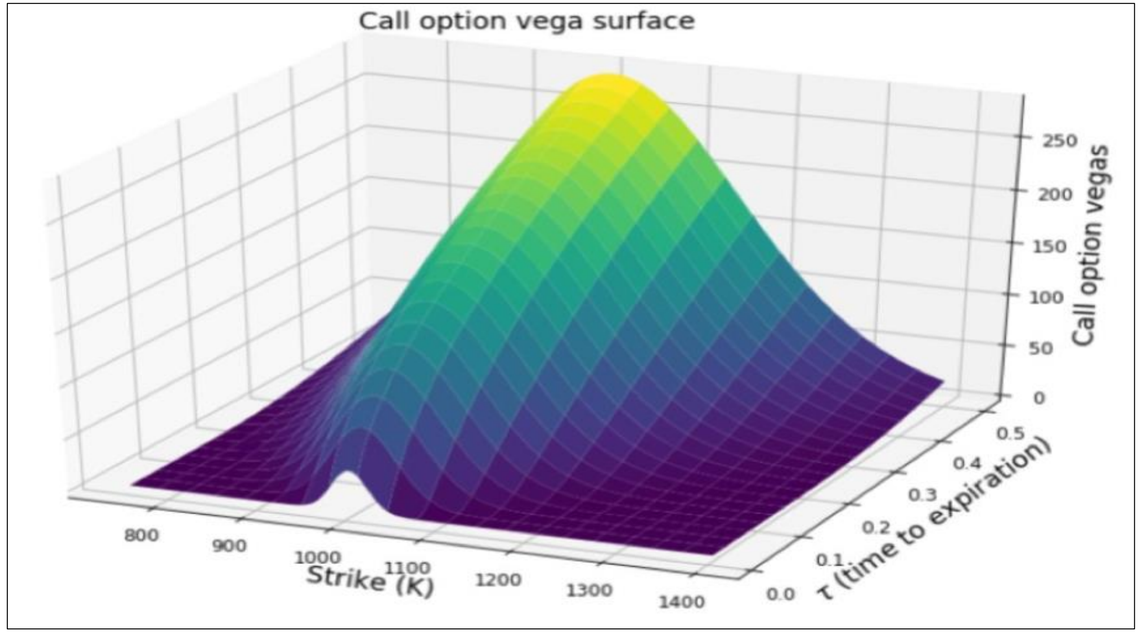
Vega (v)

Sensitivity to Volatility

- Measures how much an option's price changes with a 1% change in implied volatility.

Long options benefit from rising volatility

- Vega is highest for at-the-money options and declines as expiration nears



Option Pricing: Black-Scholes Model

The Black-Scholes model is a formula used to price European call and put options.

Helps traders estimate the fair value of an option based on the underlying asset price, strike price, time to maturity, interest rate, and volatility. It's widely used in financial markets for risk management and trading strategies

Assumptions: Constant Volatility, No Dividends, and that the option can only be exercised **at** expiration.

$$C(S_t, t) = N(d_1)S_t - N(d_2)PV(K)$$

PV(K)

Present value of the strike price

$N(d_1)$ and **$N(d_2)$**

- $d_1 = \frac{1}{\sigma\sqrt{T-t}}\left[\log\left(\frac{S_t}{K}\right) + \left(r + \frac{\sigma^2}{2}\right)(T-t)\right]$
- $d_2 = d_1 - \sigma\sqrt{T-t}$
- $PV(K) = Ke^{-r(T-t)}$

The CDF of the standard normal distribution, representing probabilities under the risk-neutral measure

Variables in the Black-Scholes Model

$C(S_t, t)$:	The price of the call option at time t
S_t:	The current price of the underlying
K:	The strike price of the option
σ:	Volatility of the underlying asset
R:	Risk-free interest rate
T – t:	Time to maturity (in years)

Option Chain View

Concepts to Highlight in the Option Chain

Moneyness
- Highlight which options are ITM, ATM, OTM
- Notice how Delta and IV vary

Implied Volatility
- Consider how IV changes across strike prices
- Volatility smile/skew
- Why longer dated options are sensitive changes in IV
- Vega curve which helps illustrate

Expiration Structure
- Flip between near-dated and long dated-options
- Consider how IV, Theta, and gamma behave in each given our surfaces

Bid – Ask Spread
- Examples of tight vs wide spreads and how that affects your ability to enter/exit a trade.
- Consider market efficiency or liquidity in different strikes/maturities

Strategy Builders
- Look at multi-leg strategies: straddles, butterfly, etc.
- Look at P/L graph

Chart | Options | Note | News | Comments | Financials | Analysis | Order Flow | Corp Actions | Releases | Profile

Single | All | Both | Calls | Puts | Regular | Weekly | Quarterly | Standard | Non-Standard | VOL: 15.56M IV: 26.62% HV: 32.74%

Delta	Open Int	Impl Vol	Mid	% Change	Last	Ask	Bid	Strike	Bid	Ask	Last	% Change	Mid	Impl Vol	Open Int	Delt
14 Apr 25 (W) 100							Calls	7 D	Puts							
0.6550	4	51.77%	26.17	-48.52%	28.29	26.31	26.03	490	10.20	10.38	10.12	+672.52%	10.29	51.77%	57	-0.346
0.6469	--	51.44%	25.44	0.00%	--	25.56	25.31	491	10.47	10.65	10.20	+742.98%	10.56	51.44%	218	-0.354
0.6386	1	51.12%	24.72	-43.72%	29.12	24.84	24.59	492	10.75	10.95	9.50	+642.19%	10.85	51.12%	107	-0.362
0.6303	--	50.80%	24.00	-9.51%	23.87	24.12	23.88	493	11.04	11.24	8.84	+612.90%	11.14	50.80%	260	-0.371
0.6217	--	50.47%	23.30	0.00%	--	23.42	23.18	494	11.33	11.52	11.49	+738.69%	11.42	50.47%	161	-0.379
0.6130	2	50.15%	22.60	-53.77%	22.53	22.72	22.49	495	11.64	11.83	11.74	+698.64%	11.74	50.15%	411	-0.388
0.6042	1	49.83%	21.93	-54.23%	21.79	22.06	21.80	496	11.95	12.16	11.60	+964.22%	12.06	49.83%	342	-0.397
0.5952	1	49.51%	21.24	0.00%	46.95	21.35	21.13	497	12.27	12.47	12.38	+803.65%	12.37	49.51%	77	-0.406
0.5860	--	49.19%	20.58	-22.21%	20.52	20.71	20.46	498	12.61	12.80	11.41	+918.75%	12.70	49.19%	185	-0.415
0.5768	--	48.88%	19.91	-23.93%	19.49	20.02	19.80	499	12.95	13.14	12.66	+627.59%	13.04	48.88%	376	-0.424
0.5673	7	48.56%	19.26	-71.13%	19.20	19.37	19.15	500	13.30	13.51	13.58	+600.00%	13.40	48.56%	1,041	-0.434
0.5181	--	46.98%	16.16	-44.83%	15.00	16.25	16.06	505	15.23	15.40	15.36	+582.67%	15.32	46.98%	684	-0.483
ITM							SPY: 505.28 -31.42 -5.85%									ITM
0.4657	1	45.42%	13.30	-77.53%	13.01	13.38	13.21	510	17.35	17.57	17.50	+536.36%	17.46	45.42%	499	-0.536
0.4109	--	43.90%	10.74	-38.88%	10.61	10.83	10.65	515	19.76	20.03	19.98	+470.86%	19.90	43.90%	1,456	-0.592
0.3548	7	42.43%	8.47	-64.76%	8.12	8.56	8.38	520	22.52	22.78	22.03	+406.44%	22.65	42.43%	2,403	-0.649
0.3435	6	42.14%	8.05	-66.23%	7.51	8.14	7.96	521	23.10	23.37	22.49	+372.48%	23.24	42.14%	56	-0.660
0.3323	--	41.86%	7.64	-41.64%	7.40	7.73	7.56	522	23.67	23.97	23.54	+384.36%	23.82	41.86%	164	-0.672
0.3211	--	41.58%	7.26	-44.77%	7.34	7.34	7.17	523	24.30	24.59	19.35	+452.86%	24.44	41.58%	58	-0.683
0.3099	6	41.30%	6.87	-58.53%	8.26	6.95	6.79	524	24.89	25.25	24.36	+390.14%	25.07	41.30%	210	-0.694
0.2988	10	41.03%	6.50	-67.43%	6.25	6.59	6.42	525	25.56	25.85	25.00	+341.70%	25.70	41.03%	12,390	-0.706
0.2878	--	40.76%	6.14	-52.22%	5.80	6.23	6.06	526	26.20	26.50	25.62	+523.36%	26.35	40.76%	182	-0.717
0.2769	1	40.49%	5.80	-83.53%	6.00	5.88	5.72	527	26.86	27.17	26.22	+359.19%	27.02	40.49%	124	-0.728
0.2661	3	40.23%	5.47	-69.36%	5.31	5.55	5.39	528	27.53	27.85	25.00	+296.83%	27.69	40.23%	213	-0.739
0.2554	--	39.98%	5.15	-45.37%	5.43	5.23	5.07	529	28.22	28.54	23.11	+238.36%	28.38	39.98%	156	-0.750
0.2449	18	39.73%	4.84	-71.20%	4.91	4.91	4.77	530	28.88	29.24	28.85	+310.97%	29.06	39.73%	1,165	-0.761

01 -4.99% IWM 181.19 (Pre: -6.96 -3.84%) T 26.64 (Pre: -0.89 -3.34%) LULU 263.70 (Pre: -12.69 -4.81%) HPQ 22.61 (Pre: -0.96 -4.25%) HP 19.82 -2.89 -12.73% | Local Time: 04/07/2025 10:15:02

General Options Example

You own 100 shares of XYZ stock, currently trading at $50

Issue

You're concerned about potential downside risk

You buy a put option with a strike price of $45 costs $2 per share

What are your total costs, and what happens if XYZ drops to $40

Answer

Cost of the put option: $200.

Stock value drops:

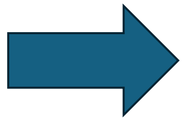
- You **own** at $50 × 100 = $5,000
- Market price = $40 × 100 = $4,000

Unrealized loss = $1,000

You exercise the put:

- You sell your 100 shares at $45 instead

You get $4,500 from exercising



Loss = $700 for the Stock + Option premium paid

You paid $5,000, but you **get $4,500** back
→ **Loss = $500** on the stock
• But you also paid **$200** for the option upfront

Tools for Options Trading

Broker Platforms

Interactive Brokers

charles SCHWAB

TradeStation®

E*TRADE®

NINJATRADER

Webull

Visualization

Use payoff graphs to show the potential profit and loss for different strategies.

Calls			Puts	
Bid ↖ Bearish	Ask ↗ Bullish	Strike: 8	Bid ↗ Bullish	Ask ↘ Bearish
13.25	13.5	222.50	5.2	5.35
11.7	11.9	225	5.95	6.3
10.1	10.6	227.50	7.25	7.45
9	9.19	230	8.44	8.65
7.85	8	232.50	9.55	10
6.8	7	235	10.9	11.45
5.85	6	237.50	12.7	13.9
4.95	5.09	240	13.65	14.7