Options 201 – Strategies and Greeks

Brain Teaser

I'm driving out to a resort, which is pretty far away. Luckily, the first three quarters of the distance is all highway driving, but I have to drive the rest on slower local roads. I drive at 60 mph on the highway, but only 20 mph on local roads. What's my average speed for this trip?

ANSWER:

You might think you can just take a weighted average of the two speeds, and conclude the answer is just $\frac{3}{4} \times 60 + \frac{1}{4} \times 20 = 50$ mph, but that's not correct! This is because average speed is calculated by averaging speed over time, not over distance.

Solution:

Let x be the total distance to the resort. The time you spend on the highway is $\frac{\frac{3}{4}x}{60} = \frac{x}{80}$ hours, and the time you spend on the local roads is $\frac{\frac{1}{4}x}{20} = \frac{x}{80}$ hours. Then your average speed is $\frac{x}{\frac{x}{80}+\frac{x}{80}} = 40$ mph.

Review – What is an option?

- **Options** are contracts between two traders who agree to certain conditions under which they are allowed/required to buy/sell stock over a prearranged timeframe. These contracts are exchange traded

- **Calls** are agreements where the buyer has the right but not the obligation to buy a security at a specific strike price, as such the seller is required to sell the security to the buyer at that price if the buyer exercises their rights under the option agreement

- **Puts** are agreements where the buyer has the right but not the obligation to sell a security at a specific strike price, as such the seller is required to buy the security from the buyer at that price if the buyer exercises their rights under the option agreement

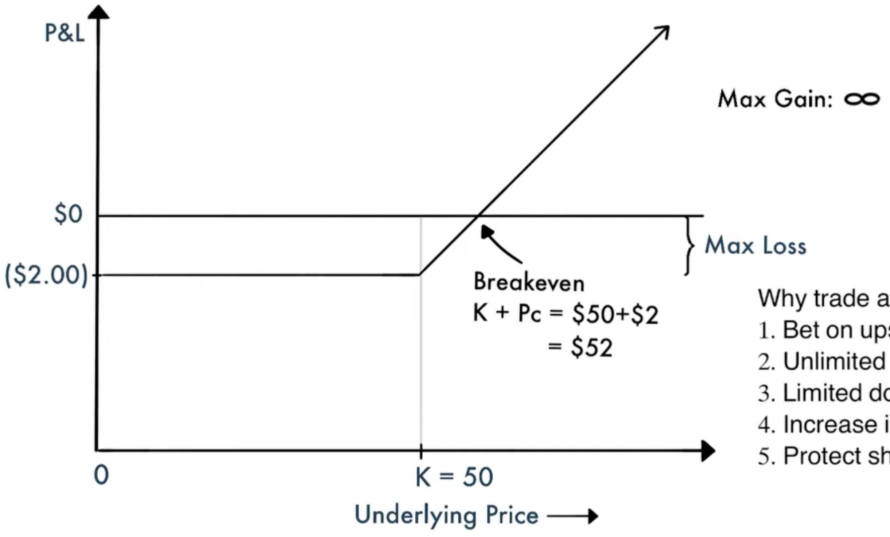
Review – Payoff Diagrams

LONG PUT

LONG CALL

Example 1: Diagram for the buyer of a call, at strike K = 50, for the price of $2.00

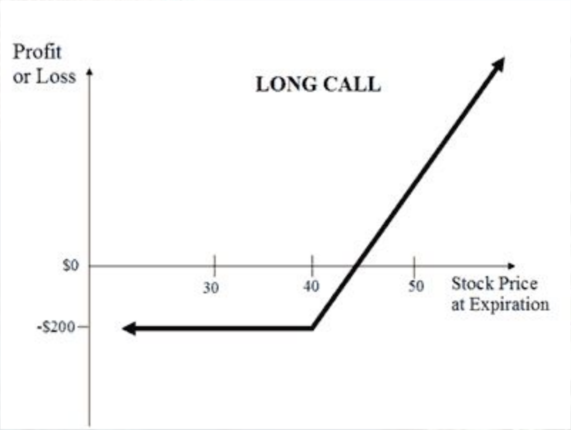
Review – Payoff Diagrams



Why trade a call?

1. Bet on upside move
2. Unlimited upside
3. Limited downside
4. Increase in Volatility
5. Protect short position

Review – Payoff Diagrams

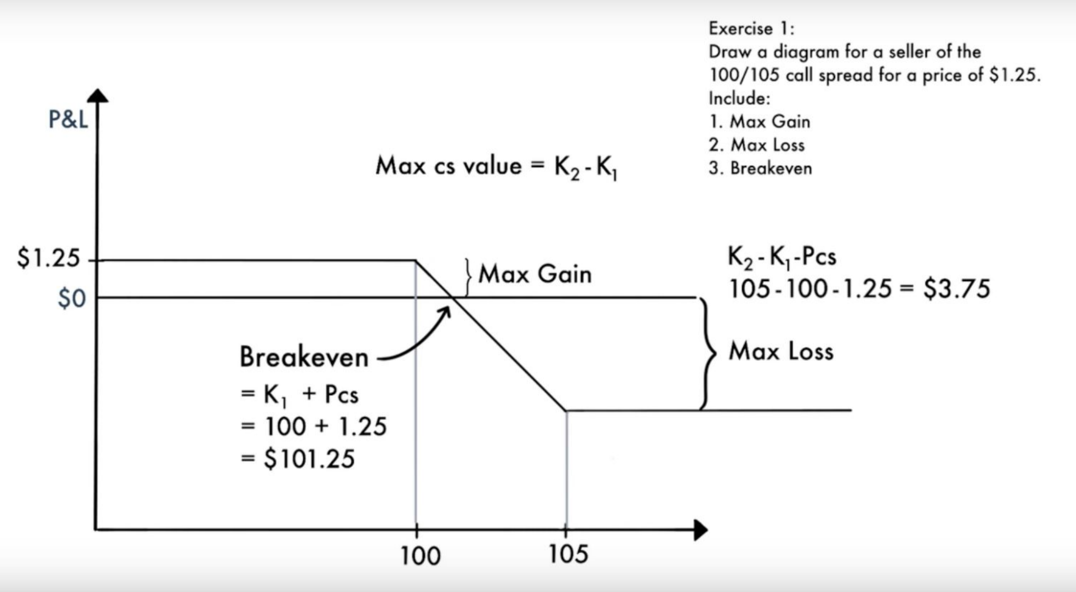


Payoff Diagrams - Call Spreads

Exercise 1:
Draw a diagram for a seller of the 100/105 call spread for a price of $1.25.
Include:

1. Max Gain
2. Max Loss
3. Breakeven

Payoff Diagrams - Call Spreads

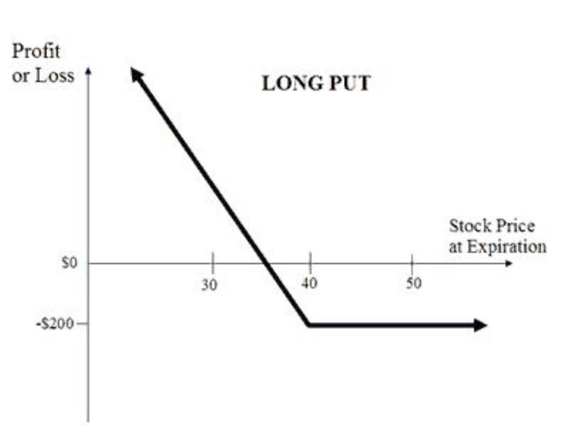


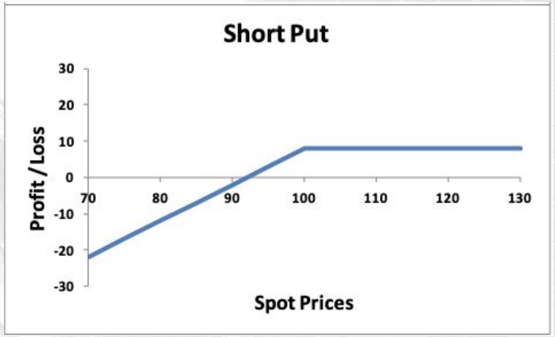
Review – Payoff Diagrams

Short Call

Short Put

Review – Payoff Diagrams

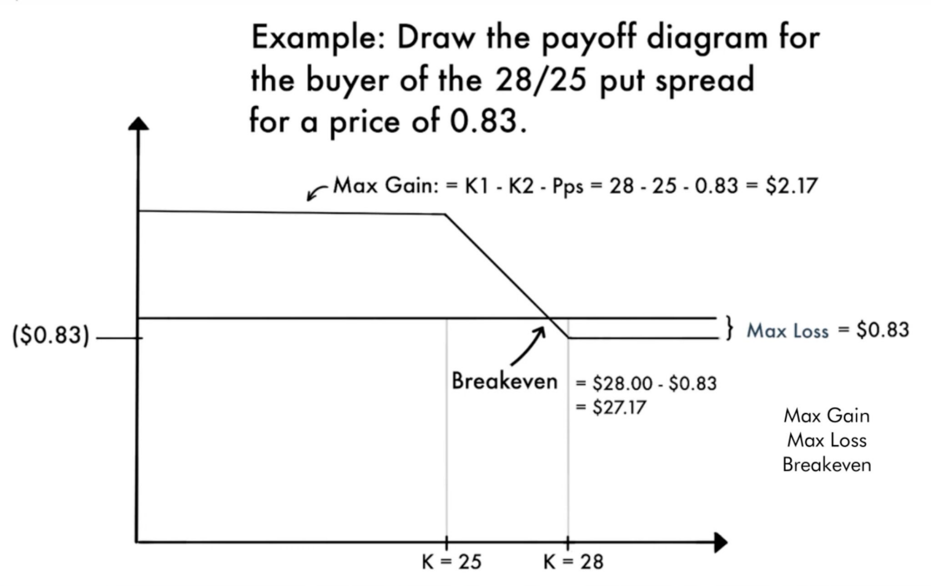




Payoff Diagrams - Put Spreads

Example: Draw the payoff diagram for the buyer of the 28/25 put spread for a price of 0.83.

Payoff Diagrams - Put Spreads



Payoff Diagrams - Put Flies

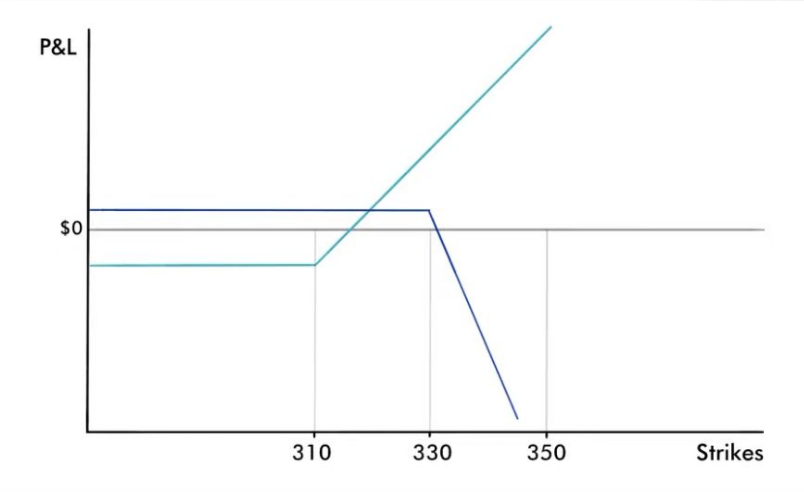
What is a call fly and what does the payoff diagram look like?

A strategy composed +1 strike - 2 strikes + 3rd strike

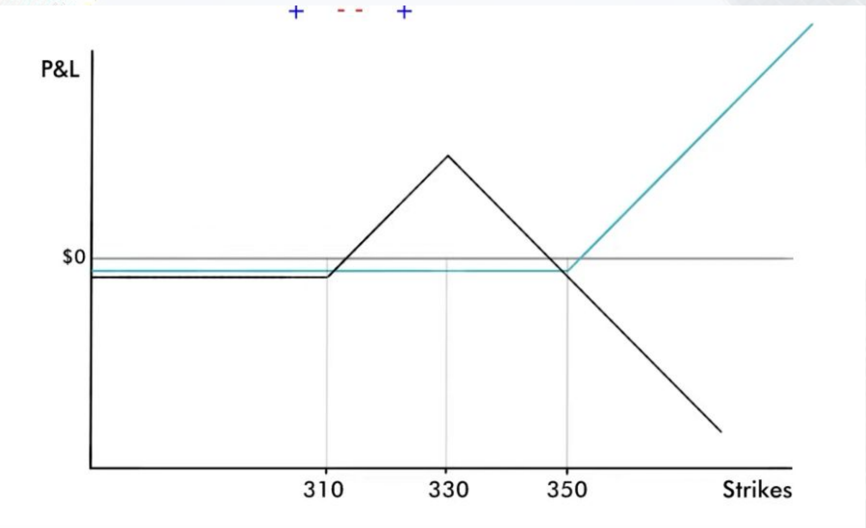
Example: The 310/330/350 call fly : buyer for $7.00

+ - - +

Payoff Diagrams - Put Flies



Payoff Diagrams - Put Flies

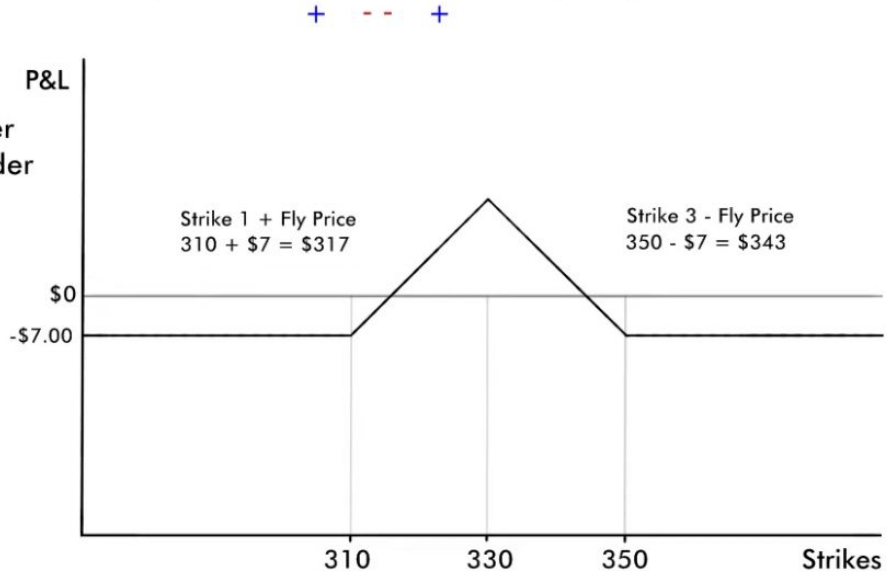


Payoff Diagrams - Put Flies

Max Loss: -$7.00

Max Gain: $13.00

Breakeven: $317 and over
$343 and under



Review - Moneyness

- **Moneyness** relates to how far above/below the strike price the underlying (and thus the option) is.

- **Out of the money (OTM)** means that the underlying spot price (share price of the stock itself) is away from the share price towards the worthless direction (if the option expired today, it would be $0).

- **In the money (ITM)** means that the underlying spot price (share price of the stock itself) is away from the share price towards the valuable direction (if the option expired today, it would still have intrinsic value).

- **At the money (ATM)** means that the spot price is exactly at the options strike price (can think of this as between ITM and OTM).

Intrinsic vs Extrinsic Value

- The **Value** of an option changes over time depending on a host of factors, we can divide this value into two components:

- **Intrinsic Value** is simply what the option would be worth if we were to exercise it at this exact moment (i.e. the actual pnl you would make).

- **Extrinsic Value** is the remainder of an options value besides the intrinsic value, this includes mainly time value of an option.

- **Extrinsic Value** can also be thought of as the difference in the intrinsic value of an option (the value you know you can extract by exercising it), vs the price the option is trading at.

Black Scholes - Greeks

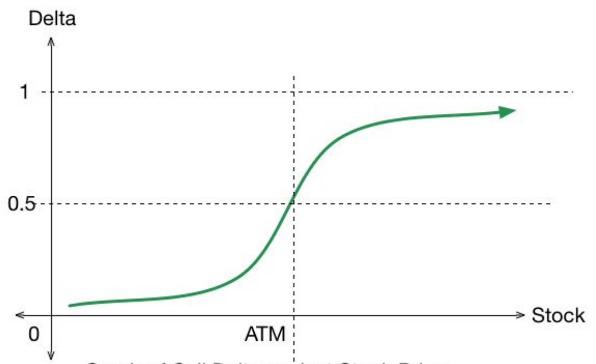
❖ The **greeks** are a set of partial derivatives which describe the effect of different :

	Call	Put
Delta; Δ	$N(d_1)$	$-N(-d_1)$
Theta; Θ	$\frac{-\sigma S N'(d_1)}{2\sqrt{T-t}} - rXe^{-r(T-t)}N(d_2)$	$\frac{-\sigma S N'(d_1)}{2\sqrt{T-t}} + rXe^{-r(T-t)}N(-d_2)$
Gamma; Γ	$\frac{N'(d_1)}{S\sigma\sqrt{\tau}}$	$\frac{N'(d_1)}{S\sigma\sqrt{\tau}}$
Vega; ν	$S_0 N'(d_1)\sqrt{\tau}$	$S_0 N'(d_1)\sqrt{\tau}$
rho	$\tau X e^{-r(\tau)} N(d_2)$	$-\tau X e^{-r(\tau)} N(-d_2)$

Greeks - Delta

$$\Delta = \frac{\partial V}{\partial S}$$

Delta is the Change in the Price of an Option Relative to a $1 Movement in Spot.



Graph of Call Delta against Stock Price

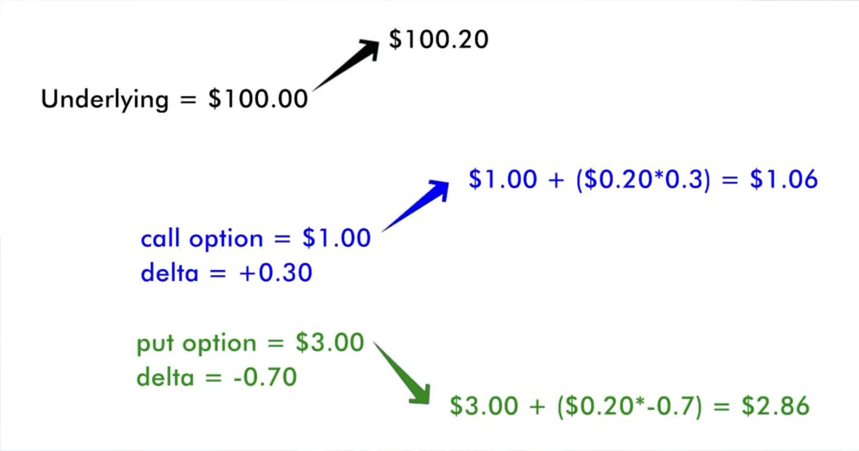
Greeks - Delta

$$\Delta = \frac{\partial V}{\partial S}$$

1. The delta of an option is the sensitivity of an option price to changes in the price of an underlying asset. Delta will tell us how much the price of the option (or option strategy) will change as the underlying changes.
2. Finally, delta can be defined as the probability that an option will expire ITM. E.g. a 0.4 (or 40) delta call is considered to have a 40% chance of finishing ITM.

Greeks - Delta

$$\Delta = \frac{\partial V}{\partial S}$$



Greeks - Delta

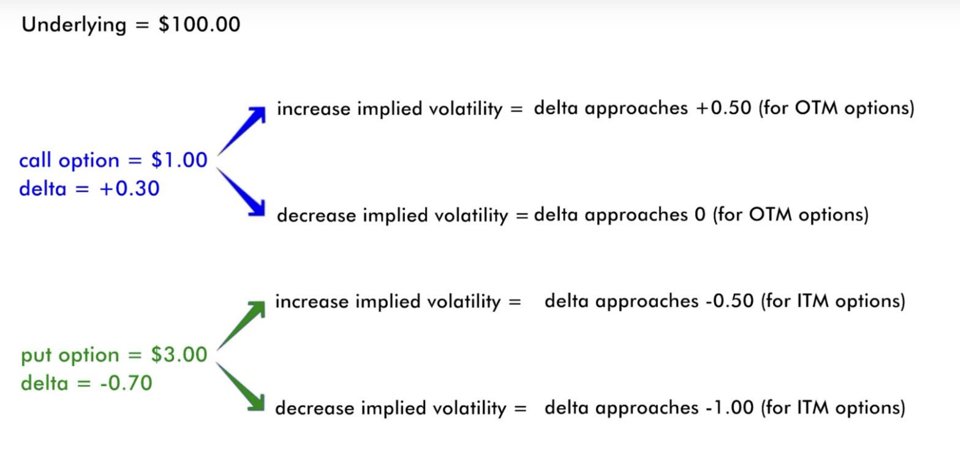
$$\Delta = \frac{\partial V}{\partial S}$$

call d: 0.18
put d: +abs(-0.82)
1.00
= 100%

Call Delta | Calls | Puts | Put Delta

Theta	Gamma	Vol	QBidO	cVolum	C Delta	Bid Qty	BidPx	Theo	Ask Px	Ask Qty	Strike	T Pos	Bid Qty	BidPx	Theo	Ask Px	Ask Qt	P Delta	pVolume	QBidO p
-0.002	0.0001	0.245	0.155		1.00			109.02			260	0	0	0	0.02	0.125	25	0.00		0.048
-0.005	0.0003	0.245	0.155		1.00			99.06			270	0	0	0	0.06	0.125	23	0.00		0.048
-0.010	0.0006	0.245	0.154		0.99			89.16			280	0	25	0.13	0.16	0.250	22	-0.01		0.048
-0.018	0.0011	0.245	0.154		0.98			79.36			290	0	21	0.250	0.36	0.375	21	-0.02		0.049
-0.027	0.0018	0.238	0.154		0.97			69.64			300	0	20	0.625	0.64	0.750	20	-0.04		0.052
-0.039	0.0027	0.231	0.152		0.94			60.09			310	0	19	1.000	1.09	1.125	19	-0.06		0.055
-0.053	0.0040	0.224	0.148		0.91			50.82			320	0	18	1.750	1.82	1.875	18	-0.09		0.058
-0.071	0.0055	0.220	0.145		0.86			42.05			330	0	16	3.000	3.05	3.125	16	-0.14		0.062
-0.089	0.0072	0.216	0.140		0.79			33.87			340	0	15	4.750	4.87	4.875	15	-0.21		0.074
-0.106	0.0088	0.213	0.135		0.71			26.55			350	0	14	7.500	7.55	7.625	14	-0.29		0.091
-0.118	0.0098	0.212	0.124		0.61	11	20.250	20.27	20.375	11	360	0	13	11.250	11.27	11.375	13	-0.39		0.108
-0.122	0.0103	0.211	0.112		0.51	11	14.875	15.00	15.000	11	370	0	12	15.875	16.00	16.000	12	-0.49		0.112
-0.120	0.0099	0.213	0.108		0.41	12	10.875	10.94	11.000	12	380	0	11	21.875	21.94	22.000	11	-0.59		0.124
-0.112	0.0091	0.215	0.098		0.32	13	7.750	7.81	7.875	13	390	0			28.81			-0.68		0.135
-0.099	0.0079	0.217	0.089		0.25	14	5.375	5.49	5.500	14	400	0			36.49			-0.76		0.140
-0.085	0.0065	0.221	0.080		0.18	15	3.750	3.86	3.875	15	410	0			44.86			-0.82		0.145
-0.071	0.0053	0.225	0.073		0.14	16	2.625	2.70	2.750	16	420	0			53.70			-0.86		0.148
-0.058	0.0042	0.229	0.067		0.10	18	1.875	1.89	2.000	18	430	0			62.89			-0.90		0.150
-0.047	0.0032	0.234	0.062		0.07	19	1.250	1.34	1.375	19	440	0			72.34			-0.93		0.150
-0.037	0.0025	0.238	0.058		0.05	20	0.875	0.93	1.000	20	450	0			81.93			-0.95		0.150
-0.028	0.0018	0.241	0.055		0.04	21	0.625	0.63	0.750	21	460	0			91.63			-0.96		0.150
-0.024	0.0014	0.248	0.053		0.03	22	0.375	0.49	0.500	22	470	0			101.49			-0.97		0.150
-0.021	0.0012	0.258	0.052		0.02	23	0.375	0.40	0.500	23	480	0			111.40			-0.98		0.150
-0.015	0.0008	0.258	0.050		0.02	25	0.250	0.26	0.375	25	490	0			121.26			-0.98		0.150
-0.010	0.0006	0.258	0.049		0.01	25	0.125	0.16	0.250	25	500	0			131.16			-0.99		0.155
-0.007	0.0004	0.258	0.049		0.01	0	0.000	0.10	0.125	25	510	0			141.10			-0.99		0.155
-0.005	0.0003	0.258	0.048		0.01	0	0.000	0.06	0.125	25	520	0			151.06			-1.00		0.155
-0.003	0.0002	0.258	0.048		0.00	0	0.000	0.04	0.125	25	530	0			161.04			-1.00		0.155
-0.002	0.0001	0.258	0.048		0.00	0	0.000	0.02	0.125	25	540	0			171.02			-1.00		0.155
-0.001	0.0001	0.258	0.048		0.00	0	0.000	0.01	0.125	25	550	0			181.01			-1.00		0.155
-0.001	0.0001	0.258	0.048		0.00	0	0.000	0.01	0.125	25	560	0			191.01			-1.00		0.155

Greeks - Delta



Greeks - Delta

Underlying = $100.00

call option = $1.00
delta = +0.30

- increase time to expiry = delta approaches +0.50 (for OTM options)
- decrease time to expiry = delta approaches 0 (for OTM options)

put option = $3.00
delta = -0.70

- increase time to expiry = delta approaches -0.50 (for ITM options)
- decrease time to expiry = delta approaches -1.00 (for ITM options)

Deep Dive – Implied Volatility

- **Implied Volatility** is a value dependent on current options black Scholes prices for those options. As we know there are 5 inputs to BSM (spot, strike, expiry, rates, and vol), if we know 4 of these and the market price, we can derive an inverse function to imply the 5th

- In practice this derivation is only really done for volatility hence why we call it ”implied volatility” as we are implying it from BSM.

- This volatility is **forward looking** as it is attached to a strike and expiry date. It is quoted in percent terms where the percent corresponds to a 1 std dev move in price. For example, if spot is $100 and IV is 10% a 1 std dev move in prices implied by the market is from 90 - 110, which, of course, has a 68% probability.

Attendance for Points

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