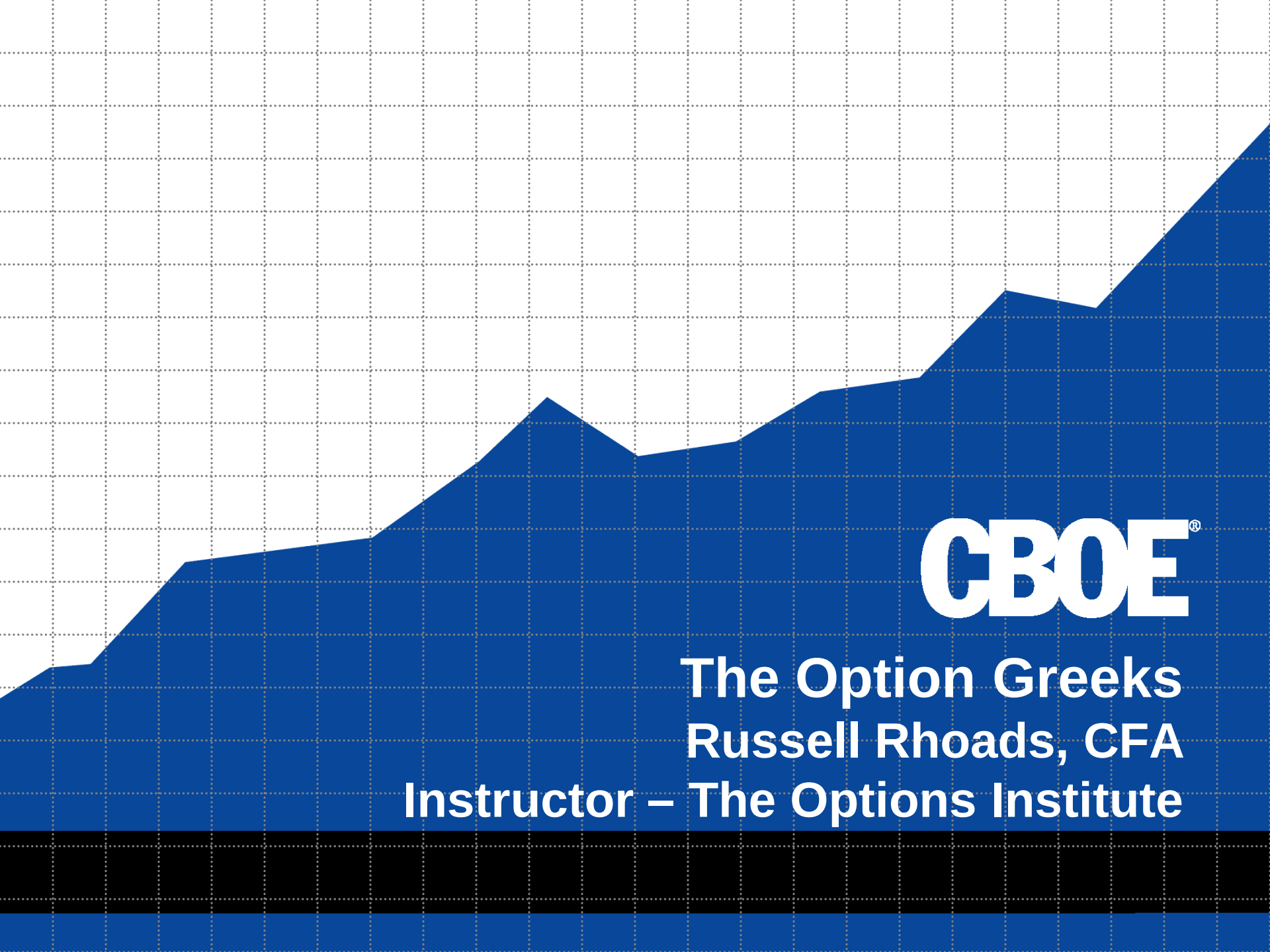

The Option Greeks

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Outline

Pricing Factors

The Greeks

- Price oriented
- Time related
- Volatility
- Interest rate
- Summary

Outline

- Option Pricing Factors
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Option Pricing Factors

Several factors influence the price of an option –

- Underlying (Stock or Index) Price
- Strike Price
- Time To Expiration
- Dividends
- Interest Rates
- Implied Volatility

Option Pricing Factors

Pricing Calculator Example –

Inputs		**Output**	**Call**	**Put**
Price	51.00	Option Value	1.90	1.10
Strike	50.00	Delta	0.60	-0.40
Days to Exp.	30	Gamma	0.12	0.11
Dividends	1.95%	Theta	-0.02	-0.02
Interest Rate	1%	Vega	0.05	0.06
Volatility	25%	Rho	0.01	-0.01

The Greeks

Categories –

Underlying Price	Delta / Gamma
Time to Expiration	Theta
Implied Volatility	Vega
Interest Rates	Rho

Underlying Price - Delta

Delta –

- Delta represents an options price change relative to the underlying price change
- Is an absolute number between 0 and 1 or in a percent term between 0% and 100%
- Delta for a call is positive
- Delta for a put is negative

Underlying Price - Delta

Basic Call Example –

Stock @ 40.00

Call @ 3.00

Call Delta = .50 or 50%

Stock @ 41.00 +1.00

Call @ 3.50 +.50 or (.50 x 1.00)

Underlying Price - Delta

Basic Put Example –

Stock @ 40.00

Put @ 3.00

Put Delta = -.50 or -50%

Stock @ 41.00 +1.00

Put @ 2.50 -.50 or (-.50 x 1.00)

Underlying Price - Delta

Delta Example – Stock @ 41.00

40 Call Delta = .65 / 40 Put Delta = -.35

Stock Price	40 Call	40 Put
40.00	1.35	1.30
41.00	2.00	0.95
42.00	2.65	0.60

Underlying Price - Gamma

Gamma –

- The change in Delta based on a change in the underlying
- Is quoted as a value based on a 1 point move in the underlying
- Gamma could be considered the “Delta of the Delta”
- Is a positive number for both calls and puts

Underlying Price - Gamma

Basic Call Example –

Stock @ 40.00

Call Delta = .50 or 50%

Call Gamma = .05

Stock @ 41.00 +1.00

Call Delta = .55 (.50 + .05)

Underlying Price - Gamma

Basic Put Example –

Stock @ 40.00

Put Delta = -.50 or -50%

Put Gamma = .05

Stock @ 41.00 +1.00

Put Delta = -.45 (-.50 +.05)

Price Related - Delta & Gamma

Delta & Gamma Call Example –

Stock @ 44.00, 45 Call @ 2.00

45 Call Delta = .45, 45 Call Gamma @ .05

Stock Price	45 Call	Delta	Gamma
44.00	2.00	0.45	0.05
45.00	2.47	0.50	0.04
46.00	2.99	0.54	0.04

Price Related - Delta & Gamma

Delta & Gamma Call Example –

Stock @ 44.00, 45 Call @ 2.00

45 Call Delta = .45, 45 Call Gamma @ .05

Stock Price	45 Call	Delta	Gamma
44.00	2.00	0.45	0.05
43.00	1.60	0.40	0.04
42.00	1.26	0.36	0.04

Underlying Price - Delta & Gamma

Delta & Gamma Put Example –

Stock @ 44.00, 45 Put @ 2.50

45 Put Delta = -.55, 45 Put Gamma @ .06

Stock Price	45 Put	Delta	Gamma
44.00	2.50	-0.55	0.06
43.00	3.08	-0.61	0.05
42.00	3.81	-0.66	0.04

Price Related - Delta & Gamma

Delta & Gamma Put Example –

Stock @ 44.00, 45 Put @ 2.50

45 Put Delta = -.55, 45 Put Gamma @ .06

Stock Price	45 Put	Delta	Gamma
44.00	2.50	-0.55	0.06
45.00	1.98	-0.49	0.05
46.00	1.51	-0.44	0.04

Underlying Price - Recap

- Delta and Gamma are functions of the price change of the underlying instrument
- Delta directly impacts an option's price change based on the price change of an underlying instrument
- Gamma is the change in the Delta based on the change in the price of an underlying instrument
- Both give a trader an idea what the price reaction of an option may be to a price move

Time to Expiration - Theta

Theta –

- Measure of the amount of value an option loses over a certain period of time
- May be depicted on a daily or multiple day basis
- Works against the value of both call and put options

Time to Expiration - Theta

Basic Call Example

30 Days to Expiration

Call @ 2.05

Theta = .05

29 Days to Expiration (-1 Day)

Call @ 2.00 -.05 or (1 x -.05)

Time to Expiration - Theta

Basic Put Example

30 Days to Expiration

Put @ 2.05

Theta = .05

29 Days to Expiration (-1 Day)

Put @ 2.00 -.05 or (-1 x .05)

Time to Expiration - Theta

Theta – why it's not so simple –

- The level of time value deterioration changes as expiration approaches
- The longer time to expiration, the slower the day to day loss of time value
- At about 45 days to expiration time value starts to deteriorate at an accelerated pace

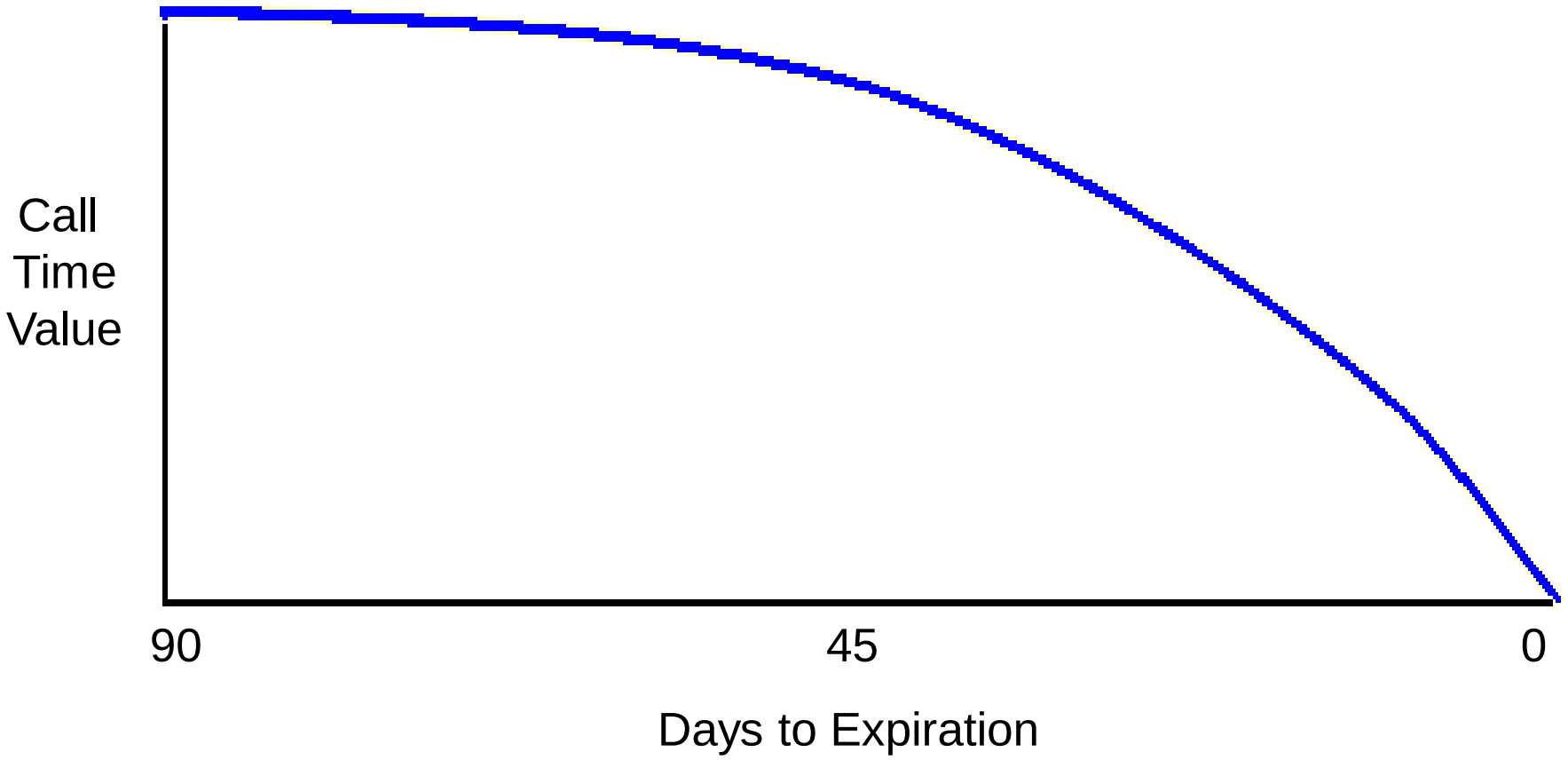
Time to Expiration - Theta

Theta – Multi Day Example

Days To Expiration	45 Call	7 Day Theta
35	1.71	-0.18
28	1.53	-0.21
21	1.32	-0.26
14	1.08	-0.32
7	0.76	-0.76
0	0.00	0.00

Time to Expiration - Theta

Time Decay –



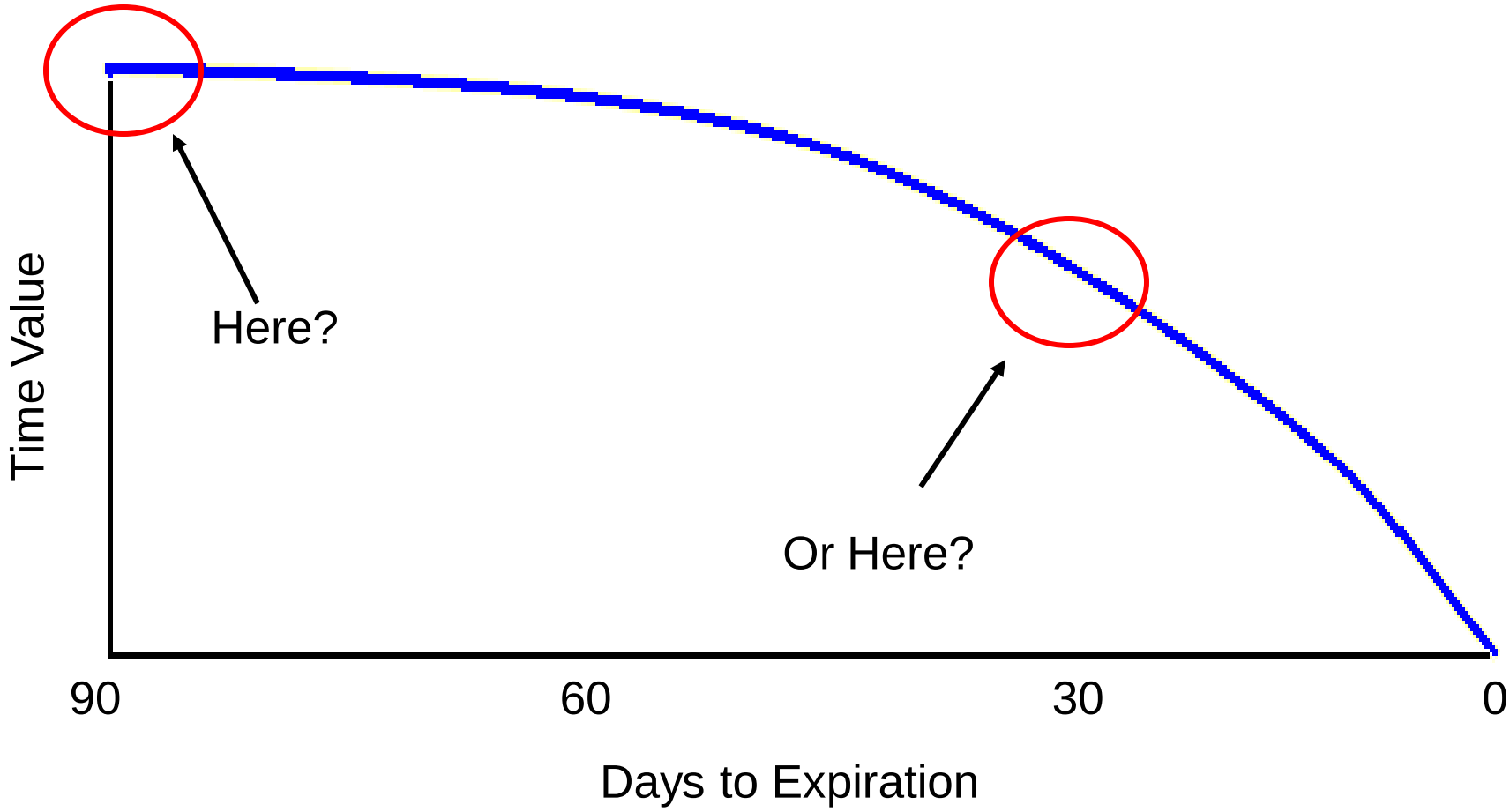
Time to Expiration - Theta

Theta – how to use it to your advantage

- When selling options you benefit from the time value deterioration of the option
- Time to expiration may figure into the Theta of an option
- Theta should be a consideration when choosing an option to sell

Time to Expiration - Theta

Where is better to sell ?



Time to Expiration - Recap

Summary –

- Theta indicates the deterioration of time value of an option over a certain period of time
- Both put and call options experience time deterioration in a similar way
- Theta will vary over the life of an option and the level will accelerate when expiration approaches

Implied Volatility - Vega

Volatility –

- Two types – historical (known) and implied (unknown)
- Historical volatility of a stock may be measured through historical price moves
- Implied volatility is projected by the market through option prices
- Vega relates to implied volatility

Implied Volatility - Vega

Vega –

- Indicates the price change of an option based on a 1% change in volatility
- Is sort of a ‘wild card’ as it may fluctuate over the life of an option
- Both put and call prices react similarly to a rise or fall in volatility

Implied Volatility - Vega

Vega Single Call Example –

Call @ 4.00, Volatility = 35%, Vega = .15

All else the same –

Volatility = 36% +1%

Call @ 4.15 (.15 x 1)

Implied Volatility - Vega

Vega Single Put Example –

Put @ 3.00, Volatility = 35%, Vega = .15

All else the same –

Volatility = 36% +1%

Put @ 3.15 (.15 x 1)

Implied Volatility - Vega

Volatility = 35%, Vega = .35

	30 Call	30 Put
34%	**1.65**	**1.55**
35%	**2.00**	**1.90**
36%	**2.35**	**2.25**

Vega has the same impact on both calls and puts!

Implied Volatility - Recap

Summary –

- Can vary over the life of an option regardless of the other Greeks
- Usually rises in front of an announcement or company event
- Should be taken into account when determining if an option is expensive or cheap

Interest Rates - Rho

Rho –

- Depicts the effect of a change in interest rates on the value of options
- In the current low interest rate environment Rho is not getting much attention
- Has more of an effect on options with more time to expiration (LEAPS®)

Interest Rates - Rho

Rho –
XYZ @ 67.50, 90 Days to Expiration
30% Volatility

	1%	2%	3%
65 Call	**5.40**	**5.49**	**5.59**
65 Put	**2.74**	**2.67**	**2.61**
70 Call	**3.02**	**3.08**	**3.15**
70 Put	**5.35**	**5.24**	**5.14**

Interest Rates - Rho

Rho –
XYZ @ 67.50, 450 Days to Expiration
30% Volatility

	1%	2%	3%
65 LEAPS Call	**10.57**	**10.98**	**11.39**
65 LEAPS Put	**7.26**	**6.85**	**6.47**
70 LEAPS Call	**8.36**	**8.72**	**9.09**
70 LEAPS Put	**9.98**	**9.47**	**8.98**

Interest Rates - Rho

Rho Review –

- The less time to expiration, the lower the impact of a change in interest rates
- A change in interest rates lowers the value of a put and increases the value of a call
- LEAPS positions more likely impacted by a change in interest rates

Greeks - Summary

- There are 4 categories of Greeks to focus on – price, time, volatility, and interest rates.
- Pricing consists of Delta impacting price and Gamma indicating a potential change in Delta
- The impact of a change in volatility is measured by Vega
- Theta indicates the price deterioration of an option over time
- Interest rates (Rho) may come into play with LEAPS positions or when there is a large shift in interest rates