IBKRWEBINARS.COM

December 13, 2021

OCC

Options Pricing, Volatility, and Parity

Edward J Modla
Executive Director
OCC

Exchange and Industry Sponsored Webinars are presented by unaffiliated third parties. Interactive Brokers LLC is not responsible for the content of these presentations. You should review the contents of each presentation and make your own judgment as to whether the content is appropriate for you. Interactive Brokers LLC does not provide recommendations or advice. This presentation is not an advertisement or solicitation for new customers. It is intended only as an educational presentation.

IBKRWEBINARS.COM

IBKRWebinars
by InteractiveBrokers

Disclosure:

Options involve risk and are not suitable for all investors. For information on the uses and risks of options, you can obtain a copy of the Options Clearing Corporation risk disclosure document titled Characteristics and Risks of Standardized Options by calling (312) 542-6901.

Futures are not suitable for all investors. The amount you may lose may be greater than your initial investment. Before trading futures, please read the CFTC Risk Disclosure. For a copy visit interactivebrokers.com.

Security futures involve a high degree of risk and are not suitable for all investors. The amount you may lose may be greater than your initial investment. Before trading security futures, please read the Security Futures Risk Disclosure Statement. For a copy visit Interactivebrokers.com.

There is a substantial risk of loss in foreign exchange trading. The settlement date of foreign exchange trades can vary due to time zone differences and bank holidays. When trading across foreign exchange markets, this may necessitate borrowing funds to settle foreign exchange trades. The interest rate on borrowed funds must be considered when computing the cost of trades across multiple markets.

The Order types available through Interactive Brokers LLC's Trader Workstation are designed to help you limit your loss and/or lock in a profit. Market conditions and other factors may affect execution. In general, orders guarantee a fill or guarantee a price, but not both. In extreme market conditions, an order may either be executed at a different price than anticipated or may not be filled in the marketplace.

There is a substantial risk of loss in trading futures and options. Past performance is not indicative of future results.

Any stock, options or futures symbols displayed are for illustrative purposes only and are not intended to portray recommendations.

- IRS Circular 230 Notice: These statements are provided for information purposes only, are not intended to constitute tax advice which may be relied upon to avoid penalties under any federal, state, local or other tax statutes or regulations, and do not resolve any tax issues in your favor.

- Interactive Brokers LLC is a member of NYSE FINRA SIPC

OIC The Options Industry Council℠

Options Pricing, Volatility, and Parity

Edward Modla

Executive Director, Investor Education
OCC

Business Sensitive

Disclaimer

Options involve risks and are not suitable for everyone. Individuals should not enter into options transactions until they have read and understood the risk disclosure document, Characteristics and Risks of Standardized Options, available by visiting OptionsEducation.org or by contacting your broker, any exchange on which options are traded, or The Options Clearing Corporation at 125 S. Franklin St., #1200, Chicago, IL 60606.
In order to simplify the calculations used in the examples in these materials, commissions, fees, margin, interest and taxes have not been included. These costs will impact the outcome of any stock and options transactions and must be considered prior to entering into any transactions. Investors should consult their tax advisor about any potential tax consequences.

Any strategies discussed, including examples using actual securities and price data, are strictly for illustrative and educational purposes and should not be construed as an endorsement, recommendation, or solicitation to buy or sell securities. Past performance is not a guarantee of future results.

Copyright © 2021. The Options Clearing Corporation. All rights reserved.

Presentation Outline

- Options Pricing Models
- Volatility
  - Historical
  - Implied
  - Vega
- Put Call Parity

Business Sensitive

Option Pricing Models

OIC

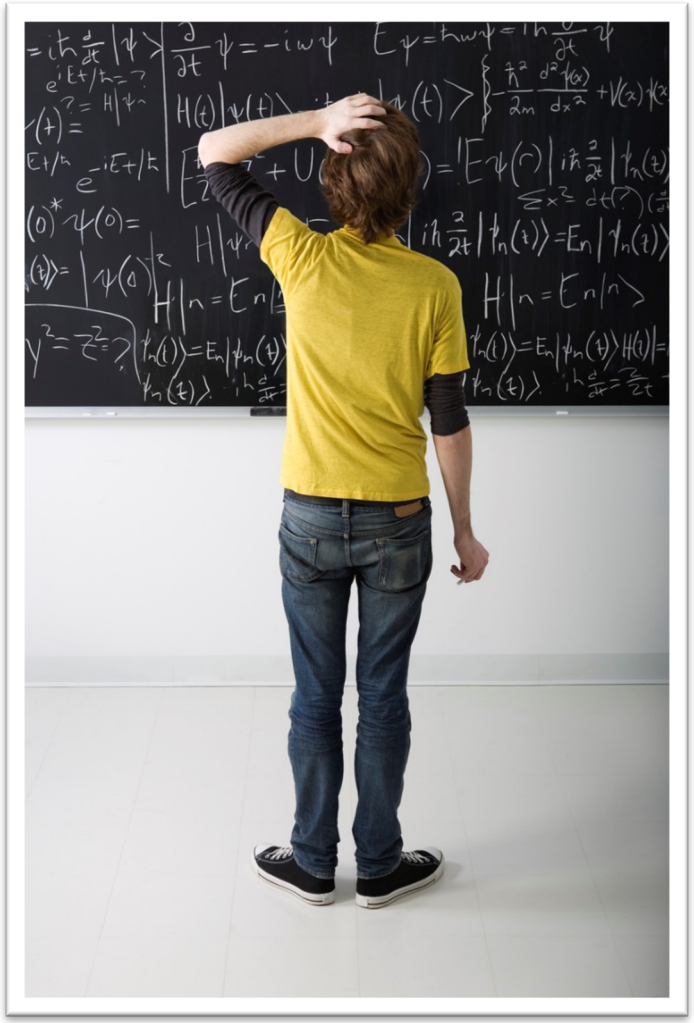
Option Pricing Models

- Mathematical formulas that can be a useful tool in establishing a trading plan
- Can remove emotion from pricing
- Models do not make your investment decisions
- Option prices are subject to many unforeseen variables
  - In addition to pricing factors there is unpredictable ***supply and demand***

Business Sensitive

Option Pricing Models

- **Pricing Model Inputs**
  - Stock price
  - Strike price
  - Volatility
  - Time until expiration
  - Cost of money (interest rates less dividends)
- **Output**
  - Call and put premiums (theoretical values)



Business Sensitive

Black-Scholes Pricing Model

Black-Scholes (1973)

The value of a call option for a non-dividend-paying underlying stock in terms of the Black–Scholes parameters is:

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

The price of a corresponding put option based on put–call parity is:

$$P(S_t, t) = Ke^{-r(T-t)} - S_t + C(S_t, t)$$
$$= N(-d_2)Ke^{-r(T-t)} - N(-d_1)S_t$$

For both, as above:

- $N(\cdot)$ is the cumulative distribution function of the standard normal distribution
- $T - t$ is the time to maturity (expressed in years)
- S_t is the spot price of the underlying asset
- K is the strike price
- r is the risk free rate (annual rate, expressed in terms of continuous compounding)
- σ is the volatility of returns of the underlying asset

Business Sensitive

Cox-Ross-Rubenstein Model

Binomial model:

- American-style options (regular equity contracts)
- Accounts for early exercise and dividends
- Cannot be priced lower than European contracts

Construction:

- Begins by identifying potential higher and lower stock prices from current level
- Calculates option values at each of these identified levels
- Discounts the calculated option values by risk free rate

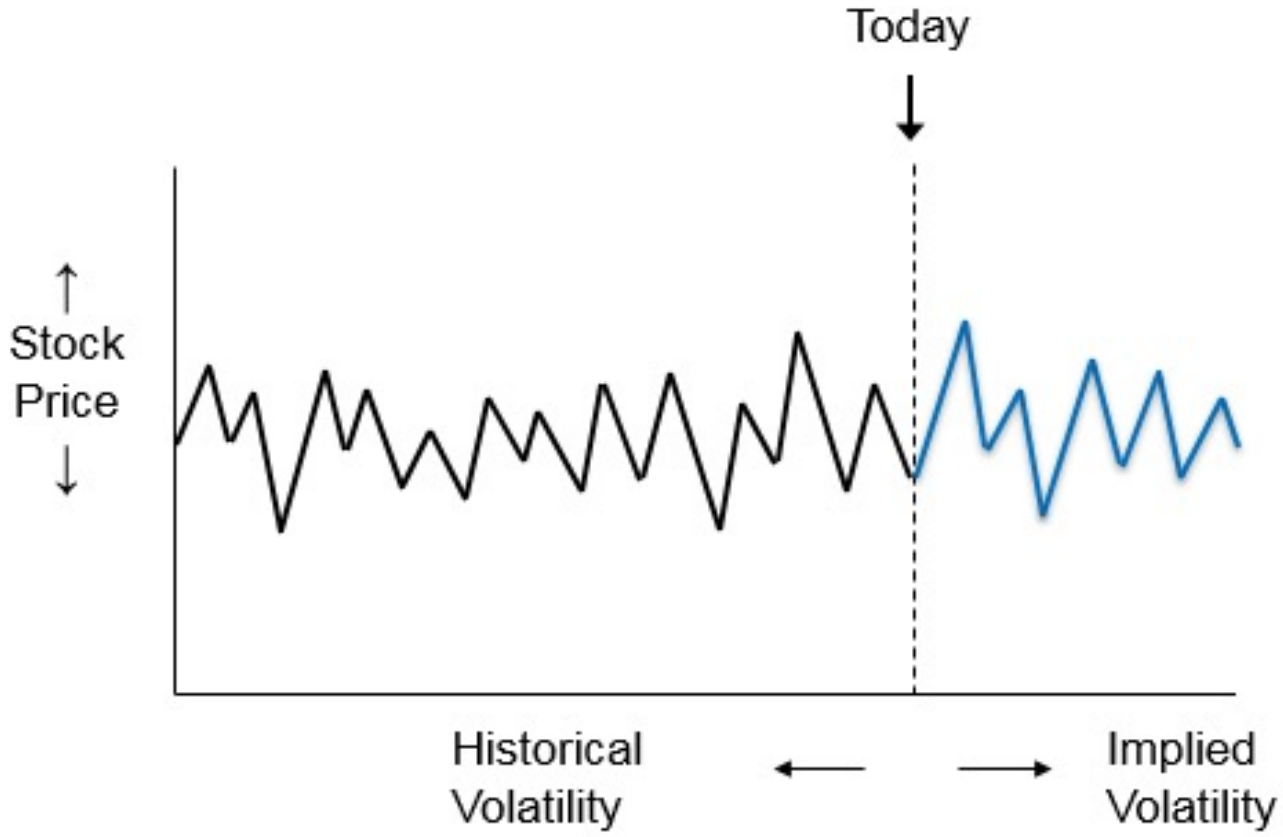
Business Sensitive

Volatility and Vega

OIC | SEMINAR

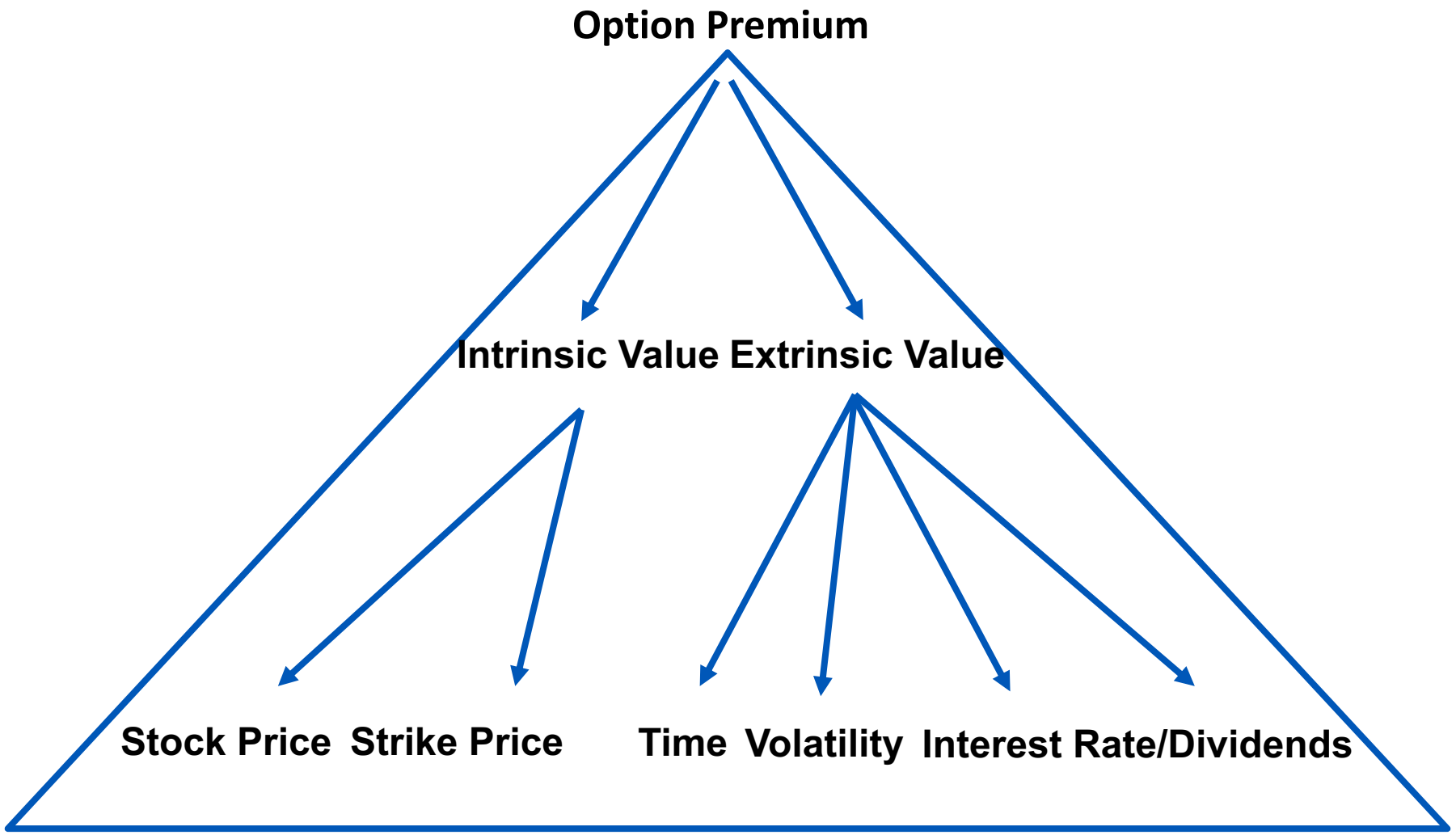
Historical vs Implied Volatility

- Historical represents past stock price fluctuation
- Implied is forward looking and only pertains to options



Business Sensitive

Option Premium



Business Sensitive

Vega: The Volatility Greek

Vega: Option value's sensitivity to volatility

- Expected change in option value
  - With a 1%-point change in implied volatility (IV)
  - Expressed in decimal form (.080)
  - Represents cash amount per option
  - All other pricing factors constant

- Calls and puts both have positive Vega amounts
  - IV ⬆ option value ⬆ by Vega amount
  - IV ⬇ option value ⬇ by Vega amount

Vega

Business Sensitive

Vega in Action

Pre-Earnings

- Stock $100
- 13-day expiry
- 50% IV

	105 Call
Value	**$1.85**
Delta	**.30**
Gamma	**.05**
Theta	**.15**
Vega	**.10**
Rho	**.01**

Post-Earnings

- Stock $105
- 3-day expiry
- 30% IV

	105 Call
Value	**$1.15**
Delta	**.50**
Gamma	**.15**
Theta	**.20**
Vega	**.05**
Rho	**.01**

Even with a $5 increase in share price, these calls lost value due to time decay and decreasing IV

Business Sensitive

Knowledge Check

With a 100-strike call, is Vega greater on a contract expiring in 5 days, 30 days, or 90 days? **90 days**

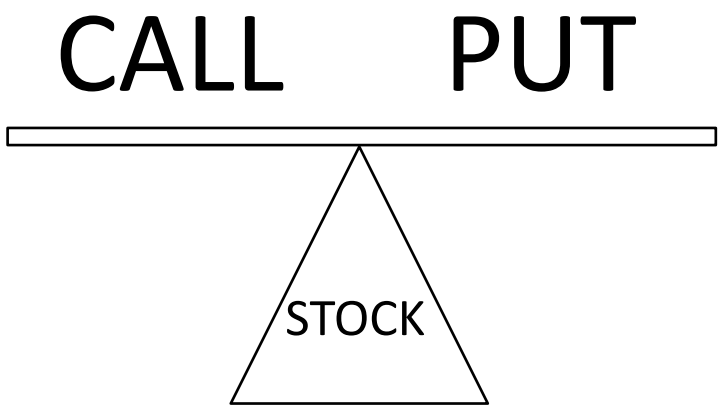
An investor puts on an Iron Condor trade. Do they have a long or short Vega position and will an increase in Vega help or hurt the trade? **Short/hurt**

Business Sensitive

Put Call Parity

Put Call Parity

- **Put Call Parity** is a concept that describes the relationship between call and put prices at the same strike and expiration
  - Knowing value of call can imply value of put, and vice versa
- Holds prices of various financial instruments (incl. options) in check
  - Tighter bid/ask spreads
  - Minimal pricing irregularities



Business Sensitive

Put Call Parity

❑ Put Call Parity Formula:

- Call Premium (C) – Put Premium (P) = Stock Price (S) – Bond (B)
- Bond = current price of bond whose maturity value is equal to the strike price

- Stock trading for $102
- 100 strike call trading $4.50
- 100 strike put trading $2.00
- Bond price is $99.50 (maturity value of $100 at expiration)

Investor A can buy Call and buy Bond for $104.00

Investor B can buy Stock and buy Put for $104.00

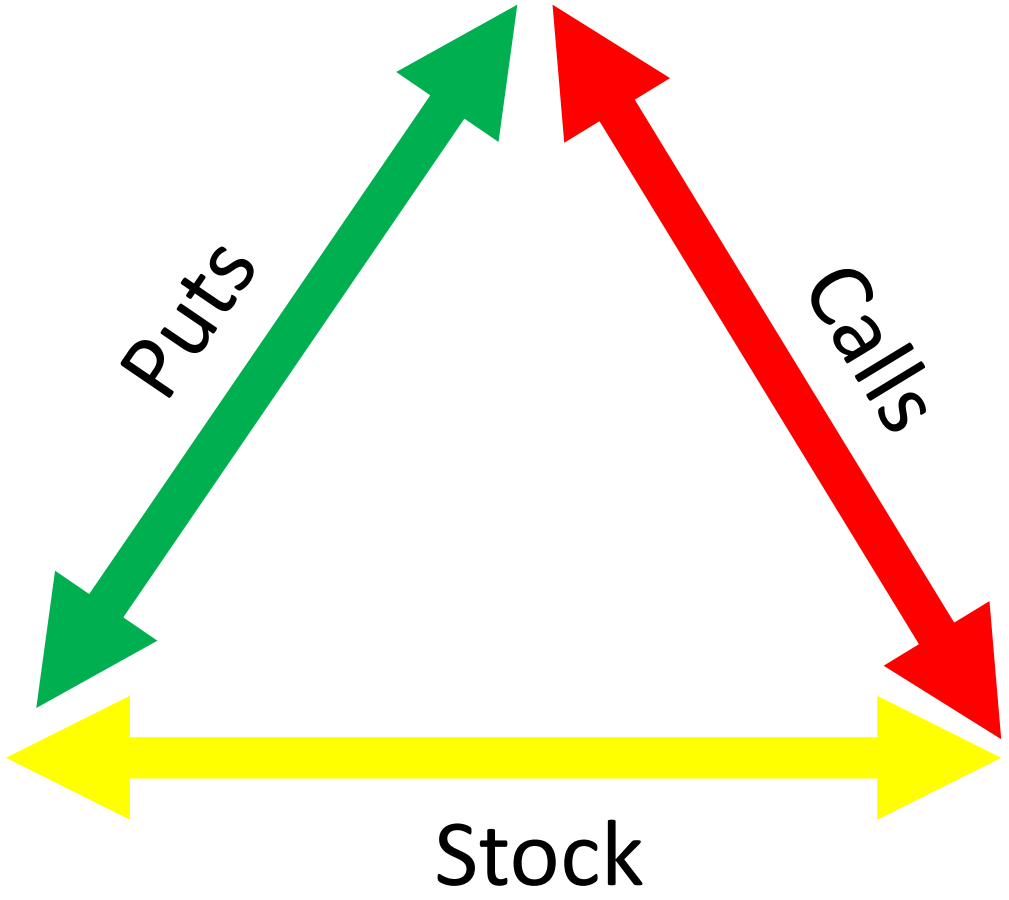
➢ **At expiration, payouts for Investor A and Investor B will be identical**

Business Sensitive

OIC

Put Call Parity

Synthetics: It's possible to recreate the P/L and risk profile of an option using a combination of other options and/or stock



Business Sensitive

About OIC

- **FREE** unbiased and professional options education
- OptionsEducation.org
- Online courses, podcasts, videos, & webinars
- Contact Investor Education at *options@theocc.com*

OIC The Options Industry Council

OCC THE FOUNDATION FOR SECURE MARKETS

Business Sensitive