CME Options Workshop

Options & Risk Management

Options & Risk Management

- Exploring techniques for managing risk in options trading
- Understanding the use of options in hedging strategies
- Analyzing portfolio risk and using options to mitigate downside risk

Let’s start with a poll

Which CME tool can we use to see trends in volatility, skew and kurtosis?

1. SpreadBuilder
2. Cross Correlation
3. **CVOL**

Recall the important points we discussed before

- Reward vs. risk
- Options risks are more difficult than a future
- Any input to the model is a risk

Recall the important points we discussed before

- Delta = options risk with respect to the underlying
  - Rate of change – parity graphs -> how does option change when not at expiration?
  - Hedge ratio – if a market maker uses options and wants to remain neutral, how many shares should they trade to stay neutral?
  - Probability – most relevant for directional traders, delta is approximately equal to the probability of ending in the money
  - Theoretical underlying position – a delta is a delta is a delta; stock replacement, portfolio aggregation
- Gamma – curvature = change in delta for a change in underlying
- Theta aka time decay aka rot = rate at which the option loses value as time passes
- Rho = interest rate risk = change in option price for a change in interest rates

Option Greeks

The option Greeks tell us how much the BSM option value will change for a small change in a particular parameter, *holding everything else constant.*

The Option Greeks include:

Delta: The change in an option value for a given small change in the value of the underlying.

Gamma: The change in a given option delta for a given small change in the underlying's value.

Theta: The change in an option value for a given small change in calendar time.

Vega: The change in an option value for a given small change in the volatility of the underlying.

Rho: The change in a given option value for a given small change in the risk-free interest rate.

Delta Hedging

Delta hedging an option is the process of establishing a position in the underlying future of a quantity that is prescribed by the option delta, so as to have no exposure to very small moves up or down in the future price.

The delta of the hedging instrument is denoted as $Delta_H$.

A delta-neutral portfolio will not change in value for small changes in the underlying asset. Delta neutral implies the portfolio delta plus $N_H Delta_H$ is equal to 0.

Delta hedging example

Let’s use CME Direct

Gamma RISK

Gamma: The change in a given option delta for a given small change in the underlying futures's value, holding everything else constant.

Option gamma is a measure of the curvature in the option price in relationship to the future price.

Gamma for a call and put option are the same

Gamma is always non-negative and takes on its largest value when an option is near at the money.

Gamma measures the non-linearity risk or the risk that remains once the portfolio is delta neutral.

Gamma Risk

Futures prices often jump rather than move continuously and smoothly, which creates “gamma risk.”

Gamma risk is so-called because gamma measures the risk of future prices jumping when hedging an option position and thus leaving a previously hedged option position suddenly unhedged.

Gamma acceleration as we approach expiration

QuikStrike simulation demo

Theta, Vega, and rho

Theta: The change in an option value for a given small change in calendar time

Theta measures time decay, the rate at which option time value declines as time passes (and expiration approaches)

Theta is negative for options; as calendar time passes, time to expiration declines and the option loses value

Theta, Vega, and rho

Vega: The change in an option value for a given small change in the volatility of the underlying future

An increase in volatility results in an increase in option value. Vega is always positive, and vega of a call equals vega of a similar put

Note that vega is based on an unobservable parameter, future volatility. Of the five BSM variables, an option's value is most sensitive to volatility changes.

Theta, Vega, and rho

Rho: The change in a given option value for a given small change in the risk-free interest rate

Rho is positive (negative) for a call (put). This is because buying a call avoids the financing costs involved with purchasing the future, while buying a put delays the chance to earn interest on proceeds of the future sale.

Interaction time:

A trader is long a future on corn ahead of a WASDE report. She is uncomfortable with this risk. What are her choices?

Basic options concepts

- Risk management vs. income generation
  - Risk management – buying insurance
  - Income generation – selling insurance
- Users of options traditionally – CTAs, pensions & endowments, hedge funds, investment advisors and retail
- Distribution of outcomes / scenario analysis / breakeven analysis
- Implied volatility (vs. realized or historical volatility)
- Skew – relative pricing of puts vs. calls
- Number of players may change but there is always a need to manage others' risk

Risk adjustment tools

- With derivatives there are many ways to accomplish a particular risk/return profile.
- A portfolio manager who seeks to reduce market exposure to a particular asset could:
  - Sell some of the underlying
  - Enter into a futures or forward contract to sell part of the underlying
  - Write covered calls
  - Buy protective puts
  - Enter into a collar

Let’s look into an example in QuikStrike but before we do, something to remember …

Put-Call Parity

- The net cost of buying a synthetic option must equal the net cost of buying the “actual” option
- The net cost of buying a synthetic asset must equal the net cost of buying the “actual” asset
- The net cost of buying a synthetic futures contract must equal the net cost of the “actual” forward (or futures) contract
- These relationships reflect “The Law of One Price”

Put-Call Parity

- The net cost of buying the asset using options must equal the net cost of buying the asset using a futures contract
- Call (K, t) – Put (K, t) = PV ($F_{0,t}$ – K)

  where Call (K, t) and Put (K, t) denote the premiums of options with strike price = K and time to expiration = t, and PV ($F_{0,t}$) is the present value of the forward price

  Positive = long position, Negative = short position
- **This is one of the most important relationships in options!**

Put-Call Parity

- Call (K, t) – Put (K, t) = PV ($F_{0,t}$ – K)
- PV ($F_{0,t}$ – K) = PV($F_{0,t}$) − PV (K)
  - PV($F_{0,t}$) = S_t
  - PV (K) = Ke^{-rt}

So:

- Call (K, t) – Put (K, t) = S_t − Ke^{-rt} prior to expiration (t > 0)
- Call (K, t) – Put (K, t) = S_t − K at expiration (t = 0)

Now, onto QuikStrike

Let’s end with a poll

Once I put on an options trade it is set-it-and-forget-it

1. True
2. **False**

Questions?

The last session is on Black-Scholes

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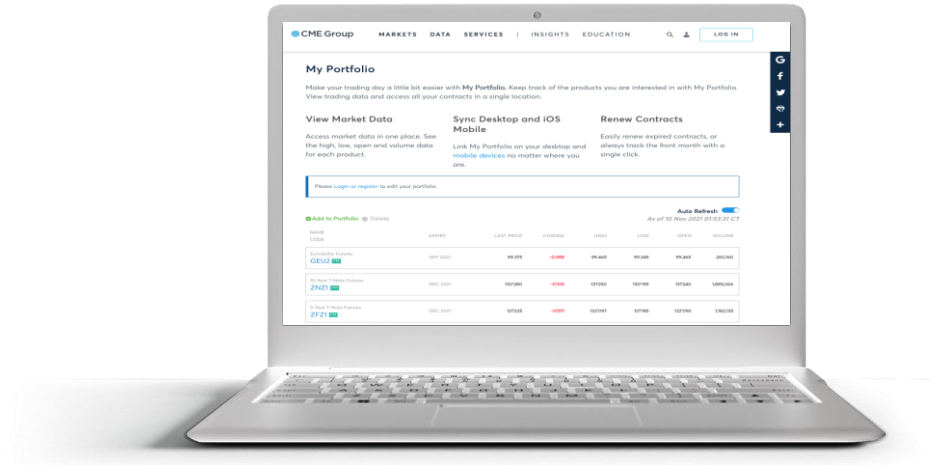

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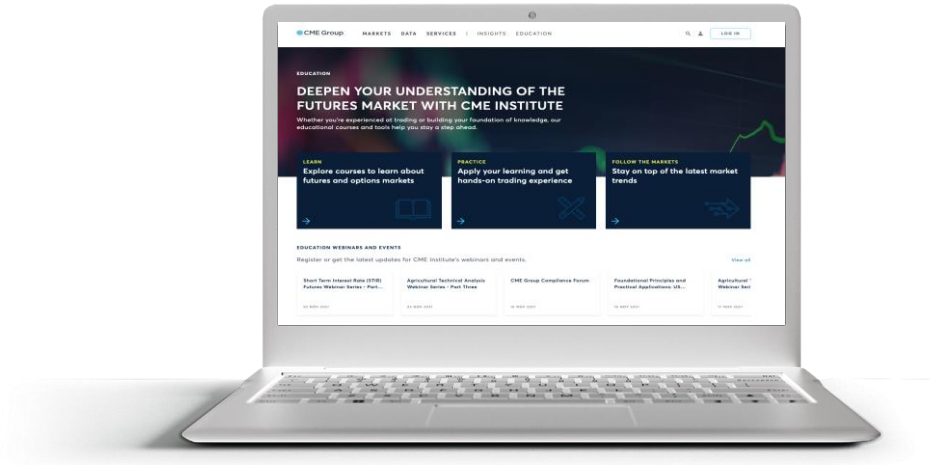

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