Options: Introduction & Applications

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ECON 4905
Agenda

- Calls & Puts
  - House insurance example
- Greeks
  - Delta, Gamma, Theta, Vega
- Application: personal trading
- Application: professional trading
- Application: VIX
Calls & Puts - House Insurance Example

- House worth \( U \)
- 2 states of world
  - Everything’s fine ($U value)
  - House burns down ($0 value)
- Risk-averse → want to buy fire insurance
  - In bad state of world, insurance company will give you \( X \)
- Suppose we pay fire insurance premium up front

- What factors influence the cost of this fire insurance?
Calls & Puts - House Insurance Example, cont.

- Current price of house (U)
- Insurance payout (X)
- Time period insurance covers
- Likelihood of bad state of world
Calls & Puts - House Insurance Example, cont.

- Current price of house (U)
- Insurance payout (X)
- Time period insurance covers
- Likelihood of bad state of world

- Put: right (but not obligation) to sell an asset at a certain price within a certain time period
- How do the 4 inputs above apply to a Put?
Calls & Puts - House Insurance Example, cont.

- Current price of house (U) <> Underlying Price
- Insurance payout (X) <> Strike Price
- Time period insurance covers <> Time to Expiry
- Likelihood of bad state of world <> Volatility

- Stuff that doesn’t matter as much:
  - Risk-free rate
  - Dividend Yield
Calls & Puts - House Insurance Example, cont.

What happens to the insurance premium if...

- Current price of house (U) increases?
- Time period insurance covers increases?
- Likelihood of bad state of world increases?
Calls & Puts - House Insurance Example, cont.

What happens to the insurance premium if...

- Current price of house (U) increases? → decrease
- Time period insurance covers increases? → increase
- Likelihood of bad state of world increases? → increase
Options Greeks

- How much do they increase/decrease?
- These relationships are denoted by the Greeks
Greeks: Delta

- As the price of the house increases, the insurance premium decreases
  - Similarly, as $U$ increases, $P$ decreases
- How much does $P$ decrease?
Greeks: Delta

- As the price of the house increases, the insurance premium decreases
  - Similarly, as $U$ increases, $P$ decreases
- How much does $P$ decrease? $\rightarrow$ defined marginally by $\frac{\delta P}{\delta U}$ (Delta)
- ATM: $50\Delta$
  - ATM, OTM, ITM
- Roughly approximates moneyness
Greeks: Delta

- As the price of the house increases, the insurance premium decreases
  - Similarly, as $U$ increases, $P$ decreases
- How much does $P$ decrease? → defined marginally by $\frac{\delta P}{\delta U}$ (Delta)

**Figure 1: Call delta vs underlying**

Source: http://www.optiontradingtips.com/greeks/delta.html
Greeks: Gamma

- But Δ only describes δP/δU at the margin -- how does Δ itself change?
- Gamma: δΔ/δU = δ^2P/δU^2
- Normal curve
  - Note: B/S assumes stock returns normally distributed
Greeks: Theta

- Time period insurance covers increases → premium increases
- As time passes (time period decreases) → premium decreases
- But how much does it decrease?
Greeks: Theta

- Time period insurance covers increases → premium increases
- As time passes (time period decreases) → premium decreases
- But how much does it decrease?
- Defined by theta: $\delta P/\delta t$
- Also a normal curve
Greeks: Vega

- Likelihood of bad state of world increases → premium increases
- More volatility → premium increases
- But how much does it increase?
Greeks: Vega

- Likelihood of bad state of world increases → premium increases
- More volatility → premium increases
- But how much does it increase?
- Defined by vega: $\frac{\delta P}{\delta \sigma}$
- Also a normal curve
Application: Personal Trading

- Covered calls
- Cash-secured puts
- Call/Put Spreads
Covered Calls

- Generally done by “income” investors
- Buy dividend stock + sell upside call
- Pretty good if you were just going to buy + hold anyways
Covered Call Example
Covered Call

- $\sigma_{ATM} = 20.45 = 20.45\%$ move in 1 year is within 1 SD
  - $\sigma_{3\text{ months}} = \sigma_{12\text{ mo}} \times \sqrt{\frac{1}{4}} = 10.225\%$ move in 3 months is within 1 SD

<table>
<thead>
<tr>
<th>State of the World</th>
<th>3-month Return</th>
<th>Benchmark (No Call)</th>
<th>Annualized Return</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up</td>
<td>7.42%</td>
<td>11.33%</td>
<td>33.1%</td>
</tr>
<tr>
<td>Neutral</td>
<td>2.53%</td>
<td>1.11%</td>
<td>10.5%</td>
</tr>
<tr>
<td>Down</td>
<td>-7.69%</td>
<td>-9.12%</td>
<td>-27.4%</td>
</tr>
</tbody>
</table>
Cash-Secured Puts

- Sell downside put
- Actually has the same risk profile as a covered call
  - $C = P + 1 \text{ delta}$
  - $1 \text{ delta} - C = - P$
Call Spreads & Put Spreads

- Suppose you think there’s a floor or ceiling to the stock
- How can you make money?
  - Can’t really with equities (or at least, a lot of variance)
  - Sell a CS/PS
PS Example -- TSLA

Market Summary > Tesla Inc
NASDAQ: TSLA

337.34 USD +6.44 (1.95%) ↑
Oct 29, 2:46 PM EDT · Disclaimer

1 day 5 days 1 month 6 months YTD 1 year 5 years Max

264.77 USD Fri, Sep 28
PS Example -- TSLA

- 9/28/18
- -15% on SEC lawsuit news
- Sell Nov (11/16) 225-200 PS (sell 225 P, buy 200 P)
- $5.41 premium → $1959 margin

- +15% on settling
- Bought back for 2.36
- $305 profit (15.6% return)
Application: Professional Trading

- Delta hedging
- Trading vol/gamma
Delta Hedging

- We don’t know where underlying will move
  - Short-term: equity returns are random walk
  - Similar to pairs trading (hedging beta) -- want to make money b/c we’re right, not b/c overall market (or underlying, for delta hedging) moves

- Constantly re-hedge as underlying moves due to gamma
  - Also: Charm ($\delta \Delta / \delta t$) at expiry, etc
Trading Vol/Gamma

- Long 1 STD (1 C, 1P) → long gamma
- Move a bit and one huge move VS 1 huge move then move a bit -- which better?
Trading Vol/Gamma

- Long 1 STD (1 C, 1P) → long gamma
- Move a bit and one huge move VS 1 huge move then move a bit -- which better?
- Gamma normal curve property
The Cboe Volatility Index - more commonly referred to as the "VIX Index" - is an up-to-the-minute market estimate of expected volatility that is calculated by using real-time prices of options on the S&P 500® Index listed on Cboe Exchange, Inc. ("Cboe Options") (Symbol: SPX). The VIX Index is calculated using SPX quotes generated during regular trading hours for SPX options. The VIX Index uses SPX options with more than 23 days and less than 37 days to expiration and then weights them to yield a constant, 30-day measure of the expected volatility of the S&P 500 Index.

VIX

- Estimate SPX IV with average tte of 30 days
- Quoted in percentage points for 1 SD annualized move
  - Can calculate for other time periods from annualized figure
Trading VIX

- Can’t directly trade VIX
- VIX futures
- VIX-tracking ETF/ETNs
  - Long: VXX
  - Short: SVXY
  - Construct 30-day VIX future via different weights on actual VIX futures
- Contango, etc