Options Part 3

Pritam Dalal

Options Buyer and Sellers

- In any insurance transaction there is a buyer and a seller.
- In most insurance markets there are certain classes of entities that buy the insurance, and other classes of entities that sell the insurance.
- For example, I've purchased car insurance from both State Farm and GEICO. There is never a time that GEICO or State Farm would buy insurance from me.
- Options markets are different. Many entities (market-makers, hedge funds, retail traders) often both buy options and sell options.
- Said in a different way, in an options transaction the buyer and seller can be the same class of entity.

Net Positions (1 of 3)

- As you saw from the exercises in the Options Part 2 slides, the payoff function of the option seller is the negative of the payoff function of the options.
- For this reason, let's associate the number $+1$ with the act of buying an options contract.
- Similarly, let's associate the number -1 with the act of selling an options contract.
- More generally, we can associate a *quantity* number Q with an options trade. If $Q > 0$ then the trade is to buy Q options. If $Q < 0$ then the trade is to sell $|Q|$ options.

Net Positions (2 of 3)

- Suppose Liwei has engaged in n trades on a particular option contract $\mathcal{O}$ and that the quantities of the trades were $Q_1, \ldots, Q_n$.

- Liwei's *net position* in the option $\mathcal{O}$ is Q^* where:

$$Q^* = \sum_{i=1}^{n} Q_i$$

Net Positions (3 of 3)

- If $Q^* > 0$ we say that Lewei is *long* Q^* contracts of $\mathcal{O}$. More generally, we would say that Lewei has a *net long* position in $\mathcal{O}$.

- If $Q^* < 0$ we say that Lewei is *short* $|Q^*|$ contracts of $\mathcal{O}$. More generally, we would say that Lewei has a *net short* position in $\mathcal{O}$.

Exercises: Trader Talk - *Long* vs *Short*

These questions are slight generalizations of some of the questions from Options Part 2. Assume that your only position related to the underlying is the options position that is mentioned.

1. If you have a net long position in a put, are you long or short the underlying?
2. If you have a net short position in a put, are you long or short the underlying?
3. If you have a net long position in a call, are you long or short the underlying?
4. If you have a net short position in a call, are you long or short the underlying?

Option Pricing

- What *should* the price of an option be at any given point in time?
- This seems like an innocent question, but it took the collective quantitative finance community over one hundred years to answer in a satisfactory way. Along the way modern finance was born.
- On your own mathematical finance journey, expect it to take years of concerted effort to fully absorb this material.
- In this class, I'm going to give you an extremely high-level overview of some aspects of option pricing. Just enough so that we can do some meaningful analysis on options data.

Black-Scholes-Merton Formula

- In the 1970s, decades of option pricing research coalesced into a pricing framework that yielded a fairly simple formula that can price vanilla options.
- Understanding the framework is more important than memorizing the formula.
- We don't have enough time to dig too deep into the framework.
- We won't fixate on the formula too much either.

Black-Scholes-Merton Formula

$$m = \mathrm{BSM}(\mathrm{p/c}, K, \mathrm{T}, S_t, \sigma, \delta, r)$$

Contract Features

- p/c - put or call
- K - strike price
- T - expiration date (time to expiration)

Market Values

- S_t - current underlying price
- σ - estimate of the standard deviation log-return of the price of underlying between now and expiration
- δ - estimate of dividends paid over the life of the option
- r - risk-free interest rate

Volatility - σ

- All the inputs of the BSM formula are readily observable, except for σ.
- The options market is the *volatility* markets.
- The market for the underlying stock is the *expected-return* market.
- **Question:** Suppose Jake is an SPY trader for Wolverine and that on a given day, the price of SPY drops by 10%. Should Jake increase or decrease σ in his pricing models?