**Option Markets**

* Basics
  + Derivative: financial contract whose value “derives” from a traditional security (stock or bond), an asset (commodity), or a market index
  + Financial option: contract that gives its owner the right but not the obligation, to purchase or sell an asset at a fixed price at some future date
    - Call option: the right to buy
    - Put option: the right to sell
  + The option premium is the purchase price of the option
* Option contract
  + Exercising an option: when the holder of an option enforces the agreement and buys or sells a share of stock at the agreed-upon price
  + Strike price: price at which they buy or sell
    - Also called exercise price
  + Expiration date: the last date on which an option holder has the right to exercise
* Option types
  + American option
    - Can be exercised on or before its expiration
    - Options on individual stocks are typically American
  + European option
    - Can be exercised only at its expiration
    - Options on indices (e.g. S&P 500) are typically European
* Option contract terms
  + Option buyer (holder)
    - Holds the right to exercise the option
    - Has a long position in the contract
  + Option seller (writer)
    - Sells the option
    - Has a short position in the contract
    - Because the long side has the option to exercise, the short side has an obligation to fulfill the contract if exercised
* Option trading
  + Most options are on organized exchanges
  + Each contract provides for the right to buy or sell 100 shares of stock
  + Open interest
    - Total number of contracts of a particular option that have been written
* Trading options—what actually happens
  + Individual stock options
    - Typically physically settled
    - You actually use your right to buy or sell and trade the underlying security
    - In order to receive the value, you would then need to make a second trade
  + Index options
    - Typically cash settled
    - Rather than actually exercising the right to buy or sell the underlying (which is an entire index), you simply receive the value of the option in cash
* Option expiration
  + Traditionally, all traded options expire on the Saturday following the third Friday of the month
    - As of 2/1/2015, all option products on the CBOE expire on Friday
  + More than that has changed
    - Other short-term expirations (“weeklys”) may be available
    - These offerings will differ based on the underlying asset
  + Expirations still tend to be fairly short, typically only a few months
* Option expirations—general guidelines
  + Individual stock options
    - ≤ 2 months: every Friday
    - ≥ 2 months: every third Friday
  + Index options
    - ≤ 1 month: every Monday, Wednesday, and Friday at the end of the month
    - 2-3 months: every Friday and the end of the month
    - 4 months-1 year: third Friday and the end of the month
    - > 1 year: third Friday
  + Note: the calendar dates are just for reference. The exchange generally allows for a min and max number of maturities for each type of option to be traded at a time, which generally fills these time windows
* “Moneyness”
  + Near the money
    - Option whose exercise price is close to the current stock price
  + At the money
    - Option whose exercise price equals the current stock price (S=X)
  + In the money
    - Option whose value would be positive if exercised immediately
      * Call: S>X
      * Put: S<X
  + Out of the money
    - Option whose value would be negative if exercised immediately
      * Call: S<X
      * Put: S>X
* Why options?
  + To hedge
    - Reduce risk by holding options whose payoffs are negatively correlated with some risk exposure
    - Ex. A famer might use options to guarantee a minimum price for their crops in a season
    - Ex. A multinational firm might use currency options to avoid adverse exchange rate movements
  + To speculate
    - Using options to place a bet on the direction the market is likely to move
    - Ex. George Soros “broke the Bank of England” by betting against the pound
    - Note: not necessarily bad🡪how would the hedgers be able to shed risk if no one was willing to take it?
* Option payoffs: long call (we bought)
  + Use option to buy (-X)
  + Sell at market price (S)
  + The value of a call at expiration is:
    - C = max (S-X, $0)
  + Where:
    - S = stock price at expiration
    - X = exercise price
    - C = value of the call option
* Example: Long Call
  + You own a call option on Cisco with a strike price of $40. The option will expire in exactly 3 months’ time
    - If the stock is trading at $55 in 3 months, what will be the payoff of the call?
    - If the stock is trading at $35 in 3 months, what will be the payoff of the call?
* Option payoffs: long put (we bought)
  + Buy at market price (-S)
  + Use option to sell (X)
  + The value of a put at expiration is:
    - P = max(X-S, $0)
  + Where:
    - S = stock price at expiration
    - X = exercise price
    - P = value of put option
* Example: Long put
  + You own a put option on Ford with a strike price of $10. This option will expire in exactly 6 months’ time
    - If the stock is trading at $8 in 6 months, what will be the payoff of the put?
    - If the stock is trading at $23 in 6 months, what will be the payoff of the put?
* Option payoffs: short call
  + The value of a short call option at expiration is:
    - C = -max(S-X, $0)
* Example: short call
  + You wrote a call option on Time Warner with a strike price of $80. The option will expire in exactly one year
    - If the stock is trading at $72 in one year, what will be your payoff from the call?
    - If the stock is trading at $86 in one year, what will be your payoff from the call?
* Option payoffs: short put
  + The value of a short put option at expiration is:
    - P = -max(X-S, $0)
* Example: short put
  + You wrote a put option on Spotify with a strike price of $110. The option will expire in exactly 3 months’ time
    - If the stock is trading at $105 in 3 months, what will be your payoff from the put?
    - If the stock is trading at $115 in 3 months, what will be your payoff from the put?
* Option strategies
  + By combining the puts and calls with various exercise prices, we create an unlimited variety of payoff patterns
  + Useful for both speculation and hedging
  + Portfolios of puts and calls
    - By the law of one price, if the cash flows are the same, the prices must be the same
* Straddle
  + A portfolio that is long a call and a put on the same stock with the same exercise date and strike price
  + Example: suppose you set up a straddle at $100 on Walmart. What would your payoff be from this position if the underlying stock is trading at $110 at expiration?
* Straddle Illustrated
  + A straddle will pay off any time the price does not remain constant at the strike price
  + But, only one option will pay off at a time
    - We still had to pay for both
    - Might require a significant deviation to be profitable
* Strangle
  + A portfolio that is long a call and a put on the same stock with the same exercise date, but the strike price on the call is higher than the strike price on the put
  + Example: you are long a call option and a put option on Cisco stock with the same expiration date. The exercise price of the call is $42 and the exercise price of the put is $38
* Straddle vs. Strangle
  + Strangles have lower payoffs than straddles
    - However, the options that we purchase to create them are less in the money than their straddle counterparts
    - Strangles are cheaper to enter into
* Butterfly Spread
  + A portfolio that is:
    - Long 1 call option with strike X1
    - Long 1 call option with strike X3
    - Short 2 call options with strike
      * X2 = ½(X1 + X3)
* Example: Butterfly Spread
  + You enter into a butterfly spread by buying one call with exercise price $100, selling two calls with exercise price $110, and buying one call with exercise price $120. What is the payoff of this position if the underlying stock is trading at $115 at expiration?
* Option Strategies: Endless Combos
  + Commonly mentioned strategies:
    - Covered call, strips, straps, spreads, collars
* Option strategies: Portfolio insurance
  + Protective put
    - A long position in a put held on a stock you already own
    - Guarantees a minimum protection equal to the put’s exercise price
  + Portfolio insurance
    - A protective put written on a portfolio rather than a single stock
    - When the put does not trade itself, it is synthetically created by constructing a replicating portfolio
    - Can also be achieved by purchasing a bond and a call option
  + To see the payoff to these two strategies, we first need the payoff to a stock a the payoff to a risk free bond
  + The payoff to the 2 strategies are identical
* Put-Call Parity
  + Because both versions of portfolio insurance provide exactly the same payoff, by the law of one price, they must have the same price
  + Relationship is known as put-call parity:
    - S + P = PV(X) + C
  + Requires us to make 2 assumptions:
    - The options are European
    - The stocks don’t pay dividends
  + We make these assumptions for simplicity. For example, dividend paying stocks could be reconciled:
    - S – PV(Dividend) + P = PV(X) + C
* Put-Call Parity—input note
  + In order to be able to use the relationship, 3 things need to be true:
    - The put and call need to be on the same underlying security
    - The put and call need to have the same expiration date
    - The put and call need to have the same exercise price
* Put-Call Parity—computational note
  + In many cases, we can get away with simple conversions
    - Ex. We could divide the annual rate by 2 to get the 6 month rate
  + However, we need a more precise calculation:
    - Need to take compounding into account
    - We take the maturity of the option and assume that is the compounding frequency as well
* Example: Put-Call Parity
  + In October 2016, a four month call option on Amazon, with an exercise price of $850 sold for $42.50. The stock price at the time was $840. Assume that the risk free rate was 3% (EAR). How much would you be willing to pay for a put on Amazon with the same maturity and exercise price?
* Option-Like Securities
  + Many securities behave like options:
    - Callable bonds
    - Convertible bonds
    - Warrants
    - Collateralized loans
    - Levered equity and risky debt
  + These concepts can be applied to corporate investment decisions