Pricing Models

Option Pricing Models

- Evaluates the value of an option
- Calculates the "Greeks" (delta, gamma, theta, vega, etc.)
- Intrinsic value of an option is simply determined by the difference between the stock price and the strike price
- Extrinsic (time value) much more complicated
- Various pricing models account for following components
    - **Underlying stock price**
    - **Option strike price**
    - **Time until expiration**
    - **Volatility of stock**
    - **Interest rates**
    - **Dividends paid by stock during the time before expiration**

Options Pricing Model

Calculating Option Price with known historical Volatility

Stock price → Option Pricing Model → **Option Price**
Strike price →
Time to expiration →
Volatility →
Interest rates →
Dividends →

Calculating implied Volatility with known Option Price

Stock price → Option Pricing Model → **Option Price**
Strike price →
Time to expiration →
Volatility →
Interest rates →
Dividends →

Options Pricing Components

- **Underlying Stock Price**
  - Calls: higher stock price => higher option price
  - Puts: higher stock price => lower option price
- **Strike Price**
  - Calls: higher strike price => lower option price
  - Puts: higher strike price => higher option price
- **Time until expiration**
  - More time to expiration (puts and calls) => higher option price
  - More time gives the underlying stock greater opportunity to move in a favorable direction
  - As time progresses, value of option decreases
    (never below intrinsic value)

Options Pricing Components - continued

- **Volatility of stock**
  - The greater the volatility of the stock, the higher the value of the option
  - Volatility can change over the lifespan of the option
- **Interest rates**
  - Risk-free interest rates (Treasuries)
  - Calls: higher interest rates => higher option price
    - As interest rates rise, it becomes more attractive to tie up less capital in the option than in buying the stock
  - Puts: higher interest rates => lower option price
    - As interest rates rise, it becomes less attractive to buy a put than it is to short the stock and receive the cash
  - Interest rates not much of a factor in this market of low rates

Options Pricing Components - continued

- **Dividends**
  - Calls: Higher dividends => lower call premiums
  - Puts: Higher dividends => higher put premiums
  - Dividends affect price of American style options:
  - Dividends have an influence on the price of options that have an early exercise because stocks drop by the amount of dividend paid.
    Stocks may drop immediately after the dividend is paid, but the options market anticipates the drop in stock price days before the dividend is paid.
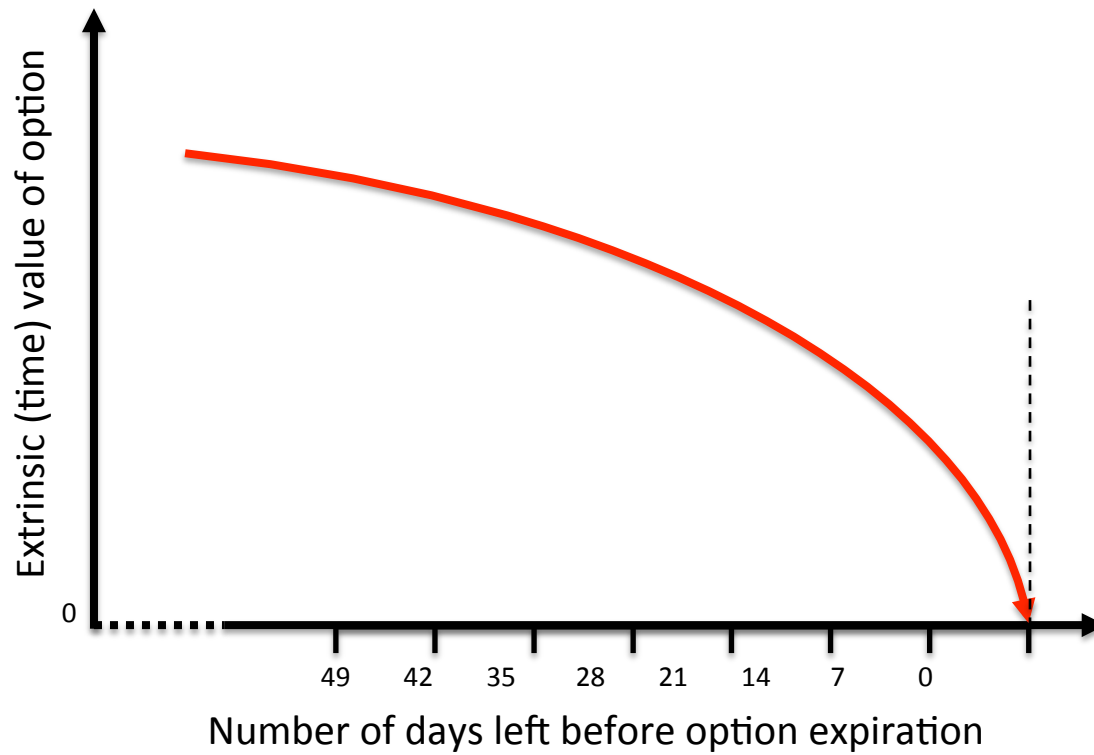
Options Pricing Models

- Black-Scholes model

- Binomial models

- Other models
  - Monte Carlo: uses a random price simulation instead of solving partial differential equations
  - Finite difference models: derived from partial differential equations and allows for changing assumptions
  - Trinomial model: an application of a finite difference model that is the most accurate, but most complex, pricing model

Options Pricing Models and Brokers

- No options pricing model is perfect
- Options pricing providers (brokers) can make use of multiple option pricing models
- ThinkOrSwim (TD Ameritrade) uses
  - Black-Scholes options pricing model for European style options
    - Early exercise is not part of the model
    - Dividends don't play a significant role with a single exercise date
  - Binomial model for American style options
    - More flexible and accurate
    - Accounts for dividends and early exercise

Time Decay

GOOG Time Decay

	Theta	Delta	Bid X	Ask X	Exp	Strike	Bid X	Ask X	Theta	Delta
NOV4 10 (3) 100 (Weeklys)										24.19%
	-.66	.56	6.00 C	6.40 C	NOV4 10	580	4.10 N	4.20 C	-.58	-.44
DEC 10 (24) 100										28.38%
	-.33	.53	17.20 C	17.50 N	DEC 10	580	15.20 N	15.40 B	-.32	-.47
JAN 11 (59) 100										31.88%
	-.24	.54	29.10 X	29.80 A	JAN 11	580	26.50 A	27.20 C	-.23	-.47
MAR 11 (115) 100										30.68%
	-.17	.54	38.80 X	39.60 X	MAR 11	580	35.80 C	36.50 C	-.16	-.46
JUN 11 (206) 100										30.93%
	-.13	.55	52.00 I	54.40 A	JUN 11	580	48.90 I	50.20 I	-.12	-.45
JAN 12 (423) 100										32.05%
	-.09	.57	78.10 I	80.50 I	JAN 12	580	72.50 I	75.00 I	-.09	-.43
JAN 13 (787) 100										27.77%
	-.07	.60	107.40 N	110.70 B	JAN 13	580	99.20 I	102.00 C	-.06	-.40