Option Greeks

Δ Delta – A measure of sensitivity to changes in the price of the underlying asset.
Γ Gamma – A measure of delta's sensitivity to changes in the price of the stock.
Θ Theta – A measure of an option's sensitivity to time decay.

Vega – A measure of an option's sensitivity to volatility.
P Rho – A measure of an option's sensitivity to changes in the risk free interest rate.

Implied volatility – The "unknown" component to the actual option price (premium)
Theoretical value – The calculated value according to Black-Scholes

Delta
Arguably the most important Greek, delta, can be expressed as a percentage, but it is most often shown in decimal form ranging from 1-1.0. A Delta of 1.0 means that the option price will change one point for every one-point move in the underlying stock. A delta of .5 (common in the at-the-money strike price) means the price of the option will move a half point for every one-point move in the underlying market.

The delta of a call is shown as a positive number, whereas the delta of a put is displayed as a negative number, because the put value moves in the opposite direction of the underlying market.

One way to look at delta is to consider it a measurement of the probability of the stock actually ending at that strike price or better on expiration. Therefore, it is prudent to look for options with a delta that reflects our own risk tolerance.

Gamma
As an option increases in value, its delta will also increase. This is where gamma comes into play. Gamma is a measurement of how much a change in the underlying stock will affect delta. If a stock has a delta of .5 and a gamma of .02 and the underlying stock moves one point, delta will now be .52 for that option.

Delta and gamma can be used to manage risk. In the mid 1980's, a US-based clearing firm collapsed after several traders with accounts there put on positions for which the gamma wound up working against them. They shorted many call contracts in out-of-the money gold call options. Because the options strike prices were far away from the price of gold, their deltas were small. As a result initially small tick up or down in the gold market did not significantly affect the option prices. However, the gold market staged a strong rally and the small deltas suddenly increased. As the market rose, not only did the price of the options increase but the rate of that change (gamma) jumped as well. They were unable to meet their margin payments and the firm collapsed.

We can use Delta and Gamma to analyze how exposed we are in short positions as well as how likely it is for us to make money in a long put or call. The better gamma and delta we have, the better the chance for the option to go our way more dramatically. If we get an option that has a poor gamma and delta the option may not move our way even if the stock does.

Theta

As the time remaining to expiration decreases, the time-value of an option also decreases (assuming all other parameters remain unchanged). The rate of this decrease is called "theta" and is also referred to as time decay or amortization. Since options pricing is not a linear function, you will notice that theta is higher for short-term options than for long-term options. For the mathematically curious, this is attributable to the fact that the time component of option value is a square-root function.

Thus a three month at-the-money call trading at 3.50, and a six month call of the same strike and stock is trading at 5 might make us think that the three-month call is a "better deal," but this is not necessarily the case as time value is melting away at a faster rate.

Implied Volatility/ Historical Volatility

We know all the factors that should predict an options price but what happens when that number does not match what the option is actually priced at? That is generally caused by implied volatility.

Historical volatility is a statistical analysis of the past deviations of the securities price. Implied volatility is an estimate made by the market maker of future volatility. Another way to look at it is through analogy.

We are driving through a stretch of Nevada desert on our way to California and are almost out of gas. The gas station is charging $5.00 a gallon for gas (implied volatility or premium) whereas the rest of the country is charging $2.50 (historical volatility) for gas. We know we have been gouged; however, the point is to get to California, right?

In a way, we should draw a certain amount of "perverse" comfort from an implied volatility score that is gouging us because the market maker thinks there is a higher degree of risk of getting called out on our call/put.

Black-Scholes Model

The Black Scholes Option Pricing Model didn't appear overnight, in fact, Fisher Black started out working to create a valuation model for stock warrants. This work involved calculating a derivative to measure how the discount rate of a warrant varies with time and stock price. The result of this calculation held a striking resemblance to a well-known heat transfer equation. Soon after this discovery, Myron Scholes joined Black and the result of their work is a startlingly accurate option-pricing model.

The Black-Scholes model makes the following assumptions:

1) The stock pays no dividends.
2) The options can only be exercised at expiration. This is European style whereas American style can be exercised before expiration, increasing the options value because of greater flexibility.
3) No commissions are charged.
4) The risk-free rate never changes.

Theoretical Option Price = $pN(d_1) - se^{-rt}N(d_2)$

Where $d_1 = \dfrac{\ln(p/s) + (r + v^2/2)t}{v\sqrt{t}}$

$d_2 = d_1 - v\sqrt{t}$

The variables are:

p = stock price
s = striking price
t = time remaining until expiration, expressed as a percent
r = current risk-free interest rate
v = volatility measured by annual standard deviation
ln = natural logarithm
N(x) = cumulative normal density function