Different types of exposures

- Delta
- Gamma
- Vega
- Theta

Delta

Delta, i.e., $\Delta = \partial P/\partial S$

Let us consider we have

Spot gold value	$ 1,80,000
Forward contracts	- $ 60,000
Futures contracts	$ 2,000
Swaps	$ 80,000
Options	$ 1,10,000
Exotics	$ 25,000
Total	**$ 1,17,000**

Delta

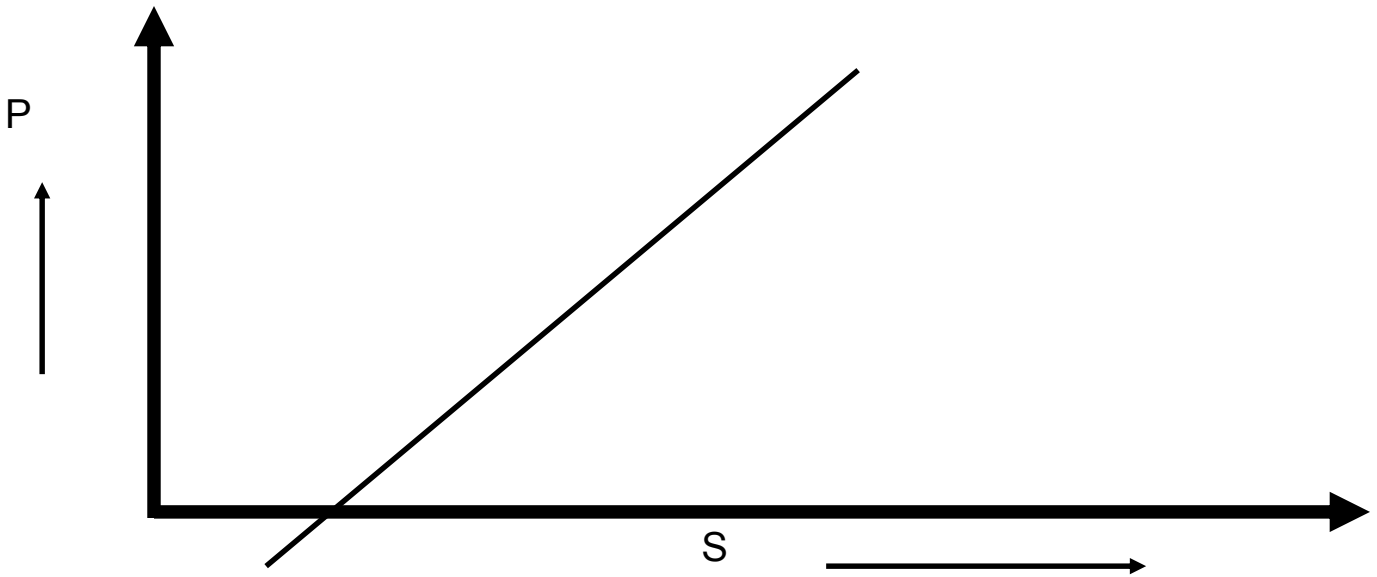
If price of gold changes from $ 500 per ounce to $ 500.10 per ounce and suppose the new value of the portfolio is now $ 1,16,900.

So the sensitivity (delta) of the portfolio is -100/0.1=-1,000

So to make it delta-neutral, buy 1000 ounce of gold, so that when this trade is combined with the existing portfolio, the resultant portfolio

Delta

Main problem is that the value of product/portfolio is not linearly dependent on the value of the market variable, i.e., we do not have the graph as shown below. In case we have the relationship as linear, then delta is constant and can be calculated from the graph, as the slope



Delta

A linear product can be hedged quite easily. Example of linear products are forwards, futures, swaps, while options are not linear products

For example consider a US bank (Citi Bank) enters into a forward position with its client in Europe (consider a corporate like Areva) and agrees to sell to the client 10,00,000 Euros, also assume the interest rate is 4% with annual compounding. This implies the present value of the amount is 1000000/(1+0.04)=961538

Delta

The bank can hedge its risk by borrowing enough dollars to buy this 961538 Euros today and investing this Euros for 1 year at 4%. So when the 1 year is over the bank has with it 10,00,000 Euros. Event it the interest is floating you can convert it through a swap to a fixed rate and have a linear product

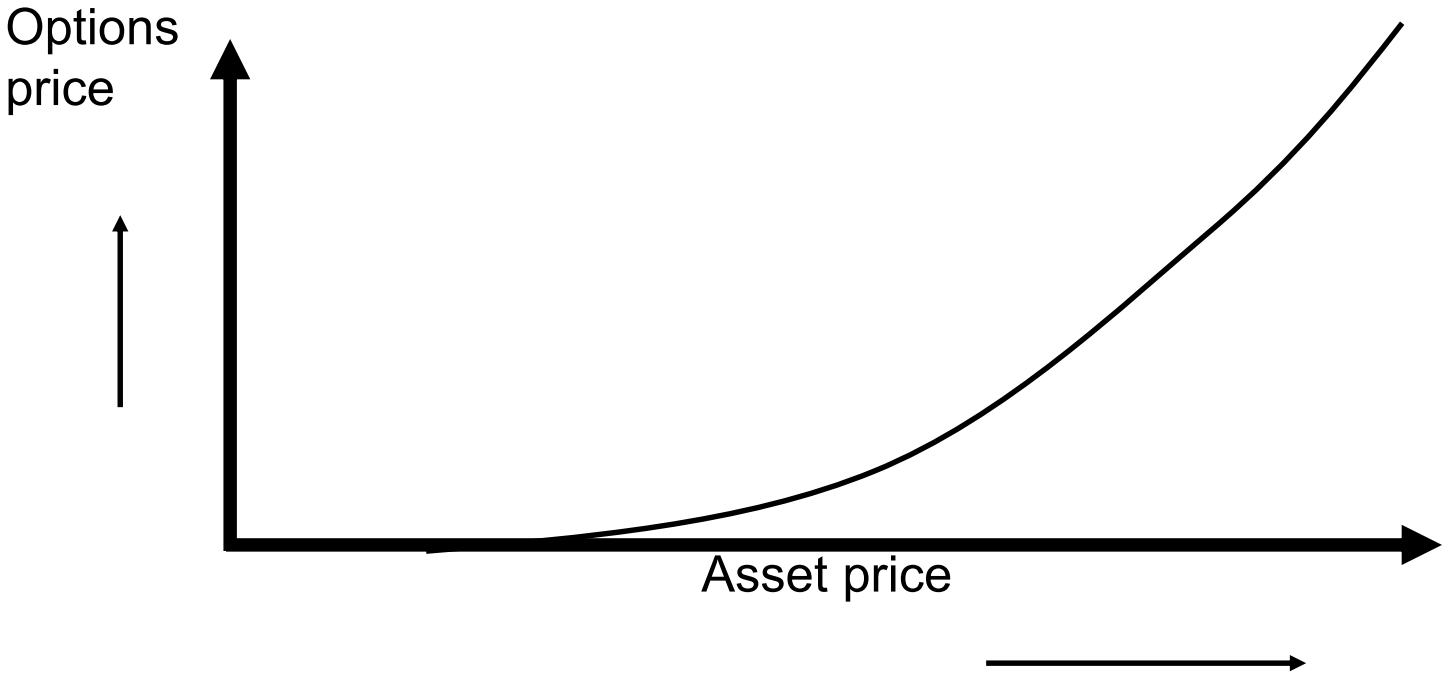
Delta

Options and such products are non-linear. Let us consider an example where a trader sells some N number of European call option on a non-dividend paying stock with the following information

- S_0= Spot price of the underlying stock
- K= Strike price
- r_f= risk free interest
- $\sigma_{\Delta S}$= volatility of the stock price change
- T= time to maturity

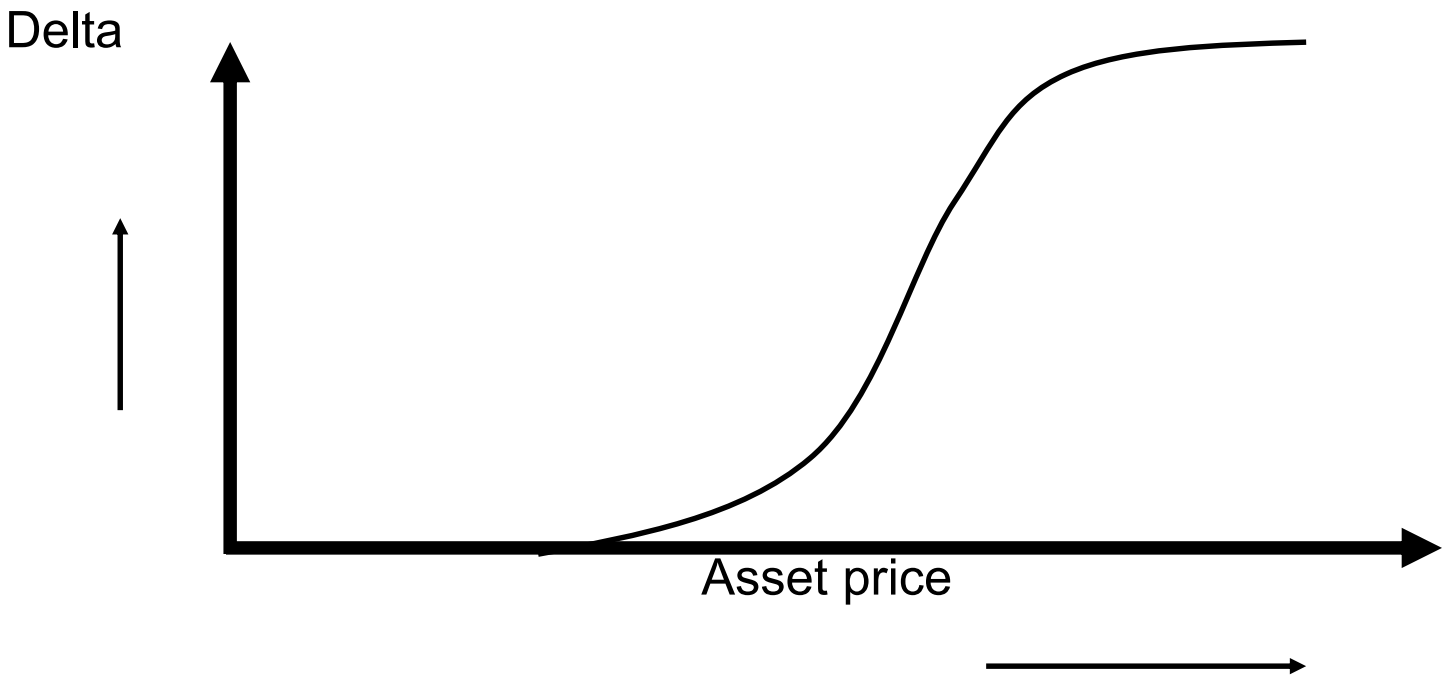
Delta

Relationship is non-linear, then the graph may look like this



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Gamma

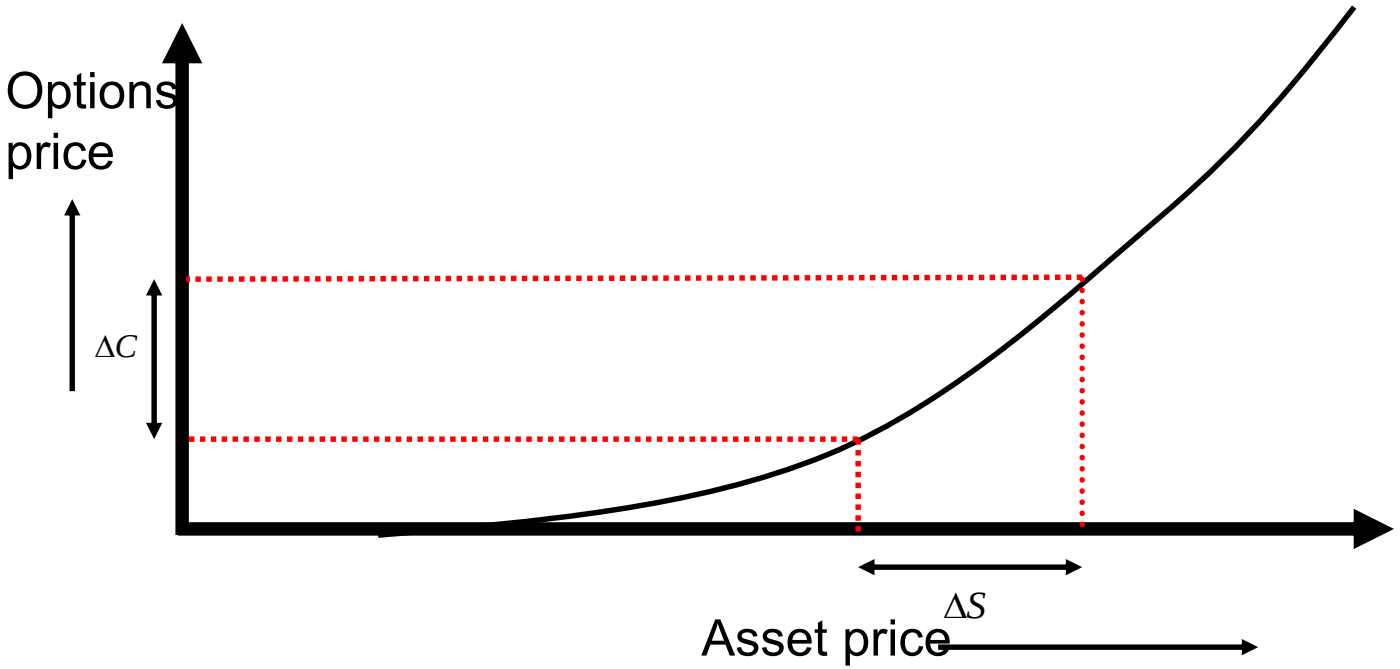
Gamma, Γ, of a portfolio is the rate of change of delta with respect to the price of the underlying asset, i.e., $\Gamma = \partial^2\Pi/\partial S^2$

If gamma is small, then the delta changes slowly and adjustments to keep a portfolio delta neutral only need to be made relatively infrequently. In case gamma is large in absolute terms, then delta is highly sensitive to the underlying price change

So for these cases we should try to adjust the portfolio so that it has the characteristics of delta neutral portfolio

Gamma

Relationship is non-linear, then the graph may look like this



Gamma

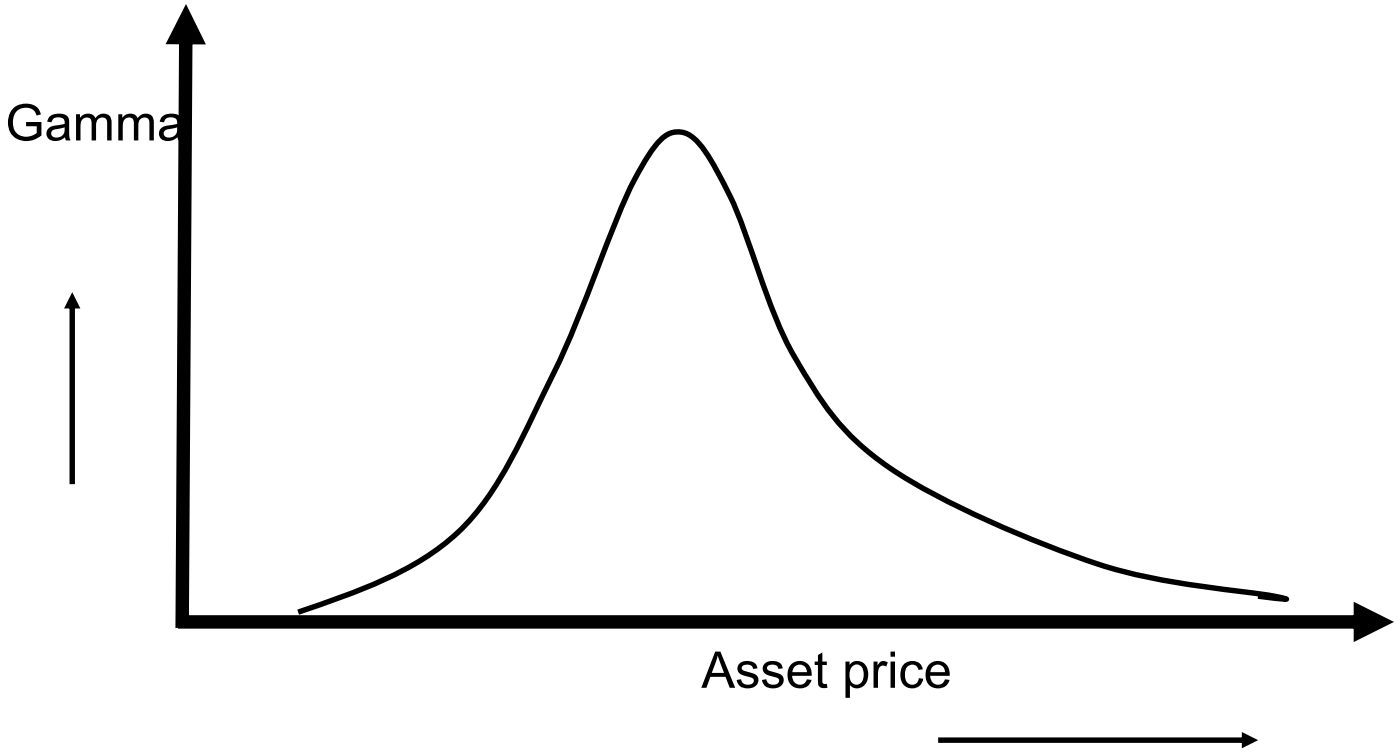
Linear products has zero gamma. But suppose a delta-neutral portfolio has a gamma equal to Γ and the traded option has a gamma of Γ_O. If the number of traded options added to the portfolio is w_O, then the gamma of the portfolio is then $w_O * \Gamma_O + \Gamma$

Gamma

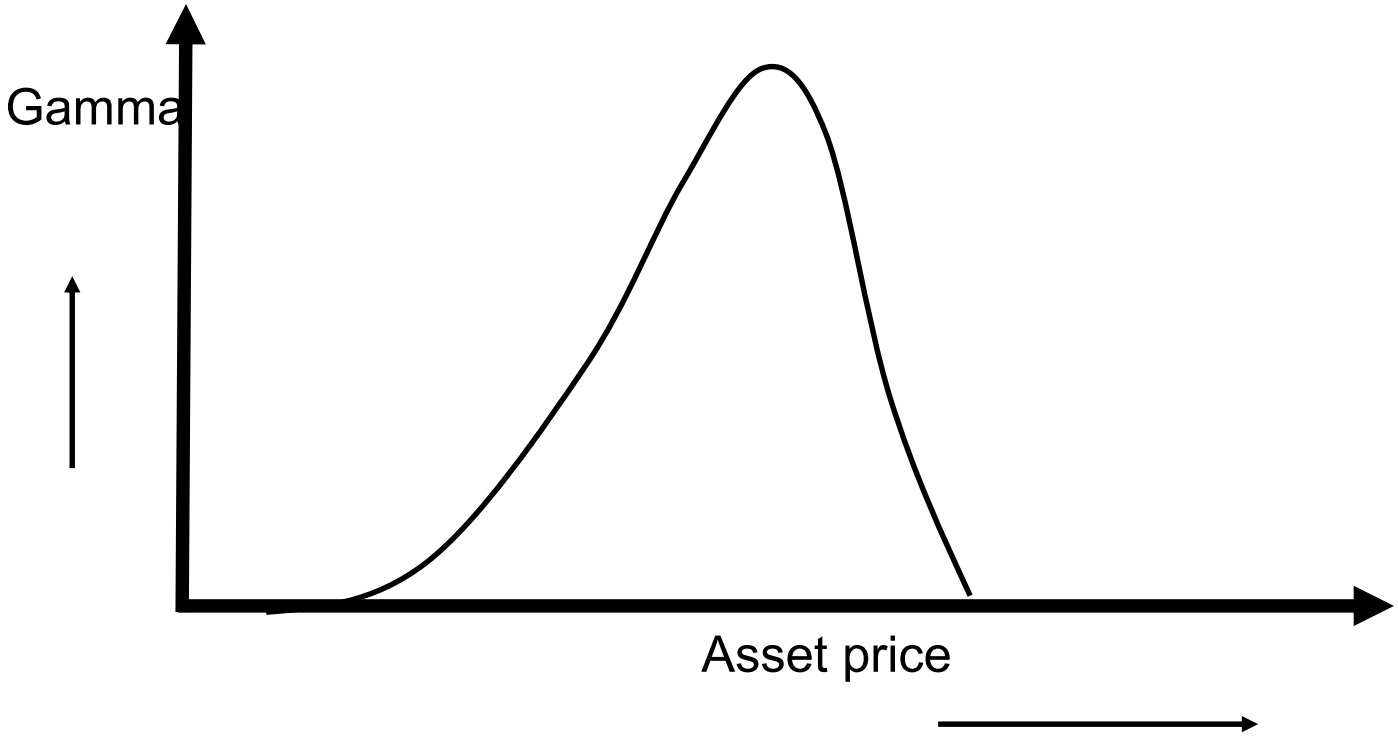
You question is now what happens if we have two different traded options, then how do we find the gamma of the combined portfolio, do we use $w_{O,1}*\Gamma_{O,1}+ w_{O,2}*\Gamma_{O,2}+\ldots+ w_{O,N}*\Gamma_{O,N}+ \Gamma$.

The answer is no, as we do not know whether the options are independent and more over if they are independent we do not know whether the correlation coefficient between the options is linear or not

Gamma



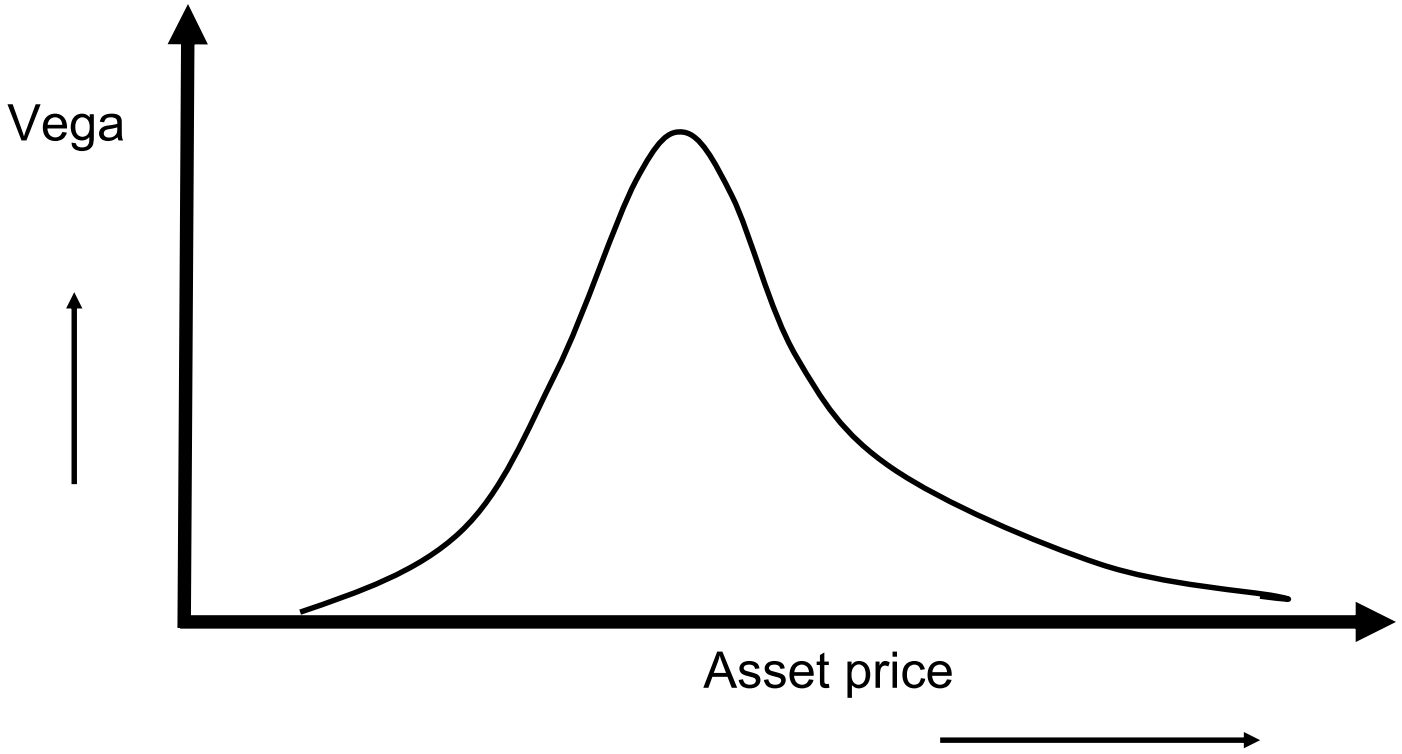
Gamma



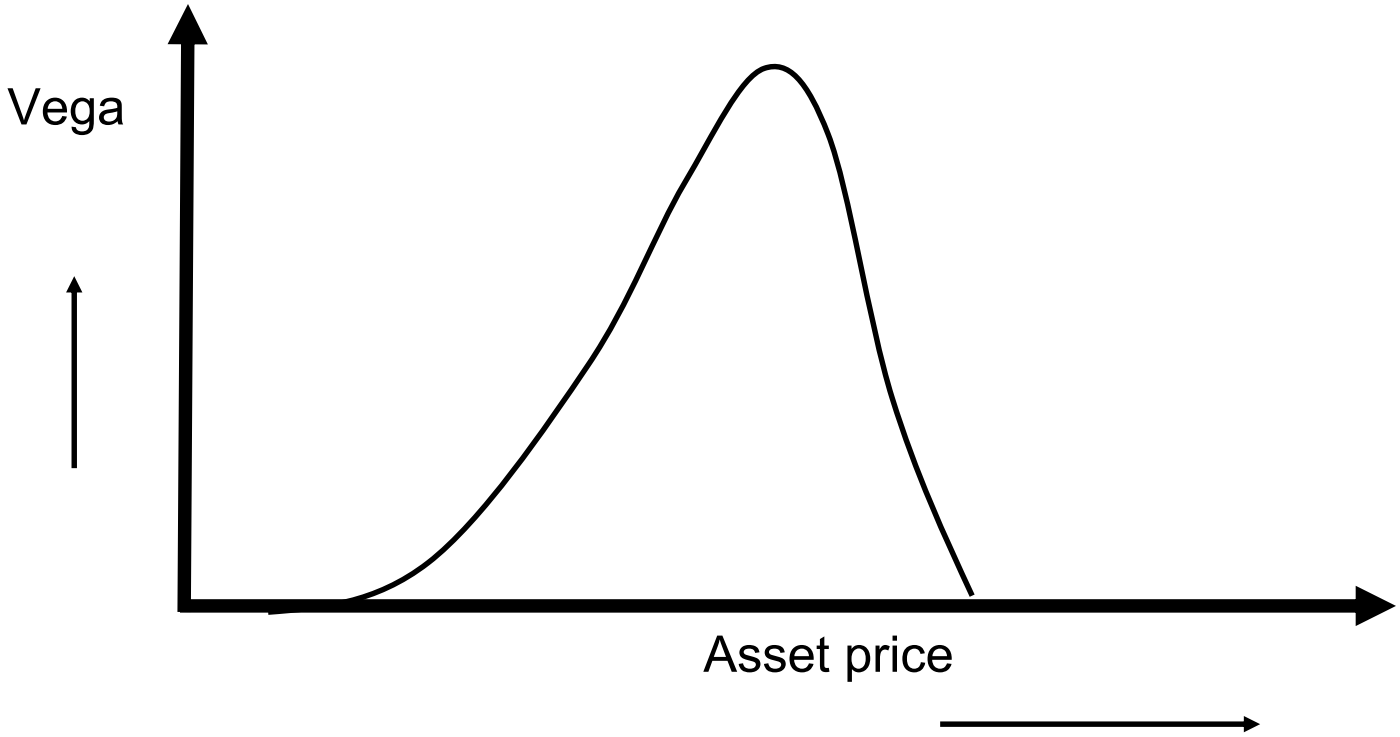
Vega

Vega $\upsilon = \partial\Pi/\partial\sigma$, here we still consider σ is independent of time.

Vega



Vega



Theta

The theta, Θ, of a portfolio is the rate of change of the value of the portfolio with respect to the passage of time with all the remaining variables remaining constant. This is also called the *time decay* of the portfolio. Theta is usually negative for an option, because as the time to maturity decreases, with all other things remaining constant, the option will generally tend to be less valuable

Rho

Rho, ρ, of a portfolio is the rate of change of the value of the portfolio with respect to the level of interest rates. If we have a currency option then we have two interest rates, one for the domestic country and another for the foreign country

Taylor series expansion

Generally we have

$\Delta\Pi = (\partial\Pi/\partial S)*\Delta S + (\partial\Pi/\partial t)*\Delta t + (\partial\Pi/\partial \sigma)*\Delta\sigma +$
$(1/2)*(\partial^2\Pi/\partial S^2)*\Delta S^2 + (1/2)*(\partial^2\Pi/\partial t^2)*\Delta t^2 +$
$(1/2)*(\partial^2\Pi/\partial\sigma^2)*\Delta\sigma^2 +$

$(\partial^2\Pi/\partial S\partial t)*\Delta S\Delta t + (\partial^2\Pi/\partial S\partial\sigma)*\Delta S\Delta\sigma +$

$(\partial^2\Pi/\partial\sigma\partial t)*\Delta\sigma\Delta t + \ldots\ldots\ldots$

Knowing the terms give us the value of $E(\Delta\Pi)$ and $V(\Delta\Pi)$, which is required to find the risk of the portfolio

Rating Agencies

Specialize in evaluating the creditworthiness of corporate, municipal and sovereign issuers of debt securities. It is their job to inform investors about the likelihood that the investors would receive their principal plus an interest payment as scheduled. Basically the rating agencies find the probability of default by these corporates etc.

History of the players

- In USA, bond rating agencies evolved from firms that evaluated the creditworthiness of merchants. Robert Dun and John Bradstreet were among the 19th century pioneers in this business and their companies ultimately merged in 1933 to form DUN and BRADSTREET
- In the first decade of the last century, John Moody extended the credit rating concept to securities-focusing first on railroads bonds and soon on utility and industrial bonds.
- ICRA was Promoted by leading financial institutions and banks of India and was formed on 16th January 1991. From Sep'01 MOODY'S is the largest shareholder in ICRA.

Long term debt rating symbols (investment grade rating)

S&P	MOODY'S	INTERPRETATION
AAA	Aaa	Highest quality; Extremely strong
AA+	Aa1	High quality
AA	Aa2	
AA-	Aa3	
A+	A1	Strong payment capacity
A	A2	
A-	A3	
BBB+	Baa1	Adequate capacity
BBB	Baa2	
BBB-	Baa3	

Long term debt rating symbols (speculative grade rating)

S&P	MOODY'S	INTERPRETATION
BB+	Ba1	Likely to fulfill obligations; ongoing uncertainty
BB	Ba2	
BB-	Ba3	
B+	B1	High risk obligations
B	B2	
B-	B3	
CCC+	Caa1	Current vulnerability to default
CCC	Caa2	
CCC-	Caa3	
CC		
C	Ca	In bankruptcy or default, or other market shortcoming
D		

Rating process

In evaluating credits, the rating agencies use many of the same tools normally used applied by equity analysts, but their approach differs in one key respect-the rating agencies have a much longer time horizon.

1) Business risk
   - Industry characteristics (seasonal, cyclic
   - Competitive position (monopoly, duopoly, limited number of players, many players)
   - Market share of the company (small, medium, large)
   - Technology (matured, changing, very complicated etc.)
   - Efficiency
   - Management

Rating process

2) Financial risk
   - Financial characteristics
   - Financial policy
   - Profitability
   - Capital structure
   - Cash flow situation
   - Financial flexibility

Financial ratios used for rating

1) Operating performance
   - EBITDA/Sales
   - Net Income/Sales
   - Effective tax rate
   - Net Income/Net worth
   - Net Income/Total Assets
   - Sales/Fixed Assets

Financial ratios used for rating

2) Debt service coverage
   - EBITDA/Interest
   - [Free cash flow – Capital expenditure]/Interest
   - [Free cash flow – Capital expenditure - Dividends]/Interest

Financial ratios used for rating

3) Financial Leverage
   - Long term debt/Capitalization
   - Long term debt/Tangible Net worth
   - Current Liabilities/Tangible Net worth