OPTION GREEKS, STRATEGIES & BACKTESTING IN PYTHON

YOUR FIRST STEP TOWARDS SYSTEMATIC TRADING

NOV. 2020

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OPTION GREEKS, STRATEGIES & BACK-TEST IN PYTHON

A comprehensive guide on trading options in India

CONTENTS

This book is educational in nature. Various Derivative contracts traded in Indian market and data used in various examples are for illustrative and educational purpose only. Example/ data used may or may not be based on Historical/factual data. We are not rendering legal/professional services or any kind of advice for trading. Past performance or data or example discussed here does not guarantee of future results. We disclaim any liability/loss/risk resulting directly or indirectly from use or application of any content of this book.

INTRODUCTION

Novice traders, as they start trading in derivatives, encounter many disappointments and exit with losses. Mostly are not equipped to compete in this game. One of the causes is naked positions in derivatives.

Derivatives give many choices to hedge risk. A novice derivative trader should start trading with options spreads as it enables to make different combinations of risk and reward. Traders can fix maximum loss in any position which is very much essential for derivative trading. Once you properly learn options you will find that options are excellent investment tool that gives you flexibility, reduce risk. To be a successful trader you must get proper education.

Reading this book is a good start !

Many traders are always in search of free ride, they are always looking for free tips or a guru who can teach them to make profits every time. In derivatives trading good performance is usually a result of lady luck; markets are random so no guru or system will be helpful in long run. The only way to 'make it' in trading is to earn it. Use the wisdom of gurus/experts but make your own decisions and be willing to take responsibility of your own decisions. No one is right every time, but you should make money more often than you lose and profitable trades should make more than losing trades lose.

Trading in derivatives is a probability game. Probability and amount of success should be higher than the probability and amount of loss. Whereas many retail investors are doing just opposite. Novice Indian retail traders are losing money systematically; they take naked positions in derivatives and trade for small profits, whereas on loss side they hold the position and hold it with them for a long until price comes back. In this case whenever there will be a big movement in adverse direction they will lose a big amount and they leave capital market with a big losses. The better way to do all these things is to use option spreads and combination in a disciplined manner.

So in this book **we will focus on spreads and combinations rather than outright naked position. Objective of trading should be to make more money with less risk, so butterfly spread explaind in detail.** Some people do trading for fun. Trading can be fun, but it's a whole lot more fun when it's profitable, so focus on the making money part and not necessarily on the trading part. That means don't trade just to trade. Trade when you have some insight and use the best possible trade structure. That will often be a spread or combination with limited risk and reward. This book will help you to develop your own strategies and back test them on past data of NSE/BSE. This book is divided in 3 parts. First part is about option Greeks. In second part, option trading strategies is dealt with in detail. The third part is about how to back test any strategy on past data in Python. At last with an example of 'event based trading' practical use of basic knowledge in trading explained.

BASICS OF DERIVATES – FUTURE & OPTIONS

Derivatives are financial instruments that derive their value from an 'underlying' asset. The underlying can be a stock issued by a company, Index, currency, commodity etc., The derivative instrument can be traded independently of the underlying asset.

There are two kinds of derivatives –

1. Future

A 'Future' is a contract to buy or sell the underlying asset. Futures are Exchange traded standard contracts which allow investors to take leveraged position. Future contract have the following feature –

- Lot Size
    - Every derivative contract has a pre specified lot size. For Example derivate contract of Infosys have lot size of 1200. If Infosys is trading at 1000 it means value of one contract is 1200 X 1000 = 12 lakh Indian Rupees. Buying or selling 1 contract of Infosys means buying or selling 1200 infosys.
- Initial Margi**n**
    - Initial margin is the minimum amount required to be paid upfront when contract is opened. For Example in case of Infosys initial margin is approximately 12.5% so buying one lot of Infosys requires initial margin of Rs 1,50,000/-. Initial margin vary from contract to contract. In case of Stock Futures trading in India it is approx 10 to 20 percent of contract value. It may be higher if volatility in underlying is high. So derivates allows to take leverage.
- **Mark to Market (MTM)**
    - Price of the **futures contract** changes. These changes result in daily gains or losses, which they are credited to or subtracted from the margin account of the **contract** holder. MTM is daily settlement based on closing price.
- **Open Interest**
    - The total number of open contracts is called its Open Interest.
- **Expiry**
    - Every future contract expires on pre-specified date. Expiry date is the last

date contract is valid. On expiry contract is settled by cash/delivery. At NSE/BSE Index future and stock future expires last Thursday of the month If the last Thursday is a trading holiday, the contracts expire on the previous trading day. Index future and currency future settled in cash at closing price of underlying security. Stock future and most of the commodity future are delivery based. If you are trading stock future in India, open position on expiry will result into delivery on T+2 (Buyer will get delivery and seller will give delivery of underlying stock).

- Index/Stock futures contracts trading at NSE/BSE have a maximum of 3-month trading cycle - the near month/Current Month, the next month and the far month. A new contract is introduced on the trading day following the expiry of the near month contract. The new contract will be introduced for three month duration. This way, at any point in time, there will be 3 future contracts of any underlying available for trading in the market.
- Currency Futures trading at BSE/NSE have 12 month trading cycle. This way, at any point in time, there will be 12 future contracts of any underlying available for trading in the market.

- **Cost of Trading-**

  - Apart from brokerage there are some regulatory expenses in India. In equity derivatives and commodity derivatives there is Security Transaction tax (STT)/ Commodity transaction tax (CTT) of Rs 1000 per crore on sell side in case of Futures. Stamp Duty of Rs 100/- per crore on both sides buy and sell. SEBI Fees of Rs 15 Rs per crore both sides. In case of currency derivatives there is no STT or CTT. That's the reason trading currency derivatives is cheaper than trading equity/commodity derivatives. Apart from the above expenses there are Exchange transaction charges and GST. In case currency derivatives trading on BSE is cheaper than trading NSE. Trader can buy or sell at any exchange. If a trader is buying USDINR future contract at NSE and selling the same at BSE then because of interoperability position will be zero. A new exchange India International Exchange (100% subsidiary of BSE) in Gift City, Gujarat does not have CTT/STT/Stamp Duty and Margins on Index future is only 4% approximately as compared to 10% to 12% at NSE/BSE. However only non-residents can trade on India International Exchange platform and all trading takes place in dollars. I have not considered any cost of trading in this book.

2. Options

Option is a contract to buy or sell a specific financial product. Options are derivative contracts. Two types of Options are traded –

1. **Call Option**
2. **Put Option**

Please refer option chain given in Table1 [Nifty Options]. In the middle, given is the strike price.

Left side is Call options and given on the right side is put options data. Bid price and ask price given on each side for Call as well as Put. One can buy a call option or sell a call option; and similarly a put option can be bought or sold.

In India Index options and Currency options settled in cash and Stock options are settled on the basis of delivery on expiry. If an investor buys any stock call option he/she has the right to buy the underlying instrument at the strike price on expiration date. If the investor is buying stock put option, then they have the right to sell the underlying instrument at the strike price on expiration date.

Currently, in India all options are European type, it means you cannot excise before expiry.

Option chain of Nifty Options-

CALLS						PUTS				
Net Chng	Bid Qty	Bid Price	Ask Price	Ask Qty	Strike Price	Bid Qty	Bid Price	Ask Price	Ask Qty	Net Chng
93.70	75	421.00	424.75	75	9600.00	750	14.10	14.45	750	-11.90
39.00	2,100	365.05	389.75	600	9650.00	75	17.20	17.50	900	-14.80
90.90	75	328.30	332.95	750	9700.00	1,575	21.65	22.00	975	-19.00
80.85	75	285.05	293.70	600	9750.00	150	27.65	27.80	1,050	-23.55
78.55	750	242.65	245.00	300	9800.00	1,350	34.05	34.50	975	-29.50
70.50	75	199.00	202.80	75	9850.00	375	42.50	43.40	75	-35.65
61.15	975	163.30	164.75	750	9900.00	750	53.05	53.75	675	-44.30
50.05	600	126.15	127.30	75	9950.00	150	65.20	66.00	375	-53.00
41.90	3,600	96.30	96.35	4,875	10000.00	825	83.20	83.95	675	-63.10
33.00	75	69.60	70.00	1,875	10050.00	150	101.40	105.00	1,500	-74.30
23.75	75	48.55	49.00	75	10100.00	75	131.85	133.35	750	-82.90
16.55	75	32.25	32.85	150	10150.00	150	161.00	175.20	75	-90.30
11.10	900	22.10	22.20	900	10200.00	750	202.25	204.95	150	-89.95
6.25	75	13.75	14.95	75	10250.00	750	230.75	257.75	600	-53.90
4.30	150	9.40	9.50	900	10300.00	450	286.60	291.15	750	-99.75
2.05	75	5.30	6.40	2,025	10350.00	600	321.15	347.35	2,700	-
1.50	675	4.25	4.35	150	10400.00	150	379.55	384.95	75	-106.15

Table1: Nifty Options (Nifty Spot price – 10000)

First, you need to understand terminology used in options. I have explained with the help of option chain given in Table1 [Nifty Options].

- **Strike Price -** A strike price is the price at which a specific derivative contract can be exercised. Please refer to the option chain given in Table No 1 [Nifty Options]. Middle row is strike price. Call option contract of 10,000 strike price is trading at Rs 96.3 – 96.35 whereas Put option contract of 10,000 strike is trading at 83.20 – 83.95. Both call and put

options contracts of Nifty are available on every strike interval of 50. For example 9650, 9600, 9550, 9500 and so on……

In the same way call and put options of other derivatives contracts are available on pre specified price interval.

- **Moneyness of an Option**

  In the money (ITM) option: A call option is said to be ITM, when spot price is higher than strike price. A put option is said to be ITM when spot price is lower than strike price. In the above Option chain all call options upto the strike price of 9950 are in the money options and all put options above the strike price of 10000 are in the money options.

  At the money (ATM) option: A call and put is said to be ATM when strike price is equal to spot price. In the above Option chain 10000 call and put options are ATM options.

  Out of the money (OTM) option: A call option is said to be OTM, when spot price is lower than strike price and a put option is said to be OTM when spot price is higher than strike price. In the above Option chain all put options upto the strike price of 9950 are out of money options and all Call options above the strike price of 10000 are Out of money options.

- **Option Price / Premium –** Option premium is the Price which the option buyer pays to option seller. As per given Option chain anyone can buy 10,100 call option at Rs 49/- So buyer will pay the premium of Rs 49 to the seller of an option who is the best seller in the order book.

  Option premium has two components intrinsic value and time value.

  Option Premium = Intrinsic Value + Time value

  Intrinsic value is how much the option is in the money, or how much one would get if the options expire. Time value is the portion of premium which is over and above the intrinsic value of an option. Please refer Nifty option chain on previous page -

  - Nifty is trading at 10000, 9900 call is trading at Rs. 164.75/- Intrinsic value of 9900 Nifty calls is 100 (10000 – 9900). One would get Rs 100/- if the option expires at current price of 10000. Balance Rs 64.75/- is time value.
  - Nifty is at 10000, 10,100 call is trading at Rs 49/- Intrinsic value of 10100 Nifty calls is 0, since it is out of the money which is how much one would get if the option expire. So price paid/received in case of out of money options is time value.
  - Nifty is at 10000, 10100 put is trading at Rs 133.35/- Intrinsic value of 10100 puts is 100 and the balance portion of 33.35 is time value and in case of 9900 put complete price paid of Rs 53.75 is time value.

  Please refer to Table1, Nifty option chain given on earlier pages. Premium of Call options are increasing with the decrease in strike price and premium of put option is increasing with increase in strike price.

- **Expiration Day –** The day on which option contracts ceases to exist is its Expiration Day. Monthly option contracts at BSE and NSE expire with future contract of the respective underlying assets.
- **Lot Size –** Lot size of future & option contracts of any underlying asset remains the same. For Example Nifty future have a lot size of 75 so the all options of Nifty have lot size of 75.
- **Sport Price –** Price at which underlying asset trades in the spot market.
- **Margin –** Buyer of any option need to pay premium only. However in case of selling an option at NSE/BSE margin required to be paid (margin on option sell is equals to the margin required on future position of any underlying asset). In the example of future of Infosys given in earlier pages margin on buying/selling of Infosys future was Rs 1,50,000/-. Same margin on selling of option is required (1,50,000 assumed for explanation, actual margins are different and has to be verified by investor).

  Recently SEBI came up with circular which is applicable from 1st June 2020. With the new rule margin on hedge position and spread position will be lesser than margin on naked position. Trader may get a maximum margin benefit up to 60-70% on hedged positions as compare to naked position (these are estimated figures). This margin benefit will bring down the cost of trading. (Link to the SEBI Circular Dated 24th Feb 2020 on review of margins - https://www.sebi.gov.in/legal/circulars/feb-2020/review-of-margin-framework-for-cash-and-derivatives-segments-except-for-commodity-derivatives-segment-_46058.html). After implementation of this circular, one will get margin benefit on hedge positions and spread positions but margin on naked position may increase with increase in volatility in underlying.
- **Exercise Style -** There are two main exercise styles: American and European. In case of American options buyer can exercise his right at any time on or before the expiry date of the contract. Whereas in case of European options owner of the option can exercise his/her right only on expiries date of the contract. Presently at NSE, BSE and MCX options are European style, so no one can exercise options before expiry. Few years back Options of Stock futures at NSE was American Style but as on today Stock options are also European style.
- **Type of Delivery -** As mentioned earlier, in India, Index options and Currency options are cash settled and Stock options are delivery based. Cash Settled means the in-the-money option buyer will receive a certain amount equals to its intrinsic value on expiry. However NSE give choice not exercises options for near money strikes. This option was given because earlier buyer of options requires to pay Security transaction tax (STT) on notional value of Option if in-the-money option is exercised, but in budget 2020 a new rule came that this STT will be limited to the amount by which option is in-the-money.

  Delivery based options means open position will result into delivery of underlying, It means that on expiry, buyer of in-the-money Call option will receive delivery of stocks and seller of In-the-money call option will give delivery. Buyer of the in-the-money put option need to give delivery of stocks. At-the-money and out of money options will be zero on expiry both in case of cash settled as well as delivery based.

TRADING FUTURE AND OPTIONS

Trading Future

Most people understand buying and selling of stock. Trader can buy stock when rise in the price is expected. Buyer will make money with rise in the price whereas seller will make money with fall in the price of stock. The same is applicable in case of stock future. Few differences in stock and stock future are margin, lot size, roll over cost.

Margin

- In case of stock, the buyer has to give 100% of money on T+2 (that is settlement day – Second working day of the trade day) and seller need to give delivery of stock. Whereas in case of Stock future buyer/seller has to give 10% to 20% money only as initial margin and daily settlement of mark to market margin. Initial margin differ from stock to stock.

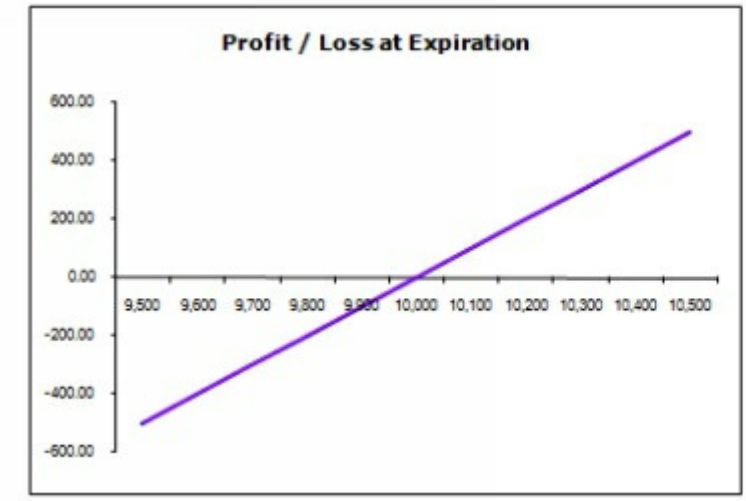
Lot Size

- In case of stock buyer and seller can trade in any number of shares whereas in case of stock future they can trade in the multiple of lot only.

Roll over Cost

- Every derivative contract has an expiry date. On expiry day of contract if buyer of the contract wants to carry position next month than he need to sell current month contract which is going to expire and buy next month contract, this is called Roll-over of buy position. Buying current month expiry contract and selling next month expiry contract is called Roll-over of sell position. Roll-over could be done thru spread contracts also available on exchanges. For a buyer of equity shares there is no roll over cost whereas in case of buyer of a stock future roll cost is there if he wants to carry position in next month because mostly next month contracts trade on higher price than current month contracts. So seller of the future earns this money. Few traders sell USDINR future contract to earn rollover cost paid by buyer and they just rollover of their USDINR future sold position every month. This is a very risky way of trading future. Investors should avoid naked position in derivatives market. Few traders buy underlying asset and sell future to earn interest, this strategy is prevailing in the commodity segment. The relationship between futures prices and spot prices can be summarized in terms of the cost of carry. This measures the storage cost plus the interest that is paid to finance the asset less the income earned on the asset.

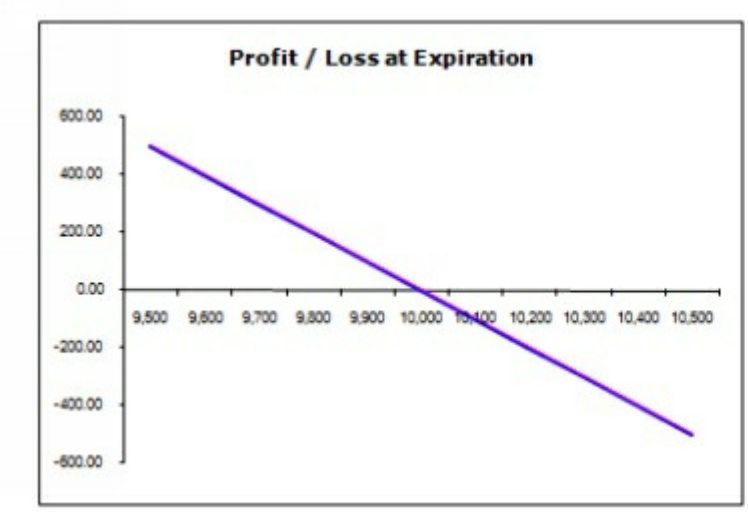
Payoff for buyer of Future – If trader is buying Nifty future at 10,000 then theoretically his profit potential is unlimited and his risk is limited to the contract value (10000 X Lot of 75 = 7.5 lakh Rs). Buyer will make money with rise in price. If Nifty future will increase to 10100 than profit is Rs 7500 (75 X 100 = Rs. 7500/-). Profit will increase with rise in the prices. If Nifty future will come down to 9900 than his loss is Rs 7500 (75 X 100 = 7500/- Rs) Loss will increase with fall in the prices.



P&L Payoff at Expiration Matrix

Underlying Price	Profit /Loss
9,500	-500.00
9,600	-400.00
9,700	-300.00
9,800	-200.00
9,900	-100.00
10,000	0.00
10,100	100.00
10,200	200.00
10,300	300.00
10,400	400.00
10,500	500.00

Payoff for Seller of Future – Seller of future contract will make money with fill in prices whereas he will lose money with increase in prices. Theoretically risk and profit potential both are unlimited. Trading in derivatives is a zero sum game. In any trade 2 parties requires, one who will buy the contract and second who will sell the contract. One will make money and another will lose money. However profit and loss across all participants will remain zero. So one persons gain is equivalent to another's loss and net change in wealth is zero.



P&L Payoff at Expiration Matrix

Underlying Price	Profit /Loss
9,500	500.00
9,600	400.00
9,700	300.00
9,800	200.00
9,900	100.00
10,000	0.00
10,100	-100.00
10,200	-200.00
10,300	-300.00
10,400	-400.00
10,500	-500.00

Trading Options

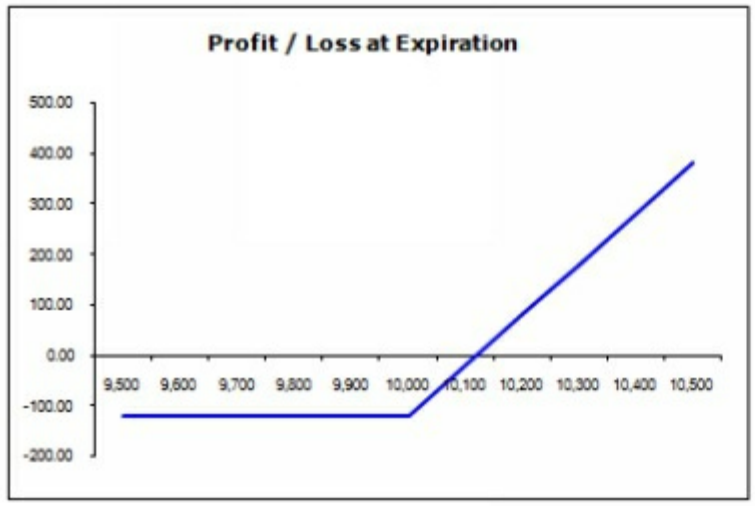
A bullish position taken by buying a future can also be taken in options by buying a call or selling a put. A bearish position taken by selling a future can also be taken by buying a put or selling a call. Options are much more complicated than future. We will discuss Trading in options in detail in this book. Lets understand some basics of options.

Payoff for buyer of Call Option – A trader bought Nifty Call with strike 10000 at a premium of Rs 117/-. So he paid a premium of Rs 8775/- (Rs. 117 multiplied by Nifty lot size of 75). His risk is limited to the premium paid, so the maximum loss the trader can incur in this position is Rs 8775. However profit potential is unlimited. Profit will increase with the increase in price. Please refer table2 [P & L Pay off - Buyer of Call Option] given below.

If Nifty will close at 10200 on Expiry, then trader will earn a profit of Rs 83. Trader bought 10000 call, if nifty will expire at 10200 than intrinsic value of 10000 call is Rs 200. It means trader will get Rs 200. However he bought call at Rs 117. So the net profit is Rs 83 (200-117=83). If Nifty will close at 10300 on Expiry, then trader will earn a profit of Rs 183. If Nifty will close at 10400 on Expiry, then trader will earn Rs283 and so on.

However on down side risk is limited to the premium paid. If nifty will close at 10000 or below than intrinsic value of 10000 call is zero. It means trader will lose Rs 117, premium paid on buying a call. Breakeven point for buyer of call option is strike + premium. So if Nifty closes above 10117 than only buyer will make money.

Table 2 : P & L Pay off - Buyer of Call Option

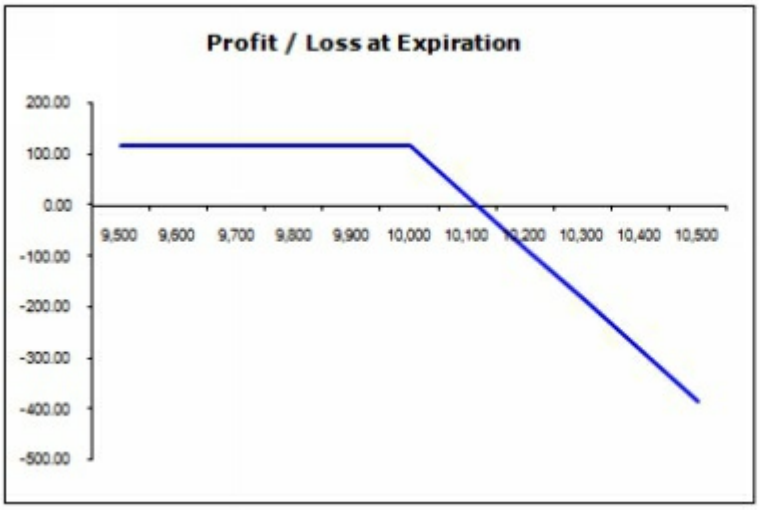


P&L Payoff at Expiration Matrix

Underlying Price	Profit /Loss
9,500	-117
9,600	-117
9,700	-117
9,800	-117
9,900	-117
10,000	-117
10,100	-17
10,200	83
10,300	183
10,400	283
10,500	383

Payoff for seller of Call Option – A trader sold Nifty Call with strike 10000 at a premium of Rs 117/-. So he received a premium of Rs 8775/- (Rs. 117 multiplied by Nifty lot size of 75). His profit is limited to the premium of Rs 8775 received. However risk profile is unlimited. Loss will increase with the increase in price. Breakeven point will be strike + premium. So if Nifty close below 10117 then seller will make money. Buyer of option need not to pay any margin but margin is required for option seller. Margin on Nifty future is approx 10% of contract value. If

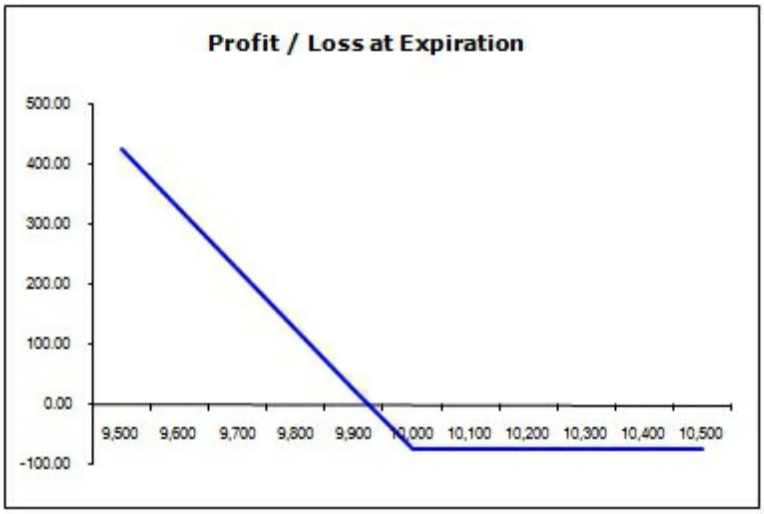
contract value is 7.5 lakhs than margin of approx Rs 75,000 will get blocked on selling of one lot of call option (75 X 10000 X 10%).



P&L Payoff at Expiration Matrix

Underlying Price	Profit /Loss
9,500	117
9,600	117
9,700	117
9,800	117
9,900	117
10,000	117
10,100	17
10,200	-83
10,300	-183
10,400	-283
10,500	-383

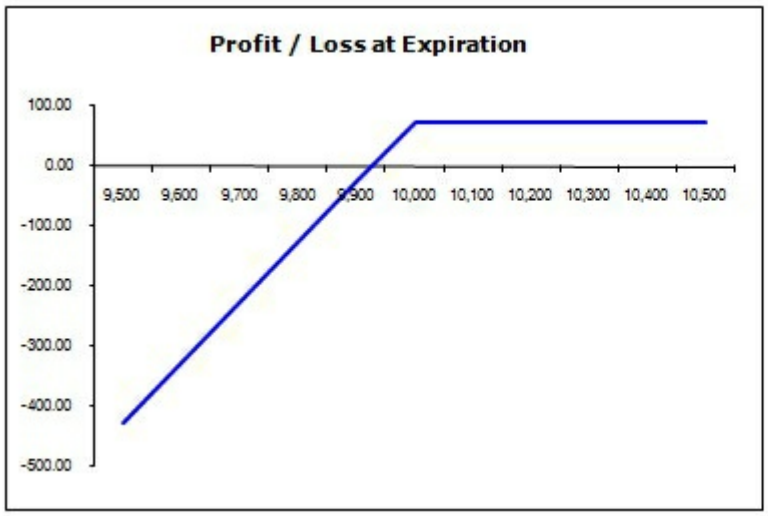
Payoff for buyer of Put Option A trader bought Nifty Put Option with strike 10000 at a premium of Rs 73/-. So he paid a premium of Rs 5475/- (Rs. 73 multiplied by Nifty lot size of 75). His risk is limited to the premium paid. So the maximum loss the trader can incur in this position is Rs 5475/-. However profit potential is unlimited. Profit will increase with the decrease in price. Breakeven point will be strike - premium. So if Nifty closes below 9927 than trader will make money.



P&L Payoff at Expiration Matrix

Underlying Price	Profit /Loss
9,500	427
9,600	327
9,700	227
9,800	127
9,900	27
10,000	-73
10,100	-73
10,200	-73
10,300	-73
10,400	-73
10,500	-73

Payoff for seller of Put Option – A trader sold Nifty Put option with strike 10000 at a premium of Rs 73/-. So he received a premium of Rs 5475/- (Rs. 73 multiplied by Nifty lot size of 75). Seller of option is required to pay margin. Margin on option sell is equal to the margin on Future buy/sell. His profit is limited to the premium of Rs 5475/- received. However risk profile is unlimited. Loss will increase with the decrease in price. Breakeven point will be strike - premium. So if Nifty closes above 9927 then seller will make money.



P&L Payoff at Expiration Matrix

Underlying Price	Profit /Loss
9,500	-427
9,600	-327
9,700	-227
9,800	-127
9,900	-27
10,000	73
10,100	73
10,200	73
10,300	73
10,400	73
10,500	73

Comparison of buying future Vs buying an Option

Please refer Table 3: Option chain Nifty (This option chain may be referred from NSE website also; data updates live with few minutes delay). If you will check the Open Interest (OI) column, 10000 call options have the highest open interest of 4083300 and 9800 put have highest open interest of 5366775. Technically 10000 is having a strong resistance and 9800 is having a strong support till expiry. (The example referred to, is of, monthly options only and add open interest of weekly options strikes for computation of open interest based resistance or support level for the month/week).

Suppose trader is bearish on Nifty because Nifty is trading at its strong resistance level of 10,000. Options give many choices to trade; let's discuss some choices if trader wants to go short –

- First, Trader can sell future of Nifty. As mentioned in above examples selling future at 10000 will have risk profile of unlimited loss and profit potential of unlimited profit.
- Second, Trader can buy any put option of Nifty. In case he is buying a put option with strike price 10000 at Rs 83 than the profit potential is unlimited like future but risk is limited to the premium of Rs 83 paid. One more noticeable difference is, selling a Nifty future require margin whereas trader can take position in put option with Rs 6225 only (Rs 83 X Lot 75 = 5475).

  So options are providing more leverage than futures for taking exposure in same quantity. Maximum cost in this case is Rs 83, If underlying will expire at 10,000 or above than trader will lose 100% of money (Rs 83/-). Options can fund the cost also, you can sell lower premium option along with buying an option.
- Third, trader can sell the put option with strike price of 9800 at Rs 34/- along with buying a put with strike price of 10000 at Rs 83. Now maximum risk in this trade has come down to Rs 49 (83 -34) and maximum profit is limited to Rs 151 (Total Rs 11325 = Premium 151 X Lot 75). So you can say that if trader will be wrong than he/she will lose X amount however if trader will be right than he/she will earn 3X amount. So risk reward ratio is 1:3. **In this case margin blocked will be significantly lesser than the future sold after new rules applicable from 1st June 2020.** Trader can also sell 2 lots of 9800 put at 34 and can buy one lot of 10000 put at Rs 83, this is called ratios. We will discuss ratios and price behavior of options before expiry in detail later on. Now we know ATM options have only time value and there is no intrinsic value. It means, if Nifty remains at 10000 till expiry the buyer of put option will lose the premium. So trader can sell any Call option if view is bearish.
- Fourth, Trader can sell Call option if he/she is bearish. Call option with strike price of 10000 is trading at Rs 96/-. In this case even if Nifty remains at 10000 or below trader will make money, however in this case profit is limited to the premium of Rs 96 (Total Rs 7200 = 96 X 75) and risk profile is unlimited. Trader can buy call option with strike price 10100 at Rs 49 along with selling Call option with strike price 10000 at Rs 96, In this case maximum profit potential is Rs 47 (96-49) and maximum possible loss is Rs 53/-. Trader can make maximum profit of Rs 3525/- per lot (Premium 47 X lot 75) and

maximum loss is limited to Rs 3975/-(Premium 53 X lot 75). Selling naked option is not a good choice. It's better to buy a low price option to limit the maximum loss along with selling of an option. Trader will get margin benefit too. Buying an option is also not a good choice, sell a lower premium option along with buying an option to bring down the cost as we discussed in point 3. So trading bull bear spreads are always better than buying selling naked future or option.

CALLS											PUTS								
OI	Chng in OI	Volume	IV	LTP	Net Chng	Bid Qty	Bid Price	Ask Price	Ask Qty	Strike Price	Bid Qty	Bid Price	Ask Price	Ask Qty	Net Chng	LTP	IV	Volume	Chng in OI	OI
438,150	-63,450	1,862	-	421.00	93.70	75	421.00	424.75	75	9600.00	750	14.10	14.45	750	-11.90	14.05	14.27	68,153	-165,825	3,136,275
825	-75	3	-	343.50	39.00	2,100	365.05	389.75	600	9650.00	75	17.20	17.50	900	-14.80	17.55	13.84	5,369	-16,575	169,950
849,075	-109,725	5,563	4.85	332.75	90.90	75	328.30	332.95	750	9700.00	1,575	21.65	22.00	975	-19.00	21.90	13.40	102,828	444,900	4,232,700
60,075	-2,850	210	6.70	285.00	80.85	75	285.05	293.70	600	9750.00	150	27.65	27.80	1,050	-23.55	27.80	13.03	8,757	30,300	452,475
1,549,575	-357,150	25,365	8.58	244.90	78.55	750	242.65	245.00	300	9800.00	1,350	34.05	34.50	975	-29.50	34.40	12.53	139,737	679,950	5,366,775
99,450	-25,950	2,047	8.55	202.45	70.50	75	199.00	202.80	75	9850.00	375	42.50	43.40	75	-35.65	43.35	12.13	9,951	63,750	385,800
3,310,425	-327,075	100,880	8.68	164.35	61.15	975	163.30	164.75	750	9900.00	750	53.05	53.75	675	-44.30	53.50	11.60	204,060	1,148,025	4,559,100
423,000	-40,650	21,459	8.38	126.90	50.05	600	126.15	127.30	75	9950.00	150	65.20	66.00	375	-53.00	66.20	11.08	24,937	468,825	629,925
4,083,300	-693,975	200,347	8.38	96.35	41.90	3,600	96.30	96.35	4,875	10000.00	825	83.20	83.95	675	-63.10	83.75	10.75	86,550	819,750	2,907,075
333,675	-213,375	18,145	8.26	69.60	33.00	75	69.60	70.00	1,875	10050.00	150	101.40	105.00	1,500	-74.30	105.00	10.41	1,967	58,725	73,200
3,662,250	182,925	133,139	8.22	48.65	23.75	75	48.55	49.00	75	10100.00	75	131.85	133.35	750	-82.90	131.95	10.26	13,978	116,400	704,325
279,600	48,600	8,165	8.22	32.85	16.55	75	32.25	32.85	150	10150.00	150	161.00	175.20	75	-90.30	166.00	10.46	64	2,475	28,500
2,942,400	-88,800	93,811	8.36	22.20	11.10	900	22.10	22.20	900	10200.00	750	202.25	204.95	150	-89.95	204.95	10.89	5,871	59,700	824,475
183,675	75	2,869	8.36	13.95	6.25	75	13.75	14.95	75	10250.00	750	230.75	257.75	600	-53.90	283.10	16.20	5	-	11,625
2,092,275	-168,600	39,736	8.64	9.50	4.30	150	9.40	9.50	900	10300.00	450	286.60	291.15	750	-99.75	291.50	12.08	2,609	-20,550	452,175
49,200	11,175	492	8.69	5.75	2.05	75	5.30	6.40	2,025	10350.00	600	321.15	347.35	2,700	-	-	-	-	-	-
1,611,000	156,750	24,623	9.16	4.30	1.50	675	4.25	4.35	150	10400.00	150	379.55	384.95	75	-106.15	385.80	13.83	876	-46,800	294,000

Table 3: Option Chain Nifty (Nifty Trading at 10000)

Anyone can open above option chain of Nifty / Bank Nifty/Stock from NSE web site. By default option current week market watch will open. One can select any other expiry. In this option chain, information on bid ask price, touch line quantity, volume, LTP, implied volatility and open interest for calls can be found on left side and for puts on right side.

One of the best things with options is that there are many ways to use them. Options make it possible to trade in the market with limited risk and to trade in the market with limited money.

Market participants can use different combinations of different option contracts to create unique expected payoff and to increase returns with pre defined risk. One can not only take directional trade in option but also they can play direction neutral strategies (Trader will make money on movement in either side). Many strategies we will discuss later in this book. It has to be understood that options are different from stocks. Direction is only one dimension. Options are sensitive not only to direction but also to time left before expiration and how volatile the stock is. Options are three-dimensional so before taking any position in options trader need to take into consideration the three factors price, time, and volatility. It is essential to understand options Greeks to understand sensitivity of option prices to all three dimensions. Till now you learned in this book that what will be the price of any option on expiry but it is also essential to understand the price behavior of option before expiry, complete understanding of Option Greeks is required to understand price behavior before expiry. For example, how the options price will move with movement in underlying, what will be the impact of time decay, what will be the impact of increase in volatility? In next chapter we will unravel options Greeks.

OPTION GREEKS

Value of any contract traded on Exchange is ultimately determined by the supply and demand. The same is true in case of options also. Academicians developed models to figure out the theoretical value of options. Most pricing models use the following inputs to determine theoretical values:

1. Stock price
2. Strike price
3. Time to expiration
4. Volatility
5. Interest rate
6. Dividends

Option Greeks help us to understand how option price may react to a given change in some of the variable pricing inputs. The most commonly used Greeks are Delta, Gamma, Theta, Vega, and Rho. Greeks are not a guarantee of exact option premium changes, but rather a theoretical guidepost that gives investors an estimate of an option's value when the underlying asset moves, interest rates change, dividend announcement, time changes, or fluctuation due to volatility.

All inputs are dynamic except Strike Price. If trader knows all of these inputs, he/she can use the Option Calculators to arrive at the theoretical price of an option. If one does not know any one input than they can use the option price (premium) to calculate it. We all know at what price/premium any option is trading in the market. This price/premium is used to calculate the volatility that is called implied volatility. When the price of option changes it means any one or more than one out of five input variable has changed. Understanding of these variables and Greeks is essential to understand the price behavior of an option before expiry. Let's understand the Greeks.

DELTA

Options price of various strikes move differently with the movement in prices of underlying asset. Time to expiry is also have impact on option price. Is there any mathematical way to estimate how much will the price of an Option contract move with change in the price of underlying?

The answer is delta!

Delta is rate of change in option price relative to a change in price of underlying security. In other words, Delta is the percentage change in the option premium for each rupees change in the underlying asset. For Example, if you have a call option of Infosys with a strike price of 1000, and the Infosys moves from 1000 to 1001, it will cause the Call option premium to increase by a certain amount—let's say it increases by Rs 0.50. Then the option will have a positive delta of 0.50 or 50%, because the option premium increased to Rs 0.50 for an increase of 1 in the stock price. Delta is also denoted by a whole number, so if an option has a 0.50 delta, then it will often be denoted as "50 delta".

Note that a put option with the same strike price will decline in price with increase in the price of underlying and therefore have a negative Delta. So any option contract have 0.50 delta means premium of option contract will increase by 0.50 paisa with Rs1 increase in underlying asset and if price of underlying asset came down by Rs 1 then option premium will also came down by 0.50 paisa. The delta for a Call option always ranges from 0 to 1, because as the underlying asset increases in price, call options increase in price. Put option Deltas always range from -1 to 0 because as the underlying security increases, the value of put option decreases.

It's crucial to understand how your option will move relative to the stock price. Without understanding Delta, it's hard to know the price behavior of option with respect to change in price of underlying asset. Delta of option contract changes with the change in input of option pricing model. Understanding the behavior of delta with change in input is essential for traders to use this Greek in options trading. You can compute delta of an option through option calculator. Example of option calculator and how to calculate greeks is given at end of this chapter.

Price of options of Nifty in the month of September 2015 of various strikes and their delta are given in below table.

	Call Options				Put Options		
Strike Prices		Price	Delta			Price	Delta
7500	ITM	556	0.99		OTM	61	-0.01
7600	ITM	471	0.96		OTM	78	-0.04
7700	ITM	390	0.90		OTM	100	-0.10
7800	ITM	318	0.81		OTM	125	-0.19

7900		ITM	250	0.68		OTM	156	-0.32
8000		**ATM**	**194**	**0.52**		**ATM**	**191**	**-0.48**
8100		OTM	139	0.36		ITM	241	-0.64
8200		OTM	96	0.22		ITM	295	-0.78
8300		OTM	63	0.12		ITM	358	-0.88
8400		OTM	40	0.06		ITM	431	-0.94
8500		OTM	23	0.03		ITM	515	-0.97

Table 4: Strike wise delta

In the given example Nifty is trading at 8000. ATM Call strike 8000 is trading at Rs 194/-. Delta of ATM Call strike 8000 is 0.52, so the Rs 1 change in Nifty (from 8000 to 8001) will result into 0.52 paisa in change in the price of 8000 call (from 194 to 194.50).

Nifty trading at 8000 and ATM call strike 8000 is trading at Rs 194/-. If Nifty goes up by 10 points from 8000 to 8010, what will be the price of ATM call strike 8000? Answer is Rs 199.20, because price of ATM call will increase by Rs 5.20 (Delta is 0.52 in the given example).

In the same way Delta of 7500 call which is in the money by 500 point is 0.99, so the Rs 1 change in Nifty will result into 0.99 paisa in change in the price of 7500 call. 7800 Call is in the money by 200 points and delta is 0.81, so 1 point change in Nifty will result in change of Rs 0.81 in the premium of 7800 call.

Value of delta is coming down with increase in strike price of call option. If Nifty will change from 8000 to 8010 then 8400 Call will change by 60 paisa only from Rs 40 to 40.60 approx and 8300 Call will change by Rs 1.2 only from Rs 63 to Rs 64.20.

In case of Put options, Delta for in the money option is high and out of money is low. It is to be observed in Table 4 [Strike wise delta] that delta of ATM strikes is near 0.50. Delta of In-the-money strikes is more than 0.50 and deep in the money option is closer to 1. Delta of out of money options is less than 0.50 and deep out of money options is closer or 0. It is again to be observed in Table 4 that value of both delta of same strike is 1. If you will add the value of call delta and the value of put delta of the same strike than the result is 1 because of call put parity. Put call parity works in European options. Today Stock options as well as Index options are European style. We will discuss this put call parity in detail when we will understand the strategy of conversion and reversal.

Delta is also used as a proxy for the probability that a call will expire in the money. So a stock with a delta of 50% is deemed to have a 50% chance of finishing in the money. An option with 0.25 Delta would be thought of having 25% chance of expiring in the money. If there is less time for expiry then there less chance of expiring in the money of OTM strike. So when time is less OTM strikes moves to zero and ITM strikes move to 1. If time to expiry will be more then delta of all strikes will move towards 0.50.

Please refer Table5 for delta of various strikes of Nifty call options on different time to expiry if volatility is approx 11%. Index is trading at 8000 so 8000 is ATM strike. With the change of 10 points in Nifty from 8000 to 8010, OTM Call strike 8200 will change by Rs 1.10 (Delta 0.11) when there are only 10 days to expiry however the same strike will change by Rs 4.5 (Delta 0.45) when there are 80 days to expiry.

Table 5: Delta of Call Options							
		Time to Expiry					
Strike Prices		**1 Day**	**5 Days**	**10 Days**	**20 Days**	**40 Days**	**80 Days**
7500	ITM	1	1.00	1.00	1.00	0.98	0.95
7600	ITM	1	1.00	1.00	0.99	0.95	0.91
7700	ITM	1	1.00	0.99	0.95	0.90	0.87
7800	ITM	1.00	0.98	0.94	0.88	0.83	0.80
7900	ITM	0.99	0.86	0.79	0.75	0.73	0.73
8000	ATM	0.52	0.54	0.55	0.57	0.60	0.64
8100	OTM	0.02	0.19	0.29	0.38	0.47	0.55
8200	OTM	0.00	0.03	0.11	0.22	0.34	0.45
8300	OTM	0.00	0.00	0.03	0.11	0.23	0.36
8400	OTM	0.00	0.00	0.01	0.04	0.14	0.28
8500	OTM	0.00	0.00	0.00	0.01	0.08	0.21

As mentioned earlier also, Delta of option contract changes with the change in other variables, i.e., time to expiry, volatility, interest rates. Volatility is also a very important input. Delta changes with change in volatility. With increase in volatility, Delta of all strikes moves towards 0.50. So in case of increase in time as well as increase in volatility there is drop in delta of in the money strikes and rise in out of money strikes. Delta at various levels of volatility of Nifty call options when time to expiry is 28 days is given below in Table 6. Observe that Delta of 7500 call will change by 1 Rs with 1 Rs change in Nifty when volatility is 5%. However, if volatility is 50% than the same contract will change by 0.72 paisa only with 1 Rs change in Nifty. In case of 8300 call when Nifty is trading at 8000 1RS change in Nifty is resulting into the change of 1 paisa only at 5% volatility whereas at 50% volatility the same with change by 0.44 paisa.

Table 6: Delta of Call Options							
		Volatility					
Strike Prices		5%	10%	20%	30%	40%	50%
7500	ITM	1	0.99	0.90	0.81	0.76	0.72
7600	ITM	1	0.98	0.86	0.77	0.72	0.69
7700	ITM	1	0.95	0.80	0.72	0.68	0.65
7800	ITM	0.99	0.87	0.72	0.66	0.63	0.62
7900	ITM	0.91	0.75	0.64	0.61	0.59	0.58
8000	ATM	0.67	0.59	0.56	0.55	0.54	0.55
8100	OTM	0.33	0.42	0.47	0.49	0.50	0.51
8200	OTM	0.09	0.26	0.38	0.43	0.46	0.47
8300	OTM	0.01	0.14	0.30	0.37	0.41	0.44
8400	OTM	0.00	0.06	0.23	0.32	0.37	0.41
8500	OTM	0	0.03	0.17	0.27	0.33	0.37

Please refer the Table 7. Reliance Industries options are trading at approx 30% volatility, Nifty options are trading at approx 8% volatility and USDINR options are trading at approx 4%

volatility. It is the middle of month and still 14 days left for expiry. Various contracts are having different delta because of different volatility. Reliance Industries is trading at Rs 880. Rs 1 change in Reliance will result into 53 paisa change in ATM call. Nifty is trading at 10100 and Rs 1 change in Nifty will result into 0.58 paisa in ATM call. In the same way USDINR is trading at 65, if price will increase to 66, by Rs 1/-, will it result in the price of 65 call to increase by 0.65 paisa? The answer is No. It will be more than 65 paisa. Let's try to understand. When USDINR will increase by 0.50 paisa 65 call will be ITM1. If you will observer ITM1 delta is 0.92. So delta of call options is also increasing with increase in price. This rate of change in delta is called Gama. Let's understand the Gama first than return to Delta again for better understanding.

Table 7: Product wise IV & Delta										
Reliance (IV-30%)				Nifty (IV-8%)				USDINR (IV-4%)		
Strike		Delta		Strike		Delta		Strike		Delta
830	ITM	0.86		9600	ITM	1.00		62.5	ITM5	1.00
840	ITM	0.81		9700	ITM	1.00		63	ITM4	1.00
850	ITM	0.75		9800	ITM	0.98		63.5	ITM3	1.00
860	ITM	0.68		9900	ITM	0.93		64	ITM2	0.99
870	ITM	0.61		10000	ITM	0.80		64.5	ITM1	0.92
880	**ATM**	**0.53**		**10100**	**ATM**	**0.58**		**65**	**ATM**	**0.65**
890	OTM	0.46		10200	OTM	0.34		65.5	OTM1	0.28
900	OTM	0.38		10300	OTM	0.15		66	OTM2	0.06
910	OTM	0.31		10400	OTM	0.05		66.5	OTM3	0.01
920	OTM	0.25		10500	OTM	0.01		67	OTM4	0.00
930	OTM	0.20		10600	OTM	0.00		67.5	OTM5	0.00

GAMMA

As we know delta is not constant for any strike. It is different for different strikes. So delta itself changes as the price of underlying asset changes. Gamma is the change in delta for each unit change in the price of underlying asset.

Following example will help to understand, kindly refer underlying price, delta and gamma values given in table on next page.

When Nifty is trading at 10000 ATM call of Nifty is trading at Rs 98.45, Delta is 0.60 and Gamma is 0.0021. 1 point change in Nifty should result into 0.60 paisa change in 10000 call and 0.0021 point change in Delta. So 10 point change in Nifty resulted into Rs 6 (0.60 X 10) change in the price of call. Delta also increased by 0.020 (10 X 0.002) from 0.60 to 0.62. When there is rise in price of Nifty by 40 points than Price of call should increase by Rs 24.80 (40 Multiplied by delta of 0.62). However the price of call is Rs 130.77, increased by Rs 26.26. Difference of Rs 1.46 (26.26-24.80) is due to Gamma (as delta also changes with change in price). Delta should also increase by 0.08 (.0020 X 40) because of Gamma whereas Delta increased by only 0.07 points only (From 0.62 to 0.69) because Gamma is decreasing with increase in Nifty. Gamma which was 0.0020 at 10010 came down to 0.0019 at 10050. So Gamma is also dynamic. ATM options have relatively high Gamma whereas ITM and OTM options has low gamma.

Underlying Price of Nifty	Price (ATM CALL Strike 10000)	Delta	Gama
10000	98.45	0.60	0.0021
10010	104.51	0.62	0.0020
10050	130.77	0.69	0.0019

As we can observe in Table 8 ATM strikes have highest Gamma and rate of change of delta is decreasing as strike is going more out of money.

Table 8: Gamma & Strike			
		Call Options	Put Options
Strike Prices		Gamma	Gamma
ITM	9,600.00	0.0001	0.0001
ITM	9,700.00	0.0004	0.0004
ITM	9,800.00	0.0009	0.0009
ITM	9,900.00	0.0015	0.0015
ATM	10,000.00	0.0019	0.0019
OTM	10,100.00	0.0019	0.0019
OTM	10,200.00	0.0015	0.0015

OTM	10,300.00	0.0010	0.0010
OTM	10,400.00	0.0005	0.0005

It can be observed in Table 9, Gamma of ATM strike is more when time to expire is less. As it was discussed earlier also each Greeks have impact on another Greek that is why the gamma is different on different time to expiry.

Table 9: Gamma & Time to Expiry

Strike Prices		Time to Expiry					
		1 Day	**5 Days**	**10 Days**	**20 Days**	**40 Days**	**80 Days**
ITM	9,600.00	0.0000	0.0000	0.0000	0.0001	0.0003	0.0003
ITM	9,700.00	0.0000	0.0000	0.0001	0.0004	0.0005	0.0005
ITM	9,800.00	0.0000	0.0003	0.0007	0.0009	0.0008	0.0006
ITM	9,900.00	0.0004	0.0020	0.0019	0.0016	0.0012	0.0008
ATM	10,000.00	0.0095	0.0042	0.0029	0.0021	0.0014	0.0009
OTM	10,100.00	0.0006	0.0027	0.0025	0.0020	0.0015	0.0010
OTM	10,200.00	0.0000	0.0005	0.0012	0.0015	0.0014	0.0011
OTM	10,300.00	0.0000	0.0000	0.0003	0.0009	0.0011	0.0010
OTM	10,400.00	0.0000	0.0000	0.0000	0.0004	0.0008	0.0009

It can be observed in table10, Gamma of ATM strike is more when volatility is less. Gamma of ITM and OTM strikes are more when volatility is high. You may refer previous table of delta and volatility, as you can see delta on high volatility is low that is why gamma is high. Whereas delta of low volatility is high, as you can see delta of ITM strikes of USDINR is almost near to 1 that is why gamma which is the rate of change in delta, is low. Delta value range is 0 to 1. When delta is almost near to Zero or One the rate of change in delta will be almost nil.

Table 10: Gamma & Volatility

Strike Prices		**Volatility**					
		5%	10%	20%	30%	40%	50%
ITM	9,600.00	0.0000	0.0000	0.0000	0.0000	0.0003	0.000437
ITM	9,700.00	0.0000	0.0000	0.0001	0.0004	0.0006	0.000755
ITM	9,800.00	0.0000	0.0000	0.0006	0.0011	0.0012	0.001113
ITM	9,900.00	0.0000	0.0011	0.0023	0.0020	0.0017	0.001404
ATM	10,000.00	0.0152	0.0076	0.0038	0.0025	0.0019	0.001524
OTM	10,100.00	0.0000	0.0014	0.0025	0.0021	0.0017	0.001429
OTM	10,200.00	0.0000	0.0000	0.0007	0.0012	0.0012	0.001163
OTM	10,300.00	0.0000	0.0000	0.0001	0.0005	0.0007	0.000825
OTM	10,400.00	0.0000	0.0000	0.0000	0.0001	0.0003	0.000512

DELTA HEDGING / GAMMA SCALPING

Now we understand delta and gamma and impact of other Greeks on both.

Lets take an theoretical example to explain the basic concept of delta heading. I bought 1 ATM call of Nifty. How much this call will move with movement in Nifty?

Answer to this question is delta. As we know delta of ATM call is approximately 0.50 so this call will move 0.50 paisa with every 1 Rs change in Nifty.

Lets take an another example. I bought 2 ATM call of Nifty. How much these calls will move with movement in Nifty?

Now we have 2 lots and each lot has delta of 0.50. So we have position delta of 1 (combined delta of both calls). It means calls will move Rs 1 with every 1 Rs change in Nifty.

What if I bought 2 ATM calls and sold 1 Nifty Future. What will be the impact of price change by 10 points in Nifty on profit and loss of my position?

Answer is almost zero because if Calls will gives profit then future position will give loss and if calls will give loss then future position will give profit.

So what we understood that we can hedge delta also through future or combination of different options.

On expiry day one trader sold 4 lots of OTM call options of 0.25 delta each and bought 1 lot of Future to keep the position delta neutral, what will be the impact? Let us take one raw theoretical example to understand delta hedging and gamma effect.

Please refer below table. I bought 20 lots of ATM call 10000. ATM delta is 0.50 so position delta is 10. Trader sold 10 lots of Nifty future to hedge the delta. Lets assume after some Nifty goes upto 10100. Now options strike 10000 are in the money because index is trading at 10100. As we know in the money options have higher delta. Lets assume 100 points ITM delta is 0.60. So my new position delta is 12 (delta of 0.60 multiplied by number of lots 20). It means I need to sell 2 more lots to keep my position delta neutral. Again lets assume Nifty came down by 200 points after few minutes. Now my 20 lots of strike 10000 are out of money. As we know OTM have less delta, lets assume 100 point OTM has delta of 0.40. My new position delta is 8. So I need to buy 4 lots to keep my position delta neutral.

You can notice in above example that I am just trying to keep my position delta neutral and that is resulting into selling of future on higher levels and buying of future at lower level of Nifty. So delta hedging is giving me profit when am buying options. When will be the loss? Time value of option will erode over a period of time. Theta will give me loss if market remains range bound near 10000 with +-50 points or so because I am option buyer (we will learn Theta in next chapter).

Nifty	Bought Nifty Call 10,000	Delta	Position Delta	Nifty Futures to Hedge Delta	Buy /Selling Nifty Future
9900	20	0.4	8	-8	4
10000	20	0.5	10	-10	
10100	20	0.6	12	-12	-2

So we learned that Gamma helps the option buyer.

Lets take one more theoretical example to understand delta hedging in details. Nifty is trading at 10000. Nifty call option 10000 is trading at Rs 113/-. There are 25 more days to expiry & implied volatility is 8%. For example, Trader want to sell 20 lots of Nifty call option with strike price 10000 at 113. Delta of 10000 call options is 0.6 so Trader need to buy 12 lots Nifty future to hedge price risk of Calls sold.

Contract		Price	Position (Lots)	Delta	Position Delta	Profit /Loss
Nifty Call 10000		113	-20	0.6	-12	0
Nifty Future		10000	12	1	12	0
Net					0	0

Assume Nifty goes up by 20 points. Trader sold the calls but he also bought the future to hedge his position so the net profit/loss on this position is Nil. If trader have not bought the future to hedge the delta then this rise in price must have resulted into loss.

Contract		Price	Position (Lots)	Delta	Position Delta	Profit /Loss
Nifty Call 10000		125	-20	0.64	-12.8	-18000
Nifty Future		10020	12	1	12	18000
Net					0.80	0

Assume that after 2 days Nifty goes up to 10050. Position of sold calls is in loss but the position of future bought is in profit. ATM Call of 10000 which trader sold 2 days back is now in the money. Delta has increased to 0.7.

			Position		Position	Profit

Contract		Price	(Lots)	Delta	Delta	/Loss
Nifty Call 10000		140	-20	0.7	-14	-40500
Nifty Future		10050	12	1	12	45000
Net					-2	4500

Because Delta of Call has increased from 0.60 to 0.70 thats why position delta has also increased to 14 from 12. As of now trader have only 12 lot of future so he need to buy 2 more lots of Nifty future to make this position delta neutral.

Contract		Price	Position (Lots)	Delta	Position Delta	Profit /Loss
Nifty Call 10000		140	-20	0.7	-14	-40500
Nifty Future		10050	14	1	14	45000
Net					0	4500

Assume after 2 more days Nifty came back to 10000. 4 days back when nifty was trading at 10000, call with strike price of 10000 was trading at 113 but after 4 days this will trade at 101 because of time value (if implied volatility of 8% remains unchanged)

Contract		Price	Position (Lots)	Delta	Position Delta	Profit /Loss
Nifty Call 10000		101	-20	0.6	-12	18000
Nifty Future		10000	14	1	14	-7500
Net					2	10500

Position Delta value of calls again came back to -12 from -14. So Trader need to sell 2 lot of Nifty future to make this position delta neutral.

Let’s close all positions. In total Trader sold 20 lots of call option at 113 and he bought 12 lot Nifty futures at 10000 and 2 lot Nifty futures at 10050. Finally he squared off all positions, call options 20 lots bought at 101 and 14 lots Nifty sold at 10000. Net position is the profit of Rs 18000 because of time value in Nifty call options and Loss of Rs7500/- on 2 lots which we bought at 10050 to make the position delta neutral. So Net profit in trading is Rs 10500/-.

(In the given example we leared that if trader will sell option and he will hedge Delta with future than he will earn time value on options sold but Delta hedging will result into losses.)

In the same example if Nifty goes down to 50 points than the call options position will give the profit of Rs 46500 however approximately the loss will be incurred on future bought. Because market Nifty has come down, 10000 strike call option has become out of money so the delta has come down to 0.50. To make the position delta neutral trader need to sell 2 lots of future at 9950 which we bought at 10000.

Day 1: Nifty Future Trading 10000						
Contract		Price	Position (Lots)	Delta	Position Delta	Profit /Loss
Nifty Call 10000		113	-20	0.6	-12	0
Nifty Future		10000	12	1	12	0
				Net Delta	0	0
Day 2: Nifty Future Trading 9950						
Contract		Price	Position (Lots)	Delta	Position Dealta	Profit /Loss
Nifty Call 10000		82	-20	0.5	-10	46500
Nifty Future		10000	12	1	10	-45000
Net					0	1500

There will be no profit or loss if nifty comes back to 10000 on 3rd day.

Day 3: Nifty Future Trading 9950						
Contract		Price	Position (Lots)	Delta	Position Delta	Profit /Loss
Nifty Call 10000		107	-20	0.6	-12	9000
Nifty Future		10000	12	1	12	-7500
Net					0	1500

1st Day position Delta was 12 so trader bought 12 lot of Nifty Future, Second day position delta was 10 so trader sold 2 lots at 9950 to make position delta neutral, Third day position detla was again 12 so trader bought 2 lot again at 10000. So trader lost Rs 7500/- on future position when Nifty went 50 points down and came back . If this will happen twice than we will lose Rs 15000/- and net position of both contract will result into loss. Trader will make money only when time value earned is more than the cost incurred in delta hedge.

One more example to make delta hedging more clear, Please refer table 11. Index is trading at 10000. ATM call 20 lot sold at premium of Rs 113/-. Delta is 0.6 so 12 (20 X 0.60) lot of Nifty Future bought to hedge delta. We can easily calculate the profit & loss pay off on expiry for this position. Maximum profit will be approximately Rs 1,70,000/- (113 X 75 X 20) if Nifty closed at 10,000. But trader is hedging delta with every 50 point change in Index. Next day when underlying gone up by 50 points trader bought 2 more lot of Nifty future to make the position delta neutral.

Table 11:

Time to Expiry	Nifty Price	Nifty 10000 Call option price	Nifty Future position	Nifty Option Position	Option Delta	Profit on Future	Loss on Options	Net P& L

25 Days	10000	113	12	-20	0.6	0	0	0
24 Days	10050	143	14	-20	0.7	45000	-45000	0
23 Days	10100	177	16	-20	0.8	97500	-96000	1500
22 Days	10150	214	17	-20	0.85	157500	-151500	6000
21 Days	10200	255	18	-20	0.9	221250	-213000	8250

What if index came down by 200 points in 4 days. There is no profit and no loss on the position. In below example we make profit when index remains range bound at same level and there is fall in prices of options because of time value. Interest cost is not considered in any given example. In case of selling of a nacked option trader need to give same margin required on future contract.

Time to Expiry	Nifty Price	Nifty 10000 Call option price	Nifty Future position	Nifty Option Position	Option Delta	Loss on Future	Profit on Options	Net P& L
25 Days	10000	113	12	-20	0.6	0	0	0
24 Days	9950	82	10	-20	0.5	-45000	46500	1500
23 Days	9900	57	8	-20	0.4	-82500	84000	1500
22 Days	9850	37	6	-20	0.3	-112500	114000	1500
21 Days	9800	22	4	-20	0.2	-135000	136500	1500
15 Days	**9800**	**12**	**3**	**-20**	**0.15**	**-135000**	**151500**	**16500**
10 Days	**9800**	**5**	**2**	**-20**	**0.1**	**-135000**	**162000**	**27000**

THETA

As we learned in previous chapter that option price has intrinsic value and time value. Time value continuously declines with time. Theta is a measure of this time decay. Theta is the amount that a theoretical option's price will change for a corresponding one day change in the number of days to expiration of the option contract.

Let's understand impact of time value on option price. Please refer Table 12, theoretical value of Nifty ATM Call Options calculated when volatility is 8%. When there are 30 days remaining to expiry Call option is trading at Rs. 127.69/- and theta is 2.78. A theta of 2.78 indicates that the option is losing Rs 2.78/- of time value per day. On 29th day theoretical value of option came down to Rs. 124.91 by 2.78 when all other factors having impact on option price remain the same. So theta is good for option seller and bad for buyer. Buyer will lose theta if underlying remains on same price, however seller will make money. Theta is 2.27 when there are 80 days to expiry. When there are only 5 days to expiry value of theta is 4.9. Value of theta is increasing as expiration nears, since each day represent a greater percentage of remaining time. Long options will always be short theta and short options will always be long theta.

Time to Expiry	Underlying Nifty Price	Nifty Strike 10000 ATM Call option Theoretical price (Rs.)	Theta (Rs.)
80 Days	10000	250	2.27
70 Days	10000	227	2.33
60 Days	10000	204	2.39
50 Days	10000	180	2.48
40 Days	10000	154	2.6
30 Days	**10000**	**127.69**	**2.78**
29 Days	**10000**	**124.91**	**2.8**
28 Days	**10000**	**122.11**	**2.83**
20 Days	10000	**98**	**3.1**
10 Days	10000	**64**	**3.83**
5 Days	10000	**43**	**4.9**
2 Days	10000	**25**	**7.04**

Table 12:

In Table 13 theoretical value of Theta of Nifty options calculated when there are 20 days to expiry at different volatility levels. From this table you can observe that value of theta is highest for 'At The Money' options. Theta for ATM is highest because time value of ATM is also

highest. Theta is high when volatility is high because higher volatility results into the higher option premiums (time value will increase).

Table 13: Theta and volatility					
		Volatility			
Strike Prices		5%	10%	20%	30%
9800	ITM	-2.23	-3.15	-5.50	-7.84
9900	ITM	-2.46	-3.49	-5.74	-8.03
10000	ATM	-2.49	-3.53	-5.79	-8.09
10100	OTM	-1.74	-3.16	-5.63	-8.00
10200	OTM	-0.70	-2.45	-5.26	-7.77
10300	OTM	-0.15	-1.64	-4.74	-7.43

You can observe from the table 13, at 5% volatility theta of 10000 call is 2.49 however at 30% volatility theta is 8.09 if rest all things remain the same. Theta will be higher when time to expiry is less, volatility is high and strike is near ATM.

If you are option buyer than Theta will give you loss but Gamma will help you. Options price will increase more with increase in price of underlying because delta will also increase with increase in price of underlying because of Gamma and option prices will decrease less with decrease in prices.

If you are an option seller than Theta will give profit but gamma will give loss. We learned the example of delta hedging in previous topic. In all examples trader sold the options and hedging delta through future. Because options were sold that's why theta was giving profit whereas delta hedging was giving loss. If you will take an example of Buy option and hedging delta through future than gamma scalping will give you profit because trader will sell more future as market will go up and trader will buy future as market will come down to make his position delta neutral. But theta will give loss because you are having long position in options.

So if you are expecting a range bound underlying prices and expiry of underlying approximately on same levels than you sell options and hedge position delta to earn theta and if you are expecting volatility in prices in short span of time (frequent upside and downside) than you should buy options and hedge delta to earn the profit from gamma scalping. Delta could be hedged through future or different combinations of options also. Delta of ATM strikes change more because Gamma is highest at ATM (especially when implied volatility is low) things may be out of control very fast, So it's better to use OTM strikes if you are selling options and hedging delta.

VEGA

Volatility is expressed in terms of the annualized standard deviation of returns of the underlying stock. Implied volatility of 10 percent means that the standard deviation of annualized returns is expected to be 10 percent for the life of the option.

One standard deviation covers 68% of values. It means that the market expects the annualized return for the relevant stock to be within a range of one standard deviation from the average return about 68 percent of the time. 2 standard deviation covers approx 95% of values.

We can take the return for any time period less than one year and annualize it to tell us what the annual return would be if every time period in the year experienced that return.

The option market is the risk market. Higher perception of risk priced into the option thru extrinsic value. If risk is higher than the implied volatility will be high so option price will be higher and vice versa. Option price can change as perception of risk changes that result into change in implied volatility. So Vega measures the change in option price due to change in implied volatility.

Volatility is an important concept of option's price. There are 2 kind of volatility: Historic volatility and implied volatility. Historic volatility is calculated from past data. One can use historic volatility as an indication of how much option price may fluctuate in future, but there is no guarantee that past performance will be repeated. Implied volatility is calculated from current market price of an option. Volatility is a key element in time value portion of an option. Higher volatility means higher option premium. So option premium will increase with increase in volatility. You can say that option will be expensive if volatility will be high and option will be cheaper when volatility will be low.

Let's compare option price and volatility of some stocks. Please refer Table 14. I have taken closing price of some stocks and their call options as on 27th March 2020 to explain the impact of volatility on option price. If you will check the closing price of Sun Pharma and ICIC Bank you will find both closed at Rs 338/-. Now check the call strike price 340. Sun pharma call strike 340 was trading at Rs 29/- whereas ICICI bank call strike 340 was trading at Rs 42/-. So call of ICICI bank of same strike is approx 40% more expensive than the call of Sun Pharma reason being the volatility. ICICI bank was more volatile as compare to sun pharma in last few days, or you can say market is expecting more volatility in ICICI bank prices as compare to Sun pharma that is why options premium of ICICI bank is higher than Sun Pharma. If you will compare the option price of Indusind bank of near the money strike. It is even more expensive. It is trading at implied volatility of 238.

Table 14: Closing price on 27th March 2020

Stock	Price	Call Strike	Price	Implied volatility
Sun Pharma	338	340	29	75
ICICI Bank Limited	338	340	42	106
Indusind Bank Limited	411	400	115	238

Now let's understand, with an example of past data, how it will impact your decision. It is assumed that Market is too much volatile in last few days and trader expecting a sharp recovery in next few days. Trader wish to buy Sun pharma and Indusind bank both for 1 week. Trader is buying one lot of Sun pharma at 340 and one lot of Indusind bank at 410. Trader wants to hedge is future position through options. As we discussed earlier also naked positions in derivatives can erode your all investment, like we have seen in Crude future example given in this book earlier. So hedging is the most essential for derivative traders. Maximum loss and its willingness to take must be predefined.

In case of Sun Pharma better to buy strike 340 put trading at price of 30 along with buying a future. So maximum loss is limited to Rs 30/-, the cost of put paid. Delta of this ATM put strike is approx -0.45. So 1 Rs increase in future price will result into profit of Rs 1 on future position and loss of approx 0.45 paisa on option position, so every 1 Rs increase in price of Sun Pharma will give profit of approx 55 paisa to trader. Same is true in case if price of Sun pharma fall every 1 rs drop in price will give loss of 55 paisa. We also understood that Gamma help the option buyer that's why this 55 paisa will increase with increase in price and the loss of 55 paisa will decrease with every 1Rs fall in underlying price. If Sun pharma goes upto 380, the put price will come down to approx rs 15/- (after considering the impact of delta which is approx -0.45 and gamma). So net profit will be approximately Rs 25 if prices achieved as expected in next few days.

In case of Indusind bank along with buying of Stock future at Rs 410 better to sell Call strike 450 trading at Rs 100 (inspite of buying Put of ATM because implied volatility is very high so options are very expensive). Trader will earn Theta of Rs 1.60 and more daily. If future price remains below 450 than trader will earn Rs 100 from the Call sold. Future position is hedge till price of 310 on down side because of Rs 100 earned from call strike 450 sold. This is again a risky position. If in this month itself Indusind bank future price came down to Rs 40 only than trader will lose big amount. To hedge the position trader can buy Put strike price 300 at Rs 60.

In this combination of Buying Future at Rs 410 along with Selling Call strike 450 at Rs 100 and Buying Put Strike 300 at Rs 60, maximum loss is limited to Rs 65. Maximum profit is limit to Rs 90/-. Down side breakeven point is 365. Even if the underlying close above 365, trader will make money. As discussed earlier beauty of options is they give you choice to make different combinations of risk and rewards based on your requirement.

Vega measures the change in option premium due to change in volatility of underlying. So Vega tells us how much an option price will change with 1% change in implied volatility. We discussed implied volatility earlier also. At any given point of time we know all the inputs required in option pricing models including the price at which option is trading except volatility. Therefore volatility can be measured by re arranging the Black & Scholes equation to solve for

volatility in term of the other known factors. When we calculate the volatility using other known variables it is called implied volatility because the volatility is implied by the other known variables price of option, underlying price, time to expiry, strike & interest rate.

As we know each input has impact on Greek and value of Greek changes with change in any input. Let us see the impact of time on Vega. In Table 15 Vega value is calculated for options when Index is trading at 10000 at 10% volatility.

Table 15: Vega and Time

		2 Days	10 Days	20 Days	40 Days
9600	ITM	0	0.22	1.4	4.19
9700	ITM	0.00	0.93	3.0	6.42
9800	ITM	0.06	2.61	5.3	8.87
9900	ITM	1.08	4.99	7.7	11.13
10000	ATM	2.95	6.54	9.2	12.69
10100	OTM	1.30	5.94	9.1	13.20
10200	OTM	0.10	3.78	7.6	12.56
10300	OTM	0.00	1.71	5.3	10.95
10400	OTM	0	0.55	3.1	8.78
10500	OTM	0	0.13	1.6	6.49
10600	OTM	0	0.02	0.7	4.43

As you can observe from above table when there are only 2 days to expiry Vega of ATM is 2.95. It means 1% change in volatility will result into change of Rs 2.95 in the premium of the ATM strike. However if there are 40 days to expiry than 1% change in volatility will result into change of Rs 12.69 in the premium of same option. So Vega is high when time to expiry is more.

In Table 16 you can observe the impact of volatility on value of Vega. Vega value is increasing with the volatility. When there are 25 days to expiry and underlying is trading at 10,000, value of Vega of 9800 strike option is 1.5 at 5% volatility and value of Vega is 9.76 at 30% volatility.

Table 16: Vega and Volatility

		5%	10%	20%	30%
9600	ITM	0.02	2.13	6.90	8.57
9700	ITM	0.24	3.99	8.10	9.23
9800	ITM	1.50	6.37	9.14	9.76
9900	ITM	5.12	8.69	9.91	10.15
10000	ATM	9.54	10.19	10.35	10.38
10100	OTM	9.87	10.31	10.42	10.44
10200	OTM	5.78	9.05	10.13	10.33
10300	OTM	1.94	6.92	9.50	10.07
10400	OTM	0.38	4.62	8.62	9.67
10500	OTM	0.04	2.71	7.57	9.16
10600	OTM	0.00	1.40	6.44	8.54

One more thing you can observer from both of the tables that value of Vega is highest on ATM strike and it's going down as the option is going in the money or out of money.

How to trade implied volatility? If trader is expecting rise in implied volatility well before the event than he will buy options and hedge the delta through future (or any combination of options when position vega is positive) and if trader is expecting fall in implied volatiltiy after the event than he will sell options and hedge the delta through future (or any combination of options when position vega in negative). Trader will earn vega value with every 1% change in implied volatility. Various option strategies can also be used to trade volatility that we will learn in option trading strategies.

VOLATILITY SKEW

The phenomenon where options with lower strike prices have higher implied volatilities is called ‘skew’. You will notice in any option chain that different strikes of option contracts for the same underlying asset with same expiry will have different implied volatility (IV). The volatility skew is the difference in implied volatility (IV) between out-of-the-money options, at-the-money options, and in-the-money options. By looking at skew, you can increase your probability of success by buying the strike with the lower volatility and selling the strike with the higher volatility. This will start your trade-off with volatility already in your favor.

RHO

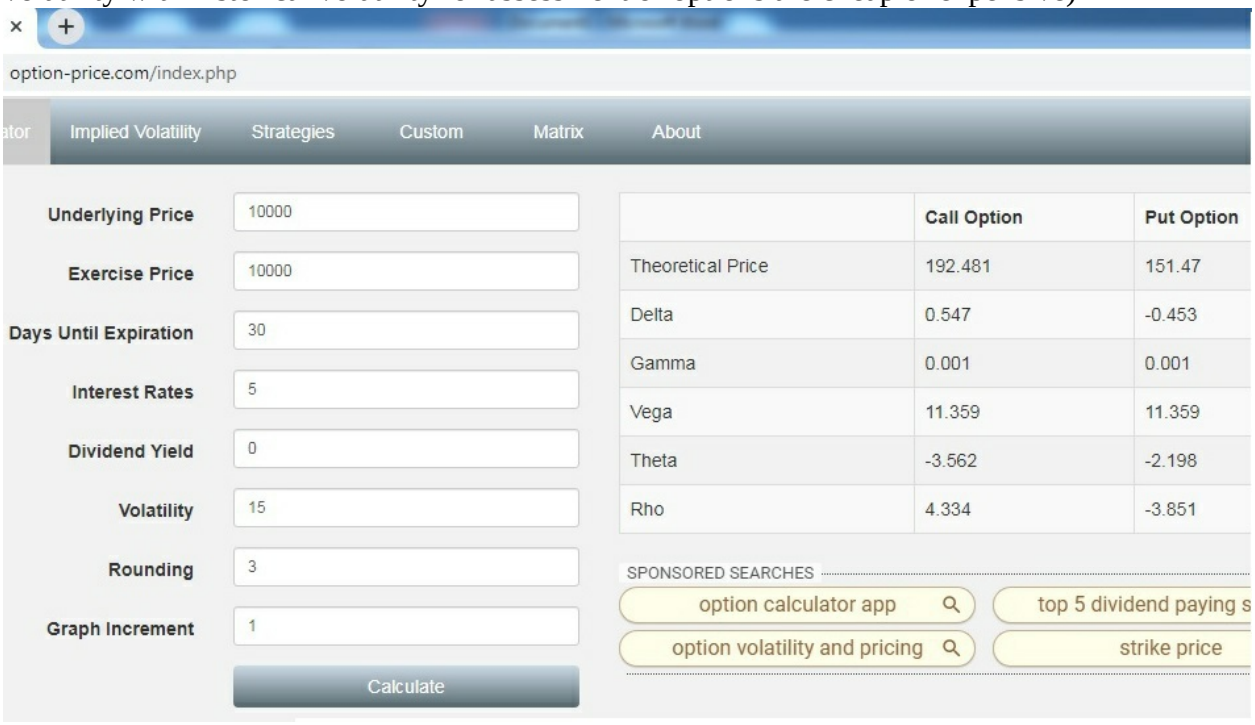
Rho is the amount of change in premiums due to a 1% change in the prevailing risk-free interest rate. Higher interest rates results into higher call premiums and lower put premiums.

Rho = Change in Option value / Change in Interest rates

OPTION CALCULATOR

Traders can use option calculators available in various front ends. Almost all trading terminals have option calculator. Traders can also Google to search option calculator. Various option calculators can be downloaded or used online. Following is an example of option calculator. Input values required are Underlying Price, Strike Price, Days to expiry, risk free interest rate, volatility. Out put is Option theoretical price, Delta, Gamma, Vega, Theta & Rho values. With the help of option calculator you can compute the values of various Greeks for a given option contract at a given point of time.

(Use price of option for computation of volatility (implied volatility), compare the current volatility with historical volatility for assessment of options are cheap or expensive)



COMPARISON OF BUYING FUTURE VS BUYING AN OPTION

We compared buying of future with buying of options in first chapter. Let us again compare them after having a fair understanding of Greeks. In our previous example we assumed that trader is bearish on Nifty than what a trader can do if he wants to go short –

- First, Trader is selling at Nifty future.
    - If Nifty will come down by 100 point Trader will make money of Rs 7500 (Lot 75 X Profit 100).
    - If Nifty Remains at same level. There is no profit and no loss.
    - If Nifty goes up by 100 point than Trader will lose money of Rs 7500.
- Second, Trader is buying a put option with strike price 10000 at Rs 83.
    - Theoretically speaking if Nifty come down by 100 point same day than Trader will make money of Rs approx 3750 because Delta of this put is 0.44 and Gama is 0.0016. It means 1 point change in index will result into 44 paisa change in price of option and 0.0016 point change in the delta. When Nifty will came down by 100 point Put which was trading at 83 should start trading at Rs 133 approx if implied volatility and time to expiry remains the same and trader will make a profit of Rs 50 (Total Profit of Rs 3750 = profit of Rs 50 X Lot 75).
    - If Nifty remains at same level than trader will lose Rs 1.82/- next day because theta of this put option is 1.82. Total loss will be Rs 136.50 per lot next day (1.82 X lot 75). As we know value of theta increases with decrease in time to expiry. So after 5 days price of this put option will come down to Rs 72/- by approximately Rs 11/- If nifty does not moves in 5 days and other inputs remain the same so trader will lose approximately Rs 825/- (11 X 75).
    - If Nifty goes up by 100 point same day than trader will lose money of approximately Rs 2850/-. When Nifty will go up by 100 point than put option whish was trading at Rs 83/- should come down to Rs 45/- because of delta and gamma if other inputs remain the same.

  One more thing you should notice that when price underlying moved favorable by 100 points than option price increased by Rs 50/- so profit was Rs 3750/- per lot but when price of underlying moved adversely then option price decreased by only Rs 38/- so the loss was Rs 2850/- per lot. Here Gamma is helping option buyer that is why profit is more and loss is less on equal point movement on either side. Delta increases when option goes in the money. IF you are buying an option than Gamma will be positive and

Theta will be negative and if you are selling an option than Gamma will negative and Theta will be positive. Gamma helps the option buyer whereas theta helps the option seller.

Implied volatility will also have an impact on price of option. Vega of 10000 put is 8.75. Price of put will increase with Rs 8.75 with 1% increase in volatility.

- Third, Trader is selling the put option with strike price of 9800 at Rs 34/- along with buying a put with strike price of 10000 at 83. Delta of 10000 long put is 0.44 and delta of short 9800 put is -0.20 so net delta of the position is 0.24. It means one point change should result into 0.25 point change in net position. If nifty will came down by 100 point than trader will make a profit of approx Rs 25/- on Net position. Total profit will be Rs 1875/-. 9800 put is trading on higher implied volatility that is why net theta of the position is approx Nil. If nifty remains on same level than there will not be any loss of time value. Vega of net position is approximately 2.5. So 1% increase in volatility of both strike will give profit of Rs 2.5/-
- Fourth, Trader can sell Call option strike 10000 at 96. Theta of the position is 3.2. Trader will earn Rs 3.2 per day and more because value of theta will increase as expiration nears. However Gamma of the position is negative so trader will lose faster if the market moves in adverse position. Delta of position is 0.58. If nifty will come down by 100 point than trader will make profit of Rs 50/- and if market will go up by 100 points trader will lose Rs 64/- (Gamma impact also considered apart from delta impact of Rs 58). Vega of this call option is 8.75 it means one point increase in implied volatility will result into the loss of Rs 8.75/-. So traders should buy an option in increasing implied volatility and sell an option in falling implied volatility. Naked option sell is not a good choice for retail investors. They should always buy any low premium options along with sell option at any strike to limit the maximum loss.

Out of above 4 choices in derivatives Buy/Sell naked future or Sell naked options is very risky and retail investors should avoid these 2 choices. We have seen market wide lower and upper circuits in year 2008, 2014 and 2020 in Index Futures. If you will have adverse position in market during these times, you may lose your entire capital in 1 day. Recently in march 2020 we also have seen more than 30% fall in a single trading day when WTI Crude at MCX from opening price of 3130 came down to 2151 with many lower circuits. Any trader with buy position at 3130 lost approx Rs 98000/- per lot in few minutes. This loss is much more than the initial margin required for buying a Future contract. Do you want to be in such potion? If answer is ‘No’, then don’t play with market. Naked positions in derivatives on adverse side can evaporate your life savings. Here I am not talking about exceptional event like settlement of crude at negative Rs 2884 (even MCX is not having provisions for trading on negative price that’s why after expiry of April 2020 they came up with auction window if price of any contract goes below Rs1, this is all together a different area to discuss so let’s come back to options). Big movement upside downside is a normal thing, so if you are trading derivatives you need to take it into consideration while trading leverage instruments. Spread positions on options is good choice for investors, it could be bull spread, bear spread or butterfly spread, because maximum loss is limited. One more benefit is the less margin required in spread position. Bull spread or bear spread will require less than half margin of naked buy or sell Future (Please refer SEBI circular on Margin framework no 27 of 24 Feb 2020 and revised circular dated 27 April 2020 for margin benefits in hedge position, applicable from 1st June 2020, link to circular already given). Let’s

learn Option trading strategies.

OPTION TRADING STRATEGIES

Trading future or stock is different from trading options. If you are bullish in the market you can buy future or stock if you are bearing in the market you can sell future but in case of options you can setup direction neutral strategies, you can setup strategies that allow you to make profit even if market does not move or market moves in either direction and you makes money. So one of the benefit of trading options is that they offer flexibility. You can trade in many ways so it's worth taking time for planning and research. Planning and research will prepare you for trading in options. As such there is no research method for trading options. You might prefer technical analysis or fundamental analysis of underlying security. No matter how much well you research there is no guarantee that your trade will be successful better you consider the probability of success of a particular trade.

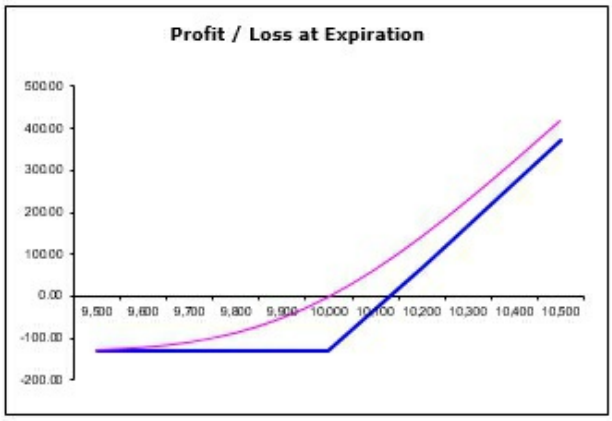
Lets again start with basic strategies we learned in first chapter along with impact of Greeks Long call, Short call, Long Put and Short Put.

LONG CALL

- Bullish. You are expecting rise in underlying asset price.
- Buyers need to pay premium only, margin not required.
- Maximum loss is limited to premium paid.

It is the most basic strategy. If you are hoping that Index will go up than you can buy call. Risk is limited to premium paid, reward is unlimited. Margin not required so more leveraged position than buying a future. Let's take an example - Index is trading at 10000 and you are buying at ATM call of current month trading at Rs 130/-. There are 25 days to expiry and call is trading at IV of 10%. Breakeven point of the given position is 10130, If Index will close above 10130 than buyer will make money and if Index close below 10130 than buyer will lose money.

Profit and loss chart and matrix at expiration is given below –



P&L Payoff at Expiration Matrix	
Underlying Price	P&L
9700	-130
9800	-130
9900	-130
10000	-130
10100	-30
10200	70
10300	170
10400	270
10500	370

Greeks –

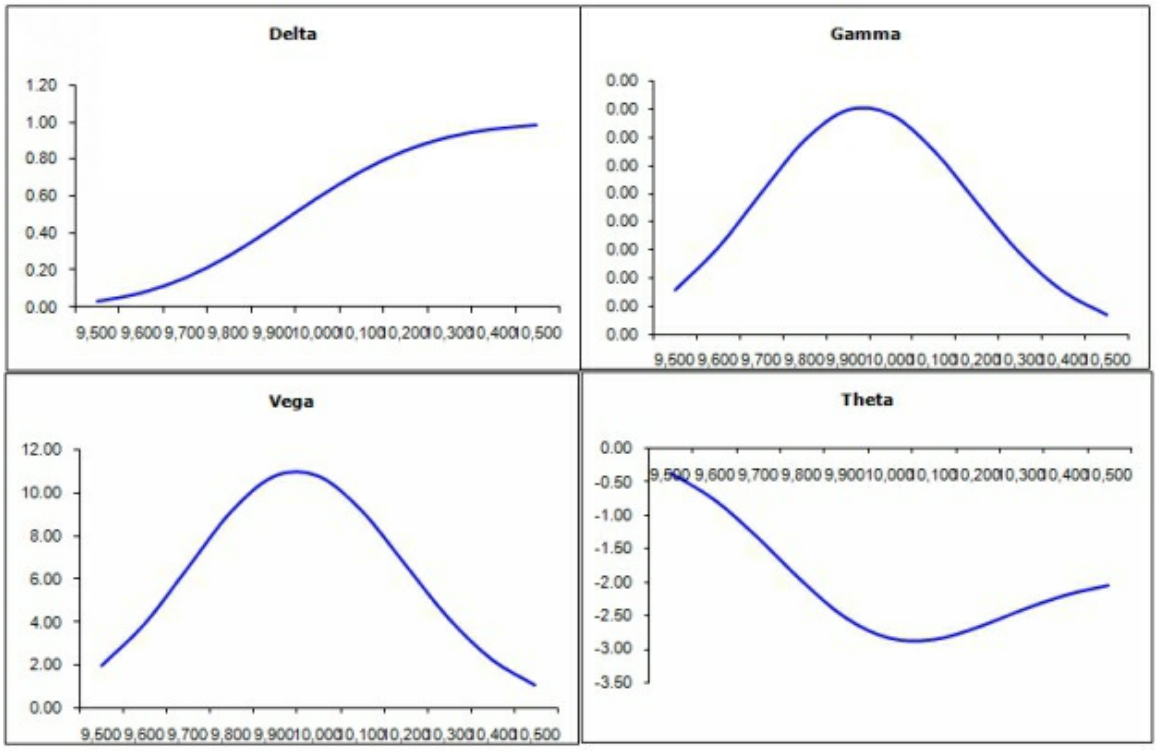
In the given example delta of call is 0.58 so Rs. 1/- Change in underlying will result into 0.58 paisa change in price of option. If index will come down by 100 point to 9900 than delta of call will be 0.43 and If Index will go up by 100 points to 10100 than delta of call is 0.72. Delta of call strike price 10000 is changing with change in underlying because of Gamma. Gamma helps the option buyer, If index will increase in intraday by 100 points than call price will increase by Rs 65/- approximately if other factors remain the same however if index will came down to 9900 than call price will decrease by Rs 50/-. So option buyer is gaining more on rise and losing less on fall but this benefit will cost theta to option buyer. Theta of this position is 3.14. So theoretically price of this call option should come down by Rs 3.14/- if rest all factors remains the same, and theta will increase as expiration nears. Gamma is positive but theta is negative for option buyer. Vega of the position is 10.24 so increase in volatility will be profitable for option buyer, with every 1% increase in implied volatility will result into increase in price by Rs 10.16 for call option.

Current Position Relative to Underlying Price Changes

(at IV of 10 & 25 Days to Expiry)

Underlying Price	Delta	Gamma	Theta	Vega	Theoretical Price
9500	0.04	0.0003	-0.49	2.10	4
9600	0.09	0.0006	-0.95	3.97	10
9700	0.17	0.0010	-1.58	6.35	22
9800	0.28	0.0013	-2.26	8.68	45
9900	0.43	0.0015	-2.83	10.16	80
10000 (ATM)	**0.58**	**0.0015**	**-3.14**	**10.24**	**130**
10100	0.72	0.0013	-3.14	8.93	195
10200	0.83	0.0009	-2.93	6.77	273
10300	0.91	0.0006	-2.62	4.47	360
10400	0.95	0.0003	-2.34	2.59	453
10500	0.98	0.0002	-2.14	1.32	550

Graph of Greeks are given below. Delta is increasing with increase in Index. Gamma, Theta & Vega values are highest when Call is ATM (Index is trading near 10000). So theta loss is maximum for ATM strike.



BUYING STOCK VS BUYING ITM CALL

If you are a short term trader than buying ITM call is better than buying stock or future. Every decision should be backed by logical reasons, so few reasons are given below –

1. Downside loss is limited to the premium paid.
2. Gamma helps the option buyer. We understood in option Greeks that when underlying will go up than delta goes up and underlying comes down delta comes down. It simple means when stock will go up trader will earn more and if stock comes down trader will lose less. The cost is Theta and trader can minimize this cost by purchasing a deep ITM call.
3. Cost benefit. Less money required as well as lower transaction charges in options.

However this benefit of buying Call inspite of buying future will cost time value of ITM option.

Let's compare it with actual data. I have taken Nifty Future and options closing price data. In the month of August Trader is buying 10900 call inspite of Nifty future. Time value in this strike is Rs 27.30, this will erode on gradually on expiry. So this is the maximum cost trader is paying.

Date	Nifty	10900 Call	P&L on Future Position	P&L on Option Position	Cost
1-Aug-18	11374.30	501.6	0.00	0	
2-Aug-18	11282.30	413.2	-92.00	-88.4	3.60
3-Aug-18	11395.75	509.65	21.45	8.05	-13.40
6-Aug-18	11414.25	520.65	39.95	19.05	-20.90
7-Aug-18	11418.35	527.65	44.05	26.05	-18.00
8-Aug-18	11467.65	575.25	93.35	73.65	-19.70
9-Aug-18	11487.55	592.8	113.25	91.2	-22.05
10-Aug-18	11439.25	544.75	64.95	43.15	-21.80
13-Aug-18	11381.15	490.4	6.85	-11.2	-18.05
14-Aug-18	11463.45	567.45	89.15	65.85	-23.30

16-Aug-18	11410.90	517.2	36.60	15.6	-21.00
17-Aug-18	11488.45	590.05	114.15	88.45	-25.70
20-Aug-18	11578.95	674.95	204.65	173.35	-31.30
21-Aug-18	11586.55	682.85	212.25	181.25	-31.00
23-Aug-18	11595.40	684.85	221.10	183.25	-37.85
24-Aug-18	11571.60	664.15	197.30	162.55	-34.75
27-Aug-18	11705.35	798.5	331.05	296.9	-34.15
28-Aug-18	11752.45	839.05	378.15	337.45	-40.70
29-Aug-18	11707.10	797.1	332.80	295.5	-37.30
30-Aug-18	11676.85	770.25	302.55	268.65	-33.90

In the month of September trader saved approx Rs 200/- when he opted to buy ITM option as compare to buying Future. Trader bought 11200 Call when nifty was trading approximately 11650. Trader paid a premium of Rs 25 only (Time value) to limit the maximum risk to premium of options. Trades expectation of upside in Index goes wrong. Index came down to 10975 and trader saved Rs 200 because he bought ITM option.

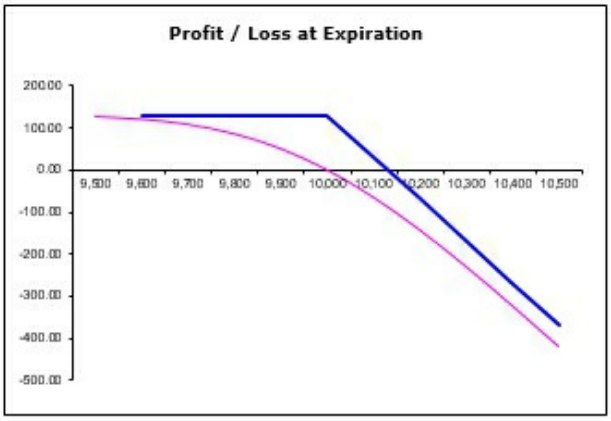
Date	Nifty	11200 Call	P&L on Future Position	P&L on Option Position	Money saved
3-Sep-18	11641.75	465.2			
4-Sep-18	11573.10	406.15	-68.65	-59.05	9.60
5-Sep-18	11518.25	355.5	-123.50	-109.7	13.80
6-Sep-18	11567.15	403.8	-74.60	-61.4	13.20
7-Sep-18	11632.95	455.25	-8.80	-9.95	-1.15
10-Sep-18	11492.70	337.1	-149.05	-128.1	20.95
11-Sep-18	11336.25	212.6	-305.50	-252.6	52.90

12-Sep-18	11417.35	257.85	-224.40	-207.35	17.05
14-Sep-18	11547.30	360.85	-94.45	-104.35	-9.90
17-Sep-18	11407.70	242.75	-234.05	-222.45	11.60
18-Sep-18	11310.20	159.05	-331.55	-306.15	25.40
19-Sep-18	11272.80	120.9	-368.95	-344.3	24.65
21-Sep-18	11166.35	64.75	-475.40	-400.45	74.95
24-Sep-18	10997.95	15.55	-643.80	-449.65	194.15
25-Sep-18	11086.70	20.5	-555.05	-444.7	110.35
26-Sep-18	11062.45	5.1	-579.30	-460.1	119.20
27-Sep-18	10974.20	0.05	-667.55	-465.15	202.40

SHORT CALL

- Outlook – Bearish. Fall in underlying price expected.
- Margin required. Profit limited & loss unlimited. Traders should avoid strategies with unlimited loss.

If you think that underlying may come down than you can sell Call. Price of call will come down when market will come down. This is a net credit transaction because you receive premium for call sold. Selling an option is very risky because risk is unlimited (without any cover) and profit is limited to premium received. Margin equal to buying/selling a future will get blocked. Let's take the same example - Index is trading at 10000 and you are selling at ATM call of current month trading at Rs 130/-. Profit and loss chart at expiration is given on previous page. This is for example only. Never sell naked option. However Call could be sold to sell stock in profit you already owned, by selling OTM call you can earn some money until it reach your target level of OTM strike. This strategy is called covered call. We will discuss it later in this book.

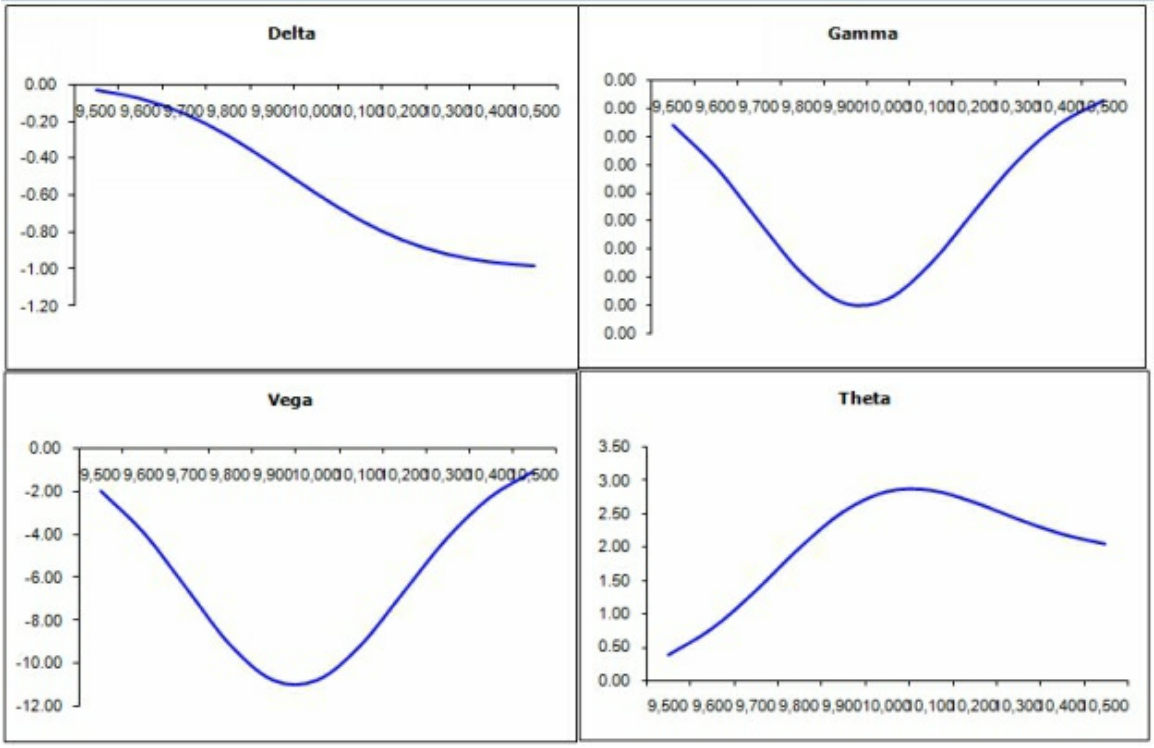


P&L Payoff at Expiration Matrix	
Underlying Price	P&L
9700	130
9800	130
9900	130
10000	130
10100	30
10200	-70
10300	-170
10400	-270
10500	-370

Greeks

In the given example delta of call is 0.58 so Rs 1 Change in underlying will result into 0.58 paisa change in price of option. Theta helps the option seller. If underlying price does not move in any direction than next day theoretically speaking price of this call will come down by approximately Rs 3/- (theta) and this amount of theta will increase as expiration nears. Theta is positive but Gamma is negative. Decrease in implied volatility will help the option seller.

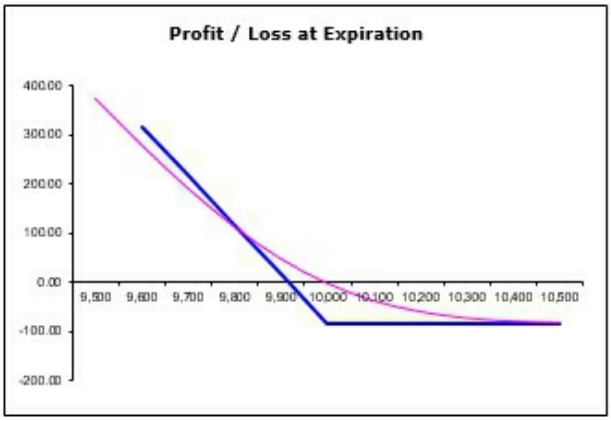
Graph of Greeks are given below.


Delta
0.00
-0.20
-0.40
-0.60
-0.80
-1.00
-1.20
9,500 9,600 9,700 9,800 9,900 10,000 10,100 10,200 10,300 10,400 10,500
Gamma
0.00
0.00
0.00
0.00
0.00
0.00
0.00
0.00
0.00
0.00
9,500 9,600 9,700 9,800 9,900 10,000 10,100 10,200 10,300 10,400 10,500
Vega
0.00
-2.00
-4.00
-6.00
-8.00
-10.00
-12.00
9,500 9,600 9,700 9,800 9,900 10,000 10,100 10,200 10,300 10,400 10,500
Theta
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
9,500 9,600 9,700 9,800 9,900 10,000 10,100 10,200 10,300 10,400 10,500

LONG PUT

- Outlook – Bearish. Buyer of put expects market direction going down.
- Only premium require. Limited loss, unlimited profit.

It is the basic strategy. If trader thinks that Index/underlying will down than he can buy Put. Risk I limited to premium paid, reward is unlimited. Margin not required. Investor will benefit as the price of underlying/Index will go down. Let's take an example - Index is trading at 10000 and investor is buying at ATM Put option of current month trading at Rs 82/-. There are 25 days to expiry and call is trading at IV of 10%. Breakeven point of the given position is 10130, If Index will close above 10130 than buyer will make money and if Index close below 10130 than buyer will lose money.



P&L Payoff at Expiration Matrix	
Underlying Price	P&L
9500	418
9600	318
9700	218
9800	118
9900	18
10000	-82
10100	-82
10200	-82
10300	-82

Greeks

Delta of 10000 strike Put is 0.42 when underlying is trading at 10000. So when the market came down by 100 point price of put should increase by Rs 42/- however price increased by Rs 50/- (From Rs 82/- to Rs 132/-). As we discussed earlier also that reason is the Gamma, Because of Gamma Delta of Put option is increasing by 0.0015 with every one point fall in index price. So delta is also not constant. In the last column theoretical prices of 10000 strike Put option given at respective underlying price mentioned in first column, when other factors affecting the option price (time to expiry, implied volatility, interest rates) are constant.

Current Position Relative to Underlying Price Changes (at IV of 10% and 25 Days to Expiry)					
Underlying Price	**Delta**	**Gamma**	**Theta**	**Vega**	**Option Premium**
9500	-0.96	0.0003	1.42	2.09	456
9600	-0.91	0.0006	0.96	3.96	362
9700	-0.83	0.0010	0.33	6.34	274
9800	-0.72	0.0013	-0.35	8.67	197

9900	-0.57	0.0015	-0.92	10.16	132
10000 ATM	-0.42	0.0015	-1.22	10.24	82
10100	-0.28	0.0013	-1.23	8.93	47
10200	-0.17	0.0009	-1.01	6.76	25
10300	-0.09	0.0006	-0.71	4.47	12
10400	-0.05	0.0003	-0.43	2.58	5
10500	-0.02	0.0002	-0.22	1.31	2

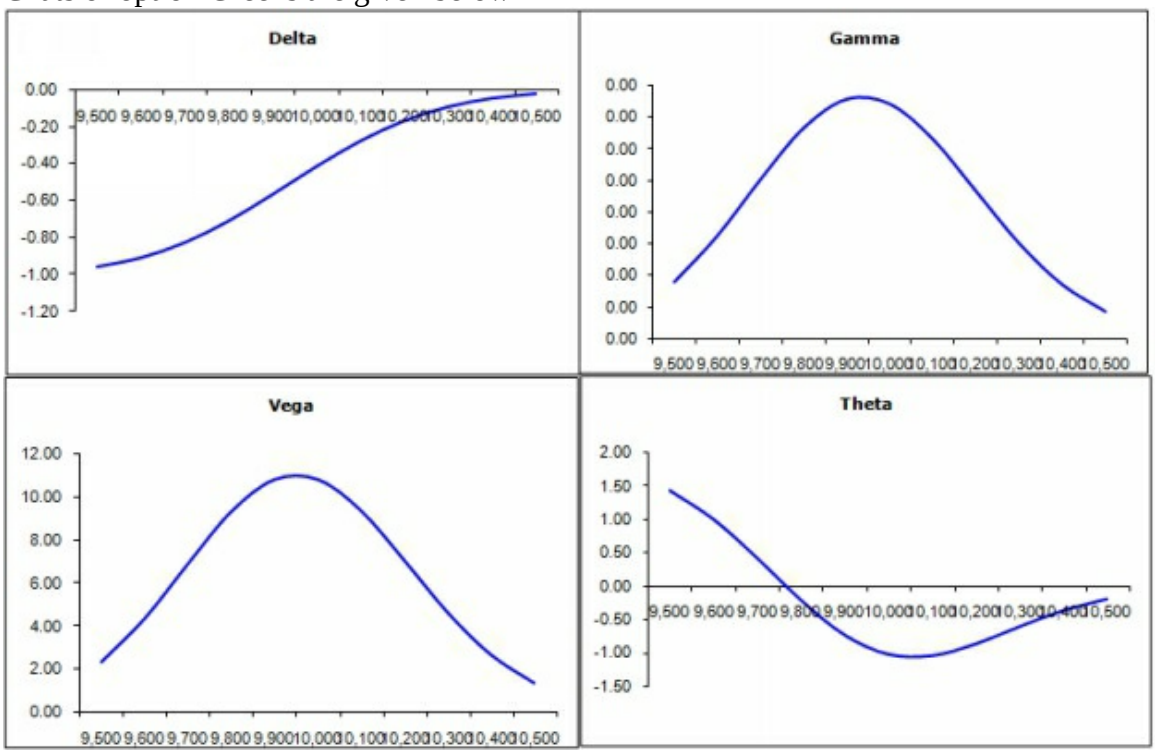
Long put is used for hedging. If investor will buy a ATM put along with buying stock or future than maximum loss will be limited to the premium paid for put option. A long put could also be used to lock your profit of long position of stock. In the previous example to long call a trader bought Nifty future at 11374 on 1st august 2018. It went up to 11676 till 30th August 2018. Trader is earning a notional profit of Rs 302. Trader is expecting that Nifty can further go up but he is also worried if Nifty future came down than he may lose the profit he earned in last one month. What trader can do is that he can buy a put option strike 11700 of September 2018 at Rs. 128/-. This way trader locked the profit of Rs 174 (302 -128). Now irrespective of nifty closing trader will earn at least Rs 174/-.

Let us continue with example of long ITM as discussed in previous chapter of long call. In the month of August trader earned a profit of Rs 268 on long call strike 10900. In September also trader is expecting that Nifty could go up so he decided to go long by buying ITM call strike 11200 at 465/-. Trader is worried if underlying will come down than he may lose the profit of Rs 268/- earned in August so he decided to buy Put 11600 at Rs 122 along with buying call strike 11200. So trader locked the profit of Rs 146 (Profit of August of Rs 268 reduced by cost of Put bough in September 122). Trader will earn Rs 146 irrespective of Nifty position. In September Nifty goes in adverse direction still trader earned a profit of Rs 34/- (621-122-465). Trader can lock profit by selling ATM call also in the month of September inspite of buying put. This decision will depend on premium of option. Buy put when option are cheap sell call when options are expensive.

Date	Nifty	11200 Call	11600 Put	P&L of Call	P&L of Put	Net P&L
9/3/2018	11641.75	465.2	122.2			
9/4/2018	11573.10	406.15	152.3	-59.05	30.1	-28.95
9/5/2018	11518.25	355.5	173.95	-109.7	51.75	-57.95
9/6/2018	11567.15	403.8	144	-61.4	21.8	-39.6
9/7/2018	11632.95	455.25	114.85	-9.95	-7.35	-17.3
9/10/2018	11492.70	337.1	188.1	-128.1	65.9	-62.2
9/11/2018	11336.25	212.6	298	-252.6	175.8	-76.8
9/12/2018	11417.35	257.85	224.85	-207.35	102.65	-104.7
9/14/2018	11547.30	360.85	127.1	-104.35	4.9	-99.45
9/17/2018	11407.70	242.75	220	-222.45	97.8	-124.65
9/18/2018	11310.20	159.05	305.8	-306.15	183.6	-122.55
9/19/2018	11272.80	120.9	331.2	-344.3	209	-135.3
9/21/2018	11166.35	64.75	433.45	-400.45	311.25	-89.2
9/24/2018	10997.95	15.55	599.7	-449.65	477.5	27.85
9/25/2018	11086.70	20.5	516.65	-444.7	394.45	-50.25
9/26/2018	11062.45	5.1	533.65	-460.1	411.45	-48.65

9/27/2018	10974.20	0.05	621.6	-465.15	499.4	34.25

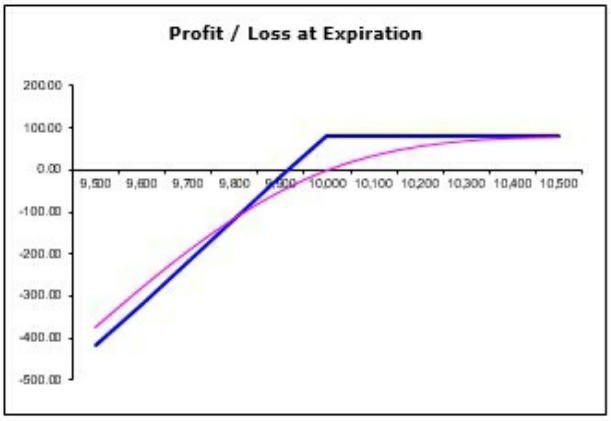
Chats of option Greeks are given below –



SHORT PUT

Outlook – Bullish. You are expecting rise in underlying asset price.

If you think that underlying may go up than you can sell Put. Price of Put will come down when market will go up. This is a net credit transaction because you receive premium for Put sold. Selling an option is very risky because risk is unlimited (without any cover) and profit is limited to premium received. Margin equal to buying/selling a future will get blocked. Let's take the same example - Index is trading at 10000 and you are selling at ATM Put of current month trading at Rs 82/-. Profit and loss chart at expiration is given on next page.



P&L Payoff at Expiration Matrix	
Underlying Price	P&L
9500	-418
9600	-318
9700	-218
9800	-118
9900	-18
10000	82
10100	82
10200	82
10300	82

Greeks

In the given example delta of call is 0.42. Theta is Rs 1.22, it helps the option seller. Theta will increase as expiration nears. Theta is positive but Gamma is negative. Decrease in implied volatility will help the option seller.

This strategy could be used to buy stock on lower price. Let's take an example. I have taken closing price of Reliance Industry and its put. On 3rd September 2018 Reliance Industry was trading at Rs 1230 approx. One investors wish to buy Reliance industry at approx 1200. He has 2 options –

1. First he can wait for his prices. On 19th September prices came down to 1200 during the day and he bought.
2. Second he sold put strike 1200 September contract at 16.45 on 3rd September itself. On expiry day 27th September 2018 Reliance closed above 1200 so investor earned Rs 16.45. This put is backed by 100% cash for buying shares, so investor earned approx 1.3% return. Again he sold put strike 1200 October contract at 15.95. October expiry was below 1200. Stock future and options in India are delivery based, so investor got the shares and his cost of purchase is approx Rs 1170 (12000 -16.45

-15.95)

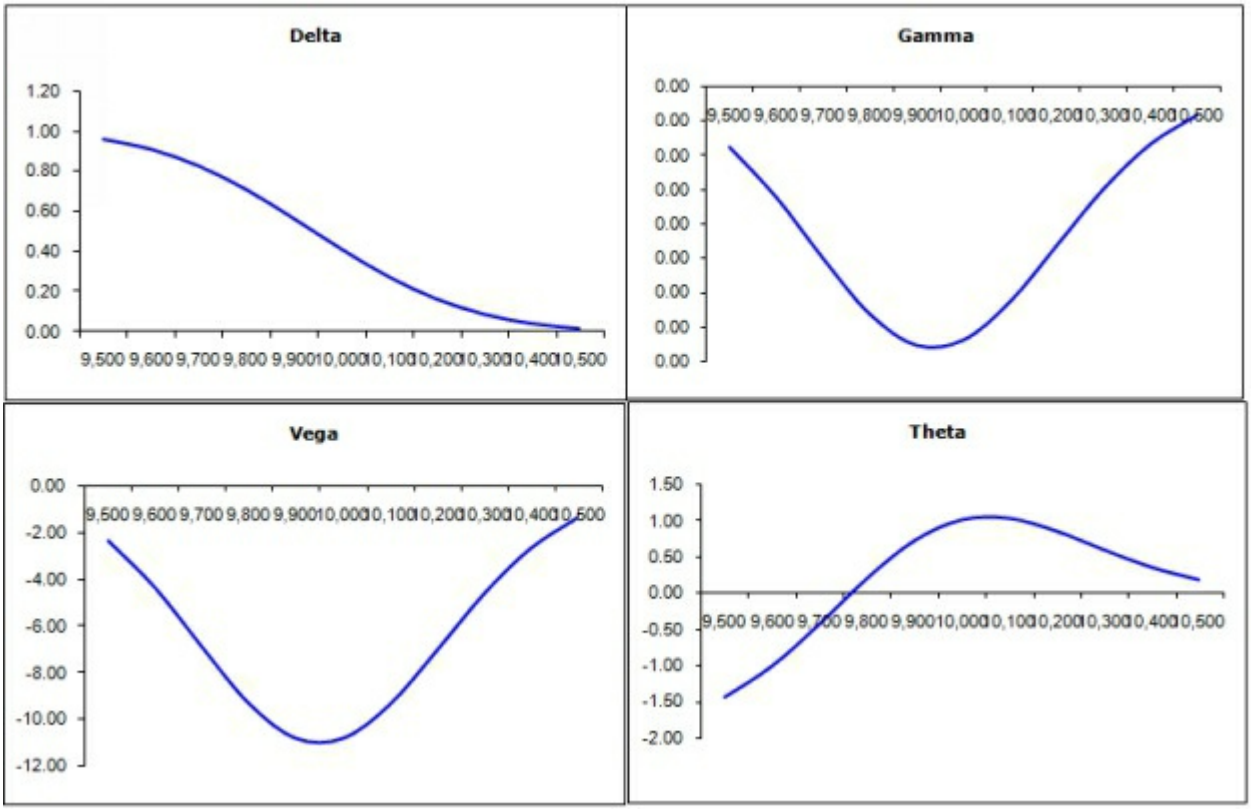
Symbol	Series	Date	Expiry	Close	Strike 1200 Put
RELIANCE	EQ	3-Sep-18	27-Sep-18	1229.15	16.45
RELIANCE	EQ	4-Sep-18	27-Sep-18	1241.95	13
RELIANCE	EQ	5-Sep-18	27-Sep-18	1227	17.4
RELIANCE	EQ	6-Sep-18	27-Sep-18	1261.4	9.4
RELIANCE	EQ	7-Sep-18	27-Sep-18	1278.6	6.55
RELIANCE	EQ	10-Sep-18	27-Sep-18	1255.85	9.35
RELIANCE	EQ	11-Sep-18	27-Sep-18	1237.7	13.2
RELIANCE	EQ	12-Sep-18	27-Sep-18	1252.5	8.6
RELIANCE	EQ	14-Sep-18	27-Sep-18	1253.15	7.35
RELIANCE	EQ	17-Sep-18	27-Sep-18	1225.9	12.95
RELIANCE	EQ	18-Sep-18	27-Sep-18	1217.15	12.8
RELIANCE	EQ	19-Sep-18	27-Sep-18	1210.75	11.15
RELIANCE	EQ	21-Sep-18	27-Sep-18	1217.5	11.4
RELIANCE	EQ	24-Sep-18	27-Sep-18	1232.05	5.2
RELIANCE	EQ	25-Sep-18	27-Sep-18	1230.6	4.35
RELIANCE	EQ	26-Sep-18	27-Sep-18	1251.4	1
RELIANCE	EQ	27-Sep-18	27-Sep-18	1253.75	0.05
RELIANCE	EQ	28-Sep-18	25-Oct-18	1257.95	15.95
RELIANCE	EQ	1-Oct-18	25-Oct-18	1231.7	21.95
RELIANCE	EQ	3-Oct-18	25-Oct-18	1205.1	35.55
RELIANCE	EQ	4-Oct-18	25-Oct-18	1122.25	96.4
RELIANCE	EQ	5-Oct-18	25-Oct-18	1048.85	150.6
RELIANCE	EQ	8-Oct-18	25-Oct-18	1109.4	97.3
RELIANCE	EQ	9-Oct-18	25-Oct-18	1090.05	117.55
RELIANCE	EQ	10-Oct-18	25-Oct-18	1102.1	103.15
RELIANCE	EQ	11-Oct-18	25-Oct-18	1087.8	114
RELIANCE	EQ	12-Oct-18	25-Oct-18	1126.55	82.8
RELIANCE	EQ	15-Oct-18	25-Oct-18	1139.75	72
RELIANCE	EQ	16-Oct-18	25-Oct-18	1163.8	53.55
RELIANCE	EQ	17-Oct-18	25-Oct-18	1151.3	60.4

RELIANCE	EQ	19-Oct-18	25-Oct-18	1101.3	96.1
RELIANCE	EQ	22-Oct-18	25-Oct-18	1062.65	136.55
RELIANCE	EQ	23-Oct-18	25-Oct-18	1054.7	148.2
RELIANCE	EQ	24-Oct-18	25-Oct-18	1045.75	153.4
RELIANCE	EQ	25-Oct-18	25-Oct-18	1030.8	170.2

So investor who wishes to buy shares on his prices, he can sell put contract of that strike. Investor will get some return every month until price goes below that level on expiry and when contract expire below strike price sold investor gets the share.

One more thing is clear from data that investor should not sell options for speculation. If you will check option prices you will find that investor is getting only Rs 16 when he is right in September and he lost Rs 170 when market goes adverse direction in October, he lost 10 month earnings in a month. Trading with unlimited risk is not a right thing to do in derivatives.

Chart of Greeks given below-



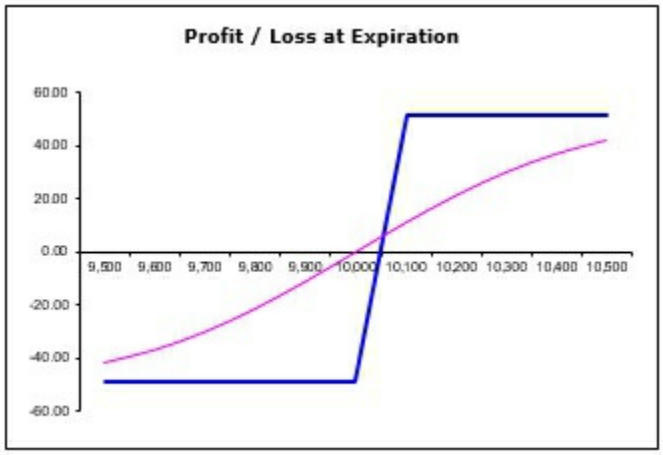
VERTICAL SPREADS

A vertical spread is the simultaneous purchase and sale of options of the same class (calls or puts) and expiration, but with different strike prices. Vertical spreads are directional strategies used when moderate movement in underlying is expected. Key benefit of vertical spreads are limited risk and low cost.

BULL CALL SPREAD

In a bull call spread lower strike option is purchased and higher strike option of same class and expiry is sold. Trader will make money when underlying will move higher. Because option of higher premium is purchased and low premium is sold so the bull call spread results into negative cash flow.

Bull Call Spread Example – Nifty Future is trading at 10000. Buy July Nifty 10000 Call at Rs. 162/- and Sell July Nifty call 10100 Call at Rs. 114/-. This will result into net debit of Rs. 48/- so maximum loss is limited to Rs 48/-. Maximum profit is limited to Rs 52/- (difference between the strikes minus price paid for the spread)



P&L Payoff at Expiration Matrix			
Underlyin	Buy Call 10000	Sell Call 10100	P&L
9700	-162	114	-48
9800	-162	114	-48
9900	-162	114	-48
10000	-162	114	-48
10100	-62	114	52
10200	38	14	52
10300	138	-86	52
10400	238	-186	52
10500	338	-286	52

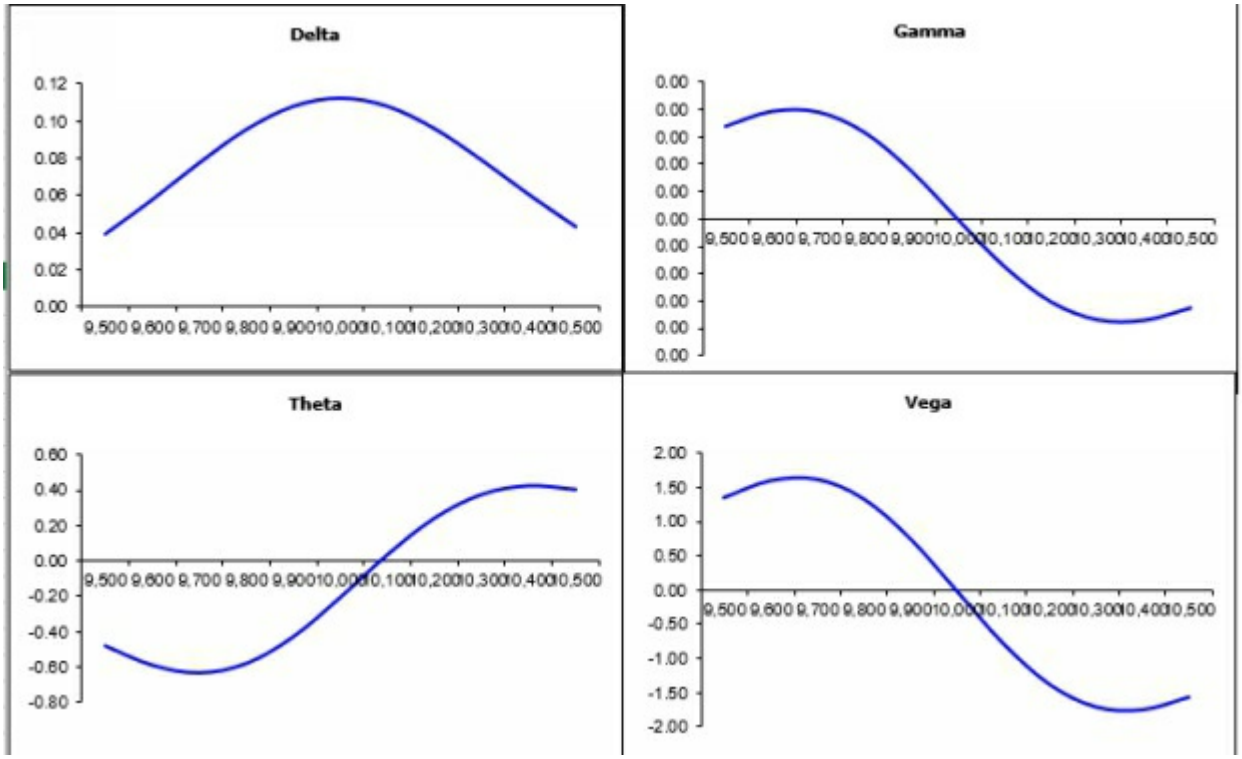
Greeks

	Buy Call 10000	**Sell Call 10100**	**Net Position**
Premium Used	162	-114	48
Delta	0.55	-0.44	0.11
Gamma	0.0011	-0.0011	0.00
Theta	-4.05	3.85	-0.21
Vega	9.92	-9.92	0.00
Rho	3.41	-2.73	0.68

Delta of 10000 call bought is 0.55 and the delta of 10100 call sold is -0.44 so the net delta of the bull Call Spread is 0.11. It means every 1 point increase in underlying will results into 11 paisa increase in Bull call spread. The delta of the bull call spread is greatly dependent on the location of the underlying and time until expiration. When expiration is near and the deltas of the component options are very sensitive, the delta of the bull call spread also is sensitive to changes

in underlying price. As you can check in below chart Delta is highest when underlying price is in between of both options and delta is decreasing with rise or fall in prices of underlying. Net Theta is -0.21 so theoretically every passing day will give a loss of 21 paisa (approx. Rs 15.75 per lot). Theta value also changes with change in underlying prices. Theoretically speaking, in the given example theta value is zero when underlying value is 10080. Theta will be positive when underlying will go above 10080 and theta will be negative when underlying will go below 10080. As we understand that change in underlying price, time to expiry and implied volatility is having impact on each Greek, i.e., Delta, Gamma, Theta and Vega. Anything in underlying price, time to expiry or implied volatility will change than value of Greeks will also change.

Chart of Greeks-



Theoretical profit and loss of position is given in below table 17 when there is change in underlying only and other Greeks are constant. You can observe that 100 point increase in underlying is resulting into profit of Rs 10/- approximately (10 multiplied by lot size of 75 so total profit of Rs 750). So net delta of any spread will give you an idea of net profit and loss with change in underlying prices.

Table 17: Current Theoretical P&L Relative to Underlying Price Changes

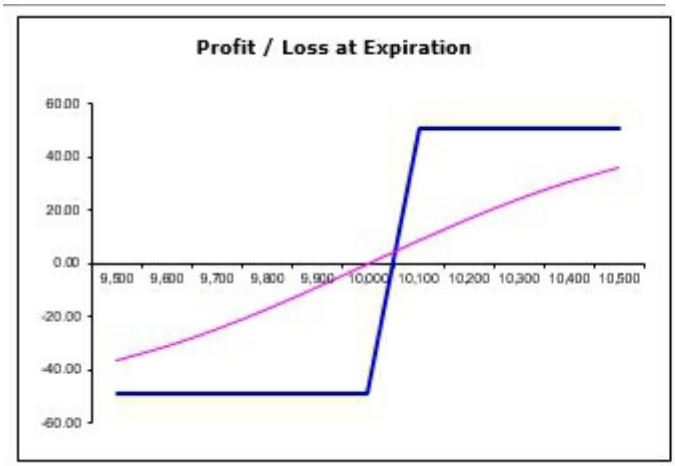
Underlying Price	Buy Call 10000	Sell Call 10100	Net Position P&L
9500	-149	107	-42
9600	-136	99	-37

9700	-117	87	-30
9800	-89	67	-21
9900	-50	39	-11
10000	0	0	0
10100	61	-50	11
10200	133	-111	21
10300	213	-182	30
10400	299	-262	37
10500	391	-349	42

BULL PUT SPREAD

In a bull put spread lower strike put option is purchased and higher strike put option of same class and expiry is sold. Trader will make money when underlying will move higher. Because option of low premium is purchased and high premium is sold so the bull put spread results into positive cash flow.

Bull Put Spread Example – Nifty Future is trading at 10000. Buy July Nifty 10000 Put at Rs. 158/- and Sell July Nifty 10100 Put at Rs. 210/-. Because of 10000 Put is cheaper than 10100 Put this spread will result into net credit of Rs. 52/-. Maximum profit is limited to Rs 52/-. Maximum loss is limited to Rs 48/- (difference between the strikes
minus premium received for the spread)



P&L Payoff at Expiration Matrix			
Underlyin	Buy Put 10000	Sell Put 10100	P&L
9600	242	-290	-48
9700	142	-190	-48
9800	42	-90	-48
9900	-58	10	-48
10000	-158	110	-48
10100	-158	210	52
10200	-158	210	52
10300	-158	210	52
10400	-158	210	52

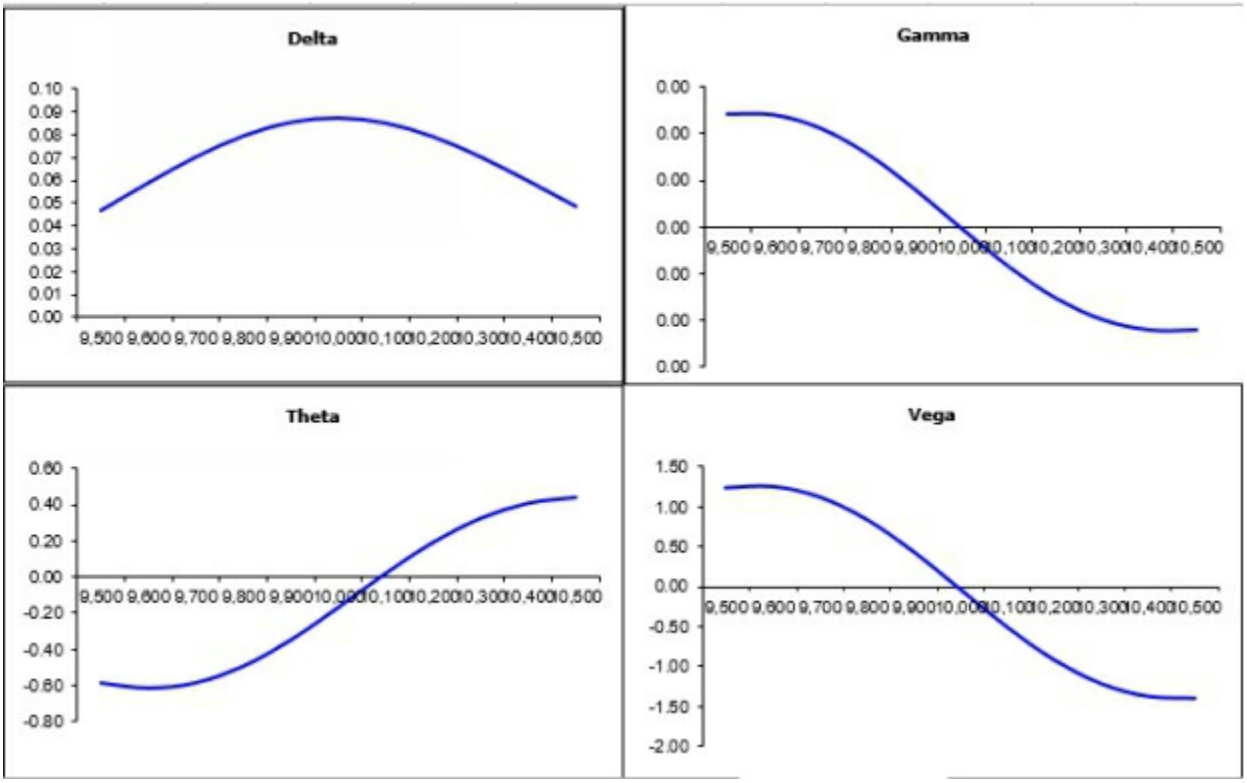
Greeks

	Buy Put 10000	**Sell Put 10100**	**Net Position**
Premium Used	158.00	210.00	52.00
Delta	-0.45	0.54	0.09
Gamma	0.00	0.00	0.00
Theta	-2.99	2.82	-0.17
Vega	9.94	-9.96	-0.02
Rho	-2.95	3.53	0.58

Delta of 10000 Put bought is -0.45 and the delta of 10100 Put sold is 0.54 so the net delta of the bull Call Spread is 0.09. It means every 1 point increase in underlying will results into 9 paisa

change in Bull put spread. Greeks of Bull put spreads are almost similar to the bull call spread. Slight change will be there because Nifty puts are always having higher implied volatility as compare to calls. Net Theta is -0.17 so theoretically every passing day will give a loss of 17 paisa (approx. Rs 12.75 per lot)

Chart of Greeks-



Theoretical profit and loss of position is given in below table 18 when there is change in underlying only and other Greeks are constant. You can observe that 100 point increase in underlying is resulting into profit of Rs 9/- approximately (9 multiplied by lot size of 75 so total profit of Rs 675).

Table 18: Current Theoretical P&L Relative to Underlying Price Changes

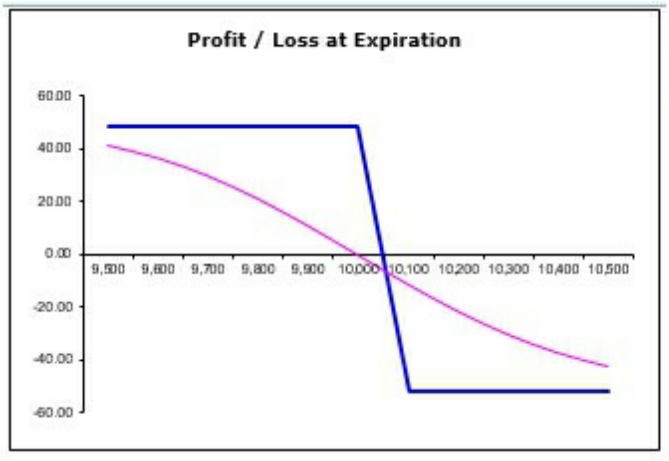
Underlying Price	Buy Put 10000	Sell Put 10100	Net Position
9500	331	-368	-36
9600	250	-281	-31
9700	175	-200	-25
9800	108	-125	-17
9900	50	-58	-9
10000	0	0	0
10100	-41	50	9
10200	-74	91	17

10300	-99	123	24
10400	-118	149	31
10500	-132	168	36

BEAR CALL SPREAD

In a Bear Call Spread Higher strike call option is purchased and lower strike call option of same class and expiry is sold, the result is positive initial cash flow. The Spread could profit when underlying moves lower.

Bear Call Spread Example – Nifty Future is trading at 10000. Sell July Nifty 10000 Call at Rs. 162/- and buy July Nifty call 10100 at Rs. 114/-. Because of 10000 call is expensive than 10100 call this spread will result into net credit of Rs. 48/-. Maximum profit is limited to Rs 52/-. Maximum loss is limited to Rs 48/- (difference between the strikes minus premium received for the spread)



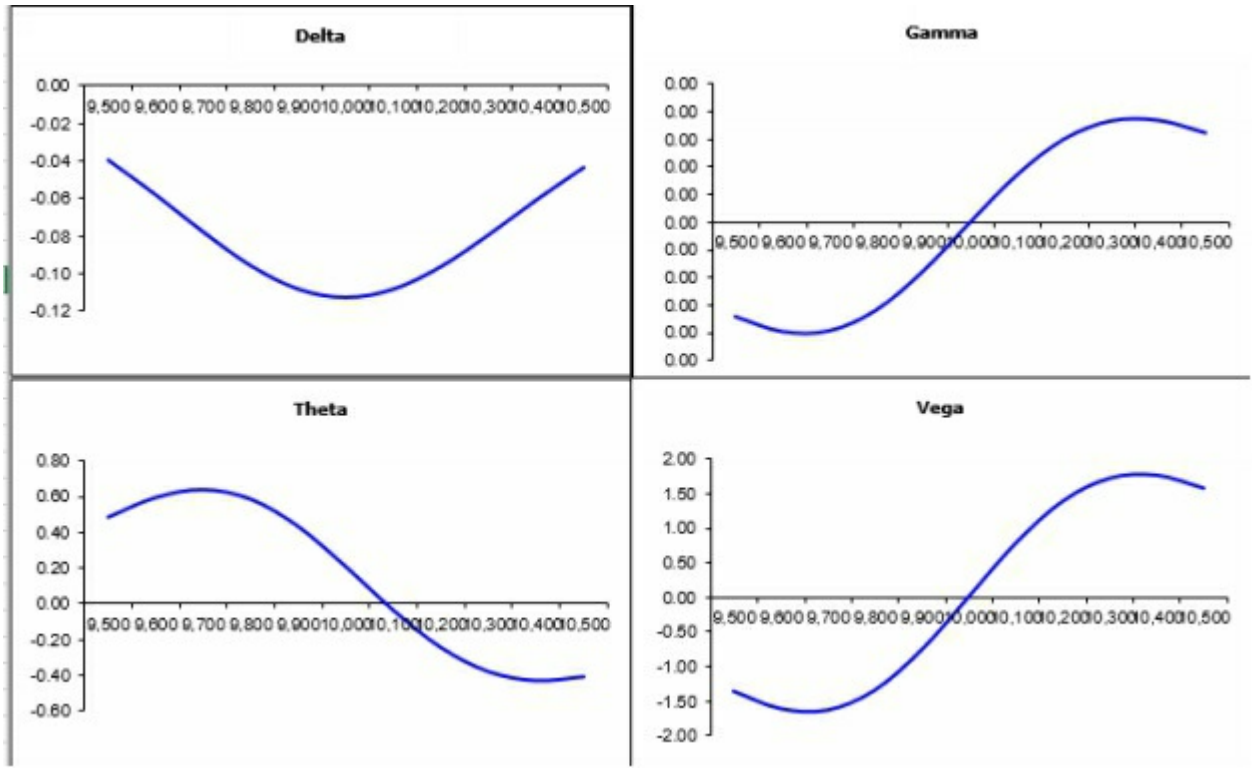
P&L Payoff at Expiration Matrix			
Underlying Price	Sell Call 10000	Buy Call 10100	Net P&L
9700	162	-114	48
9800	162	-114	48
9900	162	-114	48
10000	162	-114	48
10100	62	-114	-52
10200	-38	-14	-52
10300	-138	86	-52
10400	-238	186	-52
10500	-338	286	-52

Greeks

	Sell Call 10000	**Buy Call 10100**	**Net Position**
Premium Used	162	-114	48
Delta	-0.55	0.44	-0.11
Gamma	-0.0011	0.0011	0.00
Theta	4.05	-3.85	0.21
Vega	-9.92	9.92	0.00
Rho	-3.41	2.73	-0.68

Net delta of the bull Call Spread is -0.11. It means every 1 point increase in underlying will results into 11 paisa decrease in Bear call spread. When underlying at 10000 net Theta is 0.21 so theoretically every passing day will give a profit of 21 paisa (approx. Rs 15.75 per lot)

Chart of Greeks-



Theoretical profit and loss of position is given in below table 20 when there is change in underlying only and other Greeks are constant. You can observe that 100 point increase in underlying is resulting into loss of Rs 10/- approximately (10 multiplied by lot size of 75 so total profit of Rs 750).

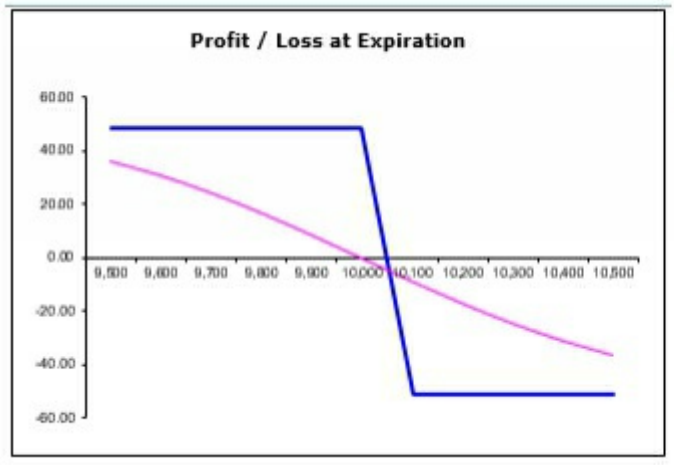
Table 20: Current Theoretical P&L Relative to Underlying Price Changes

Underlying Price	Sell Call 10000	Buy Call 10100	Net Position P&L
9500	149	-107	42
9600	136	-99	37
9700	117	-87	30
9800	89	-67	21
9900	50	-39	11
10000	0	0	0
10100	-61	50	-11
10200	-133	111	-21
10300	-213	182	-30
10400	-299	262	-37
10500	-391	349	-42

BEAR PUT SPREAD

In a Bear Put Spread Higher strike put option is purchased and lower strike put option of same class and expiry is sold, the result is negative initial cash flow. The Spread could profit when underlying moves lower.

Bear Put Spread Example – Nifty Future is trading at 10000. Sell July Nifty 10000 Put at Rs. 158/- and buy July Nifty put 10100 at Rs. 210/-. Because of 10100 put is expensive than 10000 put this spread will result into net debit of Rs. 52/-. Maximum loss is limited to Rs 52/-. Maximum profit is limited to Rs 48/- (difference between the strikes minus premium paid for the spread)



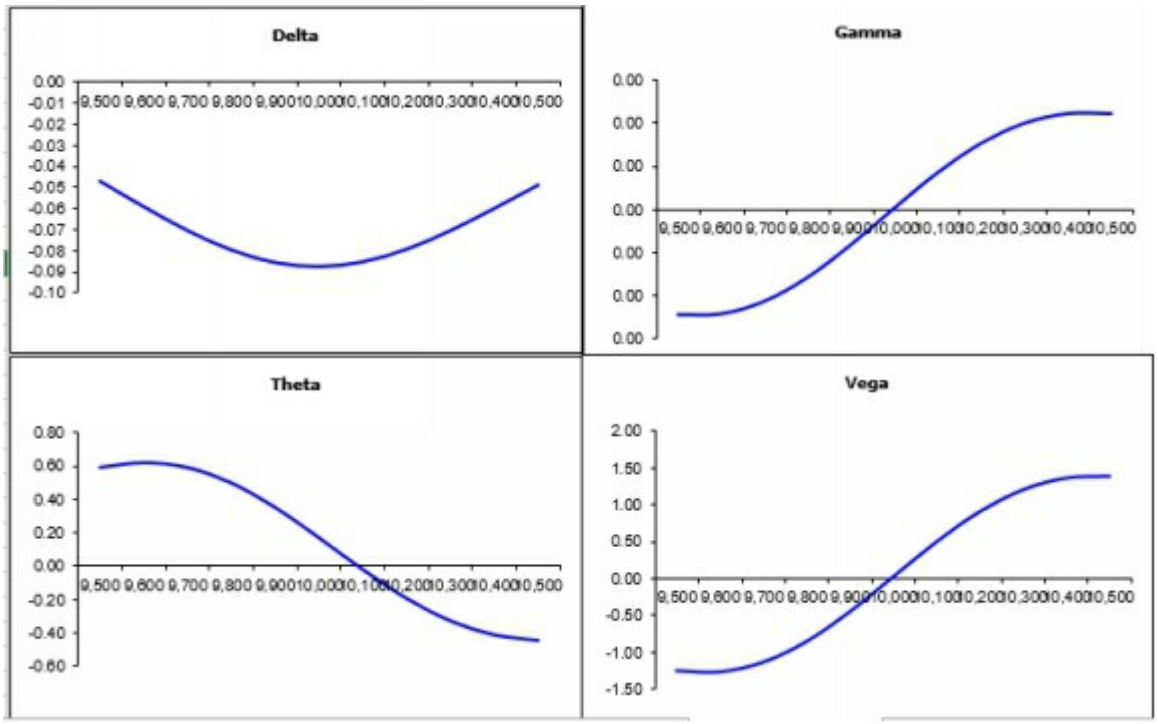
P&L Payoff at Expiration Matrix			
Underlying Price	Sell Put 10000	Buy Put 10100	Net P&L
9700	-142	190	48
9800	-42	90	48
9900	58	-10	48
10000	158	-110	48
10100	158	-210	-52
10200	158	-210	-52
10300	158	-210	-52
10400	158	-210	-52
10500	158	-210	-52

Greeks

	Sell Put 10000	**Buy Put 10100**	**Net Position**
Premium Used	158.00	-210.00	-52.00
Delta	0.45	-0.54	-0.09
Gamma	-0.0009	0.0009	0.00
Theta	2.99	-2.82	0.17
Vega	-9.94	9.96	0.02
Rho	2.95	-3.53	-0.58

Delta of 10000 Put bought is 0.45 and the delta of 10100 Put sold is -0.54 so the net delta of the bull Call Spread is 0.09. It means every 1 point increase in underlying will results into 9 paisa decrease in Bull Put spread. Net Theta is 0.17 so theoretically every passing day will give a loss of 17 paisa (approx. Rs 12.75 per lot)

Chart of Greeks-



Theoretical profit and loss of position is given in below table 21 when there is change in underlying only and other Greeks are constant (Other Greeks constant means there is no change in time to expiry and implied volatility etc. so basically we can see the impact of Delta and Gamma from below table). You can observe that 100 point increase in underlying is resulting into profit of Rs 10/- approximately (10 multiplied by lot size of 75 so total profit of Rs 750).

Table 21: Current Theoretical P&L Relative to Underlying Price Changes

Underlying Price	Buy Put 10000	Sell Put 10100	Net Position
9500	-331	368	36
9600	-250	281	31
9700	-175	200	25
9800	-108	125	17
9900	-50	58	9
10000	0	0	0
10100	41	-50	-9
10200	74	-91	-17
10300	99	-123	-24
10400	118	-149	-31
10500	132	-168	-36

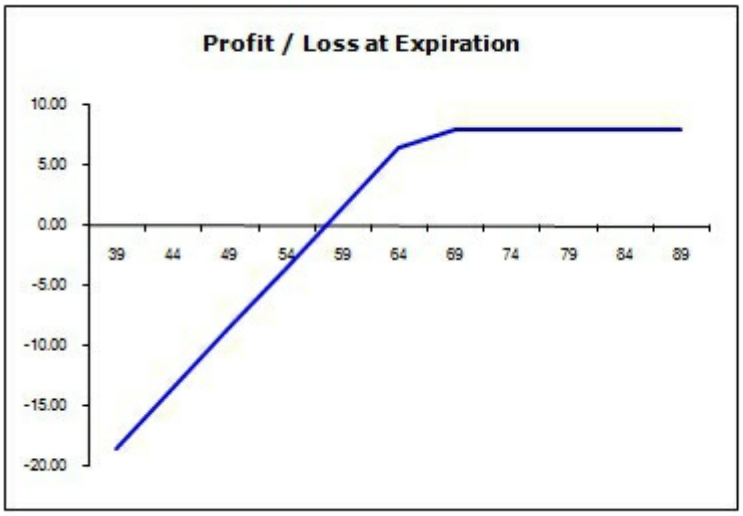
COVERED CALL

A Covered call is a combination of long stock and short call option. So basically you are giving portion of potential profit for premium of call you received. This strategy is used for stocks you already hold. You are not expecting upside in stock and you want to earn some income.

Covered Call Example (Future and options prices taken as on 30th March 2020 at NSE)–

Buy 1 lot ONGC Future at Rs. 63.5/,
Sell 1 Lot ONGC 65 call at Rs. 6.5/-.
Maximum profit – Rs 8/-,
Breakeven – 57/-,
Maximum Loss – Unlimited

In given example ONGC future bought at Rs 63.5 and a call strike 65 sold at Rs 6.5. Maximum profit in this position is limited to Rs 8/- however on downside risk is unlimited. Benefit is that trader can recover approx 30% of future price if prices remains range bound in next 3 months and Implied volatility of options remain same. Payoff on expiry is given in below table.



P&L Payoff at Expiration Matrix			
Underlying Price	Long Future	Short Option	Total P&L
38.5	-25	6.5	-18.5
43.5	-20	6.5	-13.5
48.5	-15	6.5	-8.5
53.5	-10	6.5	-3.5
58.5	-5	6.5	1.5
63.5	0	6.5	6.5
68.5	5	3.0	8.0
73.5	10	-2.0	8.0
78.5	15	-7.0	8.0
83.5	20	-12.0	8.0
88.5	25	-17.0	8.0

If trader is already holding the stock and wish to hold for more returns than he can chose to sell option strike 70 at Rs 4.5/- inspite of strike of 65. This call will create a difference of approx Rs 2/- to 3/- on both side in total P& L as given in below table, maximum profit will be more approx Rs 11/- and down side loss will also increase by Rs 2 at each level on expiry.

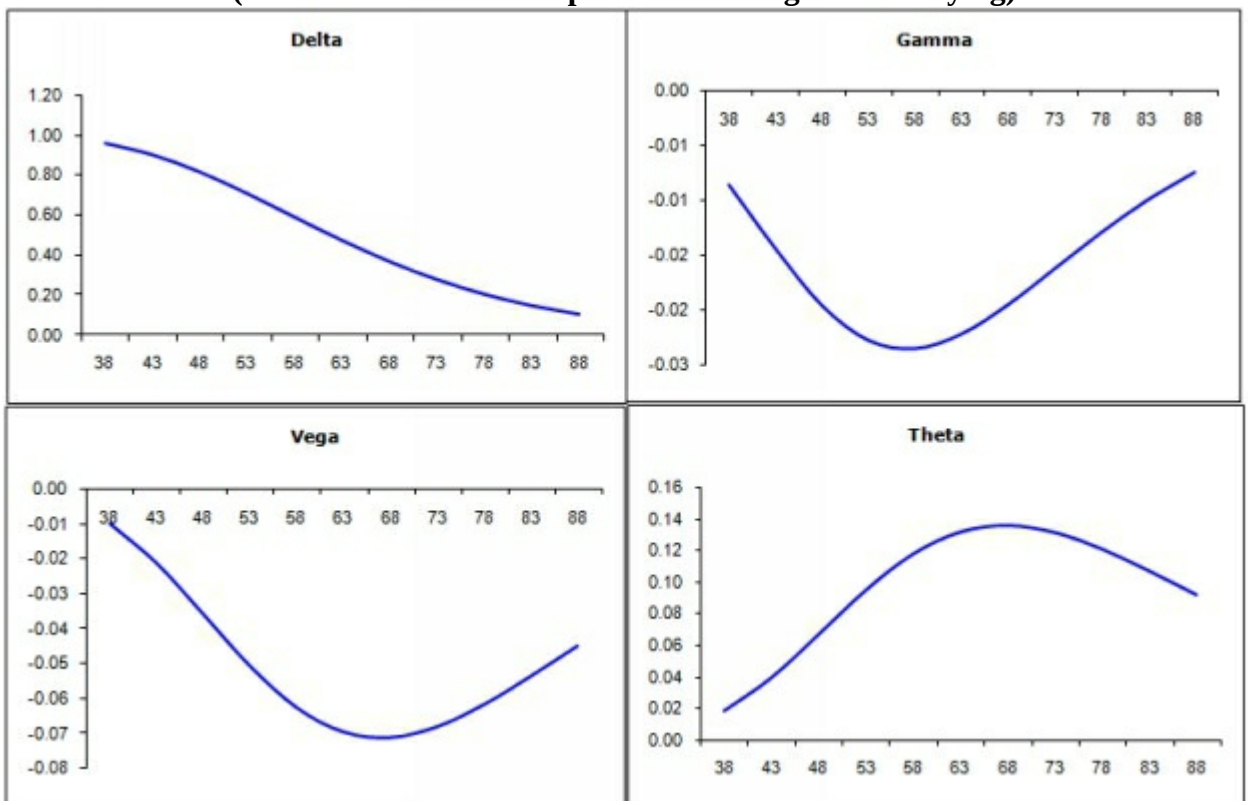
Greeks –

Delta of long future is 1. Delta of short option is -0.53. Delta of net position is 0.47. It means trader will earn or lose 0.47 paisa with increase or decrease in price respectively. If future price

goes up by Rs 4 from 63.5 to 68.5 than trader will earn approx Rs2 and if future price came down by Rs 4 than trader will lose approx Rs 2. Trader will earn a theta of approx 12 paisa every day if stock remain range bound. This theta will increase as expiry nears.

	Long Future	Short Option Strike 65	Position Greeks
Delta	1	-0.53	0.47
Gamma	0	-0.02	-0.02
Theta	0	0.12	0.12
Vega	0	-0.07	-0.07
Rho	0	-0.02	-0.02

Chart of Greeks (Value of Greek with respect to the change in underlying)



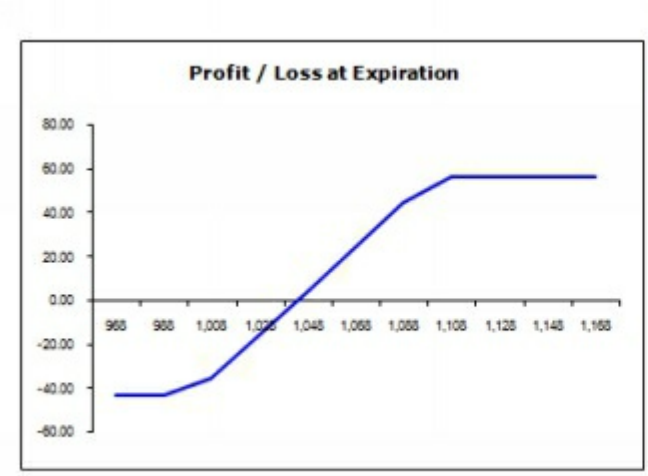
COLLAR

- Outlook – Strategy is used to protect unrealized gain.
- Profit limited, Loss limited.

Example of Collar-
Buy 1 lot RIL at 1068,
Buy 1 lot RIL 1000 Put at Rs. 79/-
Sell 1 Lot RIL 1100 Call at Rs. 104/-.
Maximum profit is limited to Rs 57/-.
Maximum loss is limited to Rs 43/.

Collar is the strategy designed to protect the unrealized gain. A stock you own, already moved up, you want to lock that profit in case of big downfall in prices you can go with 'Collar' but disadvantage is that you will not earn also in case of big move upside. In this strategy you purchase a protective put on your long stock position and offset the cost by writing call. We use both out of money options. Short call is covered by long stock. In this strategy profit and loss both are limited.

Let's take an example to explain. You are holding Reliance industry which you bought at 800 now it is trading at 1068. You buy a Put strike 1000 to protect the unrealized gain. It cost you Rs 79/-. To cover this cost you sold a Call strike 1100 at Rs 104/-. On expiry day if stock price is 1100 than profit from stock is Rs 32 (1100-1068) and profit from options are Rs 25. Maximum loss in this strategy is limited to Rs 43/- and maximum profit is limited to Rs 57/-. Short call of 1100 is hedged by long stock. So profit above 1100 will remain same (Rs 57). Long stock is hedged by put of 1000. So loss below 1000 will remain same (Rs 43).

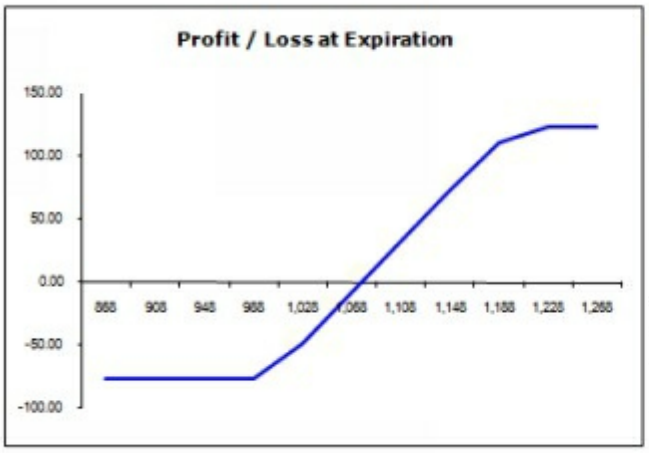


P&L Payoff at Expiration Matrix

Underlying Price	Long Stock	Short Call	Long Put	Total P&L
968	-100	104	-47	-43
988	-80	104	-67	-43
1008	-60	104	-79	-35
1028	-40	104	-79	-15
1048	-20	104	-79	5
1068	0	104	-79	25
1088	20	104	-79	45
1108	40	96	-79	57
1128	60	76	-79	57
1148	80	56	-79	57
1168	100	36	-79	57

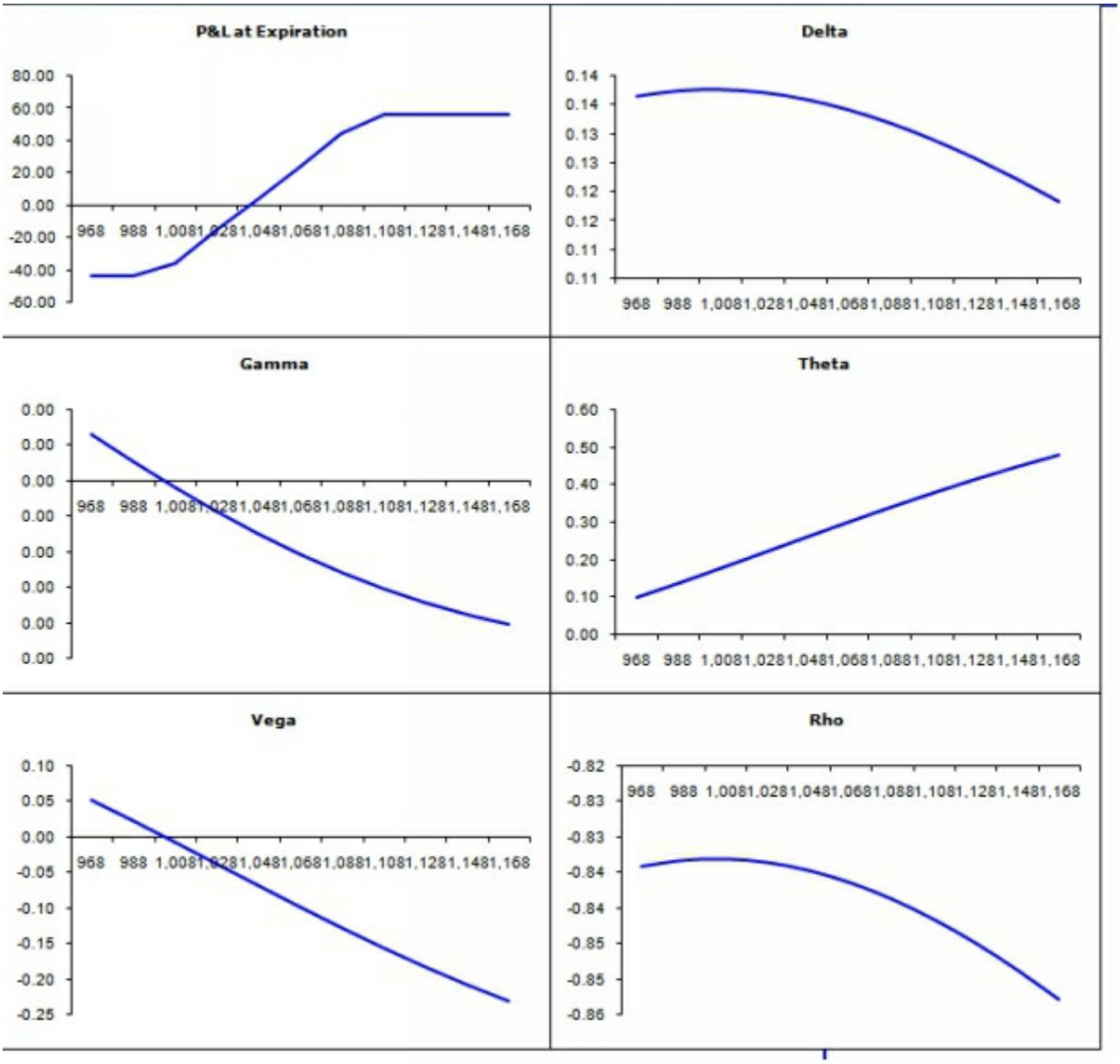
If you are willing to take more risk for more return you may execute a wider collar. You are holding stock which is trading at 1068. You buy put of 1000 at Rs 79/- and you sell call strike 1200 at Rs 71/-. Maximum loss in this strategy is limited to Rs 76/- and maximum profit is

limited to Rs 124/-.Pay off on expiration are given in below table.



P&L Payoff at Expiration Matrix				
Underlying Price	Long Stock	Short Call	Long Put	Total P&L
868	-200	71	53	-76
908	-160	71	13	-76
948	-120	71	-27	-76
988	-80	71	-67	-76
1028	-40	71	-79	-48
1068	0	71	-79	-8
1108	40	71	-79	32
1148	80	71	-79	72
1188	120	71	-79	112
1228	160	43	-79	124
1268	200	3	-79	124

Greeks of the strategy –


P&L at Expiration
80.00
60.00
40.00
20.00
0.00
-20.00
-40.00
-60.00
968 988 1,008 1,028 1,048 1,068 1,088 1,108 1,128 1,148 1,168
Delta
0.14
0.14
0.13
0.13
0.12
0.12
0.11
0.11
968 988 1,008 1,028 1,048 1,068 1,088 1,108 1,128 1,148 1,168
Gamma
0.00
0.00
0.00
0.00
0.00
0.00
0.00
0.00
968 988 1,008 1,028 1,048 1,068 1,088 1,108 1,128 1,148 1,168
Theta
0.60
0.50
0.40
0.30
0.20
0.10
0.00
968 988 1,008 1,028 1,048 1,068 1,088 1,108 1,128 1,148 1,168
Vega
0.10
0.05
0.00
-0.05
-0.10
-0.15
-0.20
-0.25
968 988 1,008 1,028 1,048 1,068 1,088 1,108 1,128 1,148 1,168
Rho
-0.82
-0.83
-0.83
-0.84
-0.84
-0.85
-0.85
-0.86
968 988 1,008 1,028 1,048 1,068 1,088 1,108 1,128 1,148 1,168

CALENDAR SPREAD

A calendar spread is executed when you buy (or sell) a longer-dated option and simultaneously sell (or buy) a shorter-dated option that is identical except for the expiration date. Calendar Spreads also called Horizontal spread or time spread. When we buy long date option it's called buying of calendar Spread, we pays net premium. When we sell long date option it's called selling the calendar spread, we collect net premium. Calendar spread could be bullish, bearish and neutral depending upon strikes and option we select. Buyer of calendar spread makes a profit if the stock price at the expiration of the short-maturity option is close to the strike price of the short-maturity option. However, a loss is incurred when the stock price is significantly above or significantly below this strike price.

Before taking position of calendar spread we need to keep following basic characteristics of options in mind, which will be applicable on most of the positions of Calendar spread. These points we learned in our earlier chapter of option Greeks also –

- Theta of longer-dated option will be lower than the theta of shorter-dated option. It means position with sell of shorter-dated options and buy of longer-dated option will be theta positive and trader will earn time value. This theta impact will be higher with options with higher implied volatility.
- Vega of longer-dated option will be higher than Vega of shorter-dated option. It means Vega of position with sell of shorter-dated options and buy of longer-dated option will be positive. Increase in volatility will be profitable for buyer of calendar spread.
- Delta of longer-dated option will be higher than delta of shorter-dated option and Gamma of longer-dated option will be lower than Gamma of shorter-dated option.

As we understood that buying calendar spread means selling shorter-dated strike along with buying longer-dated strike and selling calendar means buying shorter-dated strike along with selling longer-dated strike. Let's take an example. Nifty is trading at 10250. Nifty current month strike 10300 call is trading at Rs 119/- and Nifty next month strike 10300 call is trading at Rs 223/-. Trader who is expecting that current month contracts will expire near 10300 will sell the current month 10300 call at 119 and buy the next month 10300 call at 223/-.

Example of Calendar spread-

Sell current moth 10300 strike call at 119/-
Buy next month 10300 strike call at 223/-

Greeks of the position –

	Call Strike 10300		
	Current Month	Next Month	Net Values

Premium Used	119.25	223.21	103.96
Delta	-0.50	0.56	0.06
Gamma	0.00	0.00	0.00
Theta	3.48	-2.65	0.83
Vega	-10.49	16.22	5.74
Rho	-3.31	8.99	5.69

We can compute current month contract on expiry but in case of next month contract we can take theoretical price only. Computation of theoretical price is not easy in case of options because options price are impacted by many variable for example volatility, at every level of implied volatility the price of next month options will be different so we need to assume that implied volatility will be remain the same on expiry of current month contracts. Payoff on expiry of current month contract, with theoretical prices of next month contract, is given below -

Underlying Price	Current Month Payoff at Expiration	Next month Theoretical P&L	Net P&L On expiry of current month Contract
9750	119	-180	-61
9850	119	-159	-40
9950	119	-132	-12
10050	119	-96	23
10150	119	-52	67
10250	119	0	119
10350	69	61	130
10450	-31	129	98
10550	-131	204	73
10650	-231	285	55
10750	-331	372	41

Above profit and loss is theoretical profit and loss. Highest profit is when index closed near 10300 (strikes bought and sold). Trader will make good money if underlying will closed near the current month strike sold. In the same way we can buy or sell calendar spread with Puts. Let's take actual data for better understanding. Please check below Table 21. I have taken few months closing prices of Nifty future and options of year 2018. First column is date second column is Nifty closing price. On 2nd April 2018 Nifty closed at 10264. I have taken data of 3 strikes 1 ITM of 10100, 1 near the money of 10300, one OTM of 10500. April 2018 ITM of 10100 closed at Rs 252 and May 2018 OTM of 10100 closed at 348. Trader bought Calendar spread so he sold April Strike at 252 and bought May strike at 348. Next day on 3rd April Nifty closed at 10285. Closing price of April put was 263 and May closed at 365. If trader cover his position of 3rd April than April sold Call will be in a loss of Rs 11 (252-263) and May Call will give profit of Rs 17 (365-348) So net profit of this calendar spread will be Rs 6/-. This amount of Rs 6 is mentioned in P&L column. In the same way If you will compare the price of 4th April and 2nd April, you will find this position is giving you a profit of Rs 11/-. In the same way you can understand the strike

wise month wise data of the table.

Table 21

			Strike 10100				Strike 10300				Strike 10500		
Date	Nifty		April	May	P&L		April	May	P&L		April	May	P&L
2-Apr-18	10264		252	348			127	225			47	130	
3-Apr-18	10285		263	365	6		135	238	5		49	140	7
4-Apr-18	10147		179	286	11		81	177	-1		27	99	-11
5-Apr-18	10352		304	401	0		161	265	7		60	156	13
6-Apr-18	10353		303	406	7		158	268	12		58	158	17
9-Apr-18	10394		331	432	4		177	286	12		68	168	18
10-Apr-18	10422		350	446	0		188	297	11		71	177	23
11-Apr-18	10425		350	444	-3		187	297	13		68	176	25
12-Apr-18	10465		382	473	-6		214	324	12		81	197	33
13-Apr-18	10490		401	486	-11		226	335	12		84	204	36
16-Apr-18	10543		449	529	-17		263	366	5		103	229	43
17-Apr-18	10551		454	532	-18		267	372	8		103	230	43
18-Apr-18	10539		437	519	-14		250	359	11		92	218	43
19-													

Apr-18	10578		478	546	-29		287	382	-3		111	237	43
20-Apr-18	10586		484	532	-49		287	378	-6		102	234	49
23-Apr-18	10585		481	541	-36		287	379	-7		99	232	50
24-Apr-18	10618		513	565	-44		314	391	-20		121	242	38
25-Apr-18	10569		464	519	-42		267	354	-10		77	211	51
26-Apr-18	10612		508	552	-53		308	378	-28		101	229	45

			Strike 10600				Strike 10800				Strike 11000		
			May	June	P&L		May	June	P&L		May	June	P&L
27-Apr-18	10724		219	279			99	161			31	79	
30-Apr-18	10780		254	312	-2		123	182	-3		41	93	4
2-May-18	10739		223	282	-1		106	163	-5		35	81	-2
3-May-18	10707		201	264	3		89	148	-4		27	71	-3
4-May-18	10659		173	232	-1		73	130	-5		21	61	-9
7-May-18	10740		223	279	-5		103	161	-4		34	81	-2
8-May-18	10735		222	279	-3		103	162	-4		35	81	-2
9-May-18	10769		246	301	-5		119	177	-4		41	91	1
10-May-18													

	10725		214	272	-2		100	159	-3		33	79	-1
11-May-18	10820		277	334	-3		138	200	-1		46	103	9
14-May-18	10815		269	330	0		130	193	1		41	98	9
15-May-18	10819		257	318	1		112	185	11		30	90	13
16-May-18	10761		205	274	9		76	154	16		17	72	7
17-May-18	10696		154	231	17		50	124	12		10	55	-2
18-May-18	10597		92	179	27		22	85	2		4	35	-18
21-May-18	10539		54	144	31		9	63	-8		2	25	-26
22-May-18	10553		46	138	33		5	56	-11		2	20	-30
23-May-18	10427		14	85	11		2	32	-33		2	12	-38
24-May-18	10505		20	106	27		2	39	-25		1	14	-35
25-May-18	10602		49	149	40		4	61	-6		1	20	-29
28-May-18	10679		96	191	35		8	83	13		1	29	-20
29-May-18	10616		49	152	43		3	61	-4		1	20	-29
30-May-18	10605		31	148	57		1	60	-4		0	20	-28
31-May-													

18	10727		111	196	25		0	85	23		0	27	-21

			Strike 10500				Strike 10700				Strike 10900		
			June	July	P&L		June	July	P&L		June	July	P&L
1-Jun-18	10684		259	314			132	186			54	100	
4-Jun-18	10599		199	259	5		91	146	2		33	70	-9
5-Jun-18	10596		186	249	8		81	136	2		27	63	-10
6-Jun-18	10686		241	297	1		110	169	5		36	80	-3
7-Jun-18	10765		299	351	-3		147	208	7		49	103	7
8-Jun-18	10748		287	346	3		141	203	9		47	101	7
11-Jun-18	10786		313	370	1		158	224	12		55	115	14
12-Jun-18	10839		353	409	0		192	255	9		70	135	19
13-Jun-18	10845		360	410	-6		193	258	12		70	138	21
14-Jun-18	10814		330	380	-6		162	231	15		51	119	21
15-Jun-18	10815		326	374	-8		155	228	19		46	118	26
18-Jun-18	10790		303	356	-4		135	212	23		36	106	23
19-Jun-18	10720		241	303	6		94	172	24		20	80	14
20-Jun-18	10791		299	350	-5		128	205	23		26	97	24
21-Jun-18	10737		246	309	7		87	173	32		13	77	18
22-Jun-18	10834		331	388	1		148	231	29		26	111	39
25-Jun-18	10758		260	321	6		84	180	42		10	80	23
26-Jun-18	10767		265	331	10		85	183	45		7	82	29
27-Jun-18	10673		175	257	27		25	134	55		1	54	6
28-													

Jun-18	10590		84	192	52		0	93	39		0	34	-13

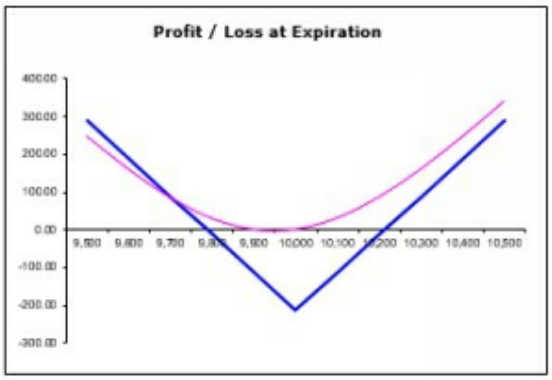
We learned that buyer of calendar spread will make money if Index will expire near current month strike. If you will observe above data you will find that in the beginning of month of April Index was trading near 10300, so one strike ITM and one Strike OTM I have taken for computation. On expiry Index closed at 10600 that's why Calendar spread bought near ATM of 10500 in profit rest 2 calendar spreads were giving loss. In May Index closed at 10700 so calendar spreads of 10500 and 10600 are in profit. June closed at 10600 so 10500 and 10700 was in profit. With the help of Python we can compute the strategy wise profit for any given contract, this we will learn later on in this book.

STRADDLES

Buy Straddle

- Outlook –Expecting significant movement in underlying asset price in either direction.
- Only margin required. Loss limited, Profit unlimited.

If you expect big movement upside you buy call and if you expect big movement down side you buy put. What if you knew there was a big catalyst about to happen such as an earnings release and you thought the catalyst would result in a big move, but you didn't know in which direction? You could buy both a call and a put. That is a long straddle. So this strategy involves buying a call and put of same underlying, same expiry & same strike. Risk is limited to the premium paid, profit potential is unlimited. This strategy has breakeven point on both side, strike price plus net premium paid and strike price minus net premium paid. Let's take an example - Index is trading at 10000 and trader is buying ATM call & put both. Current month call is trading at Rs 130/-& Put is trading at Rs 82/-. Net premium paid on both position is Rs 212/-. Breakeven point of the given position is 10212 & 9788. On expiry if Index will close above 10212 or will close below 9788 than buyer will make money and if Index close above 9788 or below 10212 than buyer will lose money. Please refer payoff matrix, if underlying price at expiry will be at 9500 than call strike price 10000 bought at 130 will expire at zero resulting into loss of Rs 130/- and put bought at Rs 82/- will expire at Rs 500/-. Profit of Rs 418 on Put and Loss of Rs 130/- on Call, so Net profit on both position will be Rs 288/-.



P&L Payoff at Expiration Matrix			
Underlying Price	P&L Buying Call	P&L Buying Put	Net P&L (of both position)
9500	-130	418	288
9600	-130	318	188
9700	-130	218	88
9800	-130	118	-12
9900	-130	18	-112
10000	-130	-82	-212
10100	-30	-82	-112
10200	70	-82	-12
10300	170	-82	88
10400	270	-82	188
10500	370	-82	288

Greeks

Delta of Call bought is 0.58 & Delta of Put sold is -0.42 so delta of straddle is 0.16, it means one point change in Index will result into Rs 0.16 (16 paisa) changes in the price of position. Combined Theta of both of the options bought is Rs -4.35 so Theta loss per day is Rs 4.35. Combined Vega is 20.48 so every one percent increase in implied volatility will give the profit of Rs 20.48. So straddle can be bought if big movement in underlying is expected or increase in volatility is expected in a short period.

Greeks			
	Buying Call	Buying Put	Net (of both position)
Premium	130	82	212

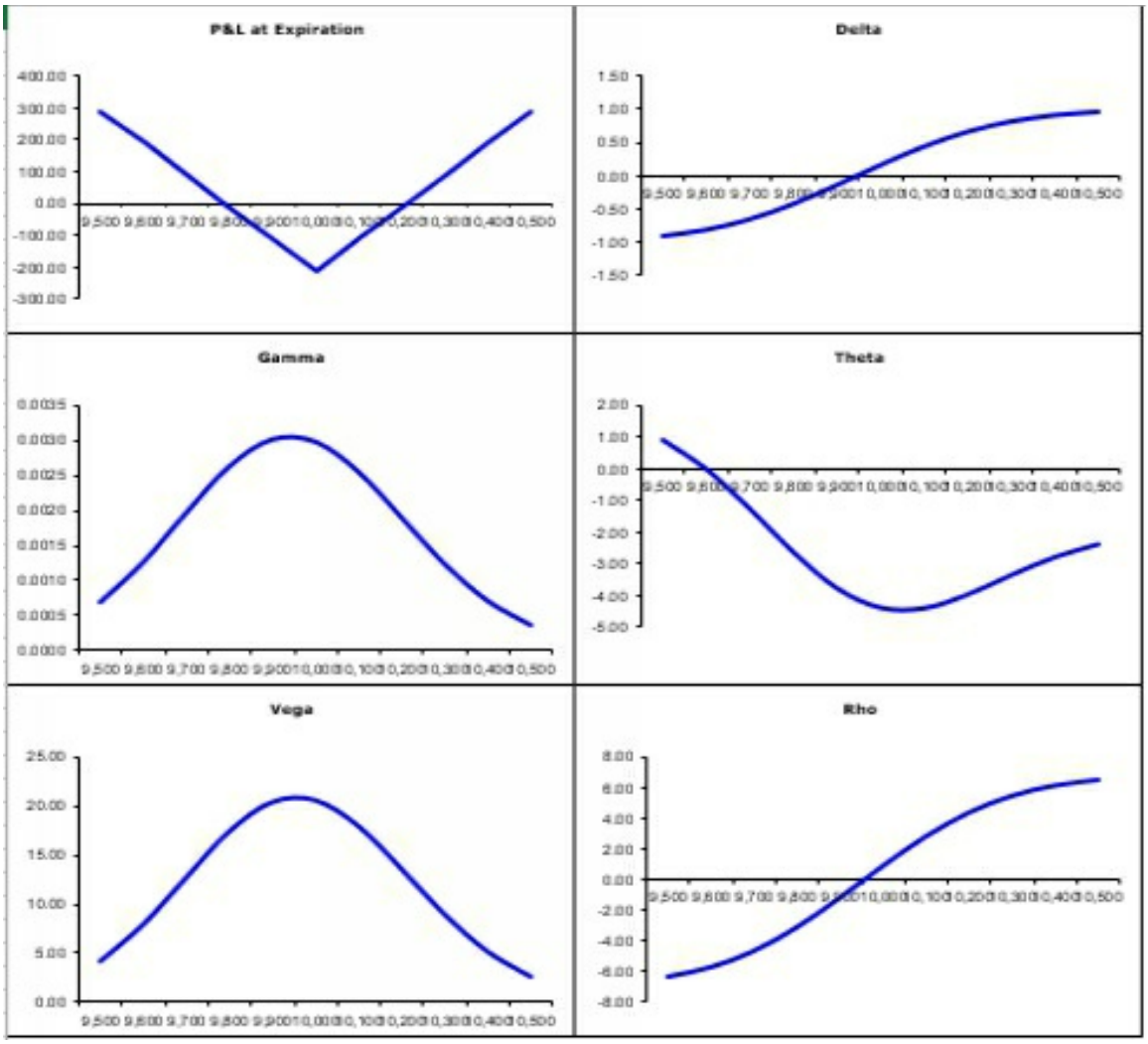
Delta	0.58	-0.42	0.16
Gamma	0.0015	0.0015	0.0030
Theta	-3.13	-1.22	-4.35
Vega	10.24	10.24	20.48
Rho	3.87	-2.95	0.92

Values of Greeks are given in below Table 22 on various levels of underlying price when other factor affecting the option prices i.e. time to expiry, Implied Volatility & interest rates are constant. Delta of both position is 0.16 when index is trading at 10000, it means 1 point fall in index price will result into 16 paisa fall in the price of both position (loss of 16 paisa with every point fall). If Index will come down to 9500 than delta is -0.92, it means every point fall will result into 92 paisa fall in the price of both position (Profit of 92 paisa with every point fall).

Current Position Relative to Underlying Price Changes (At 10% implied volatility & 25 Days to Expiry)					
Underlying Price	**Delta**	**Gamma**	**Theta**	**Vega**	**Option Premium**
9500	-0.92	0.0007	0.93	4.19	460
9600	-0.83	0.0013	0.01	7.91	372
9700	-0.67	0.0020	-1.24	12.68	297
9800	-0.44	0.0026	-2.60	17.34	241
9900	-0.15	0.0030	-3.74	20.31	212
10000 ATM	0.16	0.0030	-4.35	20.48	212
10100	0.44	0.0026	-4.37	17.86	242
10200	0.66	0.0019	-3.94	13.53	297
10300	0.82	0.0012	-3.33	8.93	372
10400	0.91	0.0007	-2.76	5.16	458
10500	0.96	0.0003	-2.35	2.62	552

Table 22

Chart of Greeks are given below –



Let's take a very simple example of buying straddle with historical data. Please refer below Table 23. Nifty closed on 8275 on 26th Dec 2014 (First trading day after December 2014 expiry). Call & put of strike price 8300 of January 2015 was trading on 122.25 and 143.3 respectively, so straddle price was 265.55. On 29th Jan 2015 both call and put contract expired. On 29th Jan 2015 (expiry day) Nifty closed on 8952, call was trading at Rs 650 and put price was zero so straddle price was 650. Straddle bought on 26 Dec 2014 at 265.55 sold at 650 on 29th Jan 2015 resulting into a profit of Rs 384.45. So total profit on one straddle was Rs 28,833 (384.45 multiplied by Nifty lot size of 75). In the same way profit and loss on buying a straddle of Nifty ATM strike at beginning of month given in below table 23. During the month of January, March and August when there is a big movement in price of Nifty, buying a straddle is profitable. In rest of the 9 month during a year of 2015 buying a straddle of ATM strikes resulted into loss. So in year 2015 buying a straddle in beginning of every month and keeping both positions open till expiry was not profitable. Total loss during the year was approx 775 points (approx Rs. 60,000 per straddle). Even though selling straddle is profitable in given example, its not good idea to sell naked options. Its very risky and one big movement in the market can erode not only the profit but capital also.

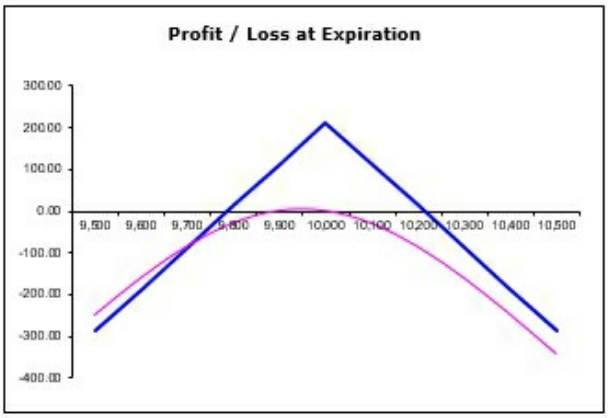
Table 23:

Month	Date	Nifty	Option Strike	Call Price	Put Price	Price of Straddle	Profit /Loss
Jan	26-Dec-14	8275	8300	122.25	143.3	265.55	
	29-Jan-15	8952	8300	650	0	650	384.45
Feb	02-Feb-15	8850	8900	147.55	185.2	332.75	
	26-Feb-15	8684	8900	0	216	216	-116.75
March	27-Feb-15	8880	8800	237.8	149.25	387.05	
	26-Mar-15	8342	8800	0	458	458	70.95
April	27-Mar-15	8434	8400	157.5	123.6	281.1	
	30-Apr-15	8177	8400	0	223	223	-58.1
May	04-May-15	8372	8400	125.3	148.5	273.8	
		8317	8400	0	80	80	-193.8
June	29-May-15	8458.65	8400	176.6	119.3	295.9	
		8397	8400	0	3	3	-292.9
July	26-Jun-15	8381.65	8400	141	158	299	
		8420	8400	20	0	20	-279
Aug	31-Jul-15	8570	8500	162	94	256	
	27-Aug-15	7948	8500	0	552	552	296
Sep	28-Aug-15	8022	8100	144	226	370	
	24-Sep-15	7870	8100	0	230	230	-140
Oct	28-Sep-15	7825	7900	145	221	366	
	29-Oct-15	8114	7900	214	0	214	-152
Nov	30-Oct-15	8094	8100	136	145	281	
	26-Nov-15	7881	8100	0	219	219	-62
Dec	27-Nov-15	7972	8000	130	158	288	
	31-Dec-15	7941	8000	0	59	59	-229

Sell Straddle

Outlook –Expecting small range bound movement in underlying asset price.

Short straddle is just opposite of buy straddle. If you thought a stock was not going to move very much, then you might sell options. This strategy involves selling a call and put of same underlying, same expiry & same strike. Risk is unlimited; profit potential is limited to the premium received. This strategy also has breakeven point on both side, strike price plus net premium paid and strike price minus net premium paid. Strategy creates net income for trader. If underlying does not move much in either direction, trader will retain the premium. However significant movement in either direction could result into loss. This strategy should be carefully adopted only when expected movement in the Index is limited and fall in volatility expected. Let's take an example - Index is trading at 10000 and trader is selling ATM call & put both. Current month call is trading at Rs 130/-& Put is trading at Rs 82/-. Net premium received on both position is Rs 212/-. Breakeven point of the given position is 10212 & 9788. If Index close within the range of 9788 to 10212 than seller will make money.



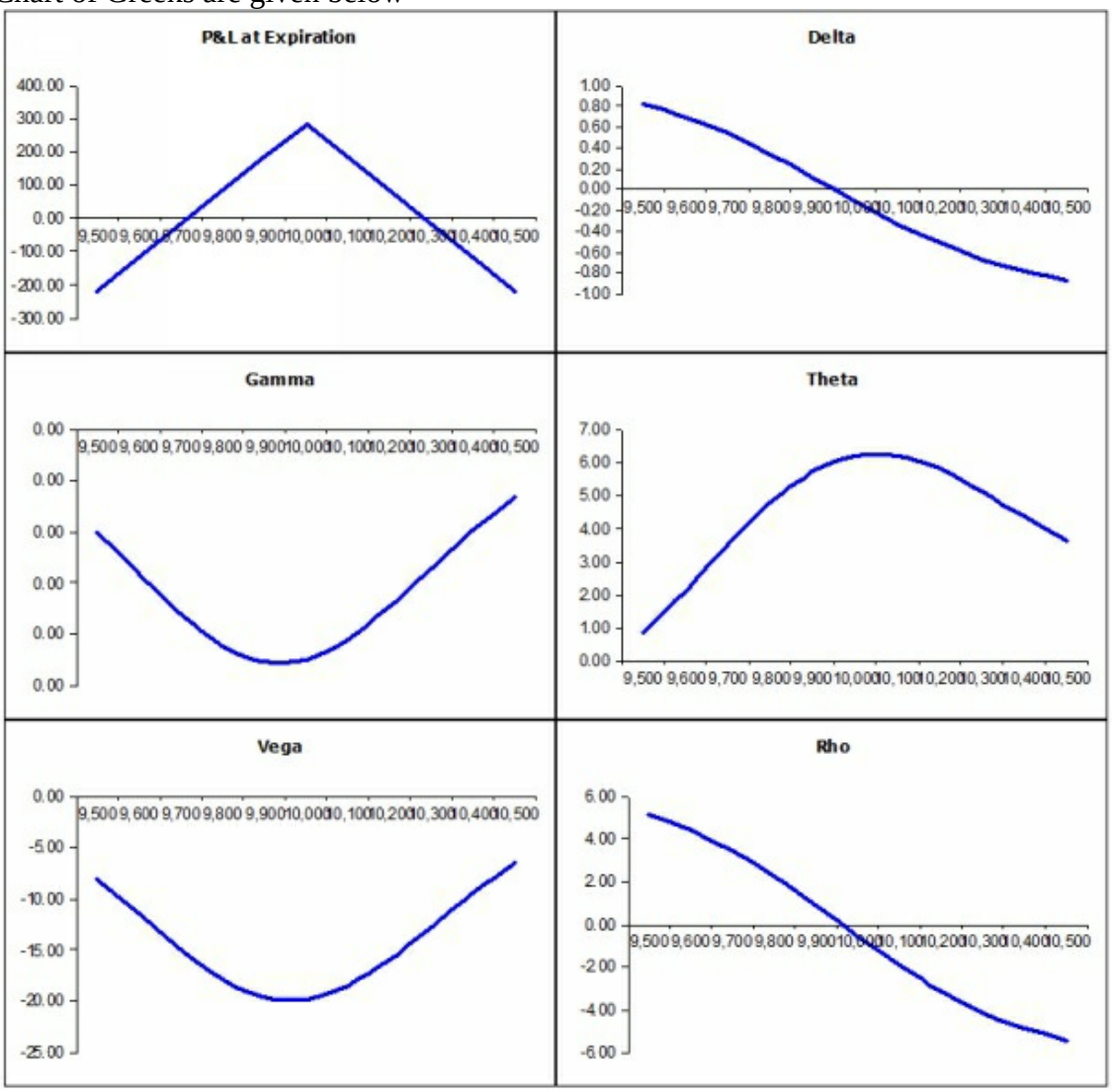
P&L Payoff at Expiration Matrix			
Underlying Price	Sell Call	Sell Put	Net P&L
9500	130	-418	-288
9600	130	-318	-188
9700	130	-218	-88
9800	130	-118	12
9900	130	-18	112
10000	130	82	212
10100	30	82	112
10200	-70	82	12
10300	-170	82	-88
10400	-270	82	-188
10500	-370	82	-288

Greeks

Delta of Call bought is 0.58 & Delta of Put sold is -0.42 so delta of straddle is 0.16, it means one point change in Index will result into Rs 0.16 (16 paisa) changes in the price of position. But because this is ATM strike so delta value will change very fast. Theta is positive, Seller will earn time value of Rs 4.35 per day. Vega is negative. With every one percent increase in implied volatility prices of call and put both will increase by Rs 20.48, resulting into loss. Every 1% fall in implied volatility will give profit of Rs 20.48. So this strategy will be profitable if underlying is range bound or fall in volatility is expected.

Greeks			
	Call	Put	Net
Premium Used	130	82	-212
Delta	-0.58	0.42	-0.16
Gamma	-0.0015	-0.0015	-0.0030
Theta	3.13	1.22	4.35
Vega	-10.24	-10.24	-20.48
Rho	-3.87	2.95	-0.92

Chart of Greeks are given below –



In our previous strategy we have taken example of buying straddle in year 2015 at beginning of every month. Buying a straddle resulted into profit in 3 months and loss in 9 months during the year 2015, so selling same contracts of straddle will result into loss in 3 months and profit in 9 months and total profit of Rs 57000/- (772 multiplied by lot size) per lot in a year. Please refer the below table for month wise details.

Month	Date	Nifty Future	Option Strike	Call Price	Put Price	Price of Straddle	Profit /Loss
Jan	26-Dec-14	8275	8300	122.25	143.3	265.55	
	29-Jan-15	8952	8300	650	0	650	-384.45
Feb	02-Feb-15	8850	8900	147.55	185.2	332.75	

	26-Feb-15	8684	8900	O	216	216	116.75
March	27-Feb-15	8880	8800	237.8	149.25	387.05	
	26-Mar-15	8342	8800	0	458	458	-70.95
April	27-Mar-15	8434	8400	157.5	123.6	281.1	
	30-Apr-15	8177	8400	0	223	223	58.1
May	04-May-15	8372	8400	125.3	148.5	273.8	
		8317	8400	0	80	80	193.8
June	29-May-15	8458.65	8400	176.6	119.3	295.9	
		8397	8400	0	3	3	292.9
July	26-Jun-15	8381.65	8400	141	158	299	
		8420	8400	20	0	20	279
Aug	31-Jul-15	8570	8500	162	94	256	
	27-Aug-15	7948	8500	0	552	552	-296
Sep	28-Aug-15	8022	8100	144	226	370	
	24-Sep-15	7870	8100	0	230	230	140
Oct	28-Sep-15	7825	7900	145	221	366	
	29-Oct-15	8114	7900	214	0	214	152
Nov	30-Oct-15	8094	8100	136	145	281	
	26-Nov-15	7881	8100	0	219	219	62
Dec	27-Nov-15	7972	8000	130	158	288	
	31-Dec-15	7941	8000	0	59	59	229
						Total Profit/ Loss	772.15

In this strategy traders are selling 2 option contracts naked so this is a very risky strategy because a big move in either side could results into big losses. It's not a good idea to sell naked options.

What trader can do is that he can buy some OTM options both side to limit the risk beyond a limit that we will understand in strategy 'butterfly'. Traders can also delta hedge their position to limit the risk. We understood the delta hedging in our second chapter 'Option Greeks'. Let's understand the impact of delta hedging with same example of selling straddle at beginning of every month of year 2015. In our previous example trader sold straddle of 8300 in Jan 2015 that resulted into loss of 384.45 per lot at end of the month (approx. Rs 28800 per lot, 384 multiplied by lot size of 75). Let's see the impact if trader is hedging delta every day on closing price. In the below mentioned Table Nifty closed on 8273.75, Call strike price 8300 closed on 122.25 and put strike price 8300 closed on 144.3. Trader sold 10 lot straddle, i.e., 10 lots of 8300 call and 10 lot of 8300 put. Delta of 8300 call is -0.547 so Delta of 10 lots sold is -5.47. In the same way Delta of 10 lots of 8300 puts sold is 4.63. Net delta of straddle is -0.85 on 26thDecember 2014. To hedge the delta trader is buying one lot Nifty future. So Net position on 26th December 2014 is 10 lots 8300 call sold at 122.25, 10 lots 8300 put sold at 144.3 and 1 lot of Nifty future bought at 8273.75.

On next trading day 29-Dec-2014 Nifty closed on 8316.45, Delta of calls bought increased to -6.07 and delta of puts sold came down to 4.22. Net delta of the options sold is -1.85, delta increased by 1 point so trader will sell 1 more lot at 8316.45 to make the position almost delta neutral. So Net position on 29th December is 10 lots of Nifty strike 8300 call sold, 10 lots of 8300 put sold and 2 lot of Nifty future bought, Delta of Options sold is -1.85 and delta of future bought is 2 so Delta of net position is -0.15 (almost equal to zero). There was no change in delta on 30th December 2014 and 31st December 2014.

In the same way trader is daily buying and selling future to make the position delta neutral, please check last column in the below table. Trader bought one lot on 26th December, one lot on 29th December again one lot on 1st January to make the position delta neutral. Delta of options sold was -2.48 and 3 lot of future already bought by him to make the position delta neutral. On 2nd January index closed up by more than 100 point as compare to previous day closing, delta increased to -6.29 from -2.48. So trader bought 3 more lot at 8458.4. Last column value on 2nd Jan is 25375.2 (8458.4 multiplied by 3).

At end of the month Price of 8300 straddle, which was sold on 266.55 on 26th Dec 2014, was trading at 650 on expiry day 29th Jan 2015. Trader was holding 10 lot each so total loss on options sold is Rs 2,87,512/- [383.35 (Loss) X 10 (Lots) X 75 (Lot size)]. Net profit on buy sell of future is 2546.15, i.e., Rs 1,90,961/- [2546.15 multiplied by 75 (lot size of Nifty future)]. Selling straddle resulted into the loss of Rs 2,87,512/- and delta hedging resulted into the profit of Rs 1,90,961/-. So net loss of this strategy of selling ATM straddle and hedging delta with future is Rs 96,551/-.

Date	**Nifty LTP**	**Strike**	**Options LTP**	**Option Delta**	**Lot**	**Future Buy Sell**
26-Dec-14	8273.75	8300 Call	122.25	-5.47	-10	
		8300 Put	144.3	4.63	-10	
		Net Position Delta		-0.85		
		Future bought to hedge delta			1	8273.75

29-Dec-14	8316.45	8300 Call	137.95	-6.07	-10	
		8300 Put	120.7	4.22	-10	
		Net Position Delta		-1.85		
		Total Future bought to hedge			2	8316.45
30-Dec-14	8317.95	8300 Call	138.95	-6.06	-10	
		8300 Put	121.55	4.23	-10	
		Future		-1.84	2	0
31-Dec-14	8337.85	8300 Call	148.9	-6.35	-10	
		8300 Put	113.7	4.04	-10	
		Future		-2.31	2	0
01-Jan-15	8343.8	8300 Call	148.9	-6.45	-10	
		8300 Put	107.65	3.97	-10	
		Future		-2.48	3	8343.8
02-Jan-15	8458.4	8300 Call	209.2	-8.98	-10	
		8300 Put	57.35	2.69	-10	
		Future		-6.29	6	25375.2
05-Jan-15	8422.85	8300 Call	181.05	-8.09	-10	
		8300 Put	61.9	2.99	-10	
		Future		-5.10	5	-8422.85
06-Jan-15	8157.9	8300 Call	69.2	-3.63	-10	
		8300 Put	206.85	6.03	-10	
		Future		2.40	-2	-57105.3
07-Jan-15	8141.85	8300 Call	63.5	-3.41	-10	
		8300 Put	219.95	6.19	-10	
		Future		2.79	-3	-8141.85
08-Jan-15	8257.25	8300 Call	92.45	-4.90	-10	
		8300 Put	134.15	5.04	-10	
		Future		0.13	0	24771.75
09-Jan-15	8315.5	8300 Call	111.9	-5.92	-10	
		8300 Put	97.75	4.30	-10	
		Future		-1.61	2	16631
12-Jan-15	8360.55	8300 Call	134.05	-6.68	-10	
		8300 Put	76.45	3.74	-10	
		Future		-2.94	3	8360.55
13-Jan-15	8316.5	8300 Call	109.6	-5.81	-10	
		8300 Put	96.55	4.36	-10	
		Future		-1.45	2	-8316.5
14-Jan-15	8307.35	8300 Call	107.8	-5.60	-10	
		8300 Put	101.4	4.50	-10	
		Future		-1.09	1	-8307.35

15-Jan-15	8515.05	8300 Call	248	-8.90	-10	
		8300 Put	34.45	2.04	-10	
		Future		-6.86	7	51090.3
16-Jan-15	8535.05	8300 Call	261.3	-9.30	-10	
		8300 Put	32.7	1.92	-10	
		Future		-7.38	7	0
19-Jan-15	8574.1	8300 Call	294	-9.48	-10	
		8300 Put	24.1	1.54	-10	
		Future		-7.94	8	8574.1
20-Jan-15	8717.15	8300 Call	424.75	-10.00	-10	
		8300 Put	11.6	0.79	-10	
		Future		-9.21	9	8717.15
21-Jan-15	8738.5	8300 Call	443.55	-10.00	-10	
		8300 Put	8.45	0.63	-10	
		Future		-9.37	9	0
22-Jan-15	8779.15	8300 Call	483.55	-10.00	-10	
		8300 Put	5.95	0.47	-10	
		Future		-9.53	10	8779.15
23-Jan-15	8844.4	8300 Call	548.85	-10.00	-10	
		8300 Put	2.4	0.22	-10	
		Future		-9.78	10	0
27-Jan-15	8922.65	8300 Call	620.5	-10.00	-10	
		8300 Put	1.2	0.12	-10	
		Future		-9.88	10	0
28-Jan-15	8904.65	8300 Call	604.4	-10.00	-10	
		8300 Put	0.8	0.09	-10	
		Future		-9.91	10	0
29-Jan-15	8948.55	8300 Call	649.85		-10	-89485.5
		8300 Put	0.05		-10	
Net Profit & Loss			383.35			-2546.15

Let's understand the impact of delta hedging in little bit more details. On 5th Jan 2015 Nifty closed on 8422, delta of net position was approx. -5 so trader was having buy position of 5 lot of Nifty future to make the position delta neutral. Next day 6th Jan 2015 closing is 8157. Delta of options sold turned positive from -5 to +2.4. Now trader needs to sell 7 lots. So in the given example delta hedging is resulting into buy on high price and selling on low price. This is because of Gamma. If you are buying an option than Gamma will help you but Theta will be negative. In the present example Theta is positive but Gamma is having adverse impact on position. In a volatile market when there is a big fluctuation in the prices delta hedging will give you losses when Theta is positive. It means in a volatile market you can make money by buying options and hedging delta, theta loss will be much lesser than the gain of Gamma. It means there

is no guarantee that selling a straddle to earn time value and hedging delta to reduce risk will always give you profit.

One more point to understand, we are taking EOD data that's why on 6th Jan 2015 all 7 lots sold on 8157 so the loss is high in our computation. On 6th Jan 2015 there was not any gap down opening, market came down from 8450 to 8157 in intraday, Losses will be much lesser on future position if trader is hedging delta on every 30-40 points or so.

We have seen the profit and loss on selling straddle in year 2015 in previous tables. Total profit at end the year was 5,79,113/- (Please refer 3rd column of below table). But risk taken was unlimited. Let's see the impact if trader is trader is hedging delta everyday on end of the day price of Nifty. Monthly profit and loss on straddle as per previous example sold and profit and loss on future positions bought and sold every day to make the position delta neutral given in below table. In Jan 2015 Loss on 8300 straddle sold was Rs. 2,88,338/- and profit on future position was 1,90,961/- so net loss was Rs 97,337. Month on months profit loss given in below table. End of the year total profit was Rs 2,58,000/-. When options sold naked than maximum loss was Rs 2,88,338 in a month out of 12 months of 2015 whereas when trader was hedging delta the maximum loss was 1,17,473. When trader is hedging delta than risk is less as compare to selling options naked.

Month (2015)	Profit /Loss On straddle sold	Total Profit/ Loss on 10 lots of Straddle sold	Profit /Loss On Future (Delta Hedging)	Net Profit/ Loss
Jan	-384.45	-2,88,338	1,90,961	-97,377
Feb	116.75	87,563	3,506	91,069
March	-70.95	-53,213	1,11,348	58,136
April	58.1	43,575	-39,997	3,578
May	193.8	1,45,350	-1,51,428	-6,078
June	292.9	2,19,675	-1,95,517	24,158
July	279	2,09,250	-1,62,806	46,444
Aug	-296	-2,22,000	1,04,527	-1,17,473
Sep	140	1,05,000	-66,847	38,153
Oct	152	1,14,000	753	1,14,753
Nov	62	46,500	-16,818	29,682
Dec	229	1,71,750	-98,790	72,960
Total	772.15	5,79,113		2,58,005

One more thing you notice in a given example that after 23rd Jan 2015 8300 call was behaving like a Nifty future. When there is no theta to earn than what is the use of selling option. Let's try a different way of reducing risk on selling straddle.

Many professional traders earning bread and butter from trading sell straddle and hedge delta with Future. However they don't sell naked options, they buy options of far strikes with lower premium to cap the maximum loss in case of sudden big fall or rise. (This option position is called iron condor, we will learn later on in this book)

Shifting position with underlying

Different examples are essential to change the way you think options. Let's compute profit and loss in a month if trader moves his straddle near ATM strike, For example if today closing is 8400 than trader is selling 8400 straddle and when index moved to 8200 than trader is buying 8400 straddle and selling 8200 straddle, so trader is moving his position with underlying and trying to keep his sold straddle near ATM.

I have taken Nifty future and options end of day closing prices in the following examples. For better comparison I am taking profit and loss of both of the strategy.

- First strategy, trader is selling at ATM Strike and holding it till expiry.
-Second strategy trader is shifting his sold straddle with underlying and trying to keep it near ATM.

If you will observe the data in following table you will find that trader is selling ATM straddle at beginning of month and holding it till expiry, this is the example of first strategy. On 28th December 2018 Nifty was trading at 10907. Trader sold 10900 Straddle at Rs 364.95. On expiry day 31st Jan 2019 Index was trading 10833 and straddle value was Rs 55.35. Trader bought it backed and booked profit of Rs 309.60. In the month of March trader again did the same, he sold ATM strike on 1st March 2019. He was holding his position till expiry on 28th March 2019. On 28th march underlying goes up to 11569, so trader lost approx Rs 328/-

Date	**Nifty**	**Strike**	**Call**	**Put**	**straddle**	**Profit /Loss**
28-Dec-18	10907.75	10900	190	174.95	364.95	
31-Jan-19	10833.85	10900	0.05	55.3	55.35	309.6
Date	**Nifty**	**Strike**	**Call**	**Put**	**straddle**	**Profit /Loss**
1-Mar-19	10917.05	10900	174.55	165.35	339.9	
28-Mar-19	11569.45	10900	668.6	0.1	668.7	-328.8

If you will observe the data in following table you will find that trader is selling ATM straddle at beginning of month and shifting his position with underlying, this is the example of second strategy. On 28th December 2018 Nifty was trading at 10907. Trader sold 10900 Straddle at Rs 364.95. On 2nd January 2019 Index came down from 10907 to 10830 so trader bought the straddle at Rs 368/- and again sold straddle of 10800 at Rs 374/-. On 3rd January 2019 Index came down to 10718 so trader bought 10800 straddle and sold 10700 straddle. If you will observe that trader is shifting his position with underlying. This way trader earned the profit of Rs 240 by end of the month.

							Profit

Date	Nifty	Strike	Call	Put	straddle	Signal	/Loss
28-Dec-18	10907.75	10900	190	174.95	364.95	Sold	
31-Dec-18	10916.85	10900	194.4	178.2	372.6		
1-Jan-19	10960.55	10900	211	150	361		
2-Jan-19	10830.85	10900	146	222.1	368.1	Bought	-3.15
2-Jan-19	10830.85	10800	199.95	174.95	374.9	Sold	
3-Jan-19	10718.5	10800	143	225.05	368.05	Bought	6.85
3-Jan-19	10718.5	10700	194.5	178.9	373.4	Sold	
4-Jan-19		10700	222.95	141	363.95	Bought	9.45
4-Jan-19	10777.6	10800	164.85	183	347.85	Sold	
7-Jan-19	10803.45	10800	165.2	163.8	329		
8-Jan-19	10844.65	10800	176	144.2	320.2		
9-Jan-19	10877.7	10800	189.1	119	308.1		
10-Jan-19	10857.75	10800	174.5	124	298.5		
11-Jan-19	10827.6	10800	150.7	137.5	288.2		
14-Jan-19	10769.8	10800	120	152.95	272.95		
15-Jan-19	10928.4	10800	206.4	84	290.4	Bought	57.45
15-Jan-19	10928.4	10900	142.25	118	260.25	Sold	
16-							

Jan-19	10921.65	10900	137.3	114.55	251.85		
17-Jan-19	10925.85	10900	121.9	110.35	232.25		
18-Jan-19	10927.15	10900	130	95.75	225.75		
21-Jan-19	10969.7	10900	147	84.45	231.45		
22-Jan-19	10936.2	10900	124	93	217		
23-Jan-19	10854.9	10900	76.6	128.25	204.85		
24-Jan-19	10868.6	10900	74	93.05	167.05		
25-Jan-19	10785.95	10900	34	148	182	Bought	78.25
25-Jan-19	10785.95	10700	134	51.7	185.7	Sold	
28-Jan-19	10676.8	10700	70	80	150		
29-Jan-19	10668.05	10700	55.55	55.65	111.2		
30-Jan-19	10642.9	10700	13.6	80	93.6	Bought	92.1
Total P&L in the month							240.95

Now let's compare the March 2019 profit and loss. In the first strategy we have seen that trader lost Rs 328 when he sold ATM strike in beginning of the month and hold it till expiry. But from the following table you will observe that trader is shifting his positing with underlying. On 1st March trader sold 10900 straddle. On 5th March when underlying goes up trader bought 10900 straddle sold on 1st March and sold 11000 straddle. On 6th March he bought 11000 and sold 11100. On 11th March he bought 11100 and sold 11200. That's why trader is shifting his straddle with underlying to keep it near ATM to earn maximum time value. At end of the month trader earned Rs 11/-.

In second strategy trader earned Rs 11 when he is shifting position with underlying whereas with the first strategy of not shifting position with underlying he lost Rs 328/-.

Date	**Nifty**	**Strike**	**Call**	**Put**	**straddle**	**Signal**	**Profit /Loss**

1-Mar-19	10917.05	10900	174.55	165.35	339.9	Sold	
5-Mar-19	11032.7	10900	232	108.75	340.75	Bought	-0.85
5-Mar-19	11032.7	11000	165.2	140.5	305.7	Sold	
6-Mar-19	11086.8	11000	197.65	116.15	313.8	Bought	-8.1
6-Mar-19	11086.8	11100	135.9	153.2	289.1	Sold	
7-Mar-19	11098.2	11100	128.5	140.55	269.05		
8-Mar-19	11076.05	11100	115	138.7	253.7		
11-Mar-19	11202.15	11100	191.5	85	276.5	Bought	12.6
11-Mar-19	11202.15	11200	126.95	120	246.95	Sold	
12-Mar-19	11336.85	11200	195.85	77.5	273.35	Bought	-26.4
12-Mar-19	11336.85	11300	132	110.2	242.2	Sold	
13-Mar-19	11366.65	11300	160	89.65	249.65	Bought	-7.45
13-Mar-19	11366.65	11400	99.6	130.15	229.75	Sold	
14-Mar-19	11381.75	11400	101	113.05	214.05		
15-Mar-19	11470.45	11400	148.5	77	225.5	Bought	4.25
15-Mar-19	11470.45	11500	93.1	120	213.1	Sold	
18-Mar-19	11494.5	11500	115.9	101.45	217.35		
19-Mar-19	11570.75	11500	134.95	57.35	192.3	Bought	20.8
19-Mar-19	11570.75	11600	77.55	98.6	176.15	Sold	
20-							

Mar-19	11553.2	11600	59	98	157		
22-Mar-19	11472.4	11600	23.3	135.7	159	Bought	17.15
22-Mar-19	11472.4	11500	58.55	77.4	135.95	Sold	
25-Mar-19	11370.05	11500	14.2	135.55	149.75	Bought	13.8
25-Mar-19	11370.05	11400	42.55	68.5	111.05	Sold	
26-Mar-19	11510.7	11400	131	11.35	142.35	Bought	-31.3
26-Mar-19	11510.7	11500	60.7	34.55	95.25	Sold	
27-Mar-19	11458.1	11500	13.5	65.25	78.75	Bought	16.5
Total P&L in the month							11

Few fulltime professional options trader sell USDINR ATM options and shift their position with USDINR prices but please note that selling straddle is a very risky strategy. In a big gap-up or a gap-down trader can lose a big amount. Better to avoid naked selling of options because even in Index we have seen many upper/lower circuits in last 10 years. In derivatives trading there must be some stop loss keeping in mind the risk and reward.

This concept of shifting position with underlying can be applied on all strategies of options. Its better to adjust position with underlying. This is a very important concept which a trader must understand.

STRANGLE

We discussed straddle where we buy 2 options of the same strike. Buying ATM options could be most expensive with highest theta value. We also know Gamma of ATM options is highest that results into very fast change in delta that results into more cost in delta hedging. Better to avoid ATM strikes when you are hedging delta along with. One more problem with straddle of stocks is that at least one strike will be in-the-money on expiry so open position will result into a delivery of underlying stock. So you essentially need to cover the position before expiry if you do not want delivery obligations. Inspite of selling ATM call and put trader can sell OTM call and put that is called strangle. This combination of an out-of-money call and out-of-money put with the same expiration date is Strangle. When buying both options we're buying Strangle, when selling both options we're selling Strangle. Rest all characteristics of strangle are similar to Straddle. If you are a buyer of strangle you need big move in either direction to make profit and if you are a seller than you need a range bound stock that expire within the range of strangle. Selling strangle means unlimited risk because you are selling 2 naked options.

Let's take an example. One trader is expecting that USDINR contract will remain range bound in this week whereas he is expecting there should be a big movement in either side in this month. So he plan to sell strangle of weekly option and plan to buy strangle of monthly option.

USDINR future trading at 75.5

Example strangle buy
Buy USDINR Monthly Call Strike 76 at Rs 0.98/-
Buy USDINR Monthly Put Strike 75 at Rs 0.62/-
Breakeven points – 77.60 on upside and 73.40 on down side

Example strangle Sell
Buy USDINR Weekly Call Strike 76 at Rs 0.20/-
Buy USDINR Weekly Put Strike 75 at Rs 0.16/-
Breakeven points – 76.36 on upside and 74.64 on down side

Greeks of both Strangles

	Monthly Straddle Buy				Weekly Straddle Sell				
	76 Call	75 Put	Total		76 Call	75 Put	Total		Grand total
Premium	0.98	0.62	1.6		0.20	0.16	-0.36		1.24
Delta	0.49	-0.35	0.14		-0.32	0.28	-0.05		0.09
Gamma	0.16	0.15	0.30		-0.38	-0.35	-0.73		-0.43
Theta	-0.02	-0.01	-0.04		0.05	0.04	0.09		0.05

Vega	0.08	0.08	0.16		-0.03	-0.03	-0.05		0.11
Rho	0.03	-0.02	0.01		0.00	0.00	0.00		0.01

In the given example to strangle buy, USDINR Options of monthly expiry call strike 76 is bought at Rs 0.98 and monthly expiry call strike 75 is bought at Rs 0.62. So total premium of Rs 1.6/- paid. Breakeven point on upside will be 77.60 and breakeven point on downside will be 73.40/-. Delta of 76 call is 0.49 and Delta of 75 Put is -0.35, so net delta of both position is 14 paisa. Gamma of 76 Call and 75 Put is 0.16 and 0.15 respectively. Gamma values are very high. Delta values will change very fast with change in prices. Theta loss is 4 paisa daily.

In the given example to strangle Sell, USDINR Options of weekly expiry call strike 76 is sold at Rs 0.20/- and weekly expiry call strike 75 is sold at Rs 0.62. So total premium of Rs 0.36/- received. Breakeven point on upside will be 76.36 and breakeven point on downside will be 74.64/-. Theta gain is 9 paisa daily.

In the below table weekly future options payoff are given at expiration, but on the day of expiry of weekly options monthly options will not expire so theoretical profit and loss is taken relative to underlying price changes. Benefit of buying monthly straddle along with selling weekly straddle is that position is hedge to some extent. Even if the price goes up by Rs 5 total loss on combination of both straddle (all 4 options) is only Rs 1.09, there is loss of Rs 4.14 on straddle sold but there is profit of Rs 3.05 also on straddle bought. Theoretically maximum loss is limited to Rs 1.09 because deep in-the-money options behave like a future but practically this amount may differ because problem is the spread. Deep in-the-money option may not be liquid enough and spread may be high. If you have problem than there is a solution also. Inspite of selling deep In-the-money call on loss you can sell future and hedge, you just need to check that interest cost on margin blocked on future position should be less than the loss because of high spread. Lets come back to our main discussion that loss is less as compare to selling only weekly option still profits on both straddle are almost equal to the weekly straddle sold if underlying remains in expected range on expiry.

Theoretical Profit and Loss on expiry of Weekly options

Underlying Price	Monthly Straddle Buy				Weekly Straddle Sell				Grand Total
	76 Call	75 Put	Total		76 Call	75 Put	Total		
70.5	-0.88	3.93	3.05		0.20	-4.34	-4.14		-1.09
71.5	-0.88	2.93	2.05		0.20	-3.34	-3.14		-1.09
72.5	-0.88	1.93	1.05		0.20	-2.34	-2.14		-1.09
73	-0.73	1.40	0.67		0.20	-1.84	-1.64		-0.97
73.5	-0.65	1.04	0.39		0.20	-1.34	-1.14		-0.75
74	-0.54	0.71	0.17		0.20	-0.84	-0.64		-0.47
74.5	**-0.40**	**0.43**	0.03		**0.20**	**-0.34**	**-0.14**		**-0.11**
75	**-0.22**	**0.20**	-0.02		**0.20**	**0.16**	**0.36**		**0.34**
75.5	**0.00**	**0.00**	0.00		**0.20**	**0.16**	**0.36**		**0.36**
76	**0.26**	**-0.16**	0.11		**0.20**	**0.16**	**0.36**		**0.47**
76.5	**0.57**	**-0.28**	0.29		**-0.30**	**0.16**	**-0.14**		**0.15**
77	**0.91**	**-0.37**	0.54		**-0.80**	**0.16**	**-0.64**		**-0.10**

77.5	1.29	-0.44	0.85		-1.30	0.16	-1.14		-0.29
78	1.69	-0.49	1.21		-1.80	0.16	-1.64		-0.43
78.5	1.62	-0.57	1.05		-2.30	0.16	-2.14		-1.09
79.5	2.62	-0.57	2.05		-3.30	0.16	-3.14		-1.09
80.5	3.62	-0.57	3.05		-4.30	0.16	-4.14		-1.09

BUTTERFLY

Butterflies are the direction less strategies. Seller of butterfly will make money underlying moves in either direction upside or down side. Buyer will make money when prices will remain in the range. So bet is not on direction but on price movement, whether there will be a significant move in prices in either direction or not. Most of the professional traders prefer to trade butterfly. **It's very important strategy, understand it very well. Good thing with this strategy is risk and reward is limited.** Use charts in python to understand the pattern of butterfly of any derivative contract. We will learn this in last chapter.

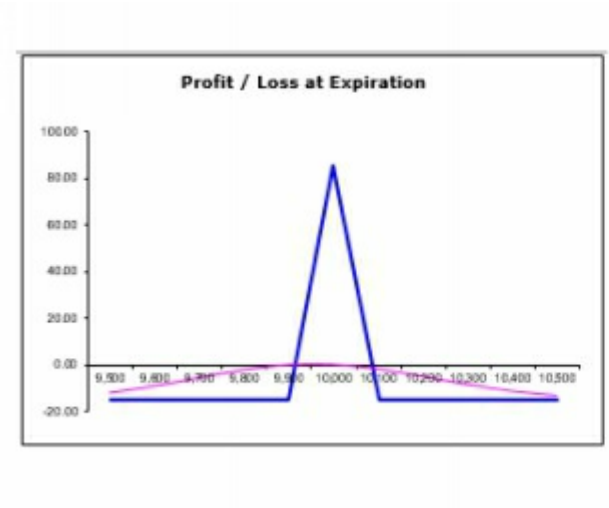
Long Butterfly

Long butterfly is a direction neutral strategy that seeks profit from time decay or decline in implied volatility. Long butterfly constructed using the 3 strikes of fix interval, buying the lower strike option, selling two middle strike options and buying higher strike option. Butterfly could be constructed using either call or put.

Example of Long butterfly-

Buy 1 lot Nifty 9900 Call at Rs. 193.55,
Sell 2 lot Nifty 10000 Call at Rs. 129.80,
Buy 1 Lot Nifty 10100 call at Rs. 80.85

Long butterfly in above example resulting into net debit of Rs. 14.80/-. Middle strike of a long butterfly should be located in the middle of expected trading range. Trader in the given example is expecting a Nifty closing near 10000 on expiry so he sold 2 lot of Nifty call strike price 10000, bought 1 lot of Nifty call strike price 9900 and bought 1 lot of Nifty call strike price 10100. Strike price distance should be equal on both side, i.e., one call trader bought is 100 point in the money and the another call trader bought is 100 point out of money so distance from the middle strike is equal on both side. Value of this butterfly will remain in the range of 0 to 100 irrespective of underlying value (distance among two strikes). Buying butterfly resulted into net debit of 14.80 so the **maximum loss is limited to Rs 14.80/-.** Maximum profit is limited to Rs 85.20/- (Strike interval of 100 minus net debit of Rs 14.75 equals to Rs. 85.20/-). Profit and loss on expiration matrix is given below. Trader will make highest profit if index will expire on 10000. If index closed below 9900 or above 10100 than trader will lost Rs. 14.80/- paid initially to buy butterfly.



P&L Payoff at Expiration Matrix				
Underlyin	Buy Call 9900	Sell 2 Calls 10000	Buy Call 10100	P&L
9500	-193.55	259.60	-80.85	-14.80
9600	-193.55	259.60	-80.85	-14.80
9700	-193.55	259.60	-80.85	-14.80
9800	-193.55	259.60	-80.85	-14.80
9900	-193.55	259.60	-80.85	-14.80
10000	-93.55	259.60	-80.85	85.20
10100	6.45	59.60	-80.85	-14.80
10200	106.45	-140.40	19.15	-14.80
10300	206.45	-340.40	119.15	-14.80
10400	306.45	-540.40	219.15	-14.80
10500	406.45	-740.40	319.15	-14.80

Short Butterfly

Short butterfly constructed using the 3 strikes of fix interval, selling the lower strike option, buying two middle strike options and selling higher strike option. Butterfly could be constructed using call or put.

Example of Short butterfly-

Sell 1 lot Nifty 9900 Call at Rs. 193.55,
Buy 2 lot Nifty 10000 Call at Rs. 129.80,
Sell 1 Lot Nifty 10100 call at Rs. 80.85

This is just opposite of long butterfly. This strategy is resulting into net credit of Rs 14.80/- so maximum profit is limited to Rs14.80. However maximum loss is limited to Rs 85.20/- (Strike interval of 100 – premium received of Rs 14.80 = 85.20).

P&L Payoff at Expiration Matrix				
Underlyin	Sell Call 9900	Buy 2 Call 10000	Sell Call 10100	P&L
9500	193.55	-259.60	80.85	14.80
9600	193.55	-259.60	80.85	14.80
9700	193.55	-259.60	80.85	14.80
9800	193.55	-259.60	80.85	14.80
9900	193.55	-259.60	80.85	14.80
10000	93.55	-259.60	80.85	-85.20
10100	-6.45	-59.60	80.85	14.80
10200	-106.45	140.40	-19.15	14.80
10300	-206.45	340.40	-119.15	14.80
10400	-306.45	540.40	-219.15	14.80
10500	-406.45	740.40	-319.15	14.80

In the above example trader constructed butterfly by selling 2 calls of Nifty strike 10000 and buying one both side on fix price difference. In the same way trader can construct butterfly at different strikes of Nifty.

For example trader can construct butterfly at 9900 also by buying 1 lot of 9800 Call, selling 2 lot of 9900 Call and buying 1 lot of 10000 Call.

Trader can also construct butterfly at 10100 also by buying 1 lot of 10000, selling 2 lots of 10100 and buying 1 lot of 10200.

Example of 100 point Butterfly of Nifty constructed at different strikes is given in below table. Please note theoretical prices are taken when nifty is trading at 10000 and there are 25 days to expiry. 100 point butterfly of 9600 resulting into a debit of Rs 3.7/- (Buy 1 lot of 9500 Call at 546.9, Sell 2 lot of 9600 Call at 450.10 and buy one lot of 9700 call at 357). In the same way 100 point 9700 butterfly is resulting into net debit of Rs 6.40/-, 100 point 9800 butterfly resulting into debit of Rs 9.9/- and so on…. ATM Butterfly is most expensive.

Nifty 100 Butterfly Prices when Index is 10000 and 25 days to expiry

Strike	Call Option Price											Butterfly

Price	9500	9600	9700	9800	9900	10000	10100	10200	10300	10400	10500	Price
9600	546.9	450.1	357.0									**3.7**
9700		450.1	357.0	270.3								**6.4**
9800			357.0	270.3	193.5							**9.9**
9900				270.3	193.5	129.8						**13.1**
10000					193.5	129.8	80.9					**14.8**
10100						129.8	80.9	46.4				**14.4**
10200							80.9	46.4	24.4			**12.5**
10300								46.4	24.4	11.7		**9.3**
10400									24.4	11.7	5.1	**6.1**

In the above example Index is trading at 10000 and there are 25 days to expiry. As the expiry nears the price of butterflies will increase marginally. ATM butterfly will increase more and OTM and ITM butterfly will increase less but there will be increase in price till 8 to 10 days of Expiry. When there are only 7-8 days to expiry the value of ATM, ITM1 and OTM1 butterfly will move towards 100 very fast. On Expiry day only ATM butterfly will be 100 rests all butterfly will be zero.

Prices of Nifty point 100 Butterfly on Expiry when Index is 10000 are given in below table -

Strike Price	9500	9600	9700	9800	9900	10000	10100	10200	10300	10400
9600	500	400	300							
9700		400	300	200						
9800			300	200	100					
9900				200	100	0				
10000					100	0	0			
10100						0	0	0		
10200							0	0	0	
10300								0	0	0
10400									0	0

You can observe that the butterfly of 10000 which was trading at Rs 14.8/- when there was 25 days to expiry is now on expiry day closed at 100 and rest all butterfly has become zero.

Example with past data -

Let’s take an example with past data for better understanding. In the next table I have taken Nifty Future and Options closing price of Jan 2017.

Please refer next table, first column is date second column is nifty closing price; on 30th Dec 2016 Nifty closing price was 8187.

3rd to 9th column are prices of butterfly of various strike computed on the basis of closing price on that date.

For example on 30th December Nifty 8100 butterfly was trading at Rs 12.8. Nifty strike 8000 closing price was 244.5, strike 8100 closing price was 170.5 and strike 8200 closing price was 109.3. Compute the price of 8100 butterfly buy 1 lot strike 8000, sell 2 lots of 8100 and buy 1 lot of 8200. (244.5-170.5-170.5+109.3=12.80/-)

In the same way prices of other butterfly computed. If one will buy the butterfly at 12.80 than maximum loss is limited to Rs 12.80 and maximum profit it limited to Rs 87.20.

If you will observe Butterfly prices in next table the most expensive butterfly was strike 8200 trading at 15.7 on 30th December 2016, and that day Nifty was trading at 8187. On 10th January Nifty price goes up to 8294, the most expensive butterfly was strike 8300 trading at 19.3/-. On 25th Jan 2017 Nifty closed at 8599. You will check highest price of the butterfly is 94.9 of option strike 8600 (computed based on closing price).

Butterfly strike 8100 which was trading at 12.80 on 30th December 2016 came down to zero by end of the month on expiry. Strike 8600 butterfly which was trading at Rs 5.2/- on 30th December 2016 goes up to 94.90 on expiry day.

You will also observe in next table that in initial days butterfly prices increasing gradually by 1 or Rs 2 in every 2-3 days. Buy if you will check the last week on 20th Jan highest price butterfly was 33, on 23rd Jan 41.70, on 24th Jan 55.9/- so prices are increasing very fast.

In initial day's butterfly price movement is less so the risk is less, in first 10 trading days highest price butterfly is Rs 20. Whereas when expiry nears price movement is fast so the risk of trading butterfly is more, for example on 24th Jan 8600 strike was trading at Rs 15.50 and closed at Rs 94.90 on 25th Jan.

Day wise strike wise Nifty 100 point butterfly computed from closing prices of options are given in following table. Observer the Butterfly price along with Nifty price and days to expiry.

			Nifty Butterfly 100						
Date	Nifty		8100	8200	8300	8400	8500	8600	8700
30-Dec-16	8187		12.8	15.7	14.7	14.1	8.0	5.2	1.8
2-Jan-17	8192		12.7	15.6	15.7	14.1	7.8	5.4	2.1
3-Jan-17	8197		15.2	15.4	14.9	13.3	8.6	5.3	1.8
4-Jan-17	8204		12.0	15.5	16.7	14.9	8.7	5.4	1.9
5-Jan-17	8288		10.5	15.0	15.1	18.3	12.5	8.2	3.9

6-Jan-17	8268		5.8	19.1	17.1	16.5	11.8	6.2	2.4
9-Jan-17	8250		12.3	17.1	18.6	16.4	10.8	5.0	1.8
10-Jan-17	8294		7.8	17.6	19.3	18.3	13.2	7.2	2.3
11-Jan-17	8387		4.3	10.9	18.2	20.4	19.9	12.6	4.8
12-Jan-17	8418		1.7	8.8	16.6	20.9	22.2	16.0	6.5
13-Jan-17	8418		10.9	3.9	16.7	24.0	24.7	14.1	4.7
16-Jan-17	8432		2.9	9.6	12.7	25.8	25.9	16.7	4.7
17-Jan-17	8409		4.1	8.0	17.5	28.2	23.8	11.9	2.9
18-Jan-17	8429		6.7	4.2	15.4	27.3	28.3	14.6	2.5
19-Jan-17	8443		1.4	6.6	15.1	26.6	32.3	14.6	2.4
20-Jan-17	8363		-0.1	11.7	27.6	33.2	17.9	3.9	0.9
23-Jan-17	8402		-4.6	10.3	17.8	41.7	28.6	3.9	0.4
24-Jan-17	8481		-0.1	0.6	3.3	24.0	55.9	15.5	0.5
25-Jan-17	8599		1.4	-3.4	1.2	-2.1	8.2	94.9	0.0

As we leaned Butterfly is direction neutral strategy. Till now you were buying when you were

bullish and selling when you are bearish so you were playing directional trades. In case of butterflies you need not take view on direction. For example on 30th December 2016 8200 100 point butterfly closed on 15.70/- was the most expensive one. If trader will sell the butterfly then 200-300 point movement in Nifty on either side will give him profit. By 12th January Index goes up by 200 points from 8187 on 30th December to 8418 on 12th January. Butterfly prices also came down from 15.70 to 8.80 so trader earned approx Rs 7 in 12 days. If index remains on same level of approx 8200 on 12th January then trader will be losing approx Rs 7/-, because highest price butterfly is trading at Rs 22 on 12th January. In initial days trading butterfly is less risky but as expiry nears prices of butterfly change very fast. You can observer the day wise price of butterflies they remains approximately on same levels if implied volatility is same. This way you will get an idea when a butterfly is expensive or cheaper. If butterfly is cheaper and you are expecting that market will remain on same level then you can buy butterfly and if butterfly is expensive and you are also expecting that market will move either side from current level then you can sell butterfly.

You will get an idea of butterfly prices when you will observe the day wise prices or you can also learn from past data. In this Python will help you a lot.

How to trade butterfly?

This is a very subjective area. Each trader can have different view on trading butterfly based on his past experience. Let's take one more example. In last table I have taken data of 100 point butterfly now in next table I am taking data of 200 point butterfly of Jan 2017 itself. Key points to note –

- Nifty is trading at 8187, strike 8200 butterfly is trading at 59. It's 200 point butterfly so value of butterfly will remain in between of zero to 200. So for buyer of butterfly maximum risk is Rs 59 and maximum profit is limited to Rs 141.
- Buyer of 8200 butterfly will make maximum profit if underlying close at 8200 on expiry. Beak even point on upside is 8341 and breakeven point on down side is 8059. So buyer will make money if index will close somewhere in between from 8059 to 8341.
- In the same way seller of the butter fly will have maximum risk of Rs 141, profit will be limited to 59. Seller will make money if index closed above 8341 or below 8059.

Traders need not to take view on direction that's why it's a direction neutral strategy. Buying butterfly means you are buying range.

So if you think market will range bound will remain at same level till expiry you will buy a butterfly and if you think market could move downside or upside from current level you will sell a butterfly.

Day wise strike wise Nifty 200 point butterfly computed from closing prices of options are given in following table.

			Nifty Butterfly 200								
Date	Nifty		7900	8000	8100	8200	8300	8400	8500	8600	870(
30-Dec-16	8187		18	31	48	59	59	51	35	20	10

2-Jan-17	8192		23	28	48	60	61	52	35	21	10
3-Jan-17	8197		21	30	50	61	59	50	36	21	10
4-Jan-17	8204		20	30	45	60	64	55	38	21	10
5-Jan-17	8288		10	22	40	56	63	64	51	33	17
6-Jan-17	8268		11	31	41	61	70	62	46	27	12
9-Jan-17	8250		10	28	49	65	71	62	43	23	9
10-Jan-17	8294		12	21	41	62	74	69	52	30	13
11-Jan-17	8387		3	10	25	44	68	79	73	50	24
12-Jan-17	8418		0	5	17	36	63	81	81	61	30
13-Jan-17	8418		-5	9	24	35	61	89	88	58	24
16-Jan-17	8432		-3	-1	13	35	61	90	94	64	27
17-Jan-17	8409		-4	8	20	38	71	98	88	51	18
18-Jan-17	8429		-4	4	18	31	62	98	98	60	20
19-Jan-17	8443		1	2	9	30	63	101	106	64	20
20-Jan-17	8363		5	10	14	51	100	112	73	26	6
23-Jan-17	8402		-4	-1	4	34	88	130	103	37	4
24-Jan-17	8481		-1	-2	0	4	31	107	151	87	16
25-Jan-17	8599		10	6	-3	-4	-3	5	109	198	95

Greeks – I have taken example to long butterfly strike 8200 to explain the Greeks.

	Strike 8000	Strike 8200	Strike 8400	Butterfly Greeks
Delta	0.85	-1.14	0.26	-0.04
Gamma	0.0010	-0.0033	0.0014	-0.0010
Theta	-2.39	5.46	-1.91	1.16

Vega	4.99	-16.84	6.90	-4.95
Rho	4.60	-6.27	1.41	-0.25

Theta of the butterfly is positive so time decay will help the option buyer. We have taken ATM butterfly in above example that's why Vega is negative -4.95. In the given example trader is buying 8200 butterfly at Rs 59/-, if implied volatility came down by 1% than price of butterfly will increase by Rs 5/- from 59 to approx 64, if other variables remain the same.

Underlying Price	Delta	Vega
7700	0.00	2.15
7800	0.02	1.99
7900	0.15	0.34
8000	0.49	-2.41
8100	0.56	-4.69
8200	-0.05	-4.95
8300	-0.57	-3.04
8400	-0.44	-0.31
8500	-0.13	1.70
8600	-0.02	2.36
8700	0.00	2.00

Greeks of butterfly will depend on location of butterfly. You will notice in the above table that if center strike of butterfly is above ATM (8200) than delta is negative and if middle strike of butterfly is below ATM than delta is positive. If you will check the Vega with respect to the underlying price in above table you will find Vega of ATM butterfly is negative but if will go for a butterfly below lower wing (strike 8000) or above upper wing (strike 8400) than Vega of butterfly is positive.

Lets discuss some more example to understand better understanding of trading butterflies. I have taken November 2020 Nifty weekly option data in following example. **Nifty is trading at 11650.** Today is Friday and there are 6 more days to expiry.

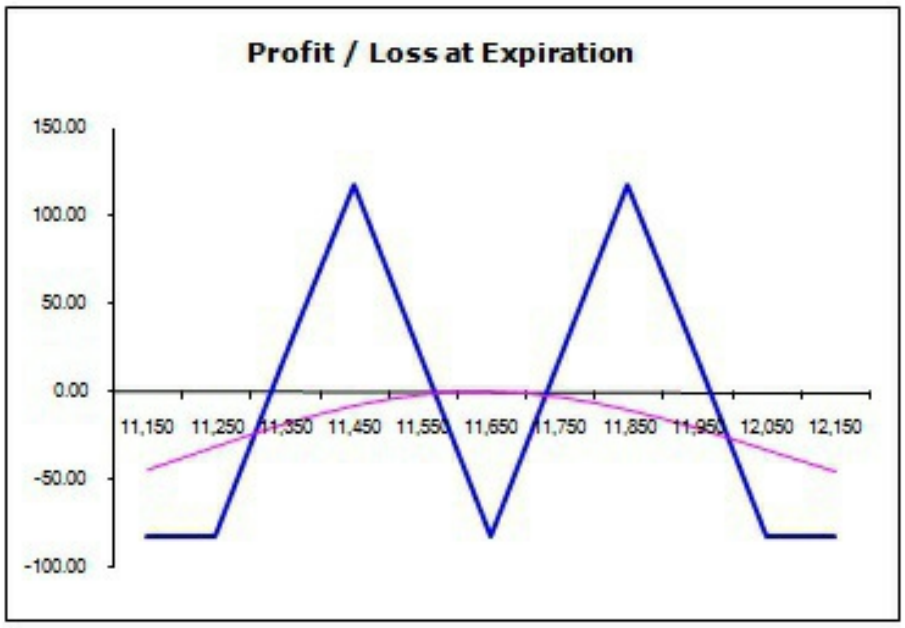
If I am bullish I can buy a butterfly of 200 point with OTM calls. I bought 1 call strike 11650, sold 2 calls strike 11850 and bought 1 call strike 12050. Cost of butterfly is Rs 43.70. I will make money if market will close above 11693.70/-. Maximum loss is limited to 43.70 and maximum profit is limited to 156.30.

BID QTY	BID PRICE	ASK PRICE	ASK QTY	STRIKE PRICE			
225	137.40	139.00	675	11,650.00	1	139	139
150	113.40	115.00	300	11,700.00			
1,650	90.00	93.00	4,200	11,750.00			
825	73.00	73.55	1,200	11,800.00			
300	57.00	58.00	375	11,850.00	-2	57	-114
1,350	44.00	44.85	750	11,900.00			
75	32.05	34.95	375	11,950.00			
1,200	25.30	25.85	1,050	12,000.00			
75	18.50	18.65	75	12,050.00	1	18.7	18.7
							43.7

If I am bearish I can buy a butterfly of 200 point with OTM puts. I bought 1 put strike 11650, sold 2 calls strike 11450 and bought 1 call strike 11250. Cost of butterfly is Rs 48.20. I will make money if market will close below 11601.80/-. Maximum loss is limited to 48.20 and maximum profit is limited to 151.80.

STRIKE PRICE	BID QTY	BID PRICE	ASK PRICE	ASK QTY			
11,250.00	75	37.25	43.50	525	1	43.5	43.5
11,300.00	75	47.30	47.90	75			
11,350.00	75	51.60	57.85	825			
11,400.00	75	66.70	68.40	75			
11,450.00	675	75.05	81.00	75	-2	75.05	-150
11,500.00	75	94.10	96.00	8,400			
11,550.00	450	111.10	113.35	75			
11,600.00	600	130.05	133.00	150			
11,650.00	225	154.00	154.80	75	1	154.8	154.8
							48.2

If I am buying both of the above butterflies then payoff chart will be like this –



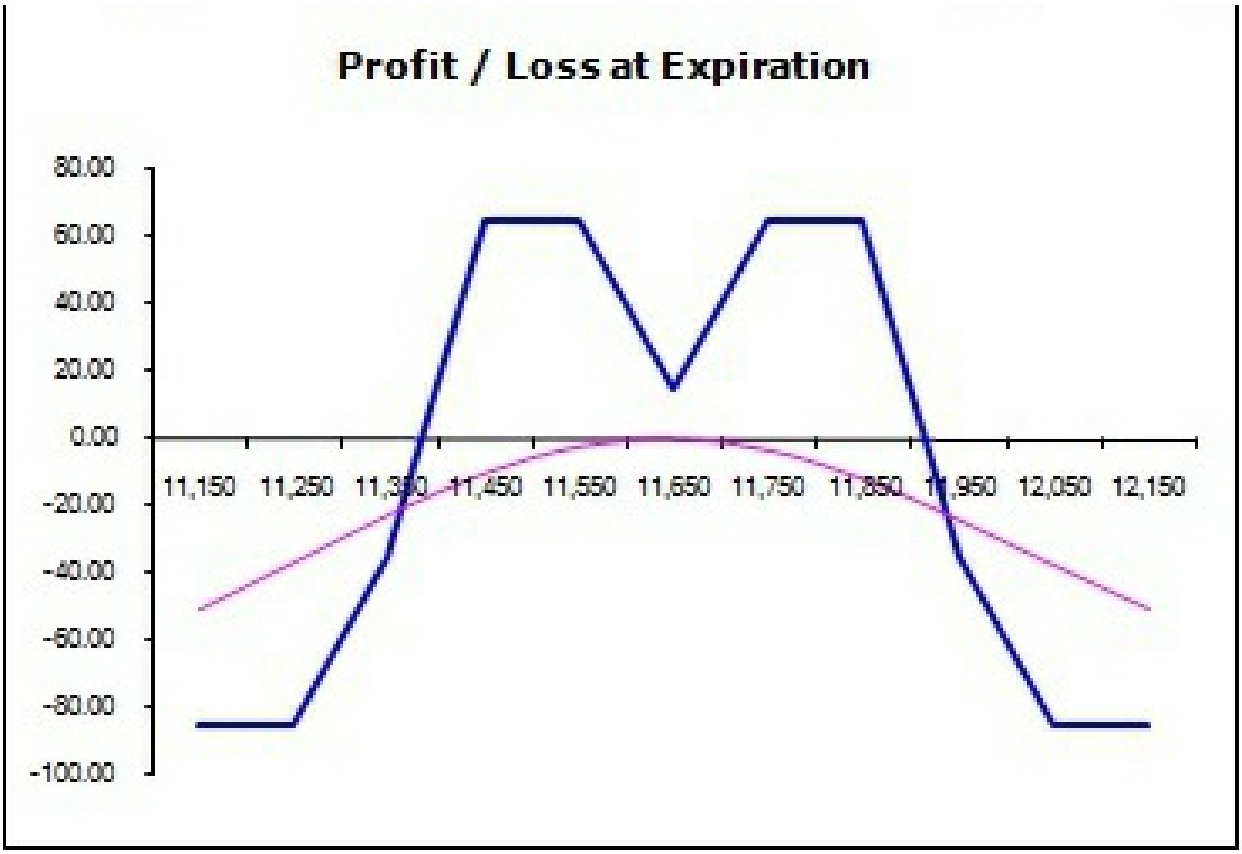
In the above position I will lose money If Index close at 11650 on expiry. To avoid this loss a trader can buy –

- Call butterfly with 1 call strike 11600, sold 2 calls strike 11800 and bought 1 call strike 12000.

- Put butterfly with 1 put strike 11700, sold 2 calls strike 11500 and bought 1 call strike 11300.

	Strat1	Strat2	Strat3	Strat4	Strat5	Strat6	Total	
Contracts	1	-2	1	1	-2	1		
Type	c	c	c	p	p	p		
Strike	11600	11800	12000	11700	11500	11300		
Calculated Premium	165.45	73.00	25.85	180.25	94.10	47.90		
Premium Used	165.45	73.00	25.85	180.25	94.10	47.90	85.25	Total Cost
Delta	0.58	-0.69	0.16	-0.54	0.61	-0.13	-0.01	Position Delta
Gamma	0.00	0.00	0.00	0.00	0.00	0.00	0.00	Position Gamma
Theta	-11.79	21.42	-6.92	-9.81	18.01	-5.52	5.40	Position Theta
Vega	5.84	-10.98	3.61	5.93	-10.47	3.15	-2.93	Position Vega
Rho	1.08	-1.29	0.30	-1.06	1.19	-0.25	-0.03	Position Rho

Trader will make money if Index will close in the range of 11385 to 11914. Maximum loss is limited to Rs 85 and maximum profit is limited to Rs 65. Payoff chart of both of the butterfly will be like this.



Usually **Professional traders' trader 2 or more butterflies of different strikes together to keep the risk limited.** I will suggest you to observe the individual butterfly prices first and get familiar with day wise prices then you can observer combined price of 2 or more butterflies of different strikes. You can fetch past data from NSE website with the help of python and you can compute day was strike wise butterfly prices of last 3 years, then you can compare day wise prices (days remains to expiry). We will learn how to fetch past data through Python and compute butterfly prices later on in this book.

IRON BUTTERFLY

Butterflies are constructed using either call options or put options but Iron Butterflies are constructed using call and put options both. In case of long Iron butterfly Call and Put of same strike is sold and Call and Put with lower premium is bought. Basically it is a combination of Bear Call Spread and Bull Put Spread. In case of short Iron Butterfly Call and Put of same strike are bought and Call and Put with lower premium is sold. Basically it is a combination of Bull Call Spread and Bear Put Spread.

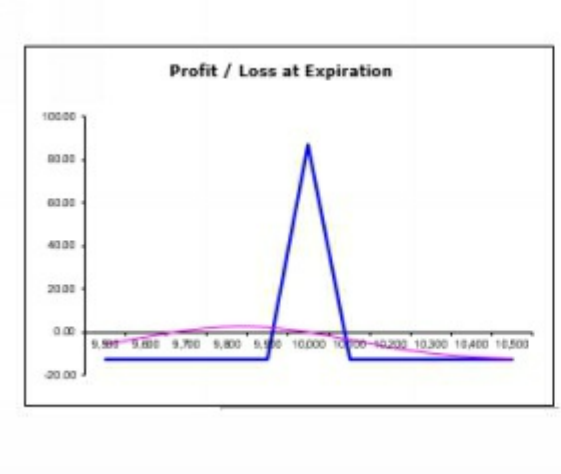
Long Iron Butterfly

Long Iron butterfly constructed using for contracts of 3 strikes, buying the lower strike Put option, selling middle strike Call Put both and buying higher strike Call option.

Example of Long Iron butterfly-

Buy 1 lot Nifty 10100 Call at Rs. 80.85,
Sell 1 lot Nifty 10000 Call at Rs. 129.80,
Sell 1 lot Nifty 10000 Put at Rs. 102.50,
Buy 1 Lot Nifty 9900 Put at Rs. 64.30.

Long Iron butterfly in above example resulting into net credit of Rs. 87.15/-. Middle strike of a long butterfly should be located in the middle of expected trading range. Trader in the given example is expecting a Nifty closing near 10000 on expiry so he sold straddle (Call and put both) of 10000, bought 1 lot of Nifty call strike price 10100 and bought 1 lot of Nifty put strike price 9900. Strike price distance should be equal on both side, i.e., one call trader bought is 100 point out of money and the another put trader bought is 100 point out of money so distance from the middle strike is equal on both side. Value of this butterfly will remain in the range of 0 to 100 irrespective of underlying value (distance among two strikes). Buying butterfly resulted into net credit of Rs 87.15 so the **maximum profit is limited to Rs 87.15/-.** Maximum loss is limited to Rs 12.85/- (Strike interval of 100 minus net credit of Rs 87.15 equals to Rs. 12.85/-). Profit and loss on expiration matrix is given below. Trader will make highest profit if index will expire on 10000. Breakeven point is 9912.85 and 10087.15. If index closed below 9900 or above 10100 than trader will lose Rs. 12.85.



P&L Payoff at Expiration Matrix					
Underlying Price	Buy Put 9900	Sell Put 10000	Sell Call 10000	Buy Call 10100	P&L
9500	335.68	-397.48	129.80	-80.85	-12.85
9600	235.68	-297.48	129.80	-80.85	-12.85
9700	135.68	-197.48	129.80	-80.85	-12.85
9800	35.68	-97.48	129.80	-80.85	-12.85
9900	-64.32	2.52	129.80	-80.85	-12.85
10000	-64.32	102.52	129.80	-80.85	87.15
10100	-64.32	102.52	29.80	-80.85	-12.85
10200	-64.32	102.52	-70.20	19.15	-12.85
10300	-64.32	102.52	-170.20	119.15	-12.85
10400	-64.32	102.52	-270.20	219.15	-12.85
10500	-64.32	102.52	-370.20	319.15	-12.85

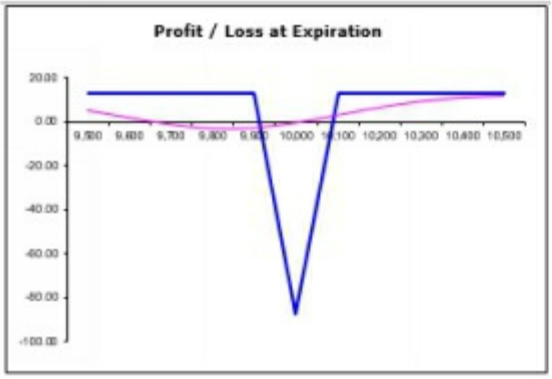
Short Iron Butterfly

Short Iron butterfly constructed using 4 contracts of 3 strikes of fix interval, It is just opposite of Long Iron Butterfly. Basically 1 straddle is bought and 1 strangle is sold.

Example of Short butterfly-

Sell 1 lot Nifty 10100 Call at Rs. 80.85,
Buy 1 lot Nifty 10000 Call at Rs. 129.80,
Buy 1 lot Nifty 10000 Put at Rs. 102.50,
Sell 1 Lot Nifty 9900 Put at Rs. 64.30.

Maximum loss is limited to the premium of Rs 87.15/- paid. Maximum profit is limited to Rs 12.85/- (Strike interval – Premium Paid). Trader will make money if underlying will close above 10100 or below 9900.



P&L Payoff at Expiration Matrix					
Underlying Price	Buy Put 9900	Sell Put 10000	Sell Call 10000	Buy Call 10100	P&L
9500	-335.68	397.48	-129.81	80.85	12.85
9600	-235.68	297.48	-129.81	80.85	12.85
9700	-135.68	197.48	-129.81	80.85	12.85
9800	-35.68	97.48	-129.81	80.85	12.85
9900	64.32	-2.52	-129.81	80.85	12.85
10000	64.32	-102.52	-129.81	80.85	-87.15
10100	64.32	-102.52	-29.81	80.85	12.85
10200	64.32	-102.52	70.19	-19.15	12.85
10300	64.32	-102.52	170.19	-119.15	12.85
10400	64.32	-102.52	270.19	-219.15	12.85
10500	64.32	-102.52	370.19	-319.15	12.85

If you will compare payoffs of Butterfly and iron butterfly you will find that both are similar. Let's take an example. I am again taking closing price of January 2017 as taken in case of example of butterfly for better comparison. Let's compare point by point –

- Nifty is trading at 8187, strike 8200 Iron butterfly is trading at 139. Buyer of strike 8200 butterfly will receive the premium of Rs 139. In case of Iron butterfly value of Iron butterfly will remain in between of zero to 200. So for buyer of butterfly maximum risk is Rs 61 and maximum profit is limited to Rs 139.
- Buyer of 8200 Iron butterfly will make maximum profit if underlying close at 8200 on expiry. Beak even point on upside is 8339 and breakeven point on down side is 8061. So buyer will make money if index will close somewhere between 8061 to 8339.
- In the same way seller of the butter fly will pay the premium of Rs 139. Buyer will have maximum risk of Rs 139, profit will be limited to 61 and he will make money if index closed above 8339 or below 8061. In case of Iron butterfly also you need not to take view on direction that's why it's a direction neutral strategy.

		Nifty Iron Butterfly 200								

Date	Nifty	7900	8000	8100	8200	8300	8400	8500	8600	8700
30-Dec-16	8187	-177	-166	-151	-139	-136	-143	-162	-178	-187
2-Jan-17	8192	-177	-168	-152	-140	-134	-144	-163	-176	-187
3-Jan-17	8197	-177	-168	-151	-139	-138	-143	-158	-173	-183
4-Jan-17	8204	-176	-168	-152	-139	-133	-138	-157	-178	-191
5-Jan-17	8288	-184	-176	-160	-144	-132	-130	-146	-165	-182
6-Jan-17	8268	-182	-172	-157	-136	-127	-130	-150	-171	-185
9-Jan-17	8250	-184	-170	-151	-133	-124	-133	-154	-172	-190
10-Jan-17	8294	-187	-176	-159	-136	-122	-127	-143	-165	-187
11-Jan-17	8387	-195	-187	-176	-155	-131	-117	-122	-148	-176
12-Jan-17	8418	-196	-191	-183	-164	-139	-118	-113	-133	-169
13-Jan-17	8418	-202	-193	-180	-165	-136	-109	-108	-140	-176
16-Jan-17	8432	-198	-198	-187	-168	-139	-107	-101	-132	-172
17-Jan-17	8409	-199	-192	-182	-161	-128	-100	-109	-145	-182
18-Jan-17	8429	-201	-194	-184	-167	-134	-99	-96	-135	-177
19-Jan-										

17	8443	-199	-198	-190	-171	-136	-96	-90	-131	-179
20-Jan-17	8363	-194	-192	-181	-147	-100	-84	-121	-171	-193
23-Jan-17	8402	-199	-201	-195	-168	-113	-63	-92	-161	-188
24-Jan-17	8481	-199	-199	-199	-195	-168	-91	-45	-107	-181
25-Jan-17	8599	-198	-199	-201	-203	-204	-198	-95	0	-85

We observed that results on buy and selling of butterfly and Iron butterfly are similar. Trader may compare the price of butterfly and Iron butterfly before taking position and they can take position with the cheaper one. For example Iron butterfly strike 8400 is costing Rs 57 on 30th December 2016 whereas butterfly is costing only 51 so better to take position with butterfly. In liquid product I doubt there will be much difference in both.

Greeks – Greeks of iron butterfly are identical to the butterfly as we learned in previous example. Greeks will depend on position of butterfly. Delta of long iron butterfly above ATM will be negative and below ATM will be positive. Theta of long iron butterfly will be positive if underlying is trading among both wings (8000 to 8400). Vega long iron butterfly will be negative if underlying is trading among both wings.

CONDOR

Long Condor

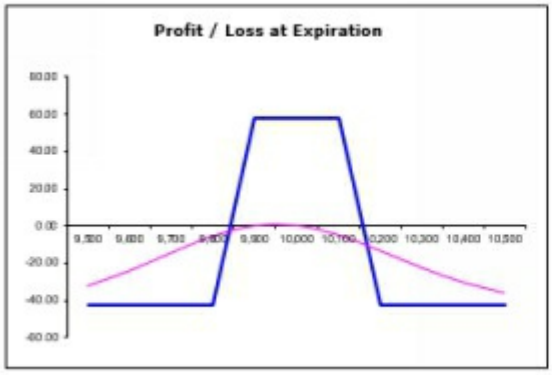
Butterfly is combination of 2 vertical spreads that share the middle strike but in case of condor these vertical spreads don't share the central strike. In case of butterfly highest profit is when underlying close at middle strike profit will be less if underlying close below or above the central strike but in case of condor this range of highest profit is wider. In case of Condor also risk reward both are limited like butterfly.

Example of Long Call Condor-

Buy 1 lot Nifty 9800 Call at Rs. 270.30,
Sell 1 lot Nifty 9900 Call at Rs. 193.55,
Sell 1 lot Nifty 10100 Call at Rs. 80.85,
Buy 1 Lot Nifty 10200 Call at Rs. 46.40.

Breakeven on downside 9842.30 and on upside 10157.70
Premium paid 42.30
Maximum profit is limited to Rs 57.70
Maximum loss – 42.30

Profit and loss on expiration matrix is given below-



P&L Payoff at Expiration Matrix					
Underlying Price	Buy Put 9800	Sell Put 9900	Sell Call 10100	Buy Call 10200	P&L
9500	-270.3	193.5	80.9	-46.4	-42.3
9600	-270.3	193.5	80.9	-46.4	-42.3
9700	-270.3	193.5	80.9	-46.4	-42.3
9800	-270.3	193.5	80.9	-46.4	-42.3
9900	-170.3	193.5	80.9	-46.4	57.7
10000	-70.3	93.5	80.9	-46.4	57.7
10100	29.7	-6.5	80.9	-46.4	57.7
10200	129.7	-106.5	-19.1	-46.4	-42.3
10300	229.7	-206.5	-119.1	53.6	-42.3
10400	329.7	-306.5	-219.1	153.6	-42.3
10500	429.7	-406.5	-319.1	253.6	-42.3

Long Call Condor in above example resulting into net debit of Rs. 42.30/-. Trader in the given example is expecting a Nifty closing in range of 9900 to 10100 on expiry so he bought 1 condor (Bought 1 lot of Nifty call strike price 9800, sold 1 lot Nifty call strike 9900, sold 1 strike Nifty call 10100 and bought 1 lot of Nifty call strike price 10200). Buying condor resulted into net debit of 42.30 so the **maximum loss is limited to Rs 42.30/-.** Maximum profit is limited to Rs 57.70/-. Trader will make profit if index will expire in a range of 9900 to 10100.

Short Condor

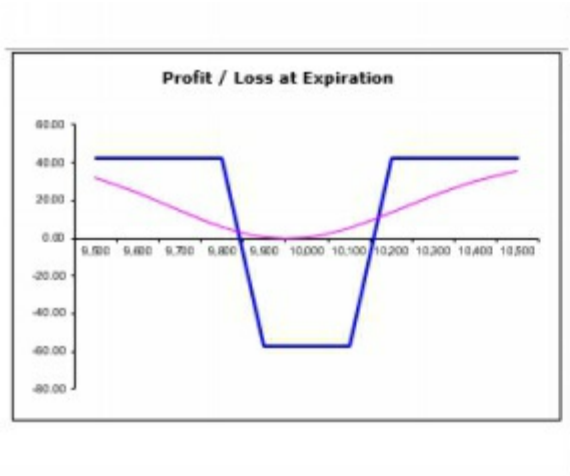
It is just opposite long condor.

Example of Short Call Condor-

Sell 1 lot Nifty 9800 Call at Rs. 270.30,
Buy 1 lot Nifty 9900 Call at Rs. 193.55,
Buy 1 lot Nifty 10100 Call at Rs. 80.85,
Sell 1 Lot Nifty 10200 Call at Rs. 46.40.

Breakeven 9842.30 and 10157.70
Received Premium of Rs 42.30/-
Maximum profit is limited to 42.30/-
Maximum loss is limited to 57.70/-

Trader will make money if Nifty close below 9842/- or it's close above 10157/-.



P&L Payoff at Expiration Matrix					
Underlying Price	Buy Put 9800	Sell Put 9900	Sell Call 10100	Buy Call 10200	P&L
9500	270.3	-193.5	-80.9	46.4	42.3
9600	270.3	-193.5	-80.9	46.4	42.3
9700	270.3	-193.5	-80.9	46.4	42.3
9800	270.3	-193.5	-80.9	46.4	42.3
9900	170.3	-193.5	-80.9	46.4	-57.7
10000	70.3	-93.5	-80.9	46.4	-57.7
10100	-29.7	6.5	-80.9	46.4	-57.7
10200	-129.7	106.5	19.1	46.4	42.3
10300	-229.7	206.5	119.1	-53.6	42.3
10400	-329.7	306.5	219.1	-153.6	42.3
10500	-429.7	406.5	319.1	-253.6	42.3

Let's take an example with past data. I am again taking closing price of January 2017 as taken in case of example of butterfly and Iron Butterfly for better comparison. First column is date, second column is closing price of Nifty and third column is Condor price of Strike 8000 computed from closing price of Option. On 30th December Nifty 100 point condor of 8000 was trading at Rs 24/- (Computed from closing price of strikes Buy 7800 Call, Sell 7900 call, Sell 8100 call buy 8200 Call). In the same way 8100 condor price computed from closing price of strikes Buy 7900 Call, Sell 8000 call, Sell 8200 call buy 8300 Call. Now again let's compare point by point –

- Nifty is trading at 8187, strike 8200 condor is trading at Rs 43. Buyer of strike 8200 condor will pay the premium of Rs 43. The value of this condor can go maximum upto Rs 100. So for buyer of Condor maximum risk is Rs 43 and maximum profit is limited to Rs 57.
- Buyer of 8200 Condor will make profit of Rs 57 if underlying close at any point in the range of 8100 to 8300 on expiry. Beak even point on upside is 8357 and breakeven point on down side is 8043. So buyer will make money if index will close somewhere between

8043 to 8357.

- In the same way seller of the butter fly will receive the premium of Rs 43. Seller will have maximum risk of Rs 57, profit will be limited to 43 and he will make money if index closed above 8357 or below 8043. In case of Condor also you need not to take view on direction that's why it's a direction neutral strategy.

		Nifty Condor							
Date	Nifty	8000	8100	8200	8300	8400	8500	8600	8700
30-Dec-16	8187	24	35	43	45	37	27	15	8
2-Jan-17	8192	21	35	44	45	38	27	15	8
3-Jan-17	8197	26	35	46	44	37	27	16	8
4-Jan-17	8204	25	33	44	47	40	29	16	8
5-Jan-17	8288	18	29	41	48	46	39	25	13
6-Jan-17	8268	20	35	42	53	45	34	20	10
9-Jan-17	8250	21	37	48	52	46	32	18	7
10-Jan-17	8294	13	34	45	55	51	39	23	10
11-Jan-17	8387	5	20	33	49	58	53	37	19
12-Jan-17	8418	1	15	27	46	60	59	45	24
13-Jan-17	8418	10	13	32	45	65	63	44	20
16-Jan-17	8432	0	11	25	48	64	68	47	22
17-									

Jan-17	8409	4	16	30	54	70	64	39	15
18-Jan-17	8429	4	11	26	47	71	70	45	18
19-Jan-17	8443	2	8	23	48	74	73	49	17
20-Jan-17	8363	7	14	39	72	79	55	23	5
23-Jan-17	8402	-4	9	24	70	88	74	33	4
24-Jan-17	8481	-2	0	4	28	83	95	72	16
25-Jan-17	8599	8	-4	-1	-4	7	101	103	95

Greeks –

Similar to the long butterfly, the delta of the long condor is positive when the underlying is below the middle strike, negative when the underlying is above the middle strike, and approximately neutral when the underlying is trading at middle strike. As expiration approaches, the delta of the long butterfly becomes much more sensitive to changes in the underlying price. The position condor will be short Vega when the underlying price is near to the middle strike and will reverse to being long vega when the underlying price is near the long wing strikes. Like the long butterfly, the long condor will have positive theta when the underlying price is near to middle strikes and will reverse to having negative theta when the underlying price is near the long wing strikes.

IRON CONDOR

Condor constructed using either call options or put options but Iron Condor constructed using call and put options both.

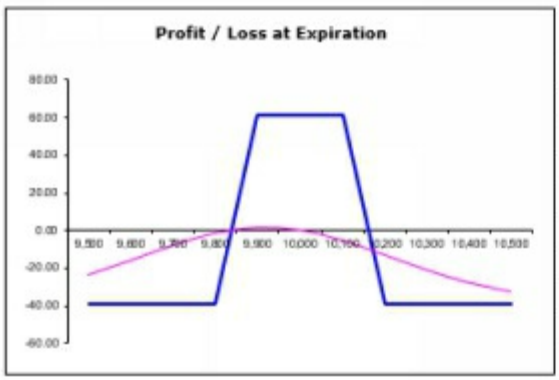
Long Iron Condor

In case of long Iron Condor OTM Call and Put are sold and Call and Put with lower premium is bought. Basically one strangle with higher premium is sold and one straddle of lower premium is bought. Long Iron condor constructed using contracts of 4 strikes, In the given example Nifty is trading at 10000. Trader is selling 1 lot of strike 9900 Put, buying 1 lot of strike 9800 Put, selling 1 lot of 10100 Call and buying 1 lot of strike 10200 call. Trader is receiving the premium of Rs 61. If underlying will expire in the range of 9839 to 10161 trader will make money. Maximum profit is limited to Rs 61. If underlying will close above 101061 or below 9839 trader will lose money. Maximum loss is limited to Rs 39.

Example of Short Call Condor-

Buy 1 lot Nifty 9800 Put at Rs. 37.55,
Sell 1 lot Nifty 9900 Put at Rs. 64.30,
Sell 1 lot Nifty 10100 Call at Rs. 80.85,
Buy 1 Lot Nifty 10200 Call at Rs. 46.40.

Breakeven – 9839 on downside and 10161on upside.
Received premium of Rs 61/-.
Maximum profit is limited to Rs 61/-.
Maximum loss is limited to Rs 39/-



P&L Payoff at Expiration Matrix					
Underlying Price	Buy Put 9800	Sell Put 9900	Sell Call 10100	Buy Call 10200	P&L
9500	262.5	-335.7	80.9	-46.4	-38.8
9600	162.5	-235.7	80.9	-46.4	-38.8
9700	62.5	-135.7	80.9	-46.4	-38.8
9800	-37.5	-35.7	80.9	-46.4	-38.8
9900	-37.5	64.3	80.9	-46.4	61.2
10000	-37.5	64.3	80.9	-46.4	61.2
10100	-37.5	64.3	80.9	-46.4	61.2
10200	-37.5	64.3	-19.1	-46.4	-38.8
10300	-37.5	64.3	-119.1	53.6	-38.8
10400	-37.5	64.3	-219.1	153.6	-38.8
10500	-37.5	64.3	-319.1	253.6	-38.8

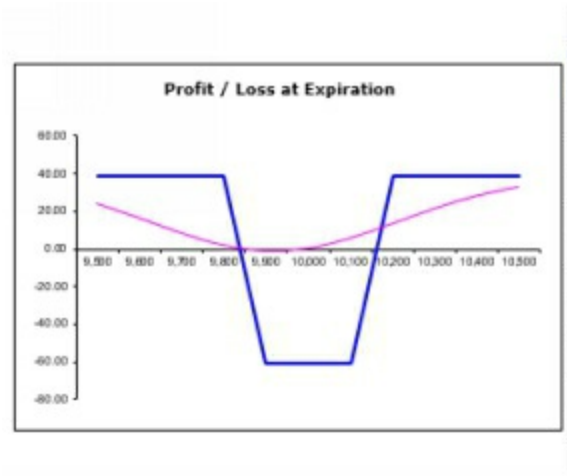
Short Iron Condor

In case of short Iron Condor OTM Call and Put are bought and Call and Put with lower premium are sold. Basically one strangle with higher premium is bought and one straddle of lower premium is sold. Long Iron condor constructed using contracts of 4 strikes, In the given example Nifty is trading at 10000. Trader is buying 1 lot of strike 9900 Put, selling 1 lot of strike 9800 Put, buying 1 lot of 10100 Call and selling 1 lot of strike 10200 call. Trader will pay the premium of Rs 61. If underlying will expire in the range of 9839 to 10161 trader will lose money. Maximum loss is limited to Rs 39. If underlying will close above 101061 or below 9839 trader will make money. Maximum profit is limited to Rs 61.

Example of Short Call Condor-

Sell 1 lot Nifty 9800 Put at Rs. 37.55,
Buy 1 lot Nifty 9900 Put at Rs. 64.30,
Buy 1 lot Nifty 10100 Call at Rs. 80.85,
Sell 1 Lot Nifty 10200 Call at Rs. 46.40.

Breakeven 9838.80 and 10161.20
Premium paid of Rs 61/-
Maximum profit is limited to Rs 39/-
Maximum loss is limited to Rs 61/-



P&L Payoff at Expiration Matrix					
Underlying Price	Buy Put 9800	Sell Put 9900	Sell Call 10100	Buy Call 10200	P&L
9500	-262.5	335.7	-80.9	46.4	38.8
9600	-162.5	235.7	-80.9	46.4	38.8
9700	-62.5	135.7	-80.9	46.4	38.8
9800	37.5	35.7	-80.9	46.4	38.8
9900	37.5	-64.3	-80.9	46.4	-61.2
10000	37.5	-64.3	-80.9	46.4	-61.2
10100	37.5	-64.3	-80.9	46.4	-61.2
10200	37.5	-64.3	19.1	46.4	38.8
10300	37.5	-64.3	119.1	-53.6	38.8
10400	37.5	-64.3	219.1	-153.6	38.8
10500	37.5	-64.3	319.1	-253.6	38.8

If you will compare payoffs of Condor and Iron Condor you will find that both are similar. Let's take an example. I am again taking closing price of January 2017 as taken in case of example of Condor for better comparison. Let's compare point by point –

- Nifty is trading at 8187, strike 8200 Iron condor is trading at 57. Buyer of strike 8200 iron condor will receive the premium of Rs 57. For buyer of Iron Condor maximum risk is Rs 43 and maximum profit is limited to Rs 57.
- Buyer of 8200 Iron condor will make maximum profit if underlying close in range of 8043 to 8357 on expiry. Beak even point on upside is 8357 and breakeven point on down side is 8043.

- In the same way seller of the Iron condor will pay the premium of Rs 57. Seller will have maximum risk of Rs 57, profit will be limited to 43 and he will make money if index closed above 8357 or below 8043. In case of Iron butterfly also you need not to take view on direction that's why it's a direction neutral strategy.

		Nifty Iron Condor 200								
Date	Nifty	8000	8100	8200	8300	8400	8500	8600	8700	8800
30-Dec-16	8187	-74	-64	-57	-54	-60	-70	-85	-91	-95
2-Jan-17	8192	-76	-64	-57	-54	-59	-72	-83	-90	-96
3-Jan-17	8197	-74	-64	-56	-55	-61	-69	-82	-88	-94
4-Jan-17	8204	-75	-65	-55	-52	-57	-67	-83	-92	-98
5-Jan-17	8288	-81	-70	-60	-51	-51	-59	-75	-84	-97
6-Jan-17	8268	-81	-66	-55	-48	-51	-61	-80	-87	-97
9-Jan-17	8250	-77	-64	-52	-46	-51	-67	-81	-88	-101
10-Jan-17	8294	-83	-68	-54	-44	-46	-61	-73	-89	-97
11-Jan-17	8387	-91	-81	-66	-51	-41	-44	-60	-82	-92
12-Jan-17	8418	-94	-86	-71	-55	-41	-38	-52	-74	-94
13-Jan-17	8418	-91	-88	-72	-52	-35	-35	-54	-80	-95
16-Jan-17	8432	-97	-88	-76	-54	-34	-30	-50	-77	-94
17-										

Jan-17	8409	-93	-86	-70	-46	-31	-34	-60	-82	-100
18-Jan-17	8429	-94	-89	-75	-50	-29	-28	-51	-81	-95
19-Jan-17	8443	-98	-92	-77	-52	-25	-24	-49	-80	-98
20-Jan-17	8363	-96	-84	-58	-28	-21	-41	-75	-95	-98
23-Jan-17	8402	-103	-92	-75	-34	-9	-22	-66	-94	-94
24-Jan-17	8481	-100	-99	-96	-72	-17	-3	-25	-81	-100
25-Jan-17	8599	-99	-102	-101	-103	-95	0	0	0	-85

RATIO SPREAD AND BACK SPREAD

Ratio spreads buy one option and sell two or more options with lower premium of the same underlying and expiration. The result is a trade that makes money if there’s a modest move in a particular direction, upward if we’re using a call ratio spread, and downward if we’re using a put ratio spread. Please note that we sold two or more options but bought only one—the trader will losses money if the move is too extreme and the losses can be substantial.

Example of Ratio Spread with CALL OPTIONS of Nifty

Nifty Call Options closing price as on 2nd April 2018 are given below-

Date	Nifty	10400	10500	10600	10700	10800
2-Apr-18	10264.00	80.25	47.25	25.15	12.5	6.2

Nifty is trading at 10264 and trader is expecting upside of 200 to 300 points till expiry. He can buy a Call strike 10400 at Rs 80/-, but if underlying remains below 10400 than trader will lose Rs 80. What we learned in spreads that by selling a lower premium strike trader can bring down the cost. As we learned earlier also if trader opted to sell 10500 along with buying 10400 than cost will bring down to Rs 33 and maximum profit will be limited to 66, this is bull call spread. In case of ratio spread trader sells more than 1 lot of lower premium option. Various options are available based on risk and reward, some of them discussed below –

- **Option 1 -** If trader opted to buy 1 Call 10400 @ Rs. 80.25 and sell 3 calls 10600 @ 25.15. Trader will pay the premium of Rs 4.80. If underlying remains below 10400 loss will be Rs 4.80 only. Breakeven point will be 10400 on lower side and 10700 on up side. Trader will make money if underlying closed in between from 10400 to 10700. Maximum profit will be Rs 200 if underlying closed at 10600 on expiry. If underlying close above 10700 than trader will lose money. Because 1 lot bought and 3 lots sold so trader will lose Rs 200 on every 100 point movement above 10700. This is a very risky strategy. Trader can lose a big amount if there is a sharp movement upside.

- **Option 2 -** If trader opted to buy 1 Call 10500 @ Rs. 47.25 and sell 3 calls 10600 @ 12.5. Trader will pay the premium of Rs 9.75. If underlying remains below 10500 loss will be Rs 9.75 only. Approx Breakeven point will be 10500 on lower side and 10800 on up side. Trader will make money if underlying closed somewhere in between from 10500 to 10800. Maximum profit will be approx Rs 200 if underlying closed at 10700 on expiry. If underlying close above 10800 than trader will lose money. Because 1 lot bought and 3 lots sold so trader will lose Rs 200 on every 100 point movement above 10800. This is a very risky strategy. Trader can lose a big amount if there is a sharp movement upside.

- **Option 3 -** If trader opted to buy 1 Call 10600 @ Rs. 25.15 and sell 3 calls 10800 @ 6.2. Trader will pay the premium of Rs 6.55. If underlying remains below 10600 loss will be Rs 6.65 only. Approx Breakeven point will be 10600 on lower side and 10900 on up side. Trader will make money if underlying closed somewhere in between from 10600 to 10900 on expiry. Maximum profit will be approx Rs 200 if underlying closed at 10800 on expiry. If underlying close above 10900 than trader will lose money. Because 1 lot bought and 3 lots sold so trader will lose Rs 200 on every 100 point movement above 10900. This is a very risky strategy. Trader can lose a big amount if there is a sharp movement upside.

- **Option 4 -** If trader opted to buy 1 Call 10700 @ Rs. 12.5 and sell 3 calls 10800 @ 6.2.

Trader will earn the premium of Rs 6.10. Approx Breakeven point will be 10850 on up side. Trader will make money if underlying closed below 10850. Maximum profit will be approx Rs 100 if underlying closed at 10800 on expiry. If underlying close above 10850 than only trader will lose money. Because 1 lot bought and 3 lots sold so trader will lose Rs 200 on every 100 point movement above 10900. This is a very risky strategy. Trader can lose a big amount if there is a sharp movement upside.

P&L Payoff Matrix at Expiration				
	Option 1	Option 2	Option 3	Option 4
Underlying Price on expiry	Buy 1 lot 10400 Sell 3 lot 10600	Buy 1 lot 10500 Sell 3 lot 10700	Buy 1 lot 10600 Sell 3 lot 10800	Buy 1 lot 10700 Sell 3 lot 10800
10,300	-4.8	-9.75	-6.55	6.1
10,400	-4.8	-9.75	-6.55	6.1
10,500	95.2	-9.75	-6.55	6.1
10,600	195.2	90.25	-6.55	6.1
10,700	-4.8	190.25	93.45	6.1
10,800	-204.8	-9.75	193.45	106.1
10,900	-404.8	-209.75	-6.55	-93.9
11,000	-604.8	-409.75	-206.55	-293.9
11,100	-804.8	-609.75	-406.55	-493.9
11,200	-1004.8	-809.75	-606.55	-693.9
11,300	-1204.8	-1009.75	-806.55	-893.9

I the following table I have taken closing prices of Nifty future and options of April 2018. Last 4 columns are the prices of each strategy discussed above. Strategy of option 1 will result into a debit of Rs 4.8 on 2-April-2018 (Buy 1 lot 10400 Call and sell 2 lot 10600 call as discussed above). On 3rd April this price increased from Rs 4.8 to Rs 6.8, it means trader earned Rs 2/-. On 10th April this was trading at Rs 15.75, so trader will earn approx Rs 11/- if he will cover the positions (Sell 1 lot of 10400 and buy 2 lots of 10600). In the same way every day price of all 4 strategies discussed above are computed in below table.

		Call Strike prices						Opt 1	Opt 2	Opt
Date	Index	10400	10500	10600	10700	10800		10400-10600	10500-10700	106 108
2-Apr-18	10264.00	80.25	47.25	25.15	12.5	6.2		4.8	9.75	6.55
3-Apr-18	10285.00	85.25	49.45	26.15	12.6	6.1		6.8	11.65	7.85
4-Apr-										

18	10146.60	48.1	27.45	14.65	7.25	4.15		4.15	5.7	2.2
5-Apr-18	10352.20	103.75	60.4	31.85	15.05	7		8.2	15.25	10.8
6-Apr-18	10352.85	101	57.8	29.9	13.8	6.65		11.3	16.4	9.95
9-Apr-18	10393.90	115.55	67.55	35.5	16.15	7.3		9.05	19.1	13.6
10-Apr-18	10421.50	123	70.65	35.75	15.9	7.35		15.75	22.95	13.7
11-Apr-18	10425.00	120.2	67.7	33.45	15	6.8		19.85	22.7	13.0
12-Apr-18	10465.00	139.1	80.55	39.85	17.5	7.15		19.55	28.05	18.4
13-Apr-18	10490.40	146.75	84.1	40.7	16.4	6.7		24.65	34.9	20.6
16-Apr-18	10542.90	176.45	103.15	51.1	20.3	7.2		23.15	42.25	29.5
17-Apr-18	10551.20	178.15	103.3	48.2	18	6.1		33.55	49.3	29.9
18-Apr-18	10538.85	164.35	91.7	39.8	12.65	4.2		44.95	53.75	27.2
19-Apr-18	10578.10	192.3	111	48.2	14.05	3.55		47.7	68.85	37.5
20-Apr-18	10585.50	187.7	101.65	39.05	9	2		70.55	74.65	33.0
23-Apr-18	10585.45	187.75	99.4	34.65	6.6	1.45		83.8	79.6	30.3
24-Apr-18	10617.90	216.85	120.5	44.25	8.2	1.3		84.1	95.9	40.3
25-Apr-										

18	10569.05	169.2	77.1	16.3	1.9	0.55		120.3	71.4	14.6
26-Apr-18	10612.20	202.25	100.7	8.55	0.05	0.05		176.6	100.55	8.4

Greeks – If you will notice from the below table theta is Positive and Vega negative. It means trader will earn time value with every passing day. Decrease in volatility will be profitable for trader.

Underlying Price	Buy 1 lot 10400 Sell 3 lot 10600				Buy 1 lot 10500 Sell 3 lot 10700			
	25 Days to expiry				25 Days to expiry			
	Delta	Gamma	Theta	Vega	Delta	Gamma	Theta	Vega
10,000	0.02	-0.0001	0.08	-0.53	0.02	0.0000	-0.11	0.34
10,100	0.00	-0.0004	0.63	-2.87	0.02	-0.0001	0.11	-0.67
10,200	-0.06	-0.0009	1.65	-6.96	0.00	-0.0004	0.69	-3.09
10,300	-0.18	-0.0016	3.11	-12.49	-0.07	-0.0009	1.73	-7.25
10,400	-0.37	-0.0023	4.77	-18.34	-0.19	-0.0016	3.19	-12.79
10,500	-0.63	-0.0028	6.29	-22.92	-0.38	-0.0022	4.85	-18.60
10,600	-0.92	-0.0029	7.31	-24.90	-0.63	-0.0027	6.36	-23.14
10,700	-1.20	-0.0028	7.66	-23.83	-0.92	-0.0029	7.37	-25.10
10,800	-1.46	-0.0023	7.40	-20.26	-1.20	-0.0027	7.73	-24.04
10,900	-1.66	-0.0017	6.75	-15.41	-1.45	-0.0023	7.47	-20.50
11,000	-1.80	-0.0012	5.98	-10.55	-1.66	-0.0017	6.83	-15.68
Underlying Price	Buy 1 lot 10600 Sell 3 lot 10800				Buy 1 lot 10700 Sell 3 lot 10800			
	25 Days to expiry				25 Days to expiry			
	Delta	Gamma	Theta	Vega	Delta	Gamma	Theta	Vega
10,000	0.01	0.0001	-0.14	0.51	0.00	-0.0001	0.10	-0.41
10,100	0.02	0.0000	-0.10	0.28	-0.01	-0.0002	0.28	-1.16
10,200	0.02	-0.0001	0.14	-0.81	-0.04	-0.0003	0.67	-2.72
10,300	-0.01	-0.0004	0.74	-3.31	-0.09	-0.0007	1.36	-5.42
10,400	-0.07	-0.0009	1.80	-7.53	-0.18	-0.0011	2.41	-9.36
10,500	-0.20	-0.0016	3.27	-13.08	-0.32	-0.0017	3.74	-14.13
10,600	-0.39	-0.0022	4.93	-18.87	-0.52	-0.0022	5.17	-18.80
10,700	-0.64	-0.0027	6.43	-23.35	-0.76	-0.0026	6.41	-22.19

Greeks of the strategy on various times to expiry will be different. We learned Greeks in details, I hope now you can understand the impact of Greek on profit. Currently Index is trading at 10264 so Theta value should be approximately Rs 2.5. If Index remains at same level for next 5 days than trader will earn a profit of approximately Rs 11/- (Why Rs 11/- why not Rs 12.5/- when Theta is Rs 2.5/- because if you will check from table Theta value is coming down with every passing day). You can check the Greeks of any option thru option calculator. You can also calculate the theoretical price of options using

historical volatility.

Buy 1 lot 10400 Sell 3 lot 10600 (combined Greeks of all 4 strikes)								
		Underlying price						
		10,200	10,300	10,400	10,500	10,600	10,700	10,800
25 Days to expiry	Delta	-0.06	-0.18	-0.37	-0.63	-0.92	-1.20	-1.46
	Gamma	-0.0009	-0.0016	-0.0023	-0.0028	-0.0029	-0.0028	-0.0023
	Theta	1.65	3.11	4.77	6.29	7.31	7.66	7.40
	Vega	-6.96	-12.49	-18.34	-22.92	-24.90	-23.83	-20.26
20 Days to expiry	Delta	0.00	-0.10	-0.28	-0.55	-0.88	-1.20	-1.49
	Gamma	-0.0006	-0.0014	-0.0023	-0.0031	-0.0034	-0.0031	-0.0025
	Theta	1.04	2.64	4.70	6.68	8.01	8.37	7.89
	Vega	-3.78	-8.92	-15.07	-20.29	-22.72	-21.61	-17.72
15 Days to expiry	Delta	0.06	0.01	-0.16	-0.45	-0.83	-1.22	-1.54
	Gamma	-0.0002	-0.0010	-0.0023	-0.0035	-0.0040	-0.0037	-0.0028
	Theta	0.15	1.81	4.43	7.22	9.09	9.43	8.49
	Vega	-0.73	-4.96	-11.23	-17.24	-20.24	-19.00	-14.61
10 Days to expiry	Delta	0.10	0.12	0.02	-0.29	-0.76	-1.25	-1.63
	Gamma	0.0005	-0.0002	-0.0020	-0.0041	-0.0051	-0.0045	-0.0030
	Theta	-1.04	0.18	3.56	8.01	11.05	11.15	9.11
	Vega	1.54	-0.77	-6.52	-13.50	-17.29	-15.65	-10.51
5 Days to expiry	Delta	0.07	0.20	0.29	0.03	-0.66	-1.38	-1.81
	Gamma	0.0010	0.0015	-0.0004	-0.0050	-0.0079	-0.0060	-0.0026
	Theta	-1.80	-3.05	0.13	9.17	16.01	14.30	8.79
	Vega	1.51	2.41	-0.64	-8.38	-13.33	-10.43	-4.62

Example of Ratio Spread with PUT OPTIONS of Nifty

Nifty Put Options closing price as on 1st October 2018 are given below-

		Option Strike					
Date	Nifty	10100	10200	10300	10400	10500	10600
1-Oct-18	11061.80	18.2	23.1	29.95	37.9	49.95	62.8

Currently Nifty is trading at 11061 and trader is expecting downside of 400 to 600 points till expiry. In case of ratio spread trader sells more than 1 lot of lower premium option. Various options are available based on risk and reward, some of them discussed below –

- **Option 1 -** If trader opted to buy 1 Put 10600 @ Rs. 62.80 and sell 2 lot Put 10400 @ 37.90. Trader will receive the premium of Rs 13. If underlying remains above 10600 profit will be Rs 13/-. Breakeven point will be 10187/-. Maximum profit will be Rs 213 if underlying closed at 10400 on expiry. If underlying close below 10187/- than trader will lose money. Because 1 lot bought and 2 lots sold so trader will lose Rs 100 on every 100 point below 10187. This is a very risky strategy. Trader can lose a big amount if there is a sharp movement downside.

- **Option 2 -** If trader opted to buy 1 Put 10500 @ Rs. 49.95 and sell 2 Put 10300 @ 29.95. Trader will receive the premium of Rs 9.95. If underlying remains above 10500 trader will make a profit of Rs 9.75. Breakeven point will be 10090. Trader will make money if underlying closed above 10090. Maximum profit will be approx Rs 210 if underlying closed at 10300 on expiry. If underlying close below 10090 than trader will lose money. Because 1 lot bought and 2 lots sold so trader will lose Rs 1 on every 1 point below 10090 on expiry. This is a very risky strategy. Trader can lose a big amount if there is a sharp movement downside.

- **Option 3 -** If trader opted to buy 1 Put 10600 @ Rs. 63.80 and sell 3 put 10200 @ 23.1/-. Trader will receive the premium of Rs 6.50/-. If underlying remains above 10600 profit will be Rs 6.50/- only. Breakeven point will be 9996, Trader will make money if underlying close above 9996 on expiry. Maximum profit will be approx Rs 400 if underlying closed at 101200 on expiry. Because 1 lot bought and 3 lots sold so trader will lose Rs 200 on every 100 point movement below 9996. This is a very risky strategy. Trader can lose a big amount if there is a sharp movement downside.

- **Option 4 -** If trader opted to buy 1 Put 10500 @ Rs. 49.95 and sell 3 put 10100 @ 18.2. Trader will receive the premium of Rs 4.65. If underlying remains 10500 profit will be Rs 4.65 only. Breakeven point will be 9897, Trader will make money if underlying close above 9897 on expiry. Maximum profit will be approx Rs 400 if underlying closed at 10100 on expiry. Because 1 lot bought and 3 lots sold so trader will lose Rs 200 on every 100 point movement below 9897. This is a very risky strategy. Trader can lose a big amount if there is a sharp movement downside.

P&L Payoff Matrix at Expiration				
	Option 1	Option 2	Option 3	Option 4
Underlying Price	10600	10500	10600	10500
	10400	10300	10200	10100
9,800	-387	-290.05	-393.5	-195.35
9,900	-287	-190.05	-193.5	4.65
10,000	-187	-90.05	6.5	204.65
10,100	-87	9.95	206.5	404.65
10,200	13	109.95	406.5	304.65
10,300	113	209.95	306.5	204.65
10,400	213	109.95	206.5	104.65
10,500	113	9.95	106.5	4.65
10,600	13	9.95	6.5	4.65
10,700	13	9.95	6.5	4.65
10,800	13	9.95	6.5	4.65

I have taken closing prices of Nifty future and Nifty Put options for the month of October 2018. Computation of prices of each strategy discussed is given in last 4 columns.

		Option Strike prices							Opt.1	Opt.2
Date	Nifty	10100	10200	10300	10400	10500	10600		10600 -10400	10500 -10300
1-Oct-18	11062	18.2	23.1	29.95	37.9	49.95	62.8		-13	-9.95
3-Oct-18	10894	27.8	36.4	47.85	61.8	79.9	100.6		-23	-15.8
4-										

Oct-18	10631	59.6	76.1	98.05	123.2	154.6	194.1		-52.2	-41.55
5-Oct-18	10347	112.1	135.6	171.7	208	261.4	324.5		-91.55	-81.95
8-Oct-18	10379	90.8	114.9	144	180.4	229.8	286.1		-74.6	-58.2
9-Oct-18	10314	98.85	126	162	207.8	264.5	330.7		-84.8	-59.45
10-Oct-18	10466	48.2	65.1	87.55	118.2	157	209.7		-26.75	-18.1
11-Oct-18	10252	110.1	143.4	184.1	233	297.1	373.5		-92.55	-71
12-Oct-18	10487	39.6	53.45	72.9	101.4	139.5	191.8		-10.95	-6.35
15-Oct-18	10517	29.4	41.4	59.45	84.9	119.6	168.4		-1.4	0.65
16-Oct-18	10590	13.1	19.9	30.8	48.3	75.2	114.4		17.8	13.6
17-Oct-18	10444	20.55	32.9	50.75	81	125.2	187.5		25.5	23.7
19-Oct-18	10303	37.3	59.35	93.3	145	212.9	298.5		8.6	26.25
22-Oct-18	10232	44.35	75.25	121.4	188.1	273	368		-8.15	30.15
23-Oct-18	10148	53.7	100.4	167.1	248.8	358.4	444.7		-52.9	24.3
24-Oct-18	10229	13.8	36.95	90.55	166.2	265	371.4		38.95	83.9
25-Oct-18	10121	2.75	69.45	171.5	265.3	373.2	475.2		-55.35	30.25

Greeks – Greeks of ratio spread of put options will be similar to call options ratio spread as discussed earlier. Theta will be Positive and Vega will be negative. Increase in volatility will have an adverse impact on profitability.

Full time professional traders trade deep out of money contracts with ratio strategy. They usually buy 1 lot of 400 points OTM call option of Nifty and sell 3 lots of either 500 or 600 points OTM strikes depneds on IVs. They shift positions with underlying. They receive net premium and earn Theta loss and IV drop. What they do on call side at 400 points difference the same they do Put side on 600 point difference. This is very risky strategy. Retail investors should avoid. Usually trders do not hold position for a long.

Ratio Back Spread

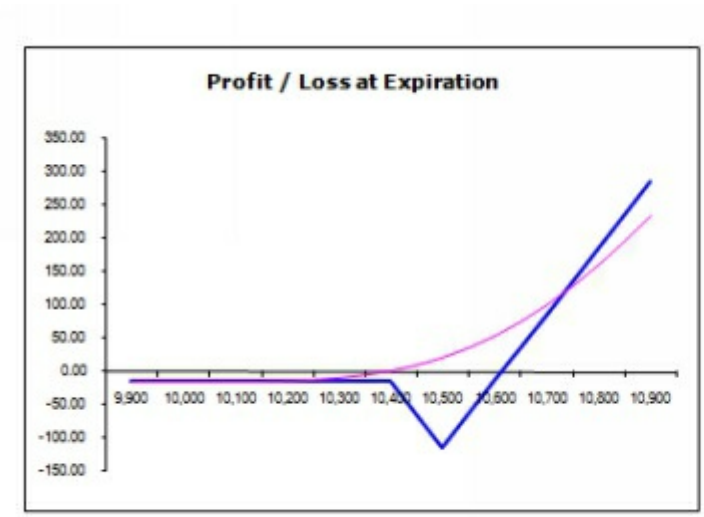
Back spread sell one option and buy two or more options with lower premium of the same underlying and expiration. A back spread is a trade that requires a substantial move, upward for a call back spread and downward for a put back spread. If the underlying moves only a little, even though it moves in our desired direction, then a back spread can lose money.

Example of Ratio Back Spread -

Nifty Call Options closing price as on 2nd April 2018 are given below-

Date	Nifty	10400	10500	10600	10700	10800
2-Apr-18	10264.00	80.25	47.25	25.15	12.5	6.2

Currently Nifty is trading at 10264 and trader is expecting a big upside. He can sell a Call strike 10400 at Rs 80/- along with buying 2 lot at Rs 47.25. So trader is paying a premium of Rs 14.25/-. Breakeven point of this strategy will be 10614. Trader will lose 14.25 if underlying will close below the strike of 10400 sold. Loss will start increase from 10400 to 10500. Trader will have highest loss at 10500 (strike at which options bought). Trader will make money If underlying will close above 10614. Because 1 option sold and 2 option bought trader will make a profit of Rs 1 on every Rs 1 increase in underlying price above 10614.



P&L Payoff at Expiration Matrix			
Underlying Price	Sell Call 10400	Buy Calls 10500	Net P&L
9,900	80.25	-94.50	-14.25
10,000	80.25	-94.50	-14.25
10,100	80.25	-94.50	-14.25
10,200	80.25	-94.50	-14.25
10,300	80.25	-94.50	-14.25
10,400	80.25	-94.50	-14.25
10,500	-19.75	-94.50	-114.25
10,600	-119.75	105.50	-14.25
10,700	-219.75	305.50	85.75
10,800	-319.75	505.50	185.75
10,900	-419.75	705.50	285.75

I have taken closing prices of Nifty future and Nifty Call options strike 10400 and 10500. Last column is computation of prices of Ratio back spread (sells one lot call option strike 10400 and buy 2 lot call option strike 10500).

Date	Nifty	Call Strik 10400	Call Strike 10500		Ratio Back Spread (Sell 10400 Buy 2 lot 10500)
2-Apr-18	10264.00	80.25	47.25		14.25

3-Apr-18	10285.00	85.25	49.45		13.65
4-Apr-18	10146.60	48.1	27.45		6.8
5-Apr-18	10352.20	103.75	60.4		17.05
6-Apr-18	10352.85	101	57.8		14.6
9-Apr-18	10393.90	115.55	67.55		19.55
10-Apr-18	10421.50	123	70.65		18.3
11-Apr-18	10425.00	120.2	67.7		15.2
12-Apr-18	10465.00	139.1	80.55		22
13-Apr-18	10490.40	146.75	84.1		21.45
16-Apr-18	10542.90	176.45	103.15		29.85
17-Apr-18	10551.20	178.15	103.3		28.45
18-Apr-18	10538.85	164.35	91.7		19.05
19-Apr-18	10578.10	192.3	111		29.7
20-Apr-18	10585.50	187.7	101.65		15.6
23-Apr-18	10585.45	187.75	99.4		11.05
24-Apr-18	10617.90	216.85	120.5		24.15
25-Apr-18	10569.05	169.2	77.1		-15
26-Apr-18	10612.20	202.25	100.7		-0.85

CONVERSION / REVERSAL

The put–call parity is a relation between the call option price, the put option price, the stock price and the strike price of the call and put option of same strike and same expiry. Profit and the loss from the long call/short put position are exactly the same as those from the long stock position. The two options create a synthetic long stock position with the same risk/reward profile of the long stock.

A conversion is a three legged combination made up of a long position in the underlying stock and a synthetic short position in the stock made up of a long put and short call, both with the same strike price and expiration date. Computation of Profit when the conversion is done:
Profit = Strike Price of Call/Put - Purchase Price of Underlying + Call Premium - Put Premium

A reversal is the opposite of a conversion. A reversal is a three legged combination made up of a short position in the underlying stock and a synthetic long position in the stock made up of a long call and short put, both with the same strike price and expiration date. Computation of Profit when the reversal is done:
Profit = Sale Price of Underlying - Strike Price of Call/Put + Put Premium - Call Premium

A long put can be synthetically created by shorting stock and purchasing a call. Adding the long call to a short stock position limits your risk to the upside because you can exercise the long call to close out your short position before expiration no matter how high the stock may climb. On the downside, your short stock position will produce a profit once you have recovered the costs of adding the long call. We can also create a synthetic long call position using stocks and puts because each component can be synthetically created by a combination of the other two. Two or more trading vehicles packaged together to emulate another trading vehicle. Some examples:

1. long call = long put + long underlying
2. short call = short put + short underlying
3. long put = long call + short underlying
4. short put = short call + long underlying
5. long underlying = long call + short put
6. short underlying= short call + long put

BOX

It is important to realize that a box-spread arbitrage only works with European options. A box spread is a combination of a bull call spread and a bear put spread with the same two strike prices. The long box is used when the spreads are underpriced in relation to their expiration values.

The strategy is called Box Spread as it is combination of 2 spreads (4 trades) and the profit/loss calculated together as 1 trade. Total cost of the box remain same irrespective to the price of underlying. The expiration value of the box spread is actually the difference between the strike prices of the options involved.

Buy Box – If the market price of the box spread is too low, it is profitable to buy the box.

Buy 1 ITM Call Strike X
Sell 1 OTM Call Strike Y
Buy 1 ITM Put Strike Y
Sell 1 OTM Put Strike X

Expiration Value of Box = Higher Strike Price - Lower Strike Price
Risk-free Profit = Expiration Value of Box - Net Premium Paid

Short Box – If the market price of the box spread is too high, it is profitable to sell the box.

Sell 1 ITM Call Strike X
Buy 1 OTM Call Strike Y
Sell 1 ITM Put Strike Y
Buy 1 OTM Put Strike X

Expiration Value of Box = Higher Strike Price - Lower Strike Price
Risk-free Profit = Net Premium Received - Expiration Value of Box

A box spread is an interest rate trade. A box spread is appropriate only for professional traders with very low execution costs. Otherwise, the cost of executing the trade will cost more than the trade generates in interest.

GUTS

Guts spread is a combination of a long in-the-money call and a long in-the-money put. The options have the same expiration but will have different strike prices. A guts is very similar to strangle, although in a strangle both of the options are out-of the-money.

JELLY ROLL

A Jelly roll, sometimes simply called a roll, is very similar to a box spread in that it has a synthetic long position and a synthetic short position but the two synthetic positions have different expirations.

DIAGONAL SPREAD

A diagonal spread is a hybrid of a vertical spread and a calendar spread. A diagonal spread buys one option and sells another option of the same type (put or call) but with a different expiration and a different strike price.

STRIPS AND STRAPS

A strip consists of a long position in one European call and two European puts with the same strike price and expiration date. A strap consists of a long position in two European calls and one European put with the same strike price and expiration date. In a strip the investor is betting that there will be a big stock price move and considers a decrease in the stock price to be more likely than an increase. In a strap the investor is also betting that there will be a big stock price move. However, in this case, an increase in the stock price is considered to be more likely than a decrease.

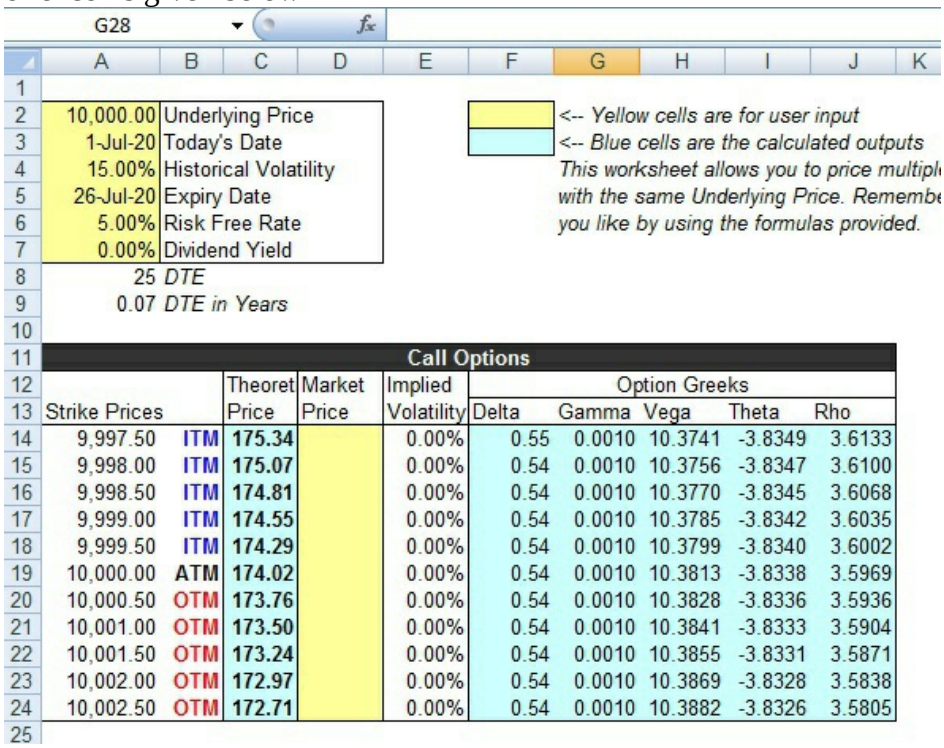
LADDER

A ladder is a spread where we buy an option, sell one that is more out of-the-money and sell another that is even further out-of-the-money.

STRATEGIES IN EXCEL

You need not prepare Excel sheet for computation of strategies payout. Many excel worksheets are available on Google free of cost, you can search and download. One of the Excel is available on following link –
https://www.softpedia.com/get/Others/Finances-Business/Option-Trading-Workbook.shtml

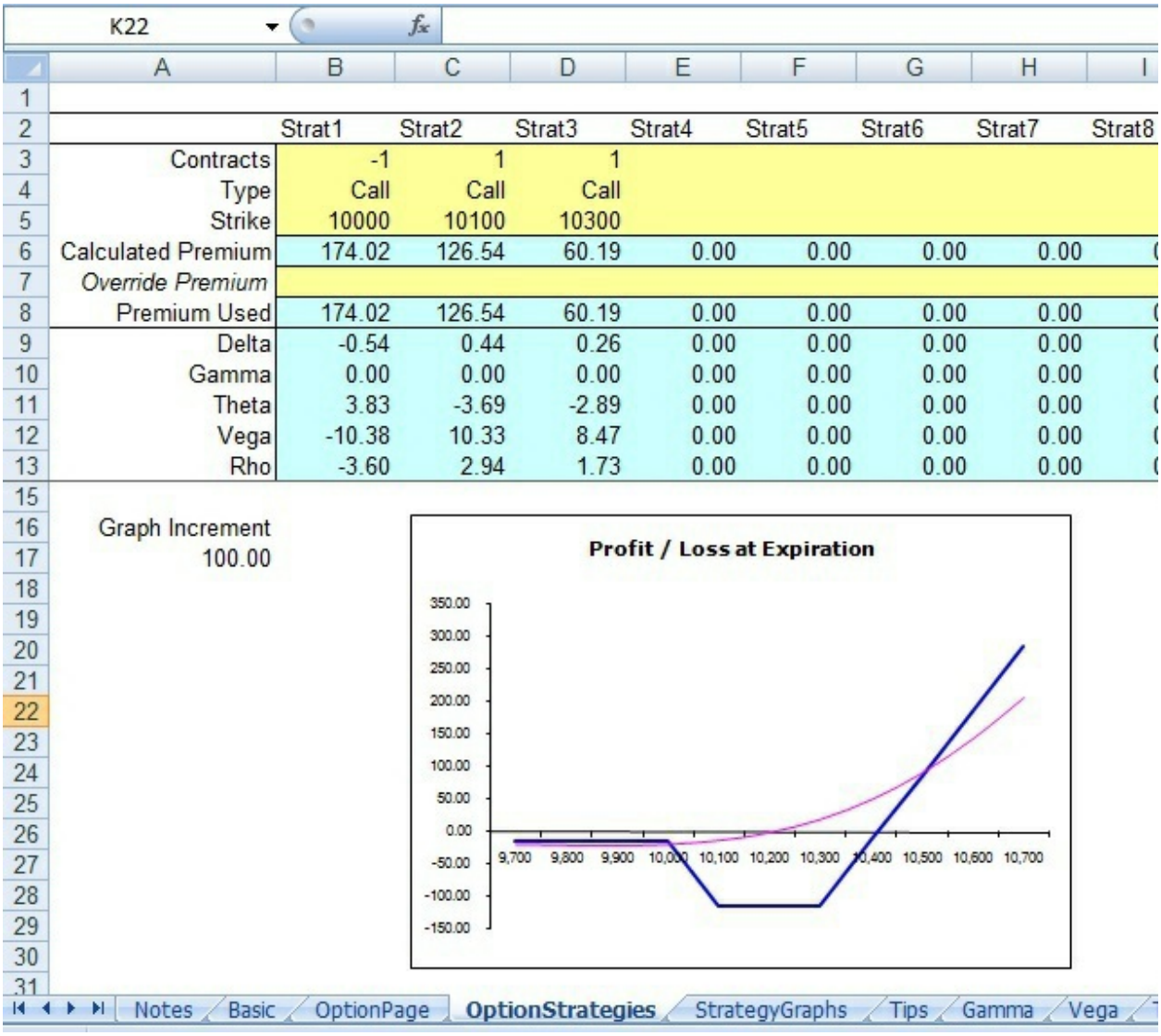
Screen shot of excel is given below-



10,000.00	Underlying Price					<-- Yellow cells are for user input				
1-Jul-20	Today's Date					<-- Blue cells are the calculated outputs				
15.00%	Historical Volatility					This worksheet allows you to price multipl				
26-Jul-20	Expiry Date					with the same Underlying Price. Remembe				
5.00%	Risk Free Rate					you like by using the formulas provided.				
0.00%	Dividend Yield									
25	*DTE*									
0.07	*DTE in Years*									

Call Options									
		Theoret	Market	Implied	Option Greeks				
Strike Prices		Price	Price	Volatility	Delta	Gamma	Vega	Theta	Rho
9,997.50	ITM	175.34		0.00%	0.55	0.0010	10.3741	-3.8349	3.6133
9,998.00	ITM	175.07		0.00%	0.54	0.0010	10.3756	-3.8347	3.6100
9,998.50	ITM	174.81		0.00%	0.54	0.0010	10.3770	-3.8345	3.6068
9,999.00	ITM	174.55		0.00%	0.54	0.0010	10.3785	-3.8342	3.6035
9,999.50	ITM	174.29		0.00%	0.54	0.0010	10.3799	-3.8340	3.6002
10,000.00	ATM	174.02		0.00%	0.54	0.0010	10.3813	-3.8338	3.5969
10,000.50	OTM	173.76		0.00%	0.54	0.0010	10.3828	-3.8336	3.5936
10,001.00	OTM	173.50		0.00%	0.54	0.0010	10.3841	-3.8333	3.5904
10,001.50	OTM	173.24		0.00%	0.54	0.0010	10.3855	-3.8331	3.5871
10,002.00	OTM	172.97		0.00%	0.54	0.0010	10.3869	-3.8328	3.5838
10,002.50	OTM	172.71		0.00%	0.54	0.0010	10.3882	-3.8326	3.5805

You can compute the Greeks, Breakeven, profit loss of on expiry or before for any combination of your choice –



Some tips are also given there –

MARKET DIRECTION	IMPLIED VOLATILITY: Low	Neutral	High
Bearish	Buy Naked Puts Bear Vertical Spreads: Buy ATM Call/Sell ITM Call Buy ATM Put/Sell OTM Put Sell OTM (ITM) Call (Put) Butterflies Buy ITM (OTM) Call (Put) Time Spreads	Sell the Underlying	Sell Naked Calls Bear Vertical Spreads: Buy OTM Call/Sell ATM Call Buy OTM (ITM) Call (Put) Time Spreads Buy ITM (OTM) Call (Put) Butterflies Sell OTM (ITM) Call (Put) Time Spreads
Neutral	Backspreads Buy Straddles/Strangles Sell ATM Call Or Put Butterflies Buy ATM Call Or Put Time Spreads	Do Nothing	Ratio Vertical Spreads Sell Straddles/Strangles Buy ATM Call Or Put Butterflies Sell ATM Call Or Put Time Spreads
Bullish	Buy Naked Calls Bull Vertical Spreads Buy ATM Call/Sell OTM Call Buy ATM Put/Sell ITM Put Sell ITM (OTM) Call (Put) Butterflies Buy OTM (ITM) Call (Put) Time Spreads	Buy the Underlying	Sell Naked Puts Bull Vertical Spreads Buy ITM Call/Sell ATM Call Buy OTM Put/Sell ATM Put Buy OTM (ITM) Call (Put) Butterflies Sell ITM (OTM) Call (Put) Time Spreads

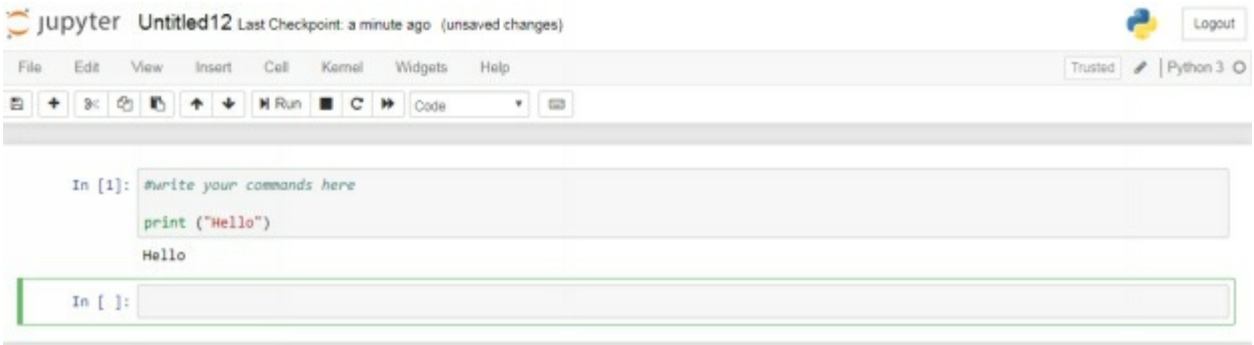
PYTHON FOR TRADING

BASICS OF PYTHON

We learned the basics of future and options, option Greeks and trading strategies. What we learned till now is 10% of knowledge and information requires before the trade, the most important part left is strategy backtesting. Whatever trade you do must be based on past data analysis and backtested results. For past data analysis you can download data in excel from exchange websites, but download and analysis of data thru excel are very time consuming and tedious tasks. So I will use Python for strategy data backtesting in this book. What python does it in seconds the same on excel could take days. Most of the machine learning packages are into python, so when you will go to the next level of trading / or in automated trading this basic knowledge discussed in this book will help. It's never too late to learn anything and programming is easy to learn. I tried to explain the functions of Python which are useful for traders. Take the help of Google also to learn the concept of python written in this book.

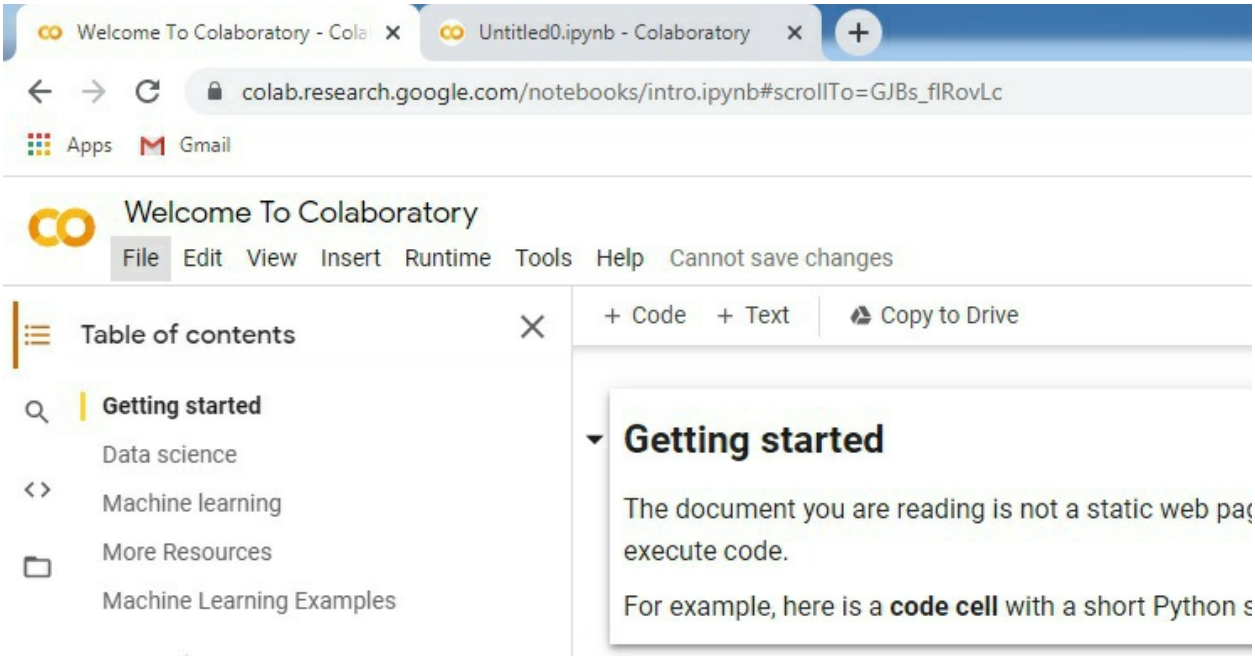
Jupyter Notebook – First get python installed on your system/laptop or you can use Google Colab. Google Colab provides you browser based Jupyter notebook where you can write and execute python program codes. You can download anaconda installer from the following link. https://www.anaconda.com/products/individual to download python on your system. Run the installer, installation of anaconda is like installation of any other program on your system. If you are facing any issue then kindly refer link of free course on Python given at end of this chapter. After installation Go to all program menu of your system/laptop, when you will search all programs you will find one folder with the name of Anaconda. Click on Anaconda, there will be many options, click on Jupyter Notebook. Jupyter notebook will look like this –

Click on new > Python 3 than a new notebook will open, will look line this –

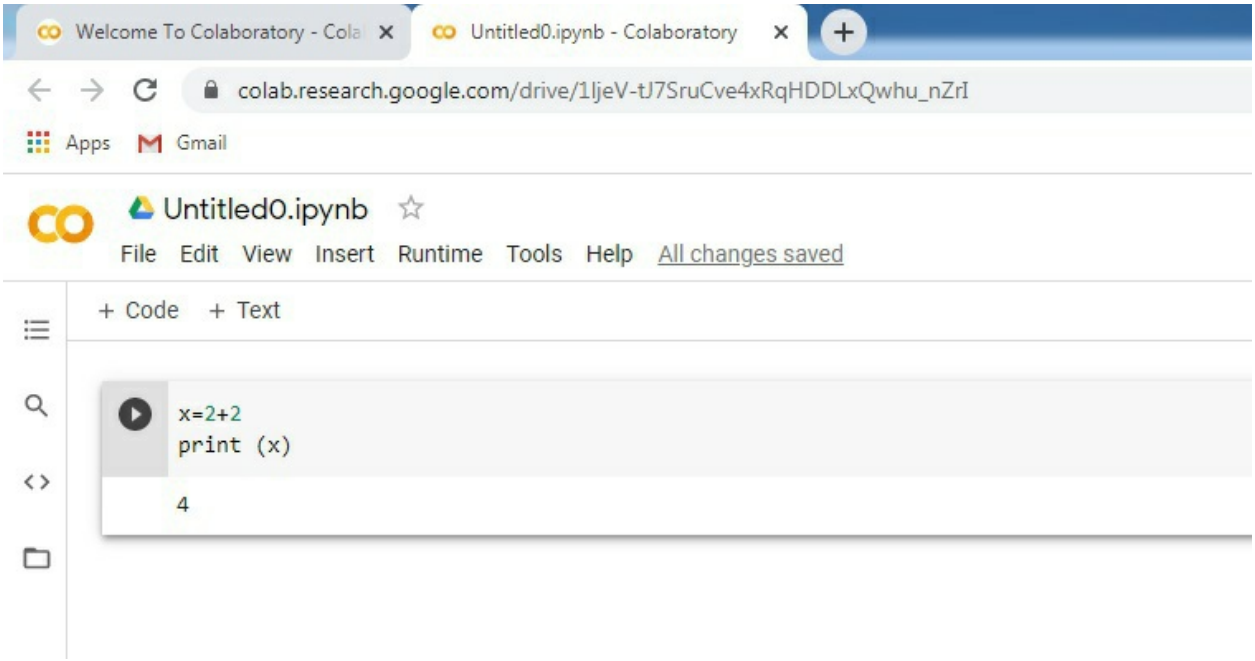


I have given print command in 1st cell. You can write and execute commands in second highlighted green cell. *Get familiar with the Jupyter Notebook interface.* Now Jupyter Notebook is your playground. Jupyter Notebook is an interactive document. You need to write commands in a predefined format and on execution of commands you get results of your commands. It's easy; you can learn the basics of python thru any video available on Google. Good thing with python is that past data of exchanges and tools are already available. Most of the professional traders use python or c++ for development and back-testing of strategies. You need not to learn complete programming language. You can analyze data in the way you want. For that you need to learn the basics of programming. How to write a program and how this software will help in past data analysis for any strategy. With understanding and use of limited commands you can backtest your strategies. So I used limited commands and functions for better understanding. Let's start with some basics of Python than we will learn how to fetch past data in python and backtesting of some strategies on past data.

In case you do not want to download python on your laptop then you can use Google Colab. Google Colaboratory (Colab) is a product from Google Research. Colab allows anybody to write and execute python code through the browser. It will look like this -



Click on 'File' then click on 'New Notebook'. A file in browser will open like this -



Lets start with some basics of Python. First, you need to understand that you need to give commands in a predefined format, it is called coding. Programming languages understand commands that are also in a predefined format. Initially, you will make lots of mistakes in coding and gradually you will learn how to write program code.

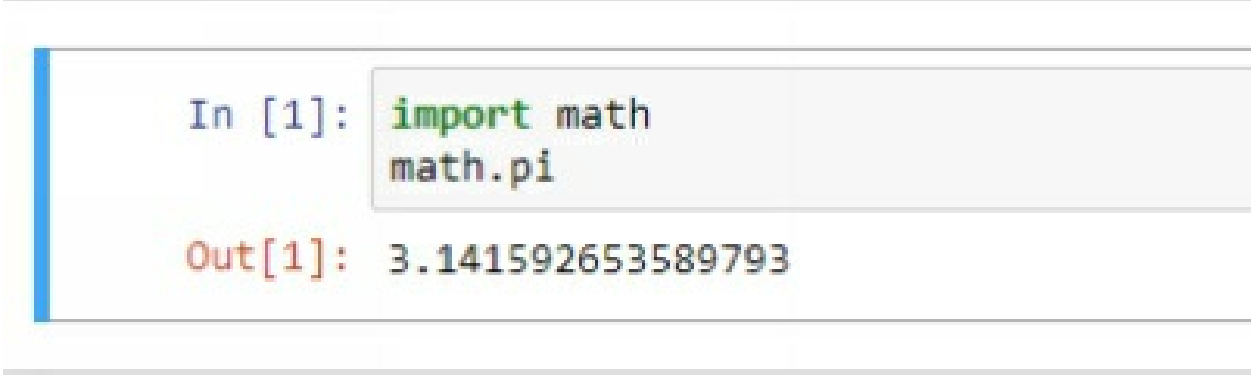
Open a new Jupyter notebook. Type following in a cell (code written in blue color is python code. Statement written after '#' is explanation in English, it's not a part of code, it is just to explain you the code) –

```
a=100                # here you assigned value of 100 to a variable 'a'
b=a/2                # here you assigned value of 50 ('a' divide by 2) to variable 'b'
c=a+b                # here you assigned value of 150 (value of a + value of b) to variable 'c'
d=(a*3)-b                    # here you assigned value of 250 [(a X 3)-b] to variable 'd'
print (a,b,c,d)              # here you are giving print command to print values of 'a', 'b', 'c' and 'd'
```

Then you can click on 'run' button or press 'Shift' and 'Enter' buttons on your laptop. You will get the results of your command. Jupyter notebook will print the value of 'a', 'b', 'c' and 'd' as per your command. Python makes use of simple syntax which looks like written English.

Be creative, do various experiments with codes in notebook. This will help you to learn more about programming.

Second, you need to understand modules in python. If you want to use mathematical functions in the Jupyter sheet than you need to import math module.



For option trader one of the basic module required is NumPy. It is used for Scientific Computing. In cell 2 I have imported module numpy. In cell 4 I have given a command to find minimum value out of 3, 6, and 9. We are using Np.min() command from NumPy module. You will check out of command is 3. So program itself found the minimum value out of 3 values. In 5th cell, I have given a command to find the maximum value. Result of command 5 is 8. So we are giving commands in predefined format and software is giving the output of that command.

```
In [2]: import numpy as np

In [4]: np.min([3,6,9])
Out[4]: 3

In [5]: np.max([2,4,8])
Out[5]: 8
```

Math, NumPy are the Built-in modules, these modules are available by default in Python. But there are many other publicly available modules which you may want to use for example backtrader. Backtrader is used for backtesting. To install a module following command is used in python –

!pip install <module name>

Following is the screenshot of installation of backtrader module in python.

```
In [6]: !pip install backtrader

Collecting backtrader
  Downloading https://files.pythonhosted.org/packages/a6/35/6ed3fbb771712d457011680970f3f0bcf38bfbc4cedd447d62705a6523c8/backtrader-1.9.74.123-py2.py3-none-any.whl (411kB)
Installing collected packages: backtrader
Successfully installed backtrader-1.9.74.123

In [7]: # Import the package
        import backtrader

        # Check the version of the package
        backtrader.__version__
Out[7]: '1.9.74.123'
```

Third and the most important thing a trader need is past data. Various options are available to get past data. You can download data from yahoo finance. The **nsepy module** is used to get the stock market data for contracts traded on both exchanges. You can install these modules thru following commands –

!pip install yfinance

!pip install nsepy

```
In [10]: !pip install nsepy
         !pip install bsedata

Collecting bsedata
  Downloading https://files.pythonhosted.org/packages/6b/f8/c4b24d9f501e78c61ce85d509e03ff1f8cb983b69e3dcb1e34776dc2a038/bsedata-0.3.1-py3-none-any.whl
Requirement already satisfied: requests in c:\programdata\anaconda3\lib\site-packages (from bsedata) (2.21.0)
Requirement already satisfied: beautifulsoup4 in c:\programdata\anaconda3\lib\site-packages (from bsedata) (4.6.3)
Requirement already satisfied: urllib3<1.25,>=1.21.1 in c:\programdata\anaconda3\lib\site-packages (from requests->bsedata) (1.24.1)
Requirement already satisfied: chardet<3.1.0,>=3.0.2 in c:\programdata\anaconda3\lib\site-packages (from requests->bsedata) (3.0.4)
Requirement already satisfied: idna<2.9,>=2.5 in c:\programdata\anaconda3\lib\site-packages (from requests->bsedata) (2.8)
Requirement already satisfied: certifi>=2017.4.17 in c:\programdata\anaconda3\lib\site-packages (from requests->bsedata) (2020.4.5.1)
Installing collected packages: bsedata
Successfully installed bsedata-0.3.1
```

Forth you need to understand data in tabular format in python. Tabular format comprising of row and columns like Excel spreadsheet in python this is called ‘data frame’. You can perform anything in a particular row and column thru commands in python. A trader can fetch past data thru nsepy in tabular format, we will learn this in the next chapter. You can also import and export csv/excel files in python. You can perform various functions on a table in python as you do on ‘Excel’. Some basic functions required for past data analysis and strategy backtesting are discussed below -

Following command will be used for import of data of a file saved on your laptop –

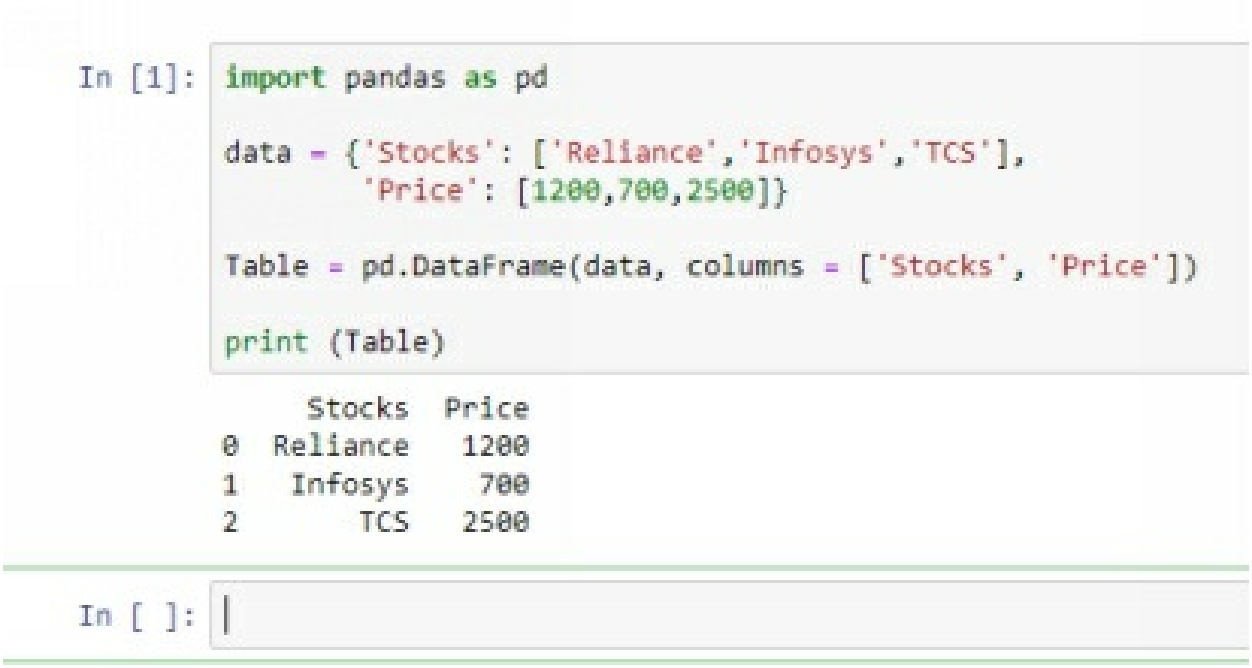
```
Table = pd.read_csv('filename.csv')
```

Following command will be used to save data in a file on your laptop (export data) –

```
filename.to_csv("giveanyname.csv", index=True, encoding='utf8')
```

Codes to create a table (Data Frame) in Python itself by typing values-

```
import pandas as pd

data = {'Stocks': ['Reliance', 'Infosys', 'TCS'],
        'Price': [1200, 700, 2500]}

Table = pd.DataFrame(data, columns = ['Stocks', 'Price'])

print (Table)
```



Add new column in Table with the following command –

```
Table['Quantity'] =0
```

```
In [2]: Table['Quantity'] =0
        print (Table)
```

```
     Stocks  Price  Quantity
0  Reliance   1200         0
1   Infosys    700         0
2       TCS   2500         0
```

Check columns with the following command –
Table.columns

```
# Inspect the columns
Table.columns
```

```
Index(['Stocks', 'Price', 'Quantity'], dtype='object')
```

Select last 2 values of column ‘Price’ in new variable ‘last’ with the following command –
last = Table['Price'][-2:]

```
# Select only the last 2 observations of `Price`
last = Table['Price'][-2:]
print (last)
```

```
1     700
2    2500
Name: Price, dtype: int64
```

Select maximum and minimum value in a table with the following commands –
Table.column.max()
Table.column.min()

```
Table.Price.min()
```

```
700
```

```
Table.Price.max()
```

```
2500
```

You can insert value in any cell thru the following command –

Table.loc[0, 'Quantity'] = 10 #this command will insert value '10' in 1st row of column 'Quantity'

```
Table.loc[0, 'Quantity'] = 10
Table.loc[1, 'Quantity'] = 20
Table.loc[2, 'Quantity'] = 30

print (Table)
```

```
     Stocks  Price  Quantity
0  Reliance   1200        10
1   Infosys    700        20
2       TCS   2500        30
```

You can also perform various mathematical/statistical functions between columns –

Table['Amount']=Table['Price']*Table['Quantity']

```
Table['Amount']=Table['Price']*Table['Quantity']
print (Table)
```

```
     Stocks  Price  Quantity  Amount
0  Reliance   1200        10   12000
1   Infosys    700        20   14000
2       TCS   2500        30   75000
```

Following command can be used for cumulative sum of any column –
Table['Total'] = Table['Amount'].cumsum()

```
Table['Total'] = Table['Amount'].cumsum()
print (Table)
```

```
     Stocks  Price  Quantity  Amount   Total
0  Reliance   1200        10   12000   12000
1   Infosys    700        20   14000   26000
2       TCS   2500        30   75000  101000
```

Following command could be used to delete columns –
Table.drop(["Total", "Amount"], axis = 1, inplace = True)

```
Table.drop(["Total", "Amount"], axis = 1, inplace = True)
print (Table)
```

```
     Stocks  Price  Quantity
0  Reliance   1200        10
1   Infosys    700        20
2       TCS   2500        30
```

Now let's learn some other functions of Python that we are going to use in coming chapters –

Object Oriented Programming - You can create your own function in Python. In the following example you have created a new function 'my_function' which multiply 'Price' and 'Quantity' of any table. So you can perform a single command or set of commands in your function and you need not to write these codes again and again. That is why it is called object oriented programming.

```
def my_function(df):
    try:
        return (df['Price']*df['Quantity'])
    except:
        return np.NaN

Table['Amount'] = Table.apply(my_function, axis=1)
print (Table)
```

```
def my_function(df):
    try:
        return (df['Price']*df['Quantity'])
    except:
        return np.NaN


Table['Amount'] = Table.apply(my_function, axis=1)
print (Table)
```

	Stocks	Price	Quantity	Amount
0	Reliance	1200	10	12000
1	Infosys	700	20	14000
2	TCS	2500	30	75000

Range - To loop through a set of code a specified number of times we can use a 'range' function. Let me explain how these loops work. Jupyter notebook will print the value of 'x' 4 times if you will write following code -

```
x=1
for x in range (1, 5):
        print (x)
```

```
x=1
for x in range (1, 5):
    print (x)
```

```
1
2
3
4
```

The range() function defaults to increment the sequence by 1, however, it is possible to specify the increment value by adding a third parameter:

```
for x in range (1, 15, 2):
        print (x)
```

```
In [6]: for x in range (1, 15, 2):
            print (x)

1
3
5
7
9
11
13

In [ ]:
```

As you can observe from the above command value of x printed with an incremental value of 2.

Fetching Expiry Date – You can fetch expiry date of all derivative contracts of NSE for a particular month and year from nsepy thru following code-

```
expiry = get_expiry_date(year=2015, month=1)
```

Lambda - you can create your own function through lambda. Here x and y are the parameters and x+y is the operation performed. So when you will use xyz in your code you will get the addition of 2 values as result.

```
xyz = lambda x,y: x+y
xyz (3,6)
```

```
xyz = lambda x,y: x+y
xyz (3,6)

9
```

Now you have a basic understanding of python. Rest all functions I will explain while using them in code. I am writing some codes thru which you can download day-wise strike wise future and options price, volume, open interest data of any contract for as many months as you want. I am also writing some codes to compute profit and loss of few strategies on past data. The same codes could be used for computation of profit and loss of strategy for any contract and for any period.

FREE ONLINE COURSES IN PYTHON

Basic online course on Option Trading strategies in Python is available free of cost at NSE Website. Use following path -

nseindia.com > Learn > Interactive online courses > Certification on Option Trading strategies in Python: Basic **(Click here for enrollment)**

You can also enroll for **free basic course** on Python through following link -

https://quantra.quantinsti.com/course/python-trading-basic

I tried to explain some basic of python which are usefull for traders for backtesting of strategies. You can also take help of google or some free courses as mentioned above.

FETCHING HISTORICAL DATA

Once nsepy installed, trader can fetch historical stock data of contracts trading on NSE (India) thru following commands. I have taken an example of SBI, trader can use any symbol from the start date to end date of your choice. Last command 'print (sbi.tail())' is used to print last 5 rows of the table. 'print (sbi.head())' could also be used to print first 5 rows of table. Trader requires writing commands in a pre-defined format than only he will get a response from the 'Jupyter' sheet.

```
from nsepy import get_history
from datetime import datetime
sbi = get_history (symbol='SBIN', start=datetime(2018,1,1), end=datetime(2018,12,31))
print (sbi.tail())
```

```
from nsepy import get_history
from datetime import datetime
sbi = get_history(symbol='SBIN',start=datetime(2018,1,1),end=datetime(2018,12,31))
print (sbi.tail())
```

```
           Symbol Series  Prev Close    Open    High     Low    Last   Close  \
Date
2018-12-24   SBIN     EQ      291.90  293.50  295.00  290.15  293.50  293.05
2018-12-26   SBIN     EQ      293.05  292.85  295.00  287.15  294.55  294.15
2018-12-27   SBIN     EQ      294.15  296.70  297.60  291.50  293.30  292.15
2018-12-28   SBIN     EQ      292.15  293.60  297.10  293.55  294.45  294.80
2018-12-31   SBIN     EQ      294.80  297.20  298.25  295.50  295.65  295.90

              VWAP    Volume      Turnover  Trades  Deliverable Volume  \
Date
2018-12-24  292.60  12048877  3.525492e+14   91297             2344946
2018-12-26  290.87  12684324  3.689454e+14   80935             1715170
2018-12-27  294.03  15304564  4.500070e+14   92770             4835730
2018-12-28  295.43  12876558  3.804110e+14   85894             3896890
2018-12-31  296.50   9526067  2.824443e+14   81758             2618550

            %Deliverble
Date
2018-12-24       0.1946
2018-12-26       0.1352
2018-12-27       0.3160
2018-12-28       0.3026
2018-12-31       0.2749
```

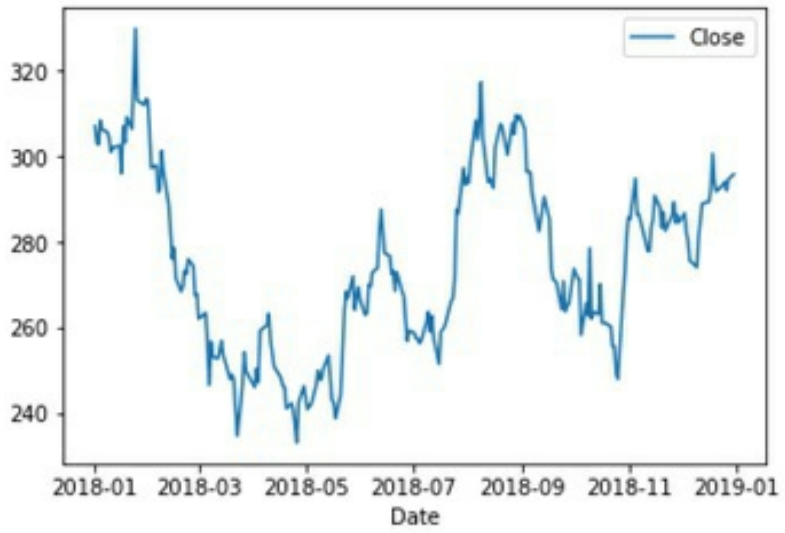
Above data could be plotted on chart also. For charting first trader need to import in-built module Matplotib. Using Matplotlib you can plot graphs, histograms and bar plot etc. After executing above commands following commands could be used for charting of data–

```
import matplotlib.pyplot
sbi[['Close']].plot()
```

#values mentioned in 'Close' column of table 'sbi' taken to plot

```
import matplotlib.pyplot as plt
sbi[['Close']].plot()
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x9218fd0>
```



You can fetch future prices also. You need to mention instrument type and expiry date of contract. Following commands can fetch future prices of given period –

```
from datetime import date
from nsepy import get_history
stock_fut = get_history(symbol="SBIN",
                        start=date(2015,1,1),
                        end=date(2015,1,10),
                        futures=True,
                        expiry_date=date(2015,1,29))
```

```
In [1]: from datetime import date
        from nsepy import get_history
        stock_fut = get_history(symbol="SBIN",
                                start=date(2015,1,1),
                                end=date(2015,1,10),
                                futures=True,
                                expiry_date=date(2015,1,29))
```

```
In [2]: print(stock_fut.tail())
```

Date	Symbol	Expiry	Open	High	Low	Close	Last
2015-01-05	SBIN	2015-01-29	318.00	318.75	314.10	315.00	315.05
2015-01-06	SBIN	2015-01-29	312.95	312.95	300.10	301.30	301.10
2015-01-07	SBIN	2015-01-29	301.95	304.55	297.35	302.25	303.50
2015-01-08	SBIN	2015-01-29	306.50	308.40	303.70	306.65	307.00
2015-01-09	SBIN	2015-01-29	306.75	309.25	301.05	304.75	304.15

Date	Settle Price	Number of Contracts	Turnover	Open Interest
2015-01-05	315.00	17455	6.898723e+09	55718750
2015-01-06	301.30	29338	1.126715e+10	56701250
2015-01-07	302.25	28489	1.074823e+10	58036250
2015-01-08	306.65	20120	7.702653e+09	57287500
2015-01-09	304.75	18961	7.247211e+09	57035000

Date	Change in OI	Underlying
2015-01-05	631250	312.75
2015-01-06	982500	299.90
2015-01-07	1335000	300.15

You can fetch option prices also. Apart from the instrument type, expiry date of contract you need to specify option_type as “CE” for call and as “PE” for put option and strike_price - the strike price of the contract. Following commands can fetch option prices of given period for a given strike –

```
from datetime import date
from nsepy import get_history
stock_opt = get_history(symbol="SBIN",
                        start=date(2015,1,1),
                        end=date(2015,1,10),
                        option_type="CE",
                        strike_price=300,
                        expiry_date=date(2015,1,29))
```

```
In [1]: from datetime import date
        from nsepy import get_history
        stock_opt = get_history(symbol="SBIN",
                                start=date(2015,1,1),
                                end=date(2015,1,10),
                                option_type="CE",
                                strike_price=300,
                                expiry_date=date(2015,1,29))
        print (stock_opt.head())
```

Date	Symbol	Expiry	Option Type	Strike Price	Open	High	Low
2015-01-01	SBIN	2015-01-29	CE	300.0	18.95	21.15	18.95
2015-01-02	SBIN	2015-01-29	CE	300.0	21.50	23.90	21.35
2015-01-05	SBIN	2015-01-29	CE	300.0	21.00	21.00	18.60
2015-01-06	SBIN	2015-01-29	CE	300.0	16.10	16.80	10.50
2015-01-07	SBIN	2015-01-29	CE	300.0	11.05	12.50	9.00

Date	Close	Last	Settle Price	Number of Contracts	Turnover
2015-01-01	20.85	20.95	20.85	44	17631000.0
2015-01-02	21.45	21.40	21.45	84	33889000.0
2015-01-05	18.60	18.60	18.60	47	18775000.0
2015-01-06	11.05	11.20	11.05	328	127846000.0
2015-01-07	11.25	11.85	11.25	1512	587993000.0

Date	Premium Turnover	Open Interest	Change in OI	Underlying
2015-01-01	NaN	310000	-10000	314.00
2015-01-02	NaN	301250	-8750	315.25
2015-01-05	NaN	307500	6250	312.75

Fetching underlying stock data is easy, you just mention the scrip code and period and you will get data. But in case of Future every month there is different expiry so you need to mention a separate expiry date. So you can fetch future data of single expiry in one go. In case of option you can data of one strike at a time. This individual data will not help because for back-testing you need data in one table.

Loop function we will use to get data of multiple expiries and option data of multiple strikes in a single table.

Suppose you wish to fetch current month Nifty future and option monthly expiry data of Jan. & Feb. 2018. In case of options, you need option prices of strikes with 100 intervals. Following program could be used to fetch data of multiple expiries and multiple strike prices-

```
#import basic modules required
from nsepy import get_history
import datetime
from datetime import date
import pandas as pd
import matplotlib.pyplot as plt
import numpy as np
s = date(2017,12,31)

#Tables ‘niftydata’ and ‘optiondata’ created to store data of Nifty future and options respectively.
nifty_fut = get_history(symbol="NIFTY",
                        start=s,
                        end=s,
                        index=True,
```

```
                        futures=True,
                        expiry_date=s)
niftydata = nifty_fut
nifty_opt = get_history(symbol="NIFTY",
                        start=s,
                        end=s,
                        index=True,
                        option_type='CE',
                        strike_price=10000,
                        expiry_date=s)
optiondata = nifty_opt
```

#date of 1st January 2018 assigned in variable ‘s’. Earlier this variable was having date of 31st December 2017 so 1 day increased.

```
s = s + datetime.timedelta(days=1)
```

#expiry dates of January, February taken in variable

```
expiry = [date(2018,1,25), date(2018,2,22)]
```

#Loops created to fetch data of all expiries

```
for x in expiry:
    expiry = x
     nifty_fut = get_history(symbol="NIFTY", start=s, end=x,
     index=True, futures=True,
    expiry_date=x)
    niftydata = niftydata.append(nifty_fut)
```

#Nifty future data of fetched above stored in nifty data table. Every month data will be appended in ‘niftydata’ table.

```
     high = nifty_fut[['Close']].max()
```

#Highest value of Nifty taken in variable ‘High’

```
     low = nifty_fut[['Close']].min()
```

#Lowest value of Nifty taken in variable ‘low’

```
     high = int((round(high/100)*100)+100)
```

#values rounded off to get nearest 100 strike

```
     low = int((round(low/100)*100)-100)
```

#values rounded off to get nearest strike

```
     for z in range (low, high, 100):
```

one more loop created to fetch option data

```
          nifty_opt = get_history(symbol="NIFTY", start=s,
          end=expiry, index=True, option_type='CE', strike_
          price=z, expiry_date=x)
          optiondata = optiondata.append(nifty_opt)
```

#Call data appended in table ‘optiondata’

```
        nifty_opt = get_history(symbol="NIFTY", start=s,
        end=expiry, index=True,option_type='PE', strike_
        price=z, expiry_date=x)
          optiondata = optiondata.append(nifty_opt)
```

#Put data appended in table ‘optiondata’

```
     s = x + datetime.timedelta(days=1)
```

#first date of next expiry assigned in variable ‘s’

If you will notice in the above program you will find that first ‘for’ loop is created with different expiries than under first loop a second ‘range’ loop created to fetch options data. Options data is fetched for strikes in the range of lowest value of Nifty to highest value of Nifty. Nifty lowest value in the month of January 2018 was 10469 and nifty highest value was 11085. So option prices of strikes, from 10400 to 11100 fetched thru above program. If you want more strikes than you can modify the high low values-

high = high+500
low=low-500

Above change in high and low values will fetch option data from strikes 10000 to 11600 in the month of January 2018.

When you will run above program you will have Nifty futures 2 months data in table ‘niftydata’ and you will have nifty options 2 months data in ‘optiondata’.

Screenshot of python program is given below -

```
from nsepy import get_history
import datetime
from datetime import date
import pandas as pd
import matplotlib.pyplot as plt
import numpy as np

s = date(2017,12,31)

nifty_fut = get_history(symbol="NIFTY",
        start=s,
        end=s,
        index=True,
        futures=True,
        expiry_date=s)
niftydata = nifty_fut

nifty_opt = get_history(symbol="NIFTY",
        start=s,
        end=s,
        index=True,
        option_type='CE',
        strike_price=10000,
        expiry_date=s)
optiondata = nifty_opt

s = s + datetime.timedelta(days=1)

expiry = [date(2018,1,25), date(2018,2,22)]
```

```
for x in expiry:
    expiry = x
    nifty_fut = get_history(symbol="NIFTY",
        start=s,
        end=x,
        index=True,
        futures=True,
        expiry_date=x)

    niftydata = niftydata.append(nifty_fut)

    high = nifty_fut[['Close']].max()
    low = nifty_fut[['Close']].min()
    high = int((round(high/100)*100)+100)
    low = int((round(low/100)*100)-100)

    for z in range (low, high, 100):
        nifty_opt = get_history(symbol="NIFTY",
        start=s,
        end=expiry,
        index=True,
        option_type='CE',
        strike_price=z,
        expiry_date=x)
        optiondata = optiondata.append(nifty_opt)
        nifty_opt = get_history(symbol="NIFTY",
        start=s,
        end=expiry,
        index=True,
        option_type='PE',
        strike_price=z,
        expiry_date=x)
        optiondata = optiondata.append(nifty_opt)
    s = x + datetime.timedelta(days=1)
```

With the help of above program now we have Nifty futures 2 months data in table ‘niftydata’ and you will have nifty options 2 months data in ‘optiondata’. Now if you will check data you will find many columns in the table –

```
In [7]: print (niftydata.tail())
```

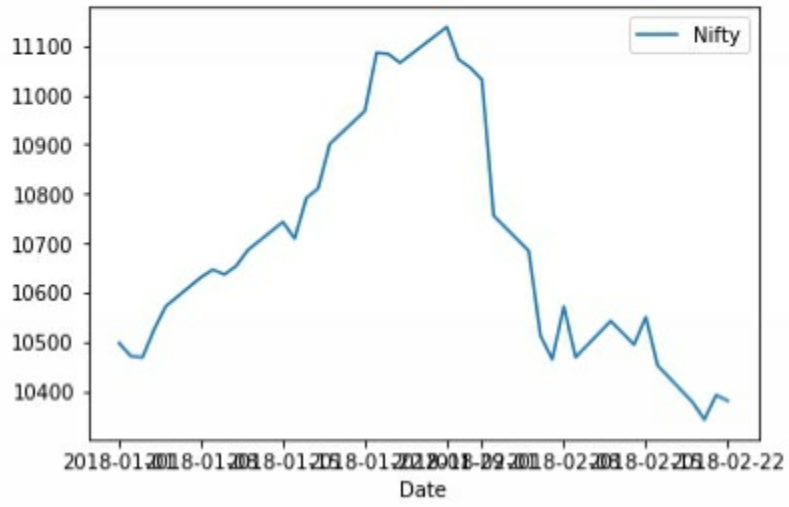
```
            Symbol      Expiry      Open      High       Low     Close  \
Date
2018-02-16  NIFTY  2018-02-22  10596.40  10615.00  10430.20  10453.35
2018-02-19  NIFTY  2018-02-22  10470.00  10485.00  10290.10  10378.55
2018-02-20  NIFTY  2018-02-22  10394.00  10425.85  10332.30  10343.75
2018-02-21  NIFTY  2018-02-22  10405.65  10409.85  10341.40  10392.90
2018-02-22  NIFTY  2018-02-22  10345.00  10396.00  10330.05  10381.80

                Last  Settle Price Number of Contracts      Turnover  \
Date
2018-02-16  10442.35      10453.35             184944  1.458370e+11
2018-02-19  10375.50      10378.55             218292  1.696925e+11
2018-02-20  10340.00      10343.75             183616  1.430082e+11
2018-02-21  10389.00      10392.90             157039  1.221798e+11
2018-02-22  10384.50      10382.70             204434  1.588982e+11

            Open Interest  Change in OI  Underlying
Date
2018-02-16       23044050          8925         NaN
2018-02-19       21720675      -1323375         NaN
2018-02-20       20325675      -1395000         NaN
2018-02-21       17130525      -3195150    10397.45
2018-02-22       11599125      -5531400         NaN
```

Suppose trader does not require so many columns he only needs closing prices of Nifty than he can take this closing price data in a separate table. Pd.DataFrame command will create a new table ‘NiftyCF’ with column ‘Nifty’. Column ‘Nifty’ will have values of column ‘Close’ of table ‘niftydata’–

NiftyCF = pd.DataFrame({“Nifty”: niftydata[“Close”]})

```
In [8]: NiftyCF = pd.DataFrame({"Nifty": niftydata["Close"]}
        NiftyCF.plot()
```

```
Out[8]: <matplotlib.axes._subplots.AxesSubplot at 0x54d0a20>
```



In the same way he can take options close price data in a separate table. ‘NiftyCO’ is the new table with 4 columns Expiry, Type, Strike, Last which have values from table optiondata.

```
In [9]: NiftyCO = pd.DataFrame({"Expiry": optiondata['Expiry'],
                                "Type": optiondata['Option Type'],
                                "Strike": optiondata['Strike Price'],
                                "Last": optiondata['Last']})

In [10]: print (NiftyCO.tail())
```

Date	Expiry	Type	Strike	Last
2018-02-16	2018-02-22	PE	11100.0	649.10
2018-02-19	2018-02-22	PE	11100.0	708.80
2018-02-20	2018-02-22	PE	11100.0	753.90
2018-02-21	2018-02-22	PE	11100.0	700.45
2018-02-22	2018-02-22	PE	11100.0	705.90

Now we have closing price of Nifty future in table ‘NiftyCF’ and closing prices of Nifty options in table ‘NiftyCO’. Thru python a trader can create pivot table also and they can rearrange data of option strikes in columns and they can add data of Nifty future also in same table.

Following commands will create a pivot table –
Opttable = pd.pivot_table(NiftyCO, values ='Last', index =['Date', 'Type', 'Expiry'], columns =['Strike'], aggfunc = np.sum)

Now we have option rearranged data in new table ‘Opttable’ Following commands will add Nifty closing prices in this table –
Opttable = Opttable.join(NiftyCF)

```
In [11]: Opttable = pd.pivot_table(NiftyCO, values ='Last', index =['Date', 'Type', 'Expiry'],
                                   columns =['Strike'], aggfunc = np.sum)
         Opttable = Opttable.join(NiftyCF)

In [12]: print (Opttable.head())
```

Date	Type	Expiry	10200.0	10300.0	10400.0	10500.0	10600.0
2018-01-01	CE	2018-01-25	NaN	NaN	178.00	120.8	73.95
	PE	2018-01-25	NaN	NaN	95.00	136.0	186.50
2018-01-02	CE	2018-01-25	NaN	NaN	163.05	106.8	62.90
	PE	2018-01-25	NaN	NaN	104.85	146.0	198.80
2018-01-03	CE	2018-01-25	NaN	NaN	163.00	105.0	61.95

Date	Type	Expiry	10700.0	10800.0	10900.0	11000.0	11100.0
2018-01-01	CE	2018-01-25	41.30	21.60	10.20	5.60	2.90
	PE	2018-01-25	253.00	332.95	413.90	510.05	586.85
2018-01-02	CE	2018-01-25	34.10	16.60	8.10	4.80	3.00
	PE	2018-01-25	269.30	352.85	433.25	533.80	623.00
2018-01-03	CE	2018-01-25	32.75	16.00	7.35	4.50	2.60

Date	Type	Expiry	Nifty
2018-01-01	CE	2018-01-25	10498.7
	PE	2018-01-25	10498.7
2018-01-02	CE	2018-01-25	10472.2
	PE	2018-01-25	10472.2
2018-01-03	CE	2018-01-25	10469.4

Now we have Nifty future and option closing price data in a single table. We can export this data in csv format from python thru

following command and new file with the name of ‘Optionpivot’ will get saved in our system which we can use in future also.

```
Opttable.to_csv("Optionpivot.csv", index=True, encoding='utf8')
```

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Date	Type	Expiry	10200	10300	10400	10500	10600	10700	10800	10900	11000	11100	Nifty
40	1/29/2018	CE	2/22/2018	947.45	853.15	765.95	667.55	584.25	498.2	422.3	344.9	276.1	218	11137.65
41	1/29/2018	PE	2/22/2018	18.5	23.2	29.7	40	52.2	67.95	88.1	113.75	143.4	180.15	11137.65
42	1/30/2018	CE	2/22/2018	877	780	689.7	590	509.3	421.05	348.8	277	213.8	156.1	11072.1
43	1/30/2018	PE	2/22/2018	13.75	18.3	24.1	32.9	44.05	60	81.55	108.6	142.55	186.65	11072.1
44	1/31/2018	CE	2/22/2018	864.9	765.45	676.05	582.85	490	407	330.35	257.05	195	142	11055.4
45	1/31/2018	PE	2/22/2018	13.5	17.75	22.55	31	40.8	54.4	74.5	101.35	136.6	182	11055.4
46	2/1/2018	CE	2/22/2018	841.8	735	645	552.25	454.65	369.25	290	212.85	150.9	100.75	11031.3
47	2/1/2018	PE	2/22/2018	8.4	10.5	14	19.85	27.6	39.5	58	83	119	165.65	11031.3
48	2/2/2018	CE	2/22/2018	558.85	466.4	382.15	305	224.5	158	104.25	64.8	38.3	22	10755.85
49	2/2/2018	PE	2/22/2018	27	37.25	49.25	67.4	90.1	122.75	168	224	296	376.85	10755.85
50	2/5/2018	CE	2/22/2018	528.65	439.95	353.5	270	195.1	134.7	87	52.4	30.9	18	10684.6
51	2/5/2018	PE	2/22/2018	25.5	36.05	49.1	68	93.5	130	180.05	242.3	318.4	404.05	10684.6
52	2/6/2018	CE	2/22/2018	414.95	332.15	260.8	192	138	92.5	59	36.6	23.25	14.8	10513.3
53	2/6/2018	PE	2/22/2018	81	99	124	157	197.1	250	320	397	474.45	564.15	10513.3
54	2/7/2018	CE	2/22/2018	325.35	254.3	190	135.55	91.35	59.5	37.95	25.25	16.6	13	10465.55
55	2/7/2018	PE	2/22/2018	82.55	109	143	185	241	305	385.35	468	557.9	651.65	10465.55
56	2/8/2018	CE	2/22/2018	410.45	324.5	249	176	118.35	73.95	44.95	26.25	15.7	10.7	10572.25
57	2/8/2018	PE	2/22/2018	42.85	57	78.35	107	145.6	199	273	345.15	434.5	526.55	10572.25
58	2/9/2018	CE	2/22/2018	345	267.05	194	136.85	88.9	51.9	30.2	17	10.2	7.35	10469.7
59	2/9/2018	PE	2/22/2018	65.85	86.6	116.2	153	203	260	340	423.1	518.55	610.3	10469.7
60	2/12/2018	CE	2/22/2018	367	282.05	206.5	139.9	88	49.85	26.5	13	6.7	4.5	10543.1
61	2/12/2018	PE	2/22/2018	36.55	52	75.05	107.6	154	209	284.95	371.45	465	559.6	10543.1
62	2/14/2018	CE	2/22/2018	295	215.65	149	91.8	49	23.1	11.3	5.95	3.65	3	10495.2
63	2/14/2018	PE	2/22/2018	43.5	64	93	133.95	187.35	258.1	345.5	445	535.65	634	10495.2

Optionpivot

You can save data of other tables also into your laptop. Better to save files into your system because you need not to go again and again to fetch same data for different analysis.

Now you have 2 months Nifty future and options price volume and open interest data. In the same way you can fetch data of multiple months thru single program in a single file.

Good thing with python is that this program to fetch data will remain saved in your Jupyter notebook and if you want to fetch data of other contract also you can fetch the same in few seconds. For example if you want to fetch data of Reliance future also in the same format as above. Just replace the name of Nifty with Reliance and slight modification in ‘range’ loop to change strike interval from 100 to 20. Because this time we are fetching stock future not index future so some modification in code to fetch stock future also required. Run the program again and you will get Reliance future and options past data in a single table for as many months as you want. So you can fetch past data in the format of your choice for any contract of your choice and for any period of your choice. You just need to write program once.

Screenshots of Jupyter notebook to fetch past data of Reliance Industry with same program are given below –

```
from nsepy import get_history
import datetime
from datetime import date
import pandas as pd
import matplotlib.pyplot as plt
import numpy as np
from nsepy.derivatives import get_expiry_date
```

```
expiry = max(get_expiry_date(year=2017, month=12))
print (expiry)
```

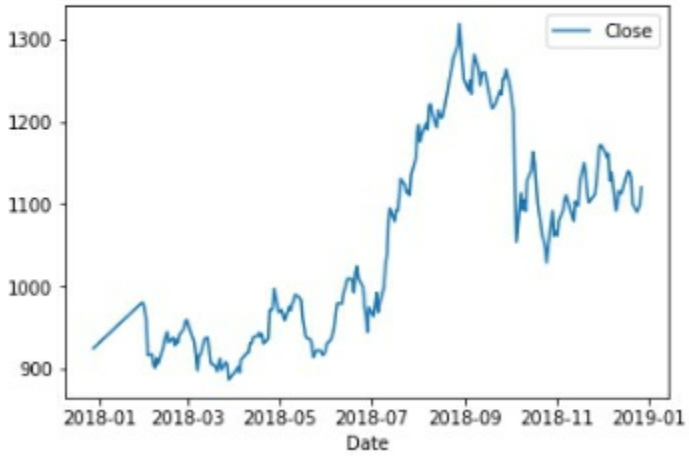
```
2017-12-28
```

```
nifty_fut = get_history(symbol="RELIANCE",
        start=expiry,
        end=expiry,
        futures=True,
        expiry_date=expiry)

niftydata = nifty_fut

nifty_opt = get_history(symbol="RELIANCE",
        start=expiry,
        end=expiry,
        option_type='CE',
        strike_price=1200,
        expiry_date=expiry)

optiondata = nifty_opt

y = expiry + datetime.timedelta(days=1)
```

```
for x in range (4,13):
    expiry = max(get_expiry_date(year=2018, month=x))
    nifty_fut = get_history(symbol="RELIANCE",
        start=y,
        end=expiry,
        futures=True,
        expiry_date=expiry)

    niftydata = niftydata.append(nifty_fut)

    high = nifty_fut[['Close']].max()
    low = nifty_fut[['Close']].min()
    Diff = high - low
    high = int((round(high/20)*20)+100)
    low = int((round(low/20)*20)-100)

    for z in range (low, high, 20):
        nifty_opt = get_history(symbol="RELIANCE",
        start=y,
        end=expiry,
        option_type='CE',
        strike_price=z,
        expiry_date=expiry)
        optiondata = optiondata.append(nifty_opt)
        nifty_opt = get_history(symbol="RELIANCE",
        start=y,
        end=expiry,
        option_type='PE',
        strike_price=z,
        expiry_date=expiry)
        optiondata = optiondata.append(nifty_opt)
    y = expiry + datetime.timedelta(days=1)
```

```
NiftyCF = pd.DataFrame({"Close": niftydata["Close"]})
NiftyCF.plot()
```

```
<matplotlib.axes._subplots.AxesSubplot at 0xc850f60>
```




```
NiftyCO = pd.DataFrame({"Expiry": optiondata['Expiry'],
                        "Type": optiondata['Option Type'],
                        "Strike": optiondata['Strike Price'],
                        "Last": optiondata['Last']})

Opttable = pd.pivot_table(NiftyCO, values ='Last', index =['Date', 'Type', 'Expiry'],
                          columns =['Strike'], aggfunc = np.sum)

Opttable = Opttable.join(NiftyCF)
print (Opttable.tail())
```

```
                           780.0  800.0  820.0  840.0  860.0  880.0  900.0  \
Date       Type Expiry
2018-12-24 PE   2018-12-27    NaN    NaN    NaN    NaN    NaN    NaN    NaN
2018-12-26 CE   2018-12-27    NaN    NaN    NaN    NaN    NaN    NaN    NaN
           PE   2018-12-27    NaN    NaN    NaN    NaN    NaN    NaN    NaN
2018-12-27 CE   2018-12-27    NaN    NaN    NaN    NaN    NaN    NaN    NaN
           PE   2018-12-27    NaN    NaN    NaN    NaN    NaN    NaN    NaN

                           920.0  940.0  960.0  ...  1240.0  1260.0  1280.0  \
Date       Type Expiry                        ...
2018-12-24 PE   2018-12-27    NaN    NaN    NaN  ...  146.00  168.95     NaN
2018-12-26 CE   2018-12-27    NaN    NaN    NaN  ...    0.05    0.10     NaN
           PE   2018-12-27    NaN    NaN    NaN  ...  152.00  180.80     NaN
2018-12-27 CE   2018-12-27    NaN    NaN    NaN  ...    0.05    0.05     NaN
           PE   2018-12-27    NaN    NaN    NaN  ...  120.85  138.00     NaN


                             Close
Date       Type Expiry
2018-12-24 PE   2018-12-27  1090.55
2018-12-26 CE   2018-12-27  1098.60
           PE   2018-12-27  1098.60
2018-12-27 CE   2018-12-27  1120.50
           PE   2018-12-27  1120.50
```

You can export above data in csv format or in excel format to save it on your desktop.

```
In [88]: Opttable.to_csv("RELIANCEOptionpivot2018.csv", index=True, encoding='utf8')
         Opttable.to_excel("RELIANCEOptionpivot2018Excel.xls", index=True, encoding='utf8')
```

Screenshot of above data saved in Excel is given below -

	A	B	C	X	Y	Z	AA	AB	AC	AD	AJ
1	Date	Type	Expiry	1180	1200	1220	1240	1260	1280	1300	Close
267		PE	2018-08-30	12.15	18.3	26.1	37	51	86	81.5	1220.25
268	2018-08-09	CE	2018-08-30	53.3	38	27	18.5	12.3	8	5.15	1220.95
269		PE	2018-08-30	12	18	26.35	37	52.1	72	82.85	1220.95
270	2018-08-10	CE	2018-08-30	43.3	30.5	21	14	9.2	5.9	3.95	1209.65
271		PE	2018-08-30	13.6	20.6	30.5	44	55.75	73	90	1209.65
272	2018-08-13	CE	2018-08-30	31.55	22.05	14.6	9.55	6.45	4.3	3	1192.95
273		PE	2018-08-30	17.1	27.1	39.55	56	70.15	73	106.45	1192.95
274	2018-08-14	CE	2018-08-30	44.9	32	21.8	14.3	9.1	5.8	3.8	1214.15
275		PE	2018-08-30	10.6	17	26.6	38.1	55.65	73	86.9	1214.15
276	2018-08-16	CE	2018-08-30	36.6	25.35	16.7	11.1	7	4.35	2.9	1204.6
277		PE	2018-08-30	12.45	20.4	31.5	45.45	62.3	73	96.8	1204.6
278	2018-08-17	CE	2018-08-30	37	25	16	10.15	6.1	3.8	2.45	1206.6
279		PE	2018-08-30	10.55	18	29.8	44.05	61.05	73	94.55	1206.6
280	2018-08-20	CE	2018-08-30	59.4	42.5	27.75	17.25	10	5.55	2.9	1235.2
281		PE	2018-08-30	3.9	6.85	12.1	21	34	49	67.55	1235.2
282	2018-08-21	CE	2018-08-30	68.5	50	34.3	20.95	12	6.35	3.2	1246.55
283		PE	2018-08-30	2.7	4.55	8	14.3	25	39	56.85	1246.55
284	2018-08-23	CE	2018-08-30	87.1	67.6	49.4	32.25	19.5	10.4	5	1267.1
285		PE	2018-08-30	1.7	2.25	3.5	6.7	13	24	38.75	1267.1
286	2018-08-24	CE	2018-08-30	95.3	75.2	56	38	22.7	11.75	5.65	1277
287		PE	2018-08-30	0.85	1.2	1.9	3.6	7.65	16.2	29.6	1277
288	2018-08-27	CE	2018-08-30	111.35	92.45	72.5	52.25	34	18.65	8.35	1292.3
289		PE	2018-08-30	0.6	0.7	0.85	0.95	2.35	6.25	15	1292.3
290	2018-08-28	CE	2018-08-30	140.9	120.7	99.15	80.1	60.9	41.45	23.95	1318.8
291		PE	2018-08-30	0.5	0.4	0.55	0.65	0.85	1.4	3.65	1318.8
292	2018-08-29	CE	2018-08-30	115.2	96.5	75.35	54.8	35.3	18.45	7.05	1296.5
293		PE	2018-08-30	0.2	0.2	0.3	0.45	0.95	3.5	11	1296.5
294	2018-08-30	CE	2018-08-30	93.9	74	53.5	33	13	0.05	0.05	1275.6

Same way you can get data of any period for any contract. If you will replace ‘RELIANCE’ with ‘SBIN’ you get SBI data in your format in few seconds. That’s why Python is better than Excel for analysis of data. Initial learning will take some time but python will save a lot of your time in long run and you can analyze thousands of data point in few minutes.

GREEKS IN PYTHON

We learned how to fetch past data. We can fetch option prices but historical value of implied volatility is not available on NSE website, you can only check current implied volatility in option chain. We can compute implied volatility of options from option price. This will give you an idea of range of implied volatility of options of any contract.

A new module 'mibian' is used in this program. MibianLib is an open source python library for options pricing. You can use it to calculate the price, the implied volatility, the greeks or the put/call parity of an options. We uused Black-Scholes pricing models for computation of implied volatility in following program. First you need to install mibian through pip install command.

```
#Import basic modules required. Fetch stocks historical prices.
from nsepy import get_history
import datetime
from datetime import date
import pandas as pd
import matplotlib.pyplot as plt
import numpy as np
from nsepy.derivatives import get_expiry_date
import mibian
data = get_history(symbol='RELIANCE',start=date(2019, 1, 1),end=date(2019, 12, 31))
data.head()
```

```
#New table Reliance created
Reliance = pd.DataFrame(index=data.index)
Reliance['Close'] = data['Close']
strike_difference = 20
Reliance['ATM_Strike']  = np.round(data.Close/strike_difference, 0)*strike_difference
Reliance.index = pd.to_datetime(Reliance.index)
Reliance['month'] = Reliance.index.month
Reliance['year'] = Reliance.index.year
Reliance.head()
```

```
# fetched expiry dates
def expiry(df):
    try:
        return max(get_expiry_date(year=df.year,
        month=df.month))
    except:
        return np.NaN
Reliance['expiry_date'] = Reliance.apply(expiry, axis=1)
Reliance.head()
```

```
#fetched closing prices of ATM Strike
def get_option_data(inst_name, start_date, end_date, option_type, strike_price, expiry_date):
        return get_history(symbol=inst_name,
                           start=start_date,
                           end=end_date,
                           option_type=option_type,
                           strike_price=strike_price,
                           expiry_date=expiry_date)

    def get_options_close(df):
    return get_option_data('RELIANCE', df.name, df.name,
    'CE', df.ATM_Strike, df.expiry_date).Close.values

Reliance['options_close'] = Reliance.apply(get_options_close, axis=1)
Reliance.head()
```

```
# Implied volatility computed
Reliance['days_to_expiry'] = (Reliance.expiry_date - Reliance.index.date)
```

```
def call_iv(df):
    try:
        return mibian.BS([df.Close, df.ATM_Strike, 0.05, df.day
        s_to_expiry.days], callPrice=df.options_close).implied
        Volatility
    except:
        return np.nan

Reliance['call_iv'] = Reliance.apply(call_iv, axis=1)
Reliance.head()

#chart of reliance plotted
Reliance.call_iv.plot()
```

Screen shot of above program and their output are given below –

```
from nsepy import get_history
import datetime
from datetime import date
import pandas as pd
import matplotlib.pyplot as plt
import numpy as np
from nsepy.derivatives import get_expiry_date
import mibian

data = get_history(symbol='RELIANCE',start=date(2019, 1, 1),end=date(2019, 12, 31))
```

```
Reliance = pd.DataFrame(index=data.index)
Reliance['Close'] = data['Close']
strike_difference = 20
Reliance['ATM_Strike']  = np.round(data.Close/strike_difference, 0)*strike_differen
Reliance.index = pd.to_datetime(Reliance.index)
Reliance['month'] = Reliance.index.month
Reliance['year'] = Reliance.index.year
Reliance.head()
```

Date	Close	ATM_Strike	month	year
2019-01-01	1121.00	1120.0	1	2019
2019-01-02	1106.40	1100.0	1	2019
2019-01-03	1092.75	1100.0	1	2019
2019-01-04	1098.65	1100.0	1	2019
2019-01-07	1104.75	1100.0	1	2019

```
def expiry(df):
    try:
        return max(get_expiry_date(year=df.year, month=df.month))
    except:
        return np.NaN


Reliance['expiry_date'] = Reliance.apply(expiry, axis=1)
Reliance.head()
```

Date	Close	ATM_Strike	month	year	expiry_date
2019-01-01	1121.00	1120.0	1	2019	2019-01-31
2019-01-02	1106.40	1100.0	1	2019	2019-01-31
2019-01-03	1092.75	1100.0	1	2019	2019-01-31
2019-01-04	1098.65	1100.0	1	2019	2019-01-31
2019-01-07	1104.75	1100.0	1	2019	2019-01-31

```
def get_option_data(inst_name, start_date, end_date, option_type,
                    strike_price, expiry_date):
        return get_history(symbol=inst_name,
                    start=start_date,
                    end=end_date,
                    option_type=option_type,
                    strike_price=strike_price,
                    expiry_date=expiry_date)


def get_options_close(df):
    return get_option_data('RELIANCE', df.name, df.name, 'CE',
                           df.ATM_Strike, df.expiry_date).Close.values


Reliance['options_close'] = Reliance.apply(get_options_close, axis=1)
Reliance.head()
```

Date	Close	ATM_Strike	month	year	expiry_date	options_close
2019-01-01	1121.00	1120.0	1	2019	2019-01-31	[38.35]
2019-01-02	1106.40	1100.0	1	2019	2019-01-31	[39.9]
2019-01-03	1092.75	1100.0	1	2019	2019-01-31	[33.55]
2019-01-04	1098.65	1100.0	1	2019	2019-01-31	[36.65]
2019-01-07	1104.75	1100.0	1	2019	2019-01-31	[36.55]

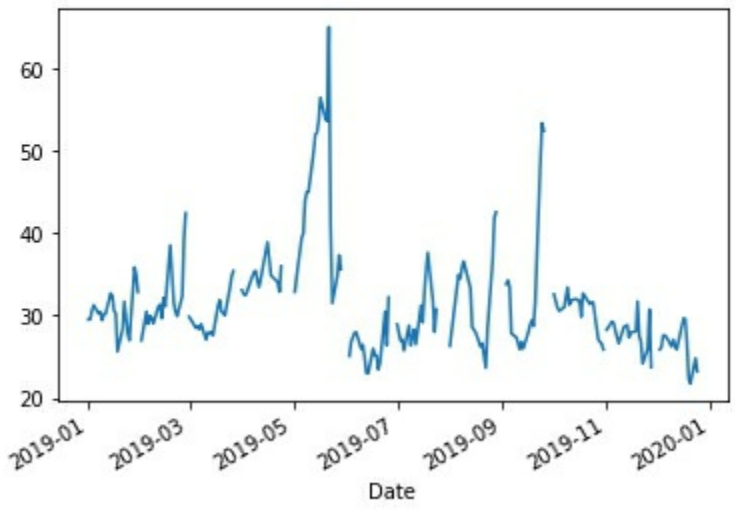
```
Reliance['days_to_expiry'] = (Reliance.expiry_date - Reliance.index.date)
```

```
def call_iv(df):
    try:
        return mibian.BS([df.Close, df.ATM_Strike, 0.05, df.days_to_expiry.days],
                         callPrice=df.options_close).impliedVolatility
    except:
        return np.nan


Reliance['call_iv'] = Reliance.apply(call_iv, axis=1)
Reliance.head()
```

Date	Close	ATM_Strike	month	year	expiry_date	options_close	days_to_expiry	call_iv
2019-01-01	1121.00	1120.0	1	2019	2019-01-31	[38.35]	30 days	29.525757
2019-01-02	1106.40	1100.0	1	2019	2019-01-31	[39.9]	29 days	29.541016
2019-01-03	1092.75	1100.0	1	2019	2019-01-31	[33.55]	28 days	30.586243
2019-01-04	1098.65	1100.0	1	2019	2019-01-31	[36.65]	27 days	31.280518
2019-01-07	1104.75	1100.0	1	2019	2019-01-31	[36.55]	24 days	30.250549

```
Reliance.call_iv.plot()
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x9de1fd0>
```



STRATEGY BACK-TESTING IN PYTHON

TRADING ON MOVING AVERAGE CROSSOVER

We learned how to get past data, now we need to learn how to analyze and back test any strategy. Let's start with one basics strategy. You want to check returns of any stock if you trading on moving average cross over. Before that learn some basic functions of python we are going to use.

We learned how to export data in csv format to laptop. We saved Nifty future and option data from 1st April 2018 to 31 December 2018 in a file 'Optionpivot'. We will use henceforth we will use this file data for strategy testing. We can get data of any csv file thru following command –

optiontable = pd.read_csv('Optionpivot.csv')

In this example I am taking 10 days and 30 days moving averages. If 10 days moving average will cross 30 days moving average from downside to upside than it means price of stock started increasing and trader is buying stock on crossover. If 10 days moving average will cross 30 days moving average from upside to downside than it means price of stock started decreasing and trader is selling stock on crossover. First you will import the relevant modules in Jupyter notebook -

```
from nsepy import get_history
import datetime
from datetime import date
import pandas as pd
import matplotlib.pyplot as plt
import numpy as np


# As discussed we are going to take 10 days and 30 days moving average crossover so Short and long moving average defined for computation
short_MA = 10
long_MA = 30

# data imported from a file saved earlier
optiontable = pd.read_csv('Optionpivot.csv')

# New table created with date and Nifty closing value
Table = pd.DataFrame({"Date": optiontable["Date"], "Close": optiontable["Nifty"]})

# Because of call and put values Nifty closing price with dates are there multiple times. Following command is used to delete duplicate values from table.
Table.drop_duplicates(subset ="Date", keep = 'first', inplace = True)

# Short and long simple moving averages computed form following command
Table['short_mavg'] = Table['Close'].rolling(window=short_MA, min_periods=1, center=False).mean()
Table['long_mavg'] = Table['Close'].rolling(window=long_MA, min_periods=1, center=False).mean()

# 'np.where' command is used to generate signals. We created a new column 'signal' in 'Table'. What this command doing that if value of short moving average will be more than long moving average than corresponding row in the column 'signal' will have value 1 and if short moving average will be less than long moving average than  corresponding row in the column 'signal' will have value 0.

Table['signal'] = 0.0
Table['signal'] = np.where(Table['short_mavg'] > Table['long_mavg'], 1.0, 0.0)

# Generate trading orders
Table['positions'] = Table['signal'].diff()

# Plot the short and long moving averages to show this cross over on charts.
Table[['Close', 'short_mavg', 'long_mavg']].plot()

# Set the initial capital
```

```
initial_capital= float(100000.0)

# Create a table `positions`
positions = pd.DataFrame(index=Table.index).fillna(0.0)

# 1 lot of Nifty bought when signal generated
positions['SH'] = 75*Table['signal']

# Initialize the portfolio with value owned
portfolio = positions.multiply(Table['Close'], axis=0)

# Store the difference in shares owned
pos_diff = positions.diff()

# Added `holdings`, 'cash', and 'total' to portfolio
Table['holdings'] = (positions.multiply(Table['Close'], axis=0)).sum(axis=1)
Table['cash'] = initial_capital - (pos_diff.multiply(Table['Close'], axis=0)).sum(axis=1).cumsum()
Table['total'] = Table['cash'] + Table['holdings']
Table['returns'] = Table['total'].pct_change()

# Print the last five lines of `Table`
print(Table.tail())
```

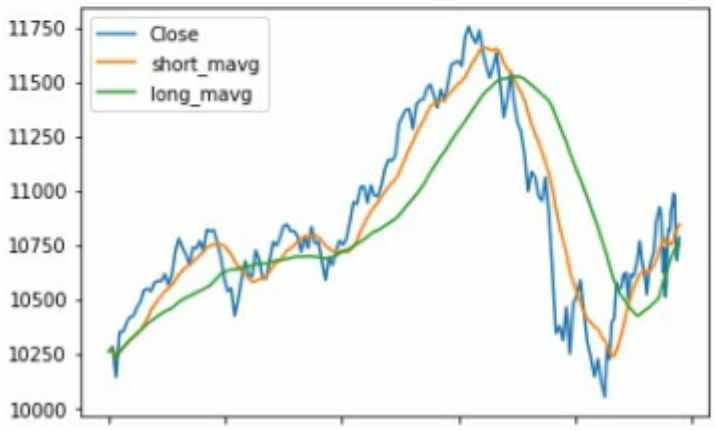
Screen shots of Jupyter notebook with above program is given below –

```
from nsepy import get_history
import datetime
from datetime import date
import pandas as pd
import matplotlib.pyplot as plt
import numpy as np
```

```
short_MA = 10
long_MA = 30

optiontable = pd.read_csv('Optionpivot.csv')

Table = pd.DataFrame({"Date": optiontable["Date"], "Close": optiontable["Nifty"]})
Table.drop_duplicates(subset ="Date", keep = 'first', inplace = True)
Table['short_mavg'] = Table['Close'].rolling(window=short_MA, min_periods=1, center=False).mean()
Table['long_mavg'] = Table['Close'].rolling(window=long_MA, min_periods=1, center=False).mean()
Table['signal'] = 0.0
Table['signal'] = np.where(Table['short_mavg'] > Table['long_mavg'], 1.0, 0.0)
Table['positions'] = Table['signal'].diff()
Table[['Close', 'short_mavg', 'long_mavg']].plot()

initial_capital= float(100000.0)
positions = pd.DataFrame(index=Table.index).fillna(0.0)
positions['SH'] = 75*Table['signal']
portfolio = positions.multiply(Table['Close'], axis=0)
pos_diff = positions.diff()
Table['holdings'] = (positions.multiply(Table['Close'], axis=0)).sum(axis=1)
Table['cash'] = initial_capital - (pos_diff.multiply(Table['Close'], axis=0)).sum(axis=1).cumsum()
Table['total'] = Table['cash'] + Table['holdings']
Table['returns'] = Table['total'].pct_change()
print(Table.tail())
```

```
print(Table.tail())
```

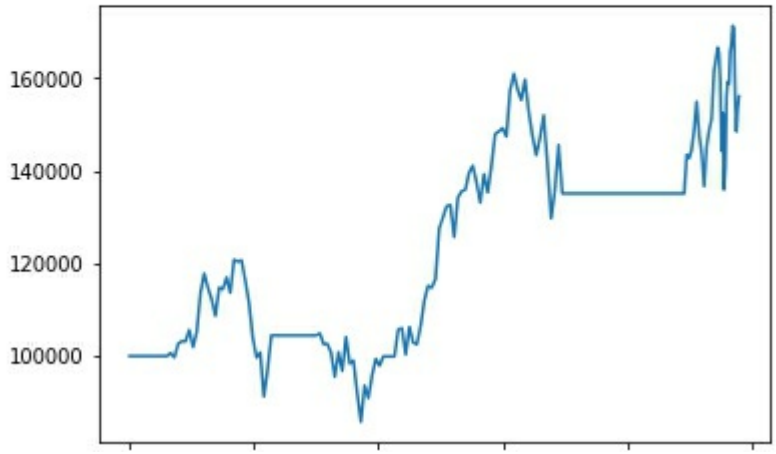
```
           Date     Close  short_mavg     long_mavg  signal  positions  \
972  12/20/2018  10978.20   10807.010  10734.038333     1.0        0.0
974  12/21/2018  10767.50   10810.245  10739.136667     1.0        0.0
976  12/24/2018  10681.90   10826.965  10741.075000     1.0        0.0
978  12/26/2018  10748.50   10843.705  10749.230000     1.0        0.0
980  12/27/2018  10783.65   10843.705  10754.820000     1.0        0.0

      holdings      cash      total   returns
972  823365.00 -652692.5  170672.50 -0.003634
974  807562.50 -652692.5  154870.00 -0.092590
976  801142.50 -652692.5  148450.00 -0.041454
978  806137.50 -652692.5  153445.00  0.033648
980  808773.75 -652692.5  156081.25  0.017180
```



After print command you will get the above chart. Blue line is the closing price of Nifty from 1st April 2018 to 31st March 2018. Orange line is 10 days moving average. Green line is 30 days moving average. When 10 days moving average is crossing downside to upside it's a buy signal and when orange line is crossing green line from upside to downside its sell signal. If you will check the last line of 'Table', on 27th December total value is 1,56,081/-. We started with capital of Rs 1,00,000/- . So past data says that if anyone trading 1 lot of Nifty on 10 days and 30 days moving average cross over during that period will earn a profit of Rs 56000 (Cost of trading and rollover cost not considered). You can download the 'Table' in csv format and open it in excel to check day wise details.

You can plot the total value to check the value of 1 lakh over the period –

```
In [3]: Table['total'].plot()
Out[3]: <matplotlib.axes._subplots.AxesSubplot at 0x936f978>
```



You can refer following blogs for python codes on other technical indicators Bollinger Bands, MACD, RSI, OBV, CCI, EVM, ROC etc -

1. https://blog.quantinsti.com/indicators-build-trend-following-strategy/

2.https://blog.quantinsti.com/build-technical-indicators-in-python/

BACK TESTING NIFTY DATA FOR OPTION STRATEGY 'RATIO'

Now let us back test some option trading strategies on Nifty future and option data. Again we are using the saved Nifty future and option data from 1st April 2017 to 31 December 2017 in a file 'Optionpivot'. Our strategy to back test is that trader is buying 1 lot of 200 points OTM Call and selling 2 lot of 400 points OTM Calls at beginning of every month and holding his position till expiry (for example if ATM 10000 than 200 point OTM means buying 1 lot 10200 and 400 point OTM means selling 2 lot of 10400 call).

#First you will import the relevant modules in Jupyter notebook –

```
from nsepy import get_history
import datetime
from datetime import date
import pandas as pd
import matplotlib.pyplot as plt
import numpy as np
```

past data sved in table 'Optionpivot' imported

```
Table = pd.read_csv('Optionpivot.csv')
Table['month']=pd.to_datetime(Table['Date']).dt.strftime('%m')
```

#'Table 1' created to get ATM strike at beginning of the month

```
Table1 = Table.groupby('month').first()
Table1['M'] = pd.to_datetime(Table1['Date']).dt.strftime('%m')
Table1['ATM_Strike'] = round(Table1['Nifty']/100)*100
```

Monthly date wise prices of option strikes fetched in table 2 thru for loop and appended in table3.

```
Table3 = pd.DataFrame({"Date":['0'], "Close":['0'], "Expiry":['0'], "Type":['0'], "month":['0'],  "ATM":['0'], "OTM":['0'], "Ratio":['0'], "P&L":['0']})

Table4 = pd.DataFrame({"Date":['0'], "Close":['0'], "Expiry":['0'], "Type":['0'], "month":['0'], "ATM":['0'], "OTM":['0'], "Ratio":['0'], "P&L":[0]})

for x in range (0,9):
    e=Table1.M[x]
    #Value of month taken in variable 'e' from row x
    d=Table1.Expiry[x]
    # Value of Expiry taken in variable 'd' from row x
    a= int((Table1.ATM_Strike[x]))
    #Value of ATM strike taken in variable 'a' from Table1
    a=a+200
    b = a+200
    f1 = str(a)
    #value of a converted from integer to string type
    f2 = str(b)
    Table2 = pd.DataFrame({"Date": Table["Date"], "Close":
    Table["Nifty"], "Expiry": Table["Expiry"], "Type": Table["
    Type"],  "month": Table["month"], "ATM": Table[f1], "OTM":
    Table[f2] })

    Table2= Table2.where((Table2.month == e) & (Table2.Ex
    piry == d) & (Table2.Type == "CE"))

    Table2 = Table2.dropna()
    Table2['Ratio']= Table2['ATM'] -(Table2['OTM']*2)
    Table2['P&L']=Table2['Ratio'].diff().cumsum()
```

```
    Table3 = Table3.append(Table2)
    Table4= Table4.append(Table2.where((Table2.Date == d)))
     Table4 = Table4.dropna()
Table4.drop(["Date", "Close", "Expiry", "Type", "ATM", "OTM",  "Ratio"], axis = 1, inplace = True)
Table4['Total_P&L']=Table4['P&L'].cumsum()
print (Table4)
```

Screen shot of above program and output given below -

```
from nsepy import get_history
import datetime
from datetime import date
import pandas as pd
import matplotlib.pyplot as plt
import numpy as np
from nsepy.derivatives import get_expiry_date

Table = pd.read_csv('Optionpivot.csv')
Table['month'] = pd.to_datetime(Table['Date']).dt.strftime('%m')

Table.head()
```

	Date	Nifty	Type	Expiry	7700	7800	7900	8000	8100	8200	...	11500	11600	11700	1180
0	3-Apr-17	9263.25	CE	27-Apr-17	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	NaN	NaN	Nal
1	3-Apr-17	9263.25	PE	27-Apr-17	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	NaN	NaN	Nal

```
Table1 = Table.groupby('month').first()
Table1['M'] = pd.to_datetime(Table1['Date']).dt.strftime('%m')
Table1['ATM_Strike'] = round(Table1['Nifty']/100)*100

Table3 = pd.DataFrame({"Date":['0'], "Close":['0'], "Expiry":['0'],
                       "Type":['0'], "month":['0'], "ATM":['0'],
                       "OTM":['0'], "Ratio":['0'], "P&L":['0']})
Table4 = pd.DataFrame({"Date":['0'], "Close":['0'], "Expiry":['0'],
                       "Type":['0'], "month":['0'], "ATM":['0'],
                       "OTM":['0'], "Ratio":['0'], "P&L":[0]})
for x in range (0,9):
    e=Table1.M[x]
    d=Table1.Expiry[x]
    a= int((Table1.ATM_Strike[x]))
    a=a+200
    b = a+200
    f1 = str(a)
    f2 = str(b)
    Table2 = pd.DataFrame({"Date": Table["Date"], "Close": Table["Nifty"],
                           "Expiry": Table["Expiry"], "Type": Table["Type"],
                       "month": Table["month"], "ATM": Table[f1], "OTM": Table[f2]})
    Table2= Table2.where((Table2.month == e) & (Table2.Expiry == d) & (Table2.Type == "CE"))
    Table2 = Table2.dropna()
    Table2['Ratio']=Table2['ATM']-(Table2['OTM']*2)
    Table2['P&L']=Table2['Ratio'].diff().cumsum()
    Table3 = Table3.append(Table2)
    Table4= Table4.append(Table2.where((Table2.Date == d)))
    Table4 = Table4.dropna()
Table4.drop(["Date", "Close", "Expiry", "Type", "ATM", "OTM", "Ratio"], axis = 1, inplace = True)
Table4['Total_P&L']=Table4['P&L'].cumsum()
print (Table4)
```

Output of the above program is as follows –

```
print (Table4)
```

	month	P&L	Total_P&L
0	0	0.00	0.00
32	04	-13.30	-13.30
70	05	-11.30	-24.60
118	06	-20.25	-44.85
158	07	179.90	135.05
204	08	-26.90	108.15
244	09	-18.15	90.00
280	10	170.05	260.05
330	11	-19.90	240.15
368	12	47.30	287.45

If you will check the output of above program you will find monthly profit loss is computed in column 'P&L'. In 4th month this strategy resulted in loss of Rs 13.30, in next month there was a loss of Rs 11.35. In last column 'Total_P&L' we have computed cumulative profit and loss. So total profit from this strategy is Rs 287/- in 9 months. So approx profit of Rs 21000 per ratio (287 multiplied by Nifty lot size of 75).
Day wise results we saved in 'Table 3'. You can export this table on your system then you can check day wise results.

```
In [9]: Table3.to_csv("Strategy_computation.csv", index=True, encoding='utf8')
```

	A	B	C	D	E	F	G	H	I	J
1		Date	Close	Expiry	Type	month	ATM	OTM	Ratio	P&L
58	122	3-Jul-17	9621.8	27-Jul-17	CE	7	29.4	5.3	18.8	
59	124	4-Jul-17	9624.05	27-Jul-17	CE	7	25.65	4.4	16.85	-1.95
60	126	5-Jul-17	9645.3	27-Jul-17	CE	7	29.7	4.85	20	1.2
61	128	6-Jul-17	9673.35	27-Jul-17	CE	7	31.8	5.1	21.6	2.8
62	130	7-Jul-17	9667.5	27-Jul-17	CE	7	28.95	4.7	19.55	0.75
63	132	10-Jul-17	9776.95	27-Jul-17	CE	7	66.45	11.5	43.45	24.65
64	134	11-Jul-17	9787.25	27-Jul-17	CE	7	72.7	12.65	47.4	28.6
65	136	12-Jul-17	9822.35	27-Jul-17	CE	7	92.8	17.9	57	38.2
66	138	13-Jul-17	9887.5	27-Jul-17	CE	7	125.15	27.9	69.35	50.55
67	140	14-Jul-17	9899.55	27-Jul-17	CE	7	134.25	26.3	81.65	62.85
68	142	17-Jul-17	9933.15	27-Jul-17	CE	7	155	32.75	89.5	70.7
69	144	18-Jul-17	9846.3	27-Jul-17	CE	7	91.55	13.75	64.05	45.25
70	146	19-Jul-17	9919.15	27-Jul-17	CE	7	139	24	91	72.2
71	148	20-Jul-17	9888.05	27-Jul-17	CE	7	107.5	15.15	77.2	58.4
72	150	21-Jul-17	9910.55	27-Jul-17	CE	7	122.8	15.4	92	73.2
73	152	24-Jul-17	9955.8	27-Jul-17	CE	7	166.25	22	122.25	103.45
74	154	25-Jul-17	9973.8	27-Jul-17	CE	7	174.55	22.85	128.85	110.05
75	156	26-Jul-17	10023.05	27-Jul-17	CE	7	228	44.5	139	120.2
76	158	27-Jul-17	10025.2	27-Jul-17	CE	7	217.1	9.2	198.7	179.9
77	164	1-Aug-17	10138.45	31-Aug-17	CE	8	51.85	12.5	26.85	
78	166	2-Aug-17	10101.1	31-Aug-17	CE	8	35.65	9.5	16.65	-10.2
79	168	3-Aug-17	10043	31-Aug-17	CE	8	24.5	6	12.5	-14.35
80	170	4-Aug-17	10108.55	31-Aug-17	CE	8	33	7.65	17.7	-9.15
81	172	7-Aug-17	10091.75	31-Aug-17	CE	8	27.5	6.5	14.5	-12.35

In date column we have date, in close column we have end of the day closing price of nifty. In the month of April 2018 Nifty was trading at 10264. So ATM is 10300. We have taken value of ATM in variable 'a' than our next command is a=a+200, it means ATM will have the value of 10500 and OTM will have the value of 10700. In ATM column we have end of day closing price of 10500 call and in OTM column we have end of the day closing price of 10500 call in the month of April 2017. In the column ratio prices of 1 lot ATM bought and 2 lots OTM sold computed. Last column is day wise cumulative profit and loss. In the above screen shot we have taken data of July 2017. On 3rd July Nifty was 9621 so our ATM strike will be 9600. In column ATM we have closing prices of strike 9800 Call and in OTM column we have closing prices of strike 10000 Call. On expiry day trader earned profit of Rs 179.9 in the month of July.

With this program you can compute profit and loss for any contract. With small modifications you can compute profit and loss of other strategies also. We have taken prices of 2017. Lets compute profit loss of same strategy for year 2018. It will take hardly 5 minutes and we will get results. I just change the input file and taken raw data of 2018. Please refer below output of code; in 2018 this strategy earned profit of 279.95. Although this strategy is profitable continuously for 2 years but still better not to go with it because you are buying 1 lot and selling 2 lots. One big movement on upside can give a big loss to trader. Trader is buying 1 lot 200 point above and selling 2 lot 400 points above so when underlying will go above 600 point in any month trader will lose money. On a big movement of 1000 point in a month trader can lose more than 400 point in single month whereas total profit in 9 months is 279 point only. So risk reward of this strategy is not much favorable.

```
    Table3 = Table3.append(Table2)
    Table4= Table4.append(Table2.where((Table2.Date == d)))
    Table4 = Table4.dropna()
Table4.drop(["Date", "Close", "Expiry", "Type", "ATM", "OTM",
Table4['Total_P&L']=Table4['P&L'].cumsum()
print (Table4)
```

```
    month     P&L  Total_P&L
0       0    0.00       0.00
108    04   78.35      78.35
252    05  -27.55      50.80
372    06  -20.30      30.50
492    07  130.10     160.60
630    08   50.30     210.90
738    09  -24.35     186.55
846    10  -18.20     168.35
940    11  129.40     297.75
980    12  -17.80     279.95
```

In above program you can select any strike or combination of strikes and you can perform any computation. We can run program on any contract of NSE/BSE options for any period and we will get results of strategy in few minutes. This is the best thing with Python.

BACK TESTING NIFTY DATA FOR OPTION STRATEGY ‘RATIO BACK SPREAD’

Now let us back test some option trading strategies on Bank Nifty future and option data. Again we are using the saved Bank Nifty future and option data from 1st April 2018 to 31 December 2018 in a file ‘bank_nifty’. Our strategy to back test is that trader is selling 1 lot of ATM Call and buying 2 lot of 400 point OTM Calls at beginning of every month and holding his position till expiry (for example if ATM 24400 than selling 1 lot 24400 and 400 point OTM means buying 2 lot of 10400 call).

#First you will import the relevant modules in Jupyter notebook –

```
from nsepy import get_history
import datetime
from datetime import date
import pandas as pd
import matplotlib.pyplot as plt
import numpy as np
```

past data sved in table ‘bank_nifty’ imported

```
Table = pd.read_csv('bank_nifty.csv')
Table['month']=pd.to_datetime(Table['Date']).dt.strftime('%m')
Table.head()
```

```
Table.head()
```

Out[1]:

ed: 0	Date	Type	Expiry	23600	23700	23800	23900	24000	24100	...	28100	28200	28300	28400	28500	28600	28700	28800	Nifty	month
0	4/2/2018	CE	4/26/2018	885.00	735.60	895.75	781.10	735.50	670.60	...	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	24431.25	04
1	4/2/2018	PE	4/26/2018	207.05	232.10	253.25	279.90	313.75	340.50	...	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	24431.25	04
2	4/3/2018	CE	4/26/2018	885.00	979.95	930.00	842.70	827.40	765.40	...	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	24596.25	04
3	4/3/2018	PE	4/26/2018	153.55	172.05	190.85	212.75	240.40	265.45	...	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	24596.25	04
4	4/4/2018	CE	4/26/2018	1055.35	979.95	732.00	626.00	552.40	489.05	...	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	24148.60	04

#’Table 1’ created to get ATM strike at beginning of the month

```
Table1 = Table.groupby('month').first()
Table1['M'] = pd.to_datetime(Table1['Date']).dt.strftime('%m')
Table1['ATM_Strike'] = round(Table1['Nifty']/100)*100
```

Monthly date wise prices of option strikes fetched in table 2 thru for loop and appended in table3.

```
Table3 = pd.DataFrame({"Date":['0'], "Close":['0'], "Expiry":['0'], "Type":['0'], "month":['0'],  "ATM":['0'], "OTM":['0'], "Ratio":['0'], "P&L":['0']})

Table4 = pd.DataFrame({"Date":['0'], "Close":['0'], "Expiry":['0'], "Type":['0'], "month":['0'], "ATM":['0'], "OTM":['0'], "Ratio":['0'], "P&L":[0]})
```

```
for x in range (0,9):
    e=Table1.M[x]
    #Value of month taken in variable ‘e’ from row x
    d=Table1.Expiry[x]
    # Value of Expiry taken in variable ‘d’ from row x
```

```
    a= int((Table1.ATM_Strike[x]))
    #Value of ATM strike taken in variable ‘a’ from Table1
    b = a+400
    f1 = str(a)
    #value of a converted from integer to string type
    f2 = str(b)

    Table2 = pd.DataFrame({"Date": Table["Date"], "Close":
    Table["Nifty"], "Expiry": Table["Expiry"], "Type": Table["
    Type"],  "month":  Table["month"], "ATM": Table[f1], "OTM":
    Table[f2] })

   Table2= Table2.where((Table2.month == e) & (Table2.Ex
   piry == d) & (Table2.Type == "CE"))

    Table2 = Table2.dropna()
    Table2['Ratio']= (Table2['OTM']*2)-Table2['ATM']
    Table2['P&L']=Table2['Ratio'].diff().cumsum()
    Table3 = Table3.append(Table2)
    Table4= Table4.append(Table2.where((Table2.Date == d)))
     Table4 = Table4.dropna()
Table4.drop(["Date", "Close", "Expiry", "Type", "ATM", "OTM",  "Ratio"], axis = 1, inplace = True)
Table4['Total_P&L']=Table4['P&L'].cumsum()
print (Table4)
```

Screen shot of above program and output given below. 6 months out of 9 months there was loss and in 3 months there was profit. Still this strategy resulted into a profit of Rs 482/- in 9 months. This strategy is just opposite of previous one. Because in this strategy you are buying 2 lot so big movement upside can you a big profit. Good thing with strategies when you buying more lot than selling is that you know the maximum possible loss so you need not to compute maximum drawdown in past.

```
print (Table4)
```

	month	P&L	Total_P&L
0	0	0.00	0.00
36	04	-343.00	-343.00
84	05	584.15	241.15
124	06	-77.20	163.95
164	07	341.25	505.20
210	08	-403.20	102.00
246	09	-25.60	76.40
282	10	-104.65	-28.25
328	11	620.05	591.80
366	12	-109.70	482.10

Let's run this strategy on the data of 2019. Screen shot of Python Jupyter notebook of code and results of this strategy in first 11 months of 2019 are given below –

```
from nsepy import get_history
import datetime
from datetime import date
import pandas as pd
import matplotlib.pyplot as plt
import numpy as np
from nsepy.derivatives import get_expiry_date

Table = pd.read_csv('BANKNiftyOptionpivot2019.csv')
Table['month'] = pd.to_datetime(Table['Date']).dt.strftime('%m')

Table.head()
```

```
Table1 = Table.groupby('month').first()
Table1['M'] = pd.to_datetime(Table1['Date']).dt.strftime('%m')
Table1['ATM_Strike'] = round(Table1['Close']/100)*100

Table3 = pd.DataFrame({"Date":['0'], "Close":['0'], "Expiry":['0'],
                       "Type":['0'], "month":['0'], "ATM":['0'],
                       "OTM":['0'], "Ratio":['0'], "P&L":['0']})
Table4 = pd.DataFrame({"Date":['0'], "Close":['0'], "Expiry":['0'],
                       "Type":['0'], "month":['0'], "ATM":['0'],
                       "OTM":['0'], "Ratio":['0'], "P&L":[0]})
for x in range (0,12):
    e=Table1.M[x]
    d=Table1.Expiry[x]
    a= int((Table1.ATM_Strike[x]))
    b = a+400
    f1 = str(a)+".0"
    f2 = str(b)+".0"
    Table2 = pd.DataFrame({"Date": Table["Date"], "Close": Table["Close"],
                           "Expiry": Table["Expiry"], "Type": Table["Type"],
                       "month": Table["month"], "ATM": Table[f1], "OTM": Table[f2]})
    Table2= Table2.where((Table2.month == e) & (Table2.Expiry == d) & (Table2.Type == "CE"))
    Table2 = Table2.dropna()
    Table2['Ratio']=(Table2['OTM']*2)-Table2['ATM']
    Table2['P&L']=Table2['Ratio'].diff().cumsum()
    Table3 = Table3.append(Table2)
    Table4= Table4.append(Table2.where((Table2.Date == d)))
    Table4 = Table4.dropna()
Table4.drop(["Date", "Close", "Expiry", "Type", "ATM", "OTM", "Ratio"], axis = 1, inplace = True)
Table4['Total_P&L']=Table4['P&L'].cumsum()
print (Table4)
```

```
print (Table4)
```

	month	P&L	Total_P&L
0	0	0.00	0.00
48	01	-71.85	-71.85
88	02	-75.95	-147.80
124	03	2385.90	2238.10
160	04	-230.30	2007.80
206	05	385.90	2393.70
244	06	-112.45	2281.25
284	07	-126.95	2154.30
330	08	-177.10	1977.20
366	09	2127.50	4104.70
410	10	-149.70	3955.00
448	11	603.15	4558.15

So this strategy resulted into a profit of Rs 4558 in 11 months of year 2019. Day wise results we saved in ‘Table 3’. You can export this table on your system than you can check day wise results. Day wise computation of March 2019 is given in below table. Trader sold 1 lot of ATM at 426 Rs and trader bought 2 lots of 400 point OTM at Rs 235. So total cost to the trader at the time of buying was Rs 44/-. Total profit at end of the month was Rs 2385.

```
In [35]: Table3.to_csv("Strategy_computation.csv", index=True, encoding='utf8')
```

	A	B	C	D	E	F	G	H	I	J
1		Date	Close	Expiry	Type	month	ATM	OTM	Ratio	P&L
46	90	3/1/2019	27201.3	3/28/2019	CE	3	426	235	44	
47	92	3/5/2019	27645.5	3/28/2019	CE	3	682.6	428.95	175.3	131.3
48	94	3/6/2019	27692.4	3/28/2019	CE	3	708.25	428.35	148.45	104.45
49	96	3/7/2019	27833.85	3/28/2019	CE	3	767.95	484.35	200.75	156.75
50	98	3/8/2019	27883.15	3/28/2019	CE	3	795.05	497.8	200.55	156.55
51	100	3/11/2019	28080.7	3/28/2019	CE	3	948.5	622.05	295.6	251.6
52	102	3/12/2019	28528.1	3/28/2019	CE	3	1355	980	605	561
53	104	3/13/2019	28938.8	3/28/2019	CE	3	1758.25	1396.5	1034.75	990.75
54	106	3/14/2019	29012.25	3/28/2019	CE	3	1816	1413.8	1011.6	967.6
55	108	3/15/2019	29465.5	3/28/2019	CE	3	2294	1894	1494	1450
56	110	3/18/2019	29660.35	3/28/2019	CE	3	2350	2078.8	1807.6	1763.6
57	112	3/19/2019	29858.1	3/28/2019	CE	3	2350	2240	2130	2086
58	114	3/20/2019	29931.3	3/28/2019	CE	3	2709.65	2325	1940.35	1896.35
59	116	3/22/2019	29638.55	3/28/2019	CE	3	2451.6	2051.6	1651.6	1607.6
60	118	3/25/2019	29312	3/28/2019	CE	3	2027.05	1651.8	1276.55	1232.55
61	120	3/26/2019	29969.7	3/28/2019	CE	3	2763.35	1968	1172.65	1128.65
62	122	3/27/2019	30040.9	3/28/2019	CE	3	2850.9	2410	1969.1	1925.1
63	124	3/28/2019	30431.4	3/28/2019	CE	3	3200.1	2815	2429.9	2385.9
64	128	4/1/2019	30504.15	4/25/2019	CE	4	540	385.25	230.5	
65	130	4/2/2019	30564.75	4/25/2019	CE	4	631.45	428.8	226.15	-4.35
66	132	4/3/2019	30330.9	4/25/2019	CE	4	470	305.9	141.8	-88.7
67	134	4/4/2019	30155	4/25/2019	CE	4	339	192.4	45.8	-184.7
68	136	4/5/2019	30316.5	4/25/2019	CE	4	391.4	228	64.6	-165.9

BACK TESTING NIFTY DATA FOR OPTION STRATEGY 'BUTTERFLY'

Now let us back test some option trading strategies on Nifty future and option data. Again we are using the saved Nifty future and option data from 1st April 2017 to 31 December 2017 in a file 'Optionpivot'. Trader is selling 200 point Nifty butterfly of calls at beginning of every month and holding his position till expiry. So trader selling 1 lot 200point ITM Call, buying 2 lot ATM call and selling 1 lot 200 point OTM call. He is doing so at beginning of every month -

#First you will import the relevant modules in Jupyter notebook –

```
from nsepy import get_history
import datetime
from datetime import date
import pandas as pd
import matplotlib.pyplot as plt
import numpy as np
```

past data sved in table 'Optionpivot' imported

```
Table = pd.read_csv('Optionpivot.csv')
Table['month']=pd.to_datetime(Table['Date']).dt.strftime('%m')
```

#'Table 1' created to get ATM strike at beginning of the month

```
Table1 = Table.groupby('month').first()
Table1['M'] = pd.to_datetime(Table1['Date']).dt.strftime('%m')
Table1['ATM_Strike'] = round(Table1['Nifty']/100)*100

Table3 = pd.DataFrame({"Date":['0'], "Close":['0'], "Expiry":['0'], "Type":['0'], "month":['0'],  "ATM":['0'], "OTM":['0'], "ITM":['0'], "Butterfly":['0'], "P&L":['0']})

Table4 = pd.DataFrame({"Date":['0'], "Close":['0'], "Expiry":['0'], "Type":['0'], "month":['0'], "ATM":['0'], "OTM":['0'], "ITM":['0'], "Butterfly":['0'], "P&L":[0]})
```

Monthly date wise prices of option strikes fetched in table 2 thru for loop and appended in table3.

```
for x in range (0,9):
    e=Table1.M[x]
    #Value of month taken in variable 'e' from row x
    d=Table1.Expiry[x]
    # Value of Expiry taken in variable'd' from row x
    a= int((Table1.ATM_Strike[x]))
    #Value of ATM strike taken in variable 'a' from Table1
    b = a+200
  c = a-200
    f1 = str(a)
    #value of a converted from integer to string type
    f2 = str(b)
  f2 = str(c)

  Table2 = pd.DataFrame({"Date": Table["Date"], "Close":
  Table["Nifty"], "Expiry": Table["Expiry"], "Type": Table["
  Type"],  "month": Table["month"], "ATM": Table[f1], "OTM":
  Table[f2], "OTM": Table[f3] })

  Table2= Table2.where((Table2.month == e) & (Table2.Ex
  piry == d) & (Table2.Type == "CE"))
```

```
    Table2 = Table2.dropna()

    Table2['Butterfly']=(Table2['ATM']*2)-Table2['ITM']
    -Table2['OTM']

    Table2['P&L']=Table2['Butterfly'].diff().cumsum()


     Table3 = Table3.append(Table2)

    Table4= Table4.append(Table2.where((Table2.Date == d)))
     Table4 = Table4.dropna()


Table4.drop(["Date", "Close", "Expiry", "Type", "ATM", "OTM",  "butterfly"], axis = 1, inplace =True)
Table4['Total_P&L']=Table4['P&L'].cumsum()
print (Table4)
```

Screenshot of Jupyter notebook of above program-

```
from nsepy import get_history
import datetime
from datetime import date
import pandas as pd
import matplotlib.pyplot as plt
import numpy as np
from nsepy.derivatives import get_expiry_date

Table = pd.read_csv('Optionpivot.csv')
Table['month'] = pd.to_datetime(Table['Date']).dt.strftime('%m')

Table.head()
```

```
Table1 = Table.groupby('month').first()
Table1['M'] = pd.to_datetime(Table1['Date']).dt.strftime('%m')
Table1['ATM_Strike'] = round(Table1['Nifty']/100)*100

Table3 = pd.DataFrame({"Date":['0'], "Close":['0'], "Expiry":['0'], "Type":['0'], "month":['0'],
                       "ATM":0, "OTM":0, "ITM":0, "Butterfly":0, "P&L":0})
Table4 = pd.DataFrame({"Date":['0'], "Close":['0'], "Expiry":['0'], "Type":['0'], "month":['0'],
                       "ATM":0, "OTM":0, "ITM":0, "Butterfly":0, "P&L":0})

for x in range (0,9):
    e=Table1.M[x]
    d=Table1.Expiry[x]
    a= int((Table1.ATM_Strike[x]))
    b = a+200
    c = a-200
    f1 = str(a)
    f2 = str(b)
    f3 = str(c)
    Table2 = pd.DataFrame({"Date": Table["Date"], "Close": Table["Nifty"], "Expiry": Table["Expiry"],
                           "Type": Table["Type"], "month": Table["month"], "ATM": Table[f1],
                           "OTM": Table[f2], "ITM": Table[f3]})
    Table2= Table2.where((Table2.month == e) & (Table2.Expiry == d) & (Table2.Type == "CE"))
    Table2 = Table2.dropna()
    Table2['Butterfly']=(Table2['ATM']*2)-Table2['ITM']-Table2['OTM']
    Table2['P&L']=Table2['Butterfly'].diff().cumsum()
    Table3 = Table3.append(Table2)
    Table4= Table4.append(Table2.where((Table2.Date == d)))
    Table4 = Table4.dropna()
```

```
Table4.drop(["Date", "Close", "Expiry", "Type", "ATM", "OTM", "ITM", "Butterfly"],
            axis = 1, inplace = True)
Table4['Total_P&L']=Table4['P&L'].cumsum()
print (Table4)
```

```
    month     P&L  Total_P&L
0       0    0.00       0.00
32     04 -103.50    -103.50
70     05   57.30     -46.20
118    06  -39.85     -86.05
158    07   43.45     -42.60
204    08   43.95       1.35
244    09   57.50      58.85
280    10   47.55     106.40
330    11   51.35     157.75
368    12   54.10     211.85
```

If you will check the output of above program you will find monthly profit loss is computed in column ‘P&L’. In April 2017 (04 month) this strategy resulted in loss of Rs 103.5, in next month there was a profit of Rs 57.30. In last column ‘Total_P&L’ we have computed cumulative profit and loss. So total profit in 9 months from this strategy is Rs 211.85 (Approx Rs 16,000 per butterfly).

Day wise results we saved in ‘Table 3’. You can export this table on your system than you can check day wise results. Let us see what happened in April 2017 when trader lost maximum.

```
Table3.to_csv("Daywise_strategy_computation.csv", index=True, encoding='utf8')
```

	A	B	C	D	E	F	G	H	I	J	K
1		Date	Close	Expiry	Type	month	ATM	OTM	ITM	Butterfly	P&L
2	0	3-Apr-17	9263.25	27-Apr-17	CE	4	81.5	18.35	211.95	-67.3	
3	2	5-Apr-17	9286.55	27-Apr-17	CE	4	82.55	15.9	216.95	-67.75	-0.45
4	4	6-Apr-17	9272.25	27-Apr-17	CE	4	68.9	11.35	197.2	-70.75	-3.45
5	6	7-Apr-17	9211.45	27-Apr-17	CE	4	49.2	6.1	160.9	-68.6	-1.3
6	8	10-Apr-17	9209.35	27-Apr-17	CE	4	42.35	4.35	151.45	-71.1	-3.8
7	10	11-Apr-17	9264.45	27-Apr-17	CE	4	58.8	6.8	191	-80.2	-12.9
8	12	12-Apr-17	9223.2	27-Apr-17	CE	4	42.15	4.2	159.2	-79.1	-11.8
9	14	13-Apr-17	9182.25	27-Apr-17	CE	4	25.6	2.4	122	-73.2	-5.9
10	16	17-Apr-17	9168.35	27-Apr-17	CE	4	18.1	1.5	109.35	-74.65	-7.35
11	18	18-Apr-17	9123.35	27-Apr-17	CE	4	12	1.1	79.4	-56.5	10.8
12	20	19-Apr-17	9135	27-Apr-17	CE	4	10.85	1.15	84.8	-64.25	3.05
13	22	20-Apr-17	9162.6	27-Apr-17	CE	4	8.2	0.6	87.9	-72.1	-4.8
14	24	21-Apr-17	9127	27-Apr-17	CE	4	4.6	0.45	62.25	-53.5	13.8
15	26	24-Apr-17	9224.45	27-Apr-17	CE	4	10.35	0.65	131.4	-111.35	-44.05
16	28	25-Apr-17	9293.9	27-Apr-17	CE	4	27.7	0.85	194	-139.45	-72.15
17	30	26-Apr-17	9342.1	27-Apr-17	CE	4	51.55	1.05	239.45	-137.4	-70.1
18	32	27-Apr-17	9345.75	27-Apr-17	CE	4	30.25	0.05	231.25	-170.8	-103.5
19	36	2-May-17	9339.3	25-May-17	CE	5	116.45	27.4	265	-59.5	
20	38	3-May-17	9340.25	25-May-17	CE	5	114.1	26.6	261.2	-59.6	-0.1
21	40	4-May-17	9376.95	25-May-17	CE	5	137.1	35	296.15	-56.95	2.55
22	42	5-May-17	9316.7	25-May-17	CE	5	97.15	20.65	239	-65.35	-5.85
23	44	8-May-17	9343.6	25-May-17	CE	5	106.5	20.7	260	-67.7	-8.2
24	46	9-May-17	9350.4	25-May-17	CE	5	104.8	18.75	262	-71.15	-11.65

On 3rd April 201 Nifty was trading at 9263 so nearest strike is 9300. So we have Strike 9300 closing prices of Call options in column ATM , strike 9100 call options in ITM and 9500 call options in OTM. Second last column we have butterfly prices and lost column is cumulative P&L for the month. With some small modifications you can compute prices of butterfly of other strikes also.

Same program code could be used for any contract and for any period it will take few minutes to fetch data and modify this program according to new contract. You will get the output in few seconds.

BACK TESTING NIFTY DATA FOR OPTION STRATEGY ‘STRADDLE’

This is the program code for strategy straddle. Again we are using the saved Nifty future and option data from 1st April 2018 to 31 December 2018 in a file ‘Optionpivot1’. Trader is buying Nifty ATM Call & Put at beginning of every month and holding his position till expiry-

```
from nsepy import get_history
from datetime import datetime
import pandas as pd
import matplotlib.pyplot as plt
import numpy as np

nifty = pd.read_csv('Optionpivot1.csv')
nifty['month']=pd.to_datetime(nifty['Date']).dt.strftime('%m')
nifty['day'] = pd.to_datetime(nifty['Date']).dt.strftime('%d')

Table1 = nifty.groupby('month').first()
Table1['M'] = pd.to_datetime(Table1['Date']).dt.strftime('%m')
Table1['ATM_Strike'] = round(Table1['Nifty']/100)*100

Table3 = pd.DataFrame({"Date": ["0"], "Close":0, "Expiry": ["0"], "Type": ["0"], "month":0, "day": ["0"]})
Table5 = pd.DataFrame({"Date": ["0"], "Close":0, "Expiry": ["0"], "Type": ["0"], "month":0, "day": ["0"]})

for x in range (0,9):
    e=Table1.M[x]
    d=Table1.Expiry[x]
    a= int((Table1.ATM_Strike[x]))
    f1 = str(a)
    Table2 = pd.DataFrame({"Date": nifty["Date"], "Close":
    nifty["Nifty"], "Expiry": nifty["Expiry"], "Type": nifty["
    Type"], "month": nifty["month"], "day": nifty["day"],
    "CE_ATM": nifty[f1]})
    Table6= Table2.where((Table2.month == e) & (Table2.Ex
    piry == d) & (Table2.Type == 'CE'))
    Table4= Table2.where((Table2.month == e) & (Table2.Ex
    piry == d) & (Table2.Type == 'PE'))
    Table6 = Table6.dropna()
    Table4 = Table4.dropna()
    Table6.set_index("Date", inplace = True)
    Table4.set_index("Date", inplace = True)
    Table4['PE_ATM'] = Table6['CE_ATM']
    Table4['Straddle']=(Table4['CE_ATM']+Table4['PE_ATM'])
    Table4['P&L']=Table4['Straddle'].diff().cumsum()
    Table3 = Table3.append(Table4)
    Table7 = Table4.groupby('month').last()
    Table5 = Table5.append(Table7)

Table5.drop(["Date", "Close", "Type", "month", "day"], axis = 1, inplace = True)
Table5 = Table5.dropna()
Table5['Total_P&L']=Table5['P&L'].cumsum()
print (Table5)
```

Output of above print command-

	Expiry	CE_ATM	PE_ATM	Straddle	P&L	Total_P&L
0	0	0	0	0	0.00	0.00
04	4/26/2018	307.9	0.05	307.95	17.45	17.45
05	5/31/2018	20.75	2.75	23.5	-257.55	-240.10
06	6/28/2018	0.1	106.95	107.05	-172.85	-412.95
07	7/26/2018	459.8	0.05	459.85	191.80	-221.15
08	8/30/2018	270.6	0.05	270.65	-1.60	-222.75
09	9/27/2018	0.05	621.6	621.65	336.40	113.65
10	10/25/2018	0.05	975.35	975.4	629.00	742.65
11	11/29/2018	450.4	0.05	450.45	43.10	785.75
12	12/27/2018	0.1	107.55	107.65	-282.10	503.65

```
Table8.to_csv("Strategy_computation.csv", index=True, encoding='utf8')
```

Day wise computation saved in Table8. You can export this table on your system then you can check day wise results. Day wise computation of April 2018 is given below-

	A	B	C	D	E	F	G	H	I	J	K
1		Date	Close	Expiry	Type	month	day	CE_ATM	PE_ATM	Straddle	P&L
2	3-Apr-17		9263.25	27-Apr-17	CE	4	3	81.5	109.05	-190.55	
3	5-Apr-17		9286.55	27-Apr-17	CE	4	5	82.55	102.5	-185.05	5.5
4	6-Apr-17		9272.25	27-Apr-17	CE	4	6	68.9	105.6	-174.5	16.05
5	7-Apr-17		9211.45	27-Apr-17	CE	4	7	49.2	132.65	-181.85	8.7
6	10-Apr-17		9209.35	27-Apr-17	CE	4	10	42.35	131.9	-174.25	16.3
7	11-Apr-17		9264.45	27-Apr-17	CE	4	11	58.8	92.3	-151.1	39.45
8	12-Apr-17		9223.2	27-Apr-17	CE	4	12	42.15	115.95	-158.1	32.45
9	13-Apr-17		9182.25	27-Apr-17	CE	4	13	25.6	143.05	-168.65	21.9
10	17-Apr-17		9168.35	27-Apr-17	CE	4	17	18.1	147.25	-165.35	25.2
11	18-Apr-17		9123.35	27-Apr-17	CE	4	18	12	192.4	-204.4	-13.85
12	19-Apr-17		9135	27-Apr-17	CE	4	19	10.85	163.65	-174.5	16.05
13	20-Apr-17		9162.6	27-Apr-17	CE	4	20	8.2	142.55	-150.75	39.8
14	21-Apr-17		9127	27-Apr-17	CE	4	21	4.6	170.9	-175.5	15.05
15	24-Apr-17		9224.45	27-Apr-17	CE	4	24	10.35	86.95	-97.3	93.25
16	25-Apr-17		9293.9	27-Apr-17	CE	4	25	27.7	34	-61.7	128.85
17	26-Apr-17		9342.1	27-Apr-17	CE	4	26	51.55	11.2	-62.75	127.8
18	27-Apr-17		9345.75	27-Apr-17	CE	4	27	30.25	0.05	-30.3	160.25
19	2-May-17		9339.3	25-May-17	CE	5	2	116.45	78.7	-195.15	
20	3-May-17		9340.25	25-May-17	CE	5	3	114.1	81.25	-195.35	-0.2
21	4-May-17		9376.95	25-May-17	CE	5	4	137.1	62.2	-199.3	-4.15
22	5-May-17		9316.7	25-May-17	CE	5	5	97.15	87	-184.15	11
23	8-May-17		9343.6	25-May-17	CE	5	8	106.5	66.2	-172.7	22.45

Above program code could be used to compute return of buy or sell straddle of any contract for any period.

STRATEGY DEVELOPMENT THROUGH DATA VISUALISATION IN PYTHON

Through Data visualization we try to understand data by placing it in a visual context so that patterns, trends and correlations that might not otherwise be detected can be exposed.

This program code written to visualize change in butterfly prices with change in price of Index future. (Same program code could be used for computation of prices of any strategy with some modifications in last loop of program) Through following program code we are fetching call options data of July 2020 then we are computing butterfly prices of various strikes. **As we have computed day wise strike wise historical butterfly prices with this python code in the same way day wise strike wise prices can be computed for any strategy. By observing this data on Excel or on chart you can try to find fixed patterns. Any pattern that is repetitive is a strategy to trade. For example I observed in weekly options of Nifty that buying Call & Put butterfly with ATM strikes was profitable (If Nifty if 12000 then buying 12100 Call butterfly along with 11900 Put butterly of 100 points). Reason? Why this strategy was profitable? This was profitable because Nifty weekly options prices on Thursday (expiry day) remains in the range of +- 200 points from the previous opening prices on Friday 80% of the time.**

This way you can develop your own strategies for the contract you are trading.

We are using Plotly Python library also in following program code. Plotly Python is a library which helps in data visualisation in an interactive manner. For that first you need to install Plotly through command

!pip install plotly.

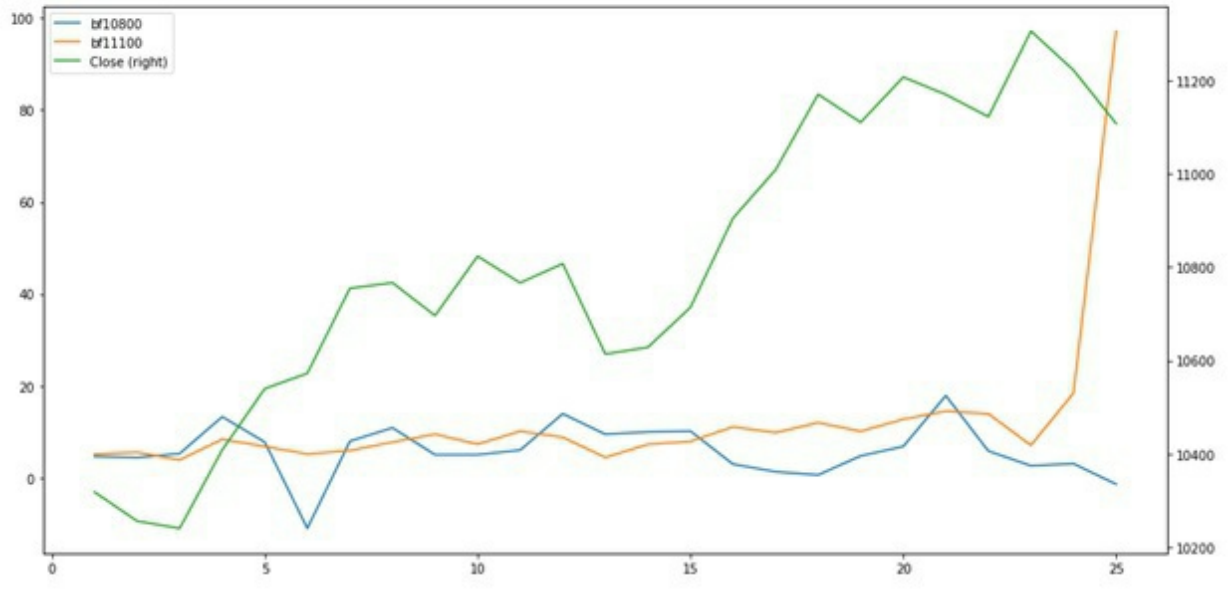
Python code –

```
from nsepy import get_history
import datetime
from datetime import date
import pandas as pd
import matplotlib.pyplot as plt
import numpy as np
from nsepy.derivatives import get_expiry_date


expiry = max(get_expiry_date(year=2020, month=6))
print (expiry)


nifty_opt = get_history(symbol="NIFTY",
        start=expiry,
        end=expiry,
```

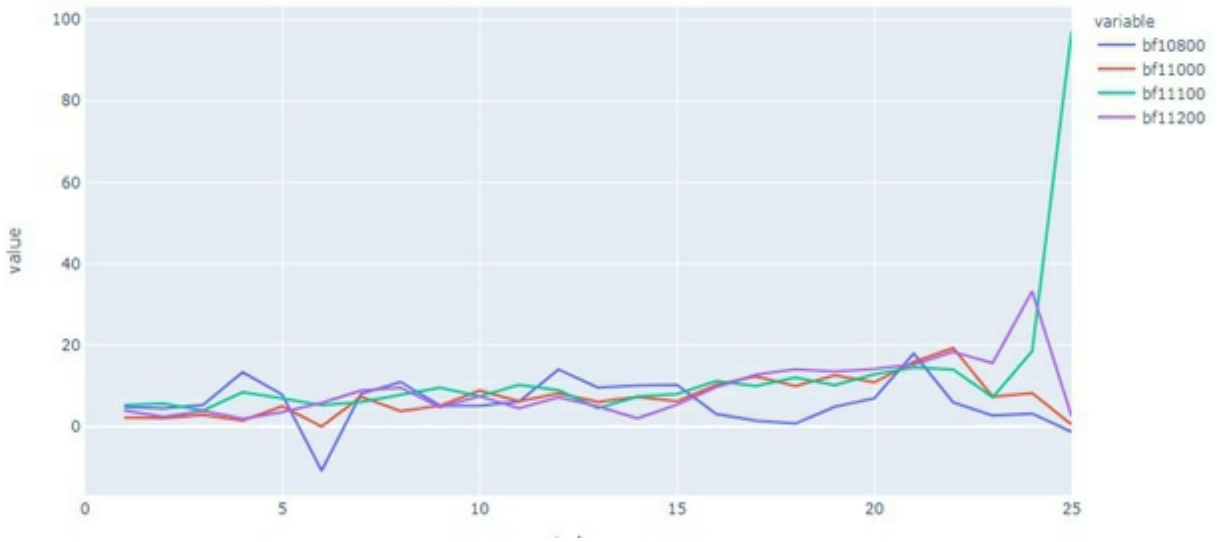
```
        index=True,
        option_type='CE',
        strike_price=10200,
        expiry_date=expiry)

optiondata = nifty_opt

y = expiry + datetime.timedelta(days=1)

expiry = max(get_expiry_date(year=2020, month=7))
niftydata = get_history(symbol="NIFTY",
        start=y,
        end=expiry,
        futures=True,
        index=True,
        expiry_date=expiry)

high = niftydata[['Close']].max()
low = niftydata[['Close']].min()
Diff = high - low
high = int((round(high/100)*100)+100)
low = int((round(low/100)*100)-100)

for z in range (low, high, 100):
    nifty_opt = get_history(symbol="NIFTY",
    start=y,
    end=expiry,
    index=True,
    option_type='CE',
    strike_price=z,
    expiry_date=expiry)
    optiondata = optiondata.append(nifty_opt)
y = expiry + datetime.timedelta(days=1)

NiftyCF = pd.DataFrame({"Close": niftydata["Close"]})
NiftyCF.plot()

NiftyCO = pd.DataFrame({"Expiry": optiondata['Expiry'],
```

```
                "Type": optiondata['Option Type'],
                "Strike": optiondata['Strike Price'],
                "Last": optiondata['Last']})

Opttable = pd.pivot_table(NiftyCO, values ='Last', index =['Date', 'Type', 'Expiry'], columns =['Strike'], aggfunc = np.sum)
Opttable = Opttable.join(NiftyCF)
Opttable.to_csv("NiftyJuly2020.csv", index=True, encoding='utf8')
optiontable = pd.read_csv('NiftyJuly2020.csv')
print (optiontable.head())

high = optiontable['Close'].max()
low = optiontable['Close'].min()
high = int((round(high/100)*100)-100)
low = int((round(low/100)*100)-100)
print (high)
print (low)

for z in range (low, high, 100):
    print (z)
    l1 = z
    l2 = z+100
    l3 = z+200
    bf0 = 'bf'+str(l2)
    bf1 = str(l1)+'.0'
    bf2 = str(l2)+'.0'
    bf3 = str(l3)+'.0'
   optiontable[bf0] = optiontable[bf1]-optiontable[bf2]-optiontable[bf2]+optiontable[bf3]

print (optiontable.tail())
optiontable[['bf10800', 'bf11100', 'Close']].plot(secondary_y='Close', figsize=(18,10))
```

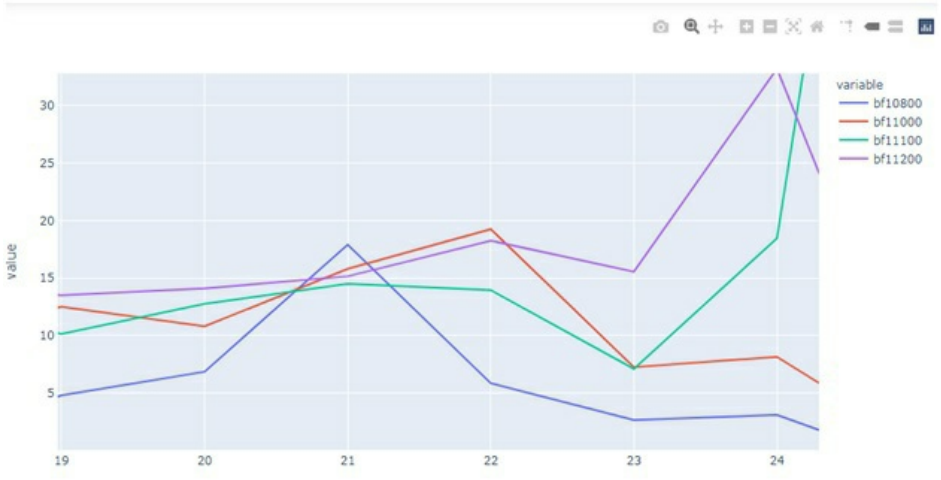
```
optiontable[['bf10800', 'bf11100', 'Close']].plot(secondary_y='Close', figsize=(16,8))
<matplotlib.axes._subplots.AxesSubplot at 0xcf16eb8>
```




```
import plotly.express as px
OT4 = optiontable[['bf10800', 'bf11000', 'bf11100', 'bf11200']]
fig = px.line(OT4)
fig.show()
```



You can observe the monthly Nifty 100 point butterfly prices of various strikes for July 2020 in the above chart. In the same way you can compute prices for any strategy to observe the pattern. You can zoom in or zoom out to check the data for any period in the charts created through plotly.


variable
bf10800
bf11000
bf11100
bf11200
value
30
25
20
15
10
5
19
20
21
22
23
24

PYTHON CODES IN GITHUB

You can download Python codes given in this book in Jupyter notebook from github. Link to the Github account is given below -

https://github.com/OptionsnPython/Option-strategies-backtesting-in-Python

EVENT BASED TRADING

Till now we learned basics of Option Greeks, basics of Option Strategies, basics of Python, basics of strategy back testing in Python. Now let's take an example how you can implement basic knowledge in trading.

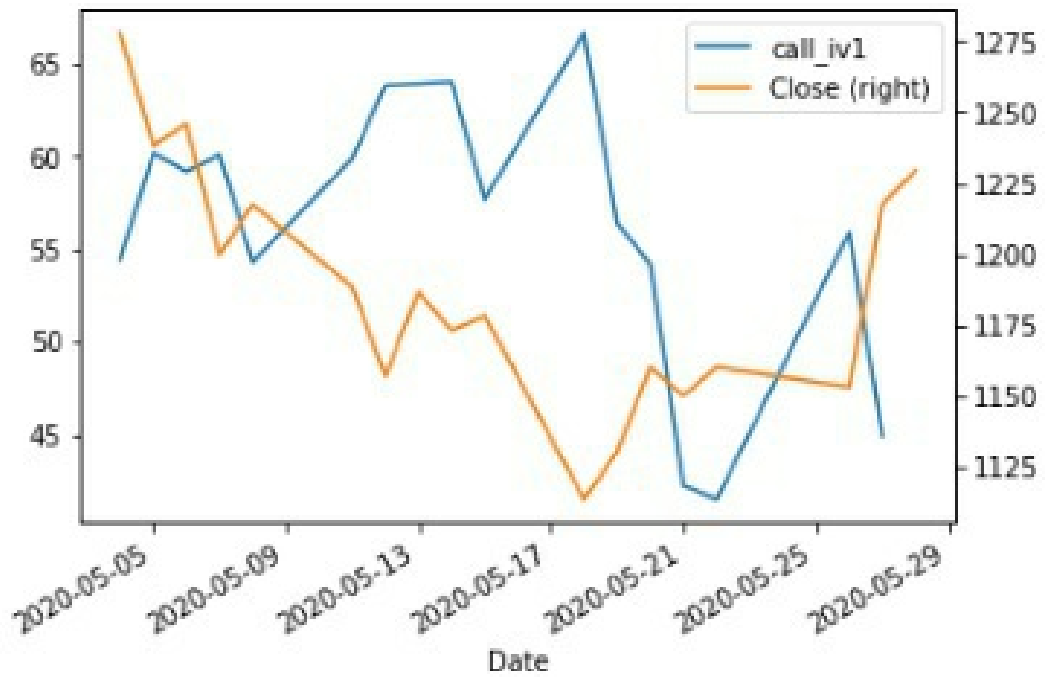
We knows that after the event implied volatility of option drops so trader can buy Iron Condor because net Vega of the position will be negative and drop in IVs will give profit. Question arise – which strikes to select for Iron Condor. As we know that strikes with highest open interest works as strong resistance and support levels so trader can sell strikes with highest open interest and buy options of lower premium to hedge.

Lets take an Example -

Results of Kotak Mahindra Bank Declared on 13th May 2020. We can compute the implied volatility using Python as we learned in previous chapter. Please refer following chart. Implied Volatility of Options given on left side and Closing prices are given on right side. We have seen rise in prices after the results and drop in Implied Volatility. On results day Kotak Bank was trading on 1186 after that came down to 1125 than goes up to 1225. However Implied volatility of option drops from 65 to 40.

```
Kotak_bank[['call_iv1', 'Close']].plot(secondary_y='Close')
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x6be4710>
```



Highest Open Interest was in the Call Strike price 1300 and Put strike price 1100. Soo 1300 was strong resistance level and 1100 was strong support level. Trader can sell Call strike 1300 and Put strike 1100. To hedge the position trader can buy Call strike 1320 and Put Strike 1080. Following were the prices on 13th May2020

Sell Call Strike 1300 at Rs 23.25

Buy Call Strike 1320 at Rs 18.60

Sell Put Strike 1100 at Rs 24.45

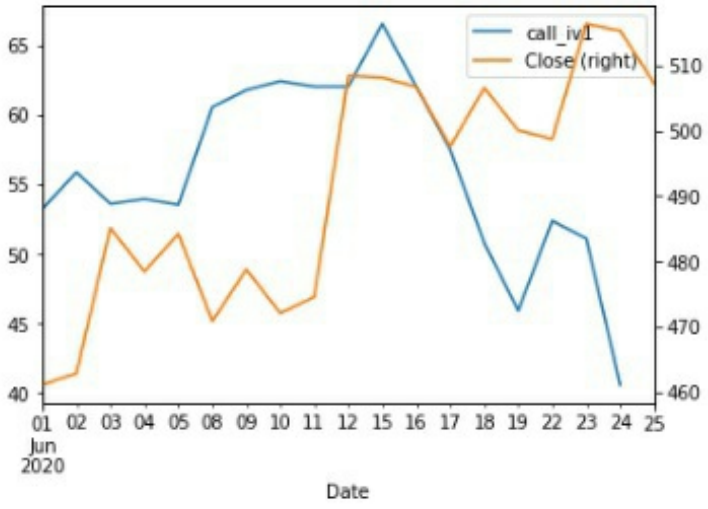
Buy Put Strike 1080 at Rs 19.45

Trader received net premium of Rs 9.65/-. So Maximum Profit is limited to Rs 9.65 and maximum loss is limited to Rs 10.35/-. Risk reward ratio is 1:1 and probability of winning is much higher than loosing.

Lets take one more Example.

Results of Mahindra and Mahindra Declared on 12th June 2020. Prices and Implied volatility for the month of June is given in the following chart. We have seen rise in prices after the results and drop in implied volatility after the event. Prices go up from 470 to 510 and IVs drops from 65 to 40.

```
In [10]: R[['call_iv1', 'Close']].plot(secondary_y='Close')
Out[10]: <matplotlib.axes._subplots.AxesSubplot at 0xb46b128>
```



Past data fetched using same python code as discussed in previous chapter. Inspite of taking rates this time we have taken Open Interest as value field in Pivot Table. Pleae refer following table. You will Find that Highest Open Interest was in Call strike price 500 on Upside and Put strike price 400 on downside. So 500 working as strong resistance and 400 working as strong support.

Date	Type	Expiry	360	380	400	420	440	460	480	500	520	M&M
6/1/2020	CE	6/25/2020	1000	27000	46000	51000	236000	199000	191000	**686000**	126000	461.6
6/2/2020	CE	6/25/2020	1000	27000	44000	48000	236000	186000	236000	**724000**	160000	463.8
6/3/2020	CE	6/25/2020	1000	27000	46000	47000	226000	176000	253000	**786000**	199000	484.6
6/4/2020	CE	6/25/2020	1000	27000	45000	46000	227000	149000	246000	**784000**	204000	479.4
6/5/2020	CE	6/25/2020	1000	27000	44000	46000	224000	141000	235000	**856000**	241000	485.35
6/8/2020	CE	6/25/2020	1000	25000	43000	42000	219000	117000	214000	**918000**	269000	471.15
6/9/2020	CE	6/25/2020	1000	25000	43000	43000	222000	122000	214000	**942000**	276000	478.6
6/10/2020	CE	6/25/2020	1000	25000	43000	43000	221000	117000	212000	**990000**	290000	471.5
6/11/2020	CE	6/25/2020	1000	25000	43000	41000	218000	118000	263000	**1110000**	405000	474.15
6/12/2020	CE	6/25/2020	1000	25000	45000	46000	216000	118000	310000	**1216000**	612000	508.85
6/15/2020	CE	6/25/2020	1000	24000	44000	46000	209000	112000	277000	**1350000**	707000	508.8
6/16/2020	CE	6/25/2020	1000	24000	44000	46000	208000	109000	237000	**1192000**	580000	507.15
6/17/2020	CE	6/25/2020	1000	24000	44000	46000	203000	104000	214000	**1094000**	558000	496.8
6/18/2020	CE	6/25/2020	1000	24000	44000	45000	202000	85000	200000	**1004000**	695000	506.35
6/19/2020	CE	6/25/2020	1000	11000	40000	45000	193000	77000	179000	**1018000**	685000	500.55
6/22/2020	CE	6/25/2020	1000	10000	40000	39000	137000	71000	164000	**1124000**	577000	499
6/23/2020	CE	6/25/2020	1000	9000	36000	36000	93000	64000	132000	**988000**	514000	516.85
6/24/2020	CE	6/25/2020	1000	9000	31000	32000	93000	48000	83000	**760000**	408000	514.7
6/25/2020	CE	6/25/2020	1000	6000	25000	30000	87000	30000	74000	**476000**	230000	508.55

Results declared on 12th June 2020. On next trading day 15th June 2020 of the event M&M was trading at 508. After the event trader is expecting drop in IVs so he can sell Call strike price 520 at Rs 16.50 and he can buy Call Strike Price 540 at Rs 9.60 to hedge the options sold. You can back test this strategy on other companies.

Most of the professional traders trade implied volatility, they are earning bread and butter from buying Iron Condor along with hedging delta with Future. (Iron Condor: Selling OTM Call and Put along with buying lower premium Call and Put to limit maximum risk)

Now you understand basics and you can develop and back test your own strategies also. You can also refer various blogs, research papers for strategies and backtest on various stocks and Index. For example a strategy on volatility risk premium effect is explaind in following link -

https://quantpedia.com/strategies/volatility-risk-premium-effect/ (Each month, at-the-money straddle, with one month until maturity, is sold at the bid price with a 5% option premium, and an offsetting 15% out-of-the-money puts are bought (at the ask price) as insurance against a market crash.)

You can refer other strategies also on above blog -

https://quantpedia.com/screener/

Link to some other blogs -

https://www.pythonforfinance.net/category/trading-strategy-backtest/

https://www.quantstart.com/articles/backtesting-systematic-trading-strategies-in-python-considerations-and-open-source-frameworks/

https://pythonprogramming.net/finance-programming-python-zipline-quantopian-intro/

ABOUT AUTHORS / ACKNOWLEDGMENTS

Anjana Gupta, I am author of this book. I am having master degree in science and management. I am having more than 10 years of experience.

Special thanks to Puneet Kanwar, who was instrumental in the completion and editing of this book. Puneet Kanwar is having an experience of 15 years in Indian capital market. He has worked with BSE Limited, formally known as Bombay Stock Exchange, for 6 years. He has also worked with prestigious broking house, Edelweiss prior to BSE. In 2017 Puneet resigned from BSE for his own venture. Currently he is a successful option trader and arbitrager.

I tried my best to explain the concepts in this book. You learned basic of options, option Greeks, options strategies and Python. Many program codes in Python explained how to back test. You should try to write and back test your own strategies. Try this, develop a python code to back test the strategy of buying In-the-money Put and Selling At-the-money Put when 21 dyas RSI is below 50 on Monthly, Weekly and Daily chart and 13 days moving average of underlying crossing 35 days moving average from upside (technically sell signal). Buying In-the-money Call and Selling At-the-money Call when 21 days RSI is above 50 on Monthly, Weekly, Daily chart and 13 days moving average of underlying crossing 35 days moving average from downside (technically buy signal).

If you found this book useful please give review on Amazon and recommend this book in your network.

For feedback / suggestions / query / doubt / socure code of python mentioned in book you can also write to me at optionsnpython@gmail.com.

Happy learning.

Anjana Gupta