1.1 Introduction

In the field of mathematics, derivation is referred as ‘to derive value from existing or given value’, for example: \( \frac{d(x^2)}{dx} \) or \( \frac{\partial(x^2)}{\partial x} \) or \( \frac{\Delta(x^2)}{\Delta x} = 2x \), where the value of 2x is derived from \( x^2 \), and \( x^2 \) acts as existing or given value. Similarly financial derivative is an instrument whose value is derived from one or more basic variable called equities, bonds, currencies and commodities. Besides, warrants, swaps, swaptions, collars, caps, floors, circuses and scores of other underlying assets are simultaneously known as Financial Derivative (Chance, 1997).

Derivative instrument is basically used as a hedging device. Those investors who trade in derivative market may reduce the level of risk up to a certain level with the help of these instruments, but they will not be able to completely eliminate the risk. For example: there are two persons A and B, A is the buyer and B is the seller, due to price fluctuation B wants to sell his commodities at a certain price in the future. So, he/she makes an agreement with A to sell his/her product at some future date. Such kind of transaction is called as derivative.

The financial derivatives have changed the pattern of investments by creating a new directions to understand the meaning of financial risks and its management, it also offers banks, securities firms, companies and investor to hedge their investment by breaking financial risk into smaller component and give opportunity to sell and buy these component with minimum or best specific risk management objective.

In the Indian context, the Securities Contracts (Regulation) Act, 1956(SC(R)A) defines "derivative" as-

1. A security derived from a debt instrument, share, loan whether secured or unsecured, risk instrument or contract for differences or any other form of security.
2. A contract which derives its value from the prices, or index of prices, of underlying securities.

Derivatives are securities under the SC(R)A and hence the trading of Derivatives are governed by the regulatory framework under the SC(R) A.

The emergence of the market for derivative products is mostly forwards, futures, options and swaps which can be traced reverse to the willingness of risk-averse economic agents to guard themselves against uncertainties arising out of fluctuations in asset prices. By their very nature, the financial markets are marked by a very high degree of volatility. In the course of the use of
derivative products, it is possible to partially or fully transfer price risks by locking in asset prices. As instruments of risk management, these normally do not manipulate the fluctuations in the underlying asset prices. However, by locking in asset prices, derivative products decrease the impact of fluctuations in asset prices on the profitability and cash flow situation of risk-averse investors. In the last decade, many emerging and transition economies have started introducing derivative contracts. As the case was, when commodity futures were first introduced on the Chicago Board of Trade in 1865, policymakers and regulators in these markets are concerned about the impact of futures on the underlying cash market. One of the reasons for this concern is the belief that futures, options and swaps trading attract speculators who then destabilize spot prices.

1.2 Emergence of Financial Derivatives
Derivative product primarily emerged as hedging device against instability in commodity prices, and commodity-linked derivatives remained the one and only form of such products for almost three hundred years. Financial derivative came into spotlight in the post-1970 era due to growing instability in the financial market. During that phase derivatives emerged as Forward Contract, but due to settlement problem between buyer and seller related to ‘credit risk’, it did not work properly. To solve this problem, a group of Chicago business men formed the Chicago Board of Trade (COBT) in 1848. The primary objective of COBT was to provide a platform for buyer and seller to make settlement of the Forward Contract. After seventeen years, when trading in forward contract market got increased, COBT established first exchange traded derivative contract in U.S in 1865, and that contract was named as ‘Futures Contract’. In 1919, Chicago Butter and Egg Board (CBEB) observed a spin-off COBT in futures trading, and its name was changed to ‘Chicago Mercantile Exchange’ (CME). The CBOT and CME are the two organised and largest futures stock exchanges of the world. In 1972, first financial derivative exchange was launched in Chicago. This division of CME called International Monetary Market (IMM) and traded currency futures. ‘Leo Melamed’ is known as the father of financial futures, because he was the chairman of the Chicago Mercantile Exchange (CME) and most of the strategies of futures market were developed by him. Merton 1993, Noble Laureate had said that “Financial future represents the most significant financial innovation of last twenty years”
The options derivative products have been exchanged since long but they were traded in Over the Counter Market (OTC), due to lack of knowledge in value calculation. In seventeenth century, Europe was the first place, where options trading was started and followed by U.S. In the early 1900s options market was established by group of firms, where they set the price of call or put option with the help of brokers and dealers. The aim of that association was to develop such kind of mechanism, which can bring buyer and seller together. But options market suffered from two major problems,

1. There was no secondary market, and
2. There was no mechanism to guarantee that the writer of options would honour the contract.

Both the problems were sorted by Black-Scholes Model which was developed by Fisher Black, Myron Scholes and Robert Morton in early 1970 and came into existence in 1973 (Black and Scholes, 1972). This model changed the whole face of financial derivative market, especially options product and gave positive impetus to the sector of financial engineering in 1980s and 1990s. In 1997, expert group of people who were trading in options market, recognised the importance of that model. Robert Merton and Myron Scholes were conferred with the Nobel Prize for the model, but the sudden demise of Fisher Black in 1995 deprived him from sharing the honour with his partners.

The origin of SAWP took place way back in 1770. According to the opinions of financial derivative market experts, it came in to existence when some powerful countries imposed foreign exchange regulation to stop cross border capital Inflow or outflow. With that affect, few Multinational Companies (MNC’s) felt that they should set some techniques or methods to increase cross border cash-flow transaction, which led some MNC’s to prepare their range and buying new financial product known as SWAP. In 1981, first swap contract was negotiated between Deutsche Bank and undisclosed counter party, and in 1984 ‘International Swaps Dealers Association’ (ISDA) was set up to promote swaps transaction. In 1985, the ISDA published the first standardized swaps code and this code was revised in 1986, and published in standard form of agreement in 1987. After such kind of development, swaps market grew very rapidly and it has become a best hedging device or tools for: interest-rate and currency swaps.
1.3 Background of Indian Derivative Market

Derivative trade in India began in 1875 in the area of commodities product, started by Bombay Cotton Trade. In 1952 Indian government banned cash settlement and options trading. After that derivative market trading was shifted to informal market. In 1990 various financial market experts gave written opinions to the Indian government to start derivative market in India. On the basis of these opinions and recommendations, NSE (National Stock Exchange) asked SEBI (Security Exchange Board of India) to grant the permission to trade Index Futures on 14 December 1995. On that effect, SEBI set up L.C Gupta committee to draft a policy framework for Index Futures on 18 November 1996 and on 11 May 1998 L.C Gupta and V.R Verma committee submitted their final report. Then in 1999 Indian government officially included derivative product in SCRA (Securities Contract Regulation Act). Finally on 9 June 2000 Indian capital market started trading in futures in Sensex and on 12 June 2000 in Nifty. It took 10 years of assessment and rethinking by Indian government to commence derivative trade in India from the period of 1990 to 2000. More than a decade back government of India gave permission to derivative trade in India. RBI also allowed forward contract in Rupee –Dollar, which gave positive direction to create a liquid market and also permitted cross border currency options trading contract. Futures contract are available in India in the form of commodity market which include turmeric, coffee, jaggery, hessian, castor seed oil, black pepper, spices, etc. Government of India also plan to establish futures contract in cotton and soya been oil.

In the beginning of derivative market in India investors were not able to see that these products are the perfect replacement of ‘Badla’ trading system and were aware about derivative product market, so the volume of turnover was a small amount of Rs 35 crores in June 2000. With the passage of time investors understood the working mechanism of these products, trading in derivative market increased steadily. In June 2001 cash settled European style Index Options was launched in Sensex and Nifty and in July 2001 stock options was introduce on 31 prominent stocks for trading on cash settled American style options. These stock options created acceleration in derivative market and in few days the volume of stock options exceeded the volume of Index options. In November 2001 SEBI permitted trading in ‘cash settled stock futures’ which increased the derivative market volume to 450 crores after few month volume of
derivative market further went up to 1350 crores daily which was more than 50% of NSE’s cash market volume. In June 2003 NSE introduced Interest Rate Futures which was subsequently banned due to price issues. With the passage of time derivative market reached to Rs. 1,30,90,477.75 crores in 2008, where the volume of NSE cash market was Rs. 35,51,038 crores. After that Indian capital market was crashed and NSE cash market volume reached to the level of Rs. 28,96,194 crores in 2009 as a result derivative market also reduced and reached to the level of Rs. 73,01,613 crores. Presently NSE derivative market reaches to a level of Rs. 313.5 lakh crores in financial year 2011-12, which was 7.2 percent more than last fiscal year. Table 1.1 traces the incremental increase in in Indian derivative market.

### Table 1.1

<table>
<thead>
<tr>
<th>Important Dates</th>
<th>Progress in Indian derivative market from 1995 to 2012</th>
</tr>
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<tbody>
<tr>
<td>14 December 1995</td>
<td>NSE asked SEBI for permission to trade Index futures</td>
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<tr>
<td>18 November 1996</td>
<td>SEBI setup L.C. Gupta and V.R Varma committee to draft a policy frame work for Index futures.</td>
</tr>
<tr>
<td>07 May 1999</td>
<td>RBI gave permission for OTC forward rate agreement (FRAs) and Interest rates.</td>
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<tr>
<td>24 May 2000</td>
<td>SIMEX chose Nifty for trading futures and options on an Indian Index.</td>
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<tr>
<td>25 May 2000</td>
<td>SEBI gave permission to NSE and BSE to do index futures trading.</td>
</tr>
<tr>
<td>09 June 2000</td>
<td>Trading of BSE Sensex futures commenced on BSE.</td>
</tr>
<tr>
<td>12 June 2000</td>
<td>Trading of Nifty futures commenced at NSE</td>
</tr>
<tr>
<td>31 August 2000</td>
<td>Trading of Futures and Options on Nifty to commence at SIMEX</td>
</tr>
<tr>
<td>June 2001</td>
<td>Trading of Equity Index Options at NSE.</td>
</tr>
<tr>
<td>July 2001</td>
<td>Trading of stock options at NSE.</td>
</tr>
<tr>
<td>09 November 2002</td>
<td>Trading of single stock futures at BSE.</td>
</tr>
<tr>
<td>June 2003</td>
<td>Trading of Interest rate futures at NSE.</td>
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<tr>
<td>13 September 2004</td>
<td>Weekly options at BSE.</td>
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<tr>
<td>1 January 2008</td>
<td>Trading of Mini Sensex at BSE.</td>
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<td>1 January 2008</td>
<td>Trading of Mini Index futures and options at NSE.</td>
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<tr>
<td>22 August 2008</td>
<td>NSE start zero-fee policy for trading in currency.</td>
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### 1.4 Working Mechanism and Valuation of Financial Derivative Products

#### (A) Forward Contract

A forward contract is a personalized contract between two entities, where settlement takes place on a specific date in the future at today’s pre-agreed price. Forward contracts are mostly used in foreign exchange markets and traded in the form of private contract between two parties. They are not traded in organised stock exchange, are customized in nature and are used to minimise the foreign currency risk. Most of the international Banks have separate ‘Forward Contract Desk’ to solve the problems of exchange transaction (Mc Donald and Robert, 2006).

For example: suppose on 20\textsuperscript{th} June 2011, the finance manager of Infosys knows that the industry will receive 100 million US dollar after three month i.e. 20\textsuperscript{th} September 2011, and wants to hedge against the exchange rate movement. In such kind of situation finance manager of Infosys will contact to the bank and find out that the exchange rate for a three month forward contract on
dollar against rupee i.e. \( \frac{\$}{Rs.} = 0.0209 \), and agrees to sell 100 million dollar. It means that finance manager has short ‘forward contract’ on US dollar or we called Infosys finance manager has agreed to sell 100 million dollar on 20\(^{th}\) September 2011 to the bank at the future dollar rate 0.0209. On the other hand bank has a ‘long forward’ contract on dollar. Both the parties have made a commitment or contract.

**Valuation of Forward Contracts**

Value of forward contract is based on formula:

\[
V_{LF} = (F_0 - D_p)e^{-R_fT}
\]

where:

- \( V_{LF} = \text{Value of long forward contract to day} \);
- \( D_p = \text{Delivery price in the contract at time } T \);
- \( F_0 = \text{Is the current forward price for contract that was negotiated some time ago} \);
- \( R_f = \text{Risk free Interest rate per annum; and} \);
- \( T = \text{Time to maturity of contract} \).

We already know the value of forward contract is zero at the time when its first entered (written), after second and other stage it may be positive or negative. When forward contract is settled first time, \( D_p \) is set equal to \( F_0 \) and \( V_{LF} = 0 \), as time passes both the forward prices \( F_0 \) and \( F_{LF} \) will change. It means that \( F_0 \) and \( D_p \) may not be equal which were equal at the time of entrance of the contract. But difference is that both will pay the amount for underlying assets at time \( T \). Under the initial (first) contract this amount is \( F_0 \), and under the second condition it is \( D_p \). Its applies that cash outflow difference is \( (F_0 - D_p) \) at time \( T \) and translate to the difference of \( V_{LF} = (F_0 - D_p)e^{-R_fT} \).

**B Futures Contract**

Futures contract is an agreement between buyer and seller, to sell or purchase an asset at a certain time in the future for a certain price. Equity, Bond, Currencies, Commodities and other Hybrid securities are allowed to trade in derivative futures. Futures contracts are traded in organised stock exchange in which a clearing house interposes itself among buyer and seller. It is standardized in nature and daily settlements are taking place, and profits or losses are paid in
cash. Working mechanism and valuation of futures contract is same as forward contract but only difference is that, it is traded in organised stock exchange and forward contract are traded in the form of unorganised or private market (Whaley, 2006).

**Hedging Using Index Futures**

Hedging using index futures includes various kinds of models, which provide risk minimization technique in well-diversified portfolio of stock. Depending on the underlying assets to be hedged, quite a lot of hedging models can be applied to stock index futures. The most popular models are:

- Naive Hedging Model; and
- Stock Index Pricing-Sensitivity Model; and

**Naive Hedging model** assumed certain ideal condition, which include: there is no quantity, quality and timing risk extend; and the value of spot position remained constant or unchanged at expiration. Hedging formula is given as:

\[ N_f = \frac{V_0}{F_0} \]  \hspace{1cm} (1.2)

where:

- \( N_f = \) Number of Future contract;
- \( V_0 = \) Value of spot position; and
- \( F_0 = \) price of future contract

**Stock Index Price-Sensitivity Model** is applied to calculate or determine the number of stock index futures contract, which minimise the unpredictability of the profit from a hedged portfolio consisting of the stock portfolio and the stock index futures contract. Hedging formula in case of Stock Index Price Sensitivity model given as:

\[ N_f^* = -\beta \frac{V_0}{F_0} \]  \hspace{1cm} (1.3)

where:

- \( N_f^* = \) Number of future contract;
- \( V_0 = \) Current value of stock position or (Value of spot position);
- \( F_0 = \) Price of future contract; and
\[ \beta = \text{Beta of stock future (} - \text{ve sign stand for opposit position) } \]

**Minimum Variance Hedge Ratio (h*) in Futures Contract**

\[ h^* = r \frac{\sigma_s}{\sigma_F} \] \hspace{1cm} (1.4)

where:

- \( r = \text{Coefficient of correlation between } \Delta S \text{ and } \Delta F; \)
- \( \Delta S = (S_2 - S_1) = \text{Change in spot price, during the life of hedge;} \)
- \( \Delta F = (F_2 - F_1) = \text{change in future price, during the life of hedge;} \)
- \( \sigma_s = \text{Standard deviation of } \Delta S; \text{ and} \)
- \( \sigma_F = \text{Standard deviation of } \Delta F \)

The hedging ratio is the size of the position taken in the futures contract to the size of the coverage of the hedging amount. Optimal hedging ratio is the product of the coefficient of correlation between \( \Delta F \) and \( \Delta S \), and the ratio of the \( \sigma \) of \( \Delta S \) to the \( \sigma \) of \( \Delta F \). See figure 1.1 which shows, how the variance of the value of the hedges position depend on the hedge ratio chosen.

**Figure 1.1**

**Dependence of Variance of Hedger’s Position on Hedge Ratio**

\[ \text{Variance of position} \]

\[ h^* \]

\[ \text{Hedge ratio, } h \]

Source: European stock market evaluation, pp-132, year-2011

(C) Options Contract

The options are marketable securities that give their owner the right but not the obligation to buy or sell a given number of shares usually of scrupulous security at a fixed price under a preset or
predetermine time period. The primary characteristics of options are: it includes limited loss, high leverage financial derivative product and options product also have limited life. Options derivative products also provide ‘limited loss’ facility to their buyer or seller. With a small amount of money there may be chances to generate or obtain high profit. Options derivative product is divided in two types, namely: Call options and Put options (McMillan, 1992).

**Call Options:** The options gives permission to the owner of the options, the right but not the obligation to buy an agreed quantity of financial assets from the other party or options seller on a certain date at previous agreed price is called call options, Example: An investor buys one call options of Reliance Industries at the strike price of Rs 5,000 at a premium fee of Rs 500. If the market price of Reliance Industries on the day of expiry is more than Rs. 5000, options execute automatically with the help of software. The buyer of call options will earn profit, when share price crosses Rs 5,500 [(Strike price + Premium), or Rs. 5,000+ Rs 500 = Rs. 5,500)]. Let the stock price be Rs 6,000, the options will be exercised and buyer of call options or investor will buy one share of Reliance Industries from the seller of the options at Rs 5,000 and sell it in market at Rs. 6,000 and generate a profit of Rs 500 [(Spot price - Strike price) – Premium paid] or [(Rs. 6,000- Rs. 5000)- Rs. 500= Rs.500]. In another case, if at the time of expiry, stock price or market price falls below to Rs 5,000, let it strike to Rs. 4,000, the buyer of call options will choose not to execute or exercise his options. In this case buyer of call options loses the premium paid Rs 500 and on the other hand this loss amount to be the profit earned by the seller of call options.

**Put Options:** The options gives permission to the owner of the options, the right but not the obligation to sell an agreed quantity of financial assets from the other party or options seller on a certain date at previous agreed price is called put options, Example: An investor buys one Put options of ACC, at the strike price of Rs 5,000 at the premium of Rs 100. Let the market price of ACC on the day of expiry is less than Rs 5,000, options can be exercised as the name ‘In the Money’. At that point buyer of put options came at the situation of no profit no loss or we called Break Even Point. BEP = Rs. 4,900 (Strike price –Premium paid) or (Rs 5,000 – Rs. 100), investor will only earn profit when market falls below Rs. 4,900. Let price of put options of ACC falls to Rs. 4,000. Then options holder automatically buys ACC share at Rs 4,000 and executes
his options selling at Rs. 5000, and generates profit of Rs. 900 [((Strike price –Spot price) –
Premium paid) or [( Rs. 5,000-Rs. 4,000) – Rs. 100]. In another case, if at the time of expiry
stock price of ACC increases up to Rs 5,500. Then the buyer of put options will choose not to
execute his options to sell. In such kind of situation, buyer of put options loses his premium of
Rs 100 and this lost premium is the profit of seller of put options.

Two Popular Models for Calculating Value of Options

- The Binomial Tree Model;
- The Black-Scholes model;

Binomial Tree Model: A very useful and very popular technique for options pricing is Binomial
Tree model. But this model is only used to analogous discrete time financial market. On the other
hand in practical application binomial tree are preferably used a numerical approximation tools
for pricing options, but it is complicated in term of calculation. According to its name the
structure of this model is like a tree and this model was suggested by Cox, Ross & Rubinstein in 1979

Structure of Binomial Tree Model

At time zero (0), the stock price is \( S_0 \), and at the time \( \Delta t \), there are two possible stock prices \( S_0u \)
and \( S_0d \), with the continuous change in time, the stock price will also change (see in Figure 1.2)

\[
S_0u^i d^{j-i}, \text{where } i = 0, 1, \ldots, j
\]  

(1.5)

where: \( u = \text{up tree, and } d = \text{down tree} \)

If \( u = \frac{1}{d} \), then \( S_0u^2d = S_0u \).

\( Up \text{ Tree} = S_0, S_0u, S_0u^2, S_0u^3, S_0u^4, \ldots, S_0u^{n-1} \)

\( Down \text{ Tree} = S_0, S_0d, S_0d^2, S_0d^3, S_0d^4, \ldots, S_0d^{n-1} \)
Suppose that the life of put or call options on a non-dividend paying stock divided into ‘n’ sub interval of lengthΔt. Now we carry ‘i’ th node at time jΔt as the (j,i ) node, where 0 ≤ j ≤ n and 0 ≤ i ≤ j. It state that  \( F_{j,i} \) give the value of call or put options at the node (j,i). The stock price given at the (j,i) node is \( S_0 u^i d^{j-i} \). Than \( F_{j,i} = F_{n,i} \), because ‘n’ replaces ‘j’ according to change in time (Δt), and value of put or call options expiration date is \( \max(D_p - S_T, 0) \), where 
\[
[S_T = S_0 u^i d^{n-i} \text{ and } D_p = \text{delivery price in the contract at time } t].
\]
Therefore
\[
F_{n,i} = \max(D_p - S_0 u^i d^{n-i}, 0), \text{where } i = 0, 1, 2, 3 \ldots n \tag{1.6}
\]
Above equation (1.6) also have a possibility of probability to move from (j,i) point. It may be in case of happing or not happing, most of the time it depend on change in time.

**The Black-Scholes Model:** Formula of valuation of call or put options was derived by Fischer Black, Myron Scholes and Robert Merton in 1773. First draft of Black-Scholes formula was sent for publication on October 1970 in the ‘Journal of Political Economy’ and it was rejected. The publisher said, ‘It was too specialized for them’. Again it was sent for publication in ‘The Review of Economics and Statistic’ and promptly got another rejection. After that he wrote another paper to emphasize the economics or technique behind the formula derivation (January 1971) with title ‘Capital Market Equilibrium and the Pricing of Corporate Liability. On that paper Merton Millor and Eugene Fama (from university of Chicago) took an interest in his paper and they gave
excellent comment on his draft and recommended to the *Journal of Political Economy* for publication. In August 1971 journal accepted his paper and it published in May/June 1973 issue of the *Journal of Political Economy*. After that when COBT started trading in listing options, Dan Galai wrote a Ph.D. thesis at the University of Chicago, in which he tested trading rules based on that formula. Now a day’s Black-Scholes Option Pricing Model is used by most of the traders to calculate the value of call and put options. The theory is based on the following assumptions:

- Trading in stock take place continuously and market are always open;
- Interest rate risk is well-known and constant over the life of options;
- The stock pays no dividend on any type of underlying assets or security;
- There is zero transaction cost on buying and selling of assets in options contract;
- There is no provision of any type of tax;
- The assets are completely divisible in nature;
- There is no penalties on short selling of shares and investor also get full use of short-sell procedure; and
- Stock price options follows a explicit type of stochastic process called diffusion process;

From the above given assumptions Black-Scholes first developed partial differential equation which holds domain. Equation is given as:

$$\frac{\partial V_{op}}{\partial t} + \frac{1}{2} \sigma^2 P^2 \frac{\partial^2 V_{op}}{\partial P^2} + R_f P \frac{\partial V_{op}}{\partial P} - R_f V_{op} \leq 0$$

(1.7)

where:

- $V_{op}$ = Value of call or put options;
- $P$ = Current price of options;
- $\sigma$ = Standard deviation;
- $R_f$ = Risk free rate of return; and
- $\delta t$ = Change in time;
While using Random Walk result $\frac{dP}{P} = e^{\mu dt + \sigma dX}$, where: $dX$ is set of $N(0,dt)$, $P$ is a function of assets value $P = P(0)$, and use definite integration property under lower limit and upper limit from $(-\infty$ to $+\infty)$ (Black and Scholes, 1972). According to Ito’s Lemma theorem in which the value of assets depend upon Random Walk[where: $R_f = \mu + \frac{1}{2} \sigma^2$]. Then after so many mathematical expressions, which include various types of above given assumptions Black-Scholes derive final formula of valuation of call and put options given as:

$$V_{cop} = P N \left( \frac{\log \frac{P}{P_E} + (R_f + \frac{1}{2} \sigma^2) t}{\sigma \sqrt{t}} \right) - e^{-RfP_E} N \left( \frac{\log \frac{P}{P_E} + (R_f - \frac{1}{2} \sigma^2) t}{\sigma \sqrt{t}} \right)$$

(1.8)

And

$$V_{pop} = e^{-RfP_E} N \left( - \left( \frac{\log \frac{P}{P_E} + (R_f - \frac{1}{2} \sigma^2) t}{\sigma \sqrt{t}} \right) \right) - PN \left( - \left( \frac{\log \frac{P}{P_E} + (R_f + \frac{1}{2} \sigma^2) t}{\sigma \sqrt{t}} \right) \right)$$

(1.9)

Where:

- $P_E =$ The exercise or execute price;
- $N =$ The value of the cumulative normal distribution at $\left( \frac{\log \frac{P}{P_E} + (R_f + \frac{1}{2} \sigma^2) t}{\sigma \sqrt{t}} \right)$ and $\left( \frac{\log \frac{P}{P_E} + (R_f - \frac{1}{2} \sigma^2) t}{\sigma \sqrt{t}} \right)$;
- $t =$ The time remaining to expiration on an annual basis;
- $e^{-Rf} = 1 + (-R_f t) + \frac{(-R_f t)^2}{2!} + \frac{(-R_f t)^3}{3!} + \frac{(-R_f t)^4}{4!} + \ldots \ldots \ldots \ldots \ldots \ldots \approx 2.7183$; and
- $\sigma =$ The standard deviation of the continuously compounded annual rate of return of the share.

It is logical approach to pricing options. The Black-Scholes Model captures most of the property but some restrictions with practical function have to be required. The hypothesis of being able to set-up a risk-less hedge by rebalancing endlessly and immediately is not reasonable in real trading because contract or transaction cost obstruct continuous process and scatter investment returns. Price changes on circumstance can be quite considerable and hypothesis of risk-free rate is idealistic.
(D) SWAPS

According to the terminology of financial derivative market the term ‘swap’ means exchange of ‘cash’ or ‘it is the process of exchange between two parties on cash flow in the future date according to predetermined method or formula’ is called swaps (Kolb, 1999).

**Major Types of Swaps are:**
- Interest-Rate Swaps; and
- Currency Swaps;

**Interest Rate Swaps:** Interest rate swaps are used to hedge the fluctuation of interest rate between exchanges of funds. Basically, this tool is only used by those industries or companies, who take financial support from banks and other financial institutions. For example: suppose a firm, which requires finance of Rs. 1 crore (10 million) for investment and forecasted fix rate of return (8.5% p.a) on investment. But it is not high rated firm, due to that reason bank gives loan on floating rate (8% p.a). If in futures when bank increases interest rate by 75 basis point (0.75%), firm will suffer a loss of 0.25% [Return – (Interest paid) = 8.5% - 8.75% = -0.25]. If such kinds of fluctuations are continuous in process, firm debt will be increasing regularly. These circumstances will be solved from interest rate swaps tools.

**Valuation of Interest Rate Swaps:**
Suppose there is no default risk and principal amount will remain unchanged during the life of swaps contract. Its value was estimated by long situation in one bond and join with short situation in another bond or as a portfolio of forward agreement. \( V_{IRS} = 0, \) if \( V_{Fixed \ Rate \ Bond} = V_{Floating \ Rate \ Bond} \), this condition creates when Interest Rate Swaps negotiated first time and during the life of swaps its value became \(-ve\) or \(+ve\), and at zero life of swaps end.

Valuation of Interest rate swaps \( (V_{IRS}) \) is based on formula:

\[
V_{IRS} = V_{Fixed \ Rate \ Bond} - V_{Floating \ Rate \ Bond}
\]  \hspace{1cm} (1.10)
where:

\[ V_{\text{Fixed Rate Bond}} = \sum_{i=1}^{n} P_{\text{FRP}} e^{r_{1}t_{i}} + P_{\text{Sum}} e^{-r_{n}t_{n}} \]  \hspace{1cm} (1.11)

And

\[ V_{\text{Floating Rate Bond}} = P_{\text{Sum}} e^{-r_{1}t_{1}} + P_{F_{r,RP}} e^{-r_{1}t_{1}} = e^{-r_{1}t_{1}} (P_{\text{Sum}} + P_{F_{r,RP}}) \]  \hspace{1cm} (1.12)

\( P_{\text{FRP}} \) = Fixed rate payment in the swaps;
\( r_{1} \) = Discount rate corresponding to maturity at time \( t \);
\( t_{1} \) = Length of the time to corresponding material;
\( P_{\text{Sum}} \) = The notational principal sum; and
\( P_{F_{r,RP}} \) = Floating rate payment;

**Currency Swaps:** This is an older concept. But it is popular nowadays due to the effect of globalization. In this concept two different firms or companies belong from different countries, exchange their currencies according to predetermined price on given date of futures agreement (Fletcher, 1997). With the help of such kind of tools, companies or firms eliminate currency exchange rate risk which occur due to fluctuation in exchange rate. For example: there are two companies A and B, A is Indian company and B is American company. According to the concept of Foreign Direct Investment (FDI), company A is interested to open its manufacturing unit in America and company B is also interested to open its manufacturing unit in India. Now company A requires money in the form of dollars and company B requires money in the form of rupees. On that result, both the companies make an agreement for currency swaps at a predetermined rate of exchange in futures at a particular date. Indian company gives rupees to American company and American company gives dollar to Indian company according to predetermined rate of exchange given in swaps agreement between two parties.

**Valuation of Currency Swaps**

From the above mentioned example the valuation of currency swaps structure is same as valuation of interest rate swaps. In other words, the value of currency swaps can be found out with the time period structure of interest rate in home market and overseas currency market, and it also includes post exchange rate of these market.
\[ V_{\text{CSWAP}} = C_{\text{ER}}V_{\text{FCB}} - V_{\text{LCD}} \]  
(1.13)

Where:

- \( C_{\text{ER}} \) = Current exchange rate (Expressed as number of unit of domestic currency per unit of foreign currency);
- \( V_{\text{FCB}} \) = Value of foreign currency bond; and
- \( V_{\text{LCD}} \) = The value of local currency bond

\[ V_{\text{FCB}} = \sum_{i=1}^{n} I_{R_{\text{COFC}}} e^{-d_{R_i} t_i} + P_{\text{Sum}_{\text{FC}}} e^{-d_{R_n} t_n} \]  
(1.14)

\[ V_{\text{LCD}} = \sum_{i=1}^{n} I_{P_{\text{FCFD}}} e^{-d_{R_i} t_i} + C'_{\text{ERSWAP}} P_{\text{Sum}_{\text{FCD}}} e^{-d_{R_n} t_n} \]  
(1.15)

Where:

- \( I_{R_{\text{COFC}}} \) = Constant foreign currency interest payment;
- \( d_{R_i} \) = Foreign currency discount rate;
- \( t_i \) = Correspondent periods to interest payment in Foreign market or Domestic market;
- \( P_{\text{Sum}_{\text{FC}}} \) = Principal sum in foreign currency;
- \( I_{P_{\text{FCFD}}} \) = Constant foreign currency interest payment in domestic market;
- \( d_{R_i} \) = Discount rate of various periods to cash flows in domestic market;
- \( C'_{\text{ERSWAP}} \) = Exchange rate at the time that the swaps was agreed; and
- \( P_{\text{Sum}_{\text{FCDD}}} \) = Foreign currency principal sum converted into the domestic currency principal sum

### 1.5 Summary

In this chapter the researcher has defined the meaning of financial derivative, its products, and the working mechanism process and valuation method of Forwards, Futures, Options and Swaps. This chapter also covers recent development in Indian derivative market and tracks the emergence history of financial derivative and its products.