Employee Stock Options Valuation

CA. Gandharv Jain
April 19, 2025

Employee Stock Options

Introduction

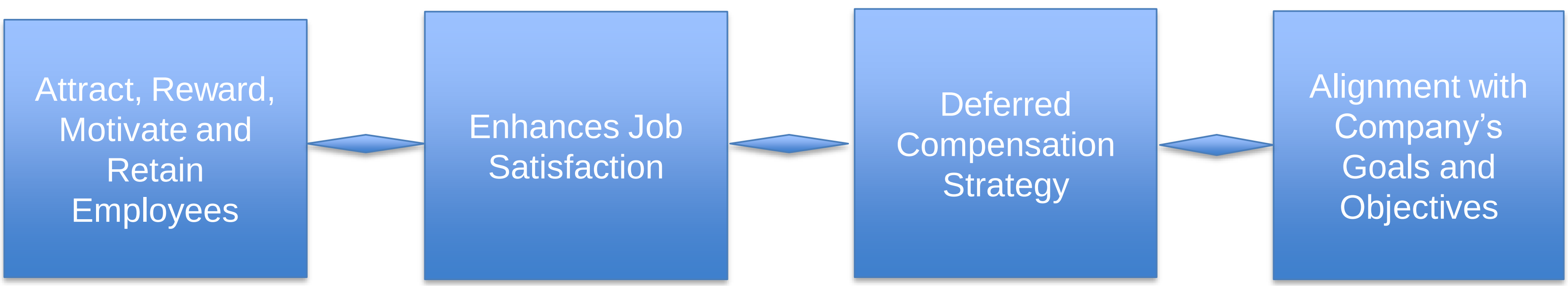
What is Employee Stock Options?

Employee stock options are the ***rights*** given to certain specified employees

- to subscribe to the ***underlying equity shares*** of the company
- at a pre-determined price,
- at or within a specified period of time subject to certain vesting conditions.

In other words, an ***employee stock option plan*** is a type of employee benefit plan that gives employees a share of the company's ownership.

Purpose of Issuing ESOPs



Employee Stock Options

Types of Employee Stock Options

Types of Employee Stock Options

Employee Stock Option Schemes (ESOPs)

- ESOP is about ‘Options’ – that the employee has the option to purchase stock of the Company at a future date at a pre-determined price.

Employee Stock Purchase Schemes (ESPS)

- Under ESPS, employee has the prerogative of purchasing stocks of the company at a discounted price.. It is like a ***‘SIP’***.
- Here the employee contribute a part of his salary between 1% and 15%, for a fixed period of time.

General Employee Benefit Schemes (GEBS)

- Dealing in shares of a company for the purpose of employee welfare including healthcare benefits, hospital care or benefits, disability, death, or scholarship funds, or such other benefit as specified by the company.

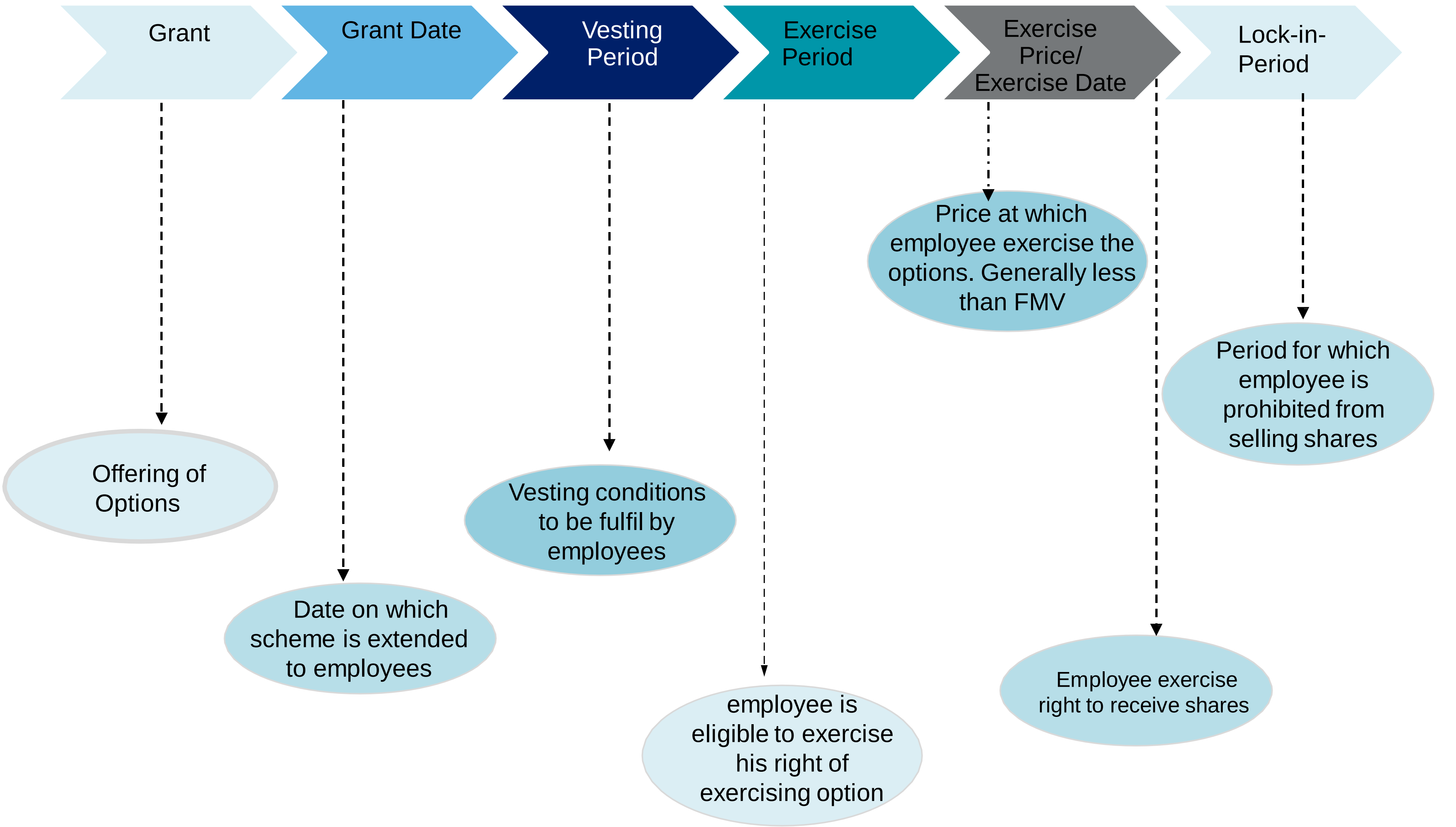
Stock Appreciation Rights Schemes (SAR)

- Companies give their management or employee a bonus if the company performs well financially. SARs resemble ESOPs.
- No shares actually get allotted to the employees. In other words, employee gets the upside of the appreciation in the stock price of the company.

Retirement Benefit Schemes (RBS)

Employee Stock Options

Key Terms



Employee Stock Options

Introduction to Options

What is an Option?

- An option is a **derivative contract** which
- provides the holder with the **right to buy or sell**
- a specified quantity
- of an **underlying asset**
- **at a fixed price** (called a strike price or an exercise price)
- at or **before the expiration date** of the option.

Since ***it is a right and not an obligation***, the holder can choose not to exercise the right and allow the option to expire. The price of the right is known as **option premium.**

Exercise styles:

- ❑ **European:** Gives owner the right to exercise the option *only on the expiration date.*
- ❑ **American:** Gives owner the right to exercise the option *on or before the expiration date.*

In India, we generally have **only European Options.**

Employee Stock Options
Nature: Call Option or Put Option?

Options are of two types:

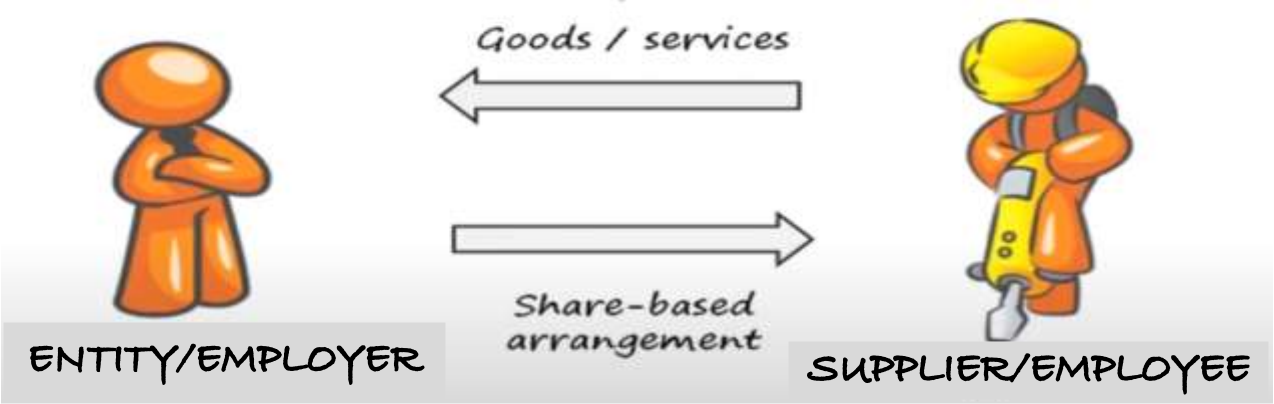
Call Options - A buyer of a call option has ***the right to buy*** the underlying asset for a certain price.
Put Options - The buyer of a put option has ***the right to sell*** the underlying asset for a certain price.

Since employee stock options ***is a right and not an obligation****,* the holder can choose not to exercise the right and allow the option to expire. Further, the holder of the employee stock options have right to buy at a future date, **hence, *employee stock options are call options*** and its valuation is to be computed like of call options.

Employee Stock Options

Regulatory Scope

IND-AS 102: SHARE BASED PAYMENTS



Objective: To specify the financial reporting by an entity when it undertakes a share-based-payment transaction. It requires an entity to reflect in its profit or loss and financial position the effects of share-based payment transactions.

Scope: An entity shall apply this Standard in accounting for all share-based payment transactions, whether or not the entity can identify specifically some or all of the goods or services received, **including**:

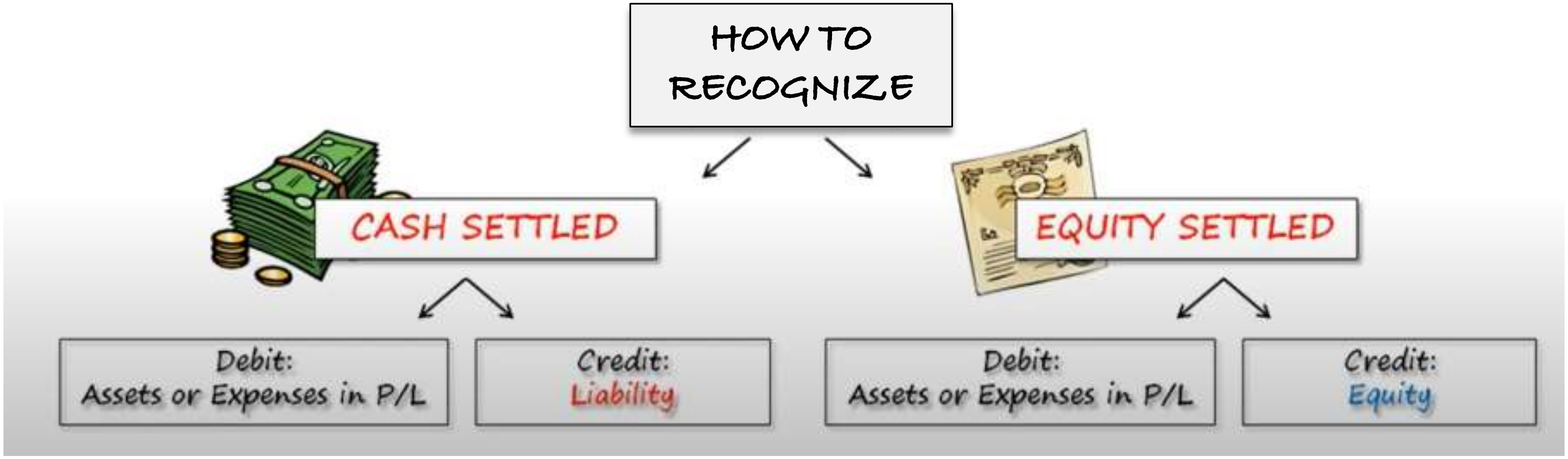
- **Equity-Settled Share-Based Payment**
- **Cash-Settled Share-Based Payment**
- **Transactions in which the Entity Receives or Acquires Goods or Services**

Employee Stock Options
Regulatory Scope

Recognition:

- ❖ An entity shall recognise the goods or services received or acquired **when it obtains** the goods or as the services are received. The entity shall recognize a corresponding **increase in equity** if the goods or services were received in an **equity-settled** share-based payment transaction, or a **liability** if the goods or services were acquired in a **cash-settled** share-based payment transaction.

- ❖ Goods or services received or acquired in a share-based payment transaction **do not qualify for recognition as assets, they shall be recognized as expenses**.



Employee Stock Options

Practical Case Scenarios:

Vanilla Structure

The Company has granted ESOPs to its employees with the below-mentioned terms:

- **Vesting Commencement Date**: February 1, 2024
- **Exercise Price/Share**: Face value per share of the Company i.e., INR 10 per share
- **Vesting Period**: 12 months from the Grant Date/Vesting Commencement Date
- **Vesting Date**: On expiry of Vesting Period of 12 months from Vesting Commencement Date – February 1, 2025
- **Exercise Period**: 6 months from the Vesting Date i.e., July 31, 2025

Employee Stock Options
Practical Case Scenarios:

Cliff Structure

The Company has granted ESOPs to its employees with the below-mentioned terms:

- **Grant Date**: September 2, 2022
- **Vesting Commencement Date**: 1 year from date of joining
- **Exercise Price/Share**: USD 0.014 per share
- **Expiration Date**: December 31, 2028
- **Cliff Period**: 1 year after date of joining of each employee where 25% of the vesting shares shall vest immediately on the Vesting Commencement Date and the remaining vesting shares shall vest in equal monthly installments over a period of 36 months commencing from the first month after the first vesting day, until all vesting shares are vested.
- **Vesting Period**: Total period of 48 months from the date of joining

Employee Stock Options

Practical Case Scenarios:

Exotic Variable Structure

A company granted ESOPs on February 6, 2024, with the total grant amounting to **0.36% of the value added in market capitalization above ₹17,500 crores**, subject to a cap of **1,50,000 options**. The **exercise price was fixed at ₹5 per option**. The vesting was structured as follows:

- **Initial vesting of 0.14%** occurs one year later (February 6, 2025)
- The **remaining 0.22% vests monthly** over a 22-month period (March 2025 to December 2026)
- The **actual number of options** granted will be determined at the time of exercise based on the company's market cap performance. A **minimum of 10,000** and a **maximum of 1,50,000 options** can be granted to an individual.

Employee Stock Options

Practical Case Scenarios:

Milestone Based Structure

Units are equally split between **Time-Based** and **Performance-Based** components.

- **Time-Based Units** vest 25% after one year, with 6.25% vesting quarterly over the next three years, contingent on continued employment.
- **Performance-Based Units** vest annually over four years, based on a weighted achievement formula:
  50% × (Actual Revenue / Budget) + 50% × (Actual EBITDA / Budget). Further, vesting is 0% below 90%, linear from 90–100%, and 100% at or above full achievement.
- A **Participation Threshold** of $1.00 per unit applies, meaning payouts begin only once this threshold is crossed.
- Upon a **Liquidity Event**, all unvested Time-Based Units vest if the employee remains in service, while unvested Performance-Based Units vest only if the unit value is at least $3.50.

Employee Stock Options Valuation

Valuation Methods

The price of any asset in the world is Present Value (PV) of future cash flows.

If we talk about call option, future cash flows are payoff:

Payoff from Call = S (Underlying Price) – E (Strike Price)

This S is uncertain and we need to model how this evolves over time. We are discussing following processes for modelling S:

1. Binomial Model (Discrete)
2. Black Scholes Merton Model (BSM) (Continuous)
3. Use of Monte Carlo Simulation in BSM

Employee Stock Options Valuation

Black Scholes Model

Overview :

- The formula, developed by three economists – Fischer Black, Myron Scholes and Robert Merton – is perhaps the **world's most well-known options pricing model**.

- It was introduced in their 1973 paper, "The Pricing of Options and Corporate Liabilities," published in the Journal of Political Economy.

- The Black Scholes model is a model of **price variation over time** of *financial instruments* such as stocks that can, *among other things, be used to determine the price of a European call option.*

- It's used to **calculate the theoretical value of European-Style Options** using current stock prices, expected dividends, the option's strike price, expected interest rates, time to expiration and expected volatility.

Employee Stock Options Valuation
Assumptions: Black Scholes Model

- The *option is European* and *can only be exercised at expiration*.
- **Perfect continuous time markets:** one can trade at any time, there are no transaction costs and taxes, no restrictions on short-selling.
- No arbitrage opportunities exist
- The **underlying asset** *does not pay any dividend* or *cash flow* during the option’s life.
- Markets are efficient (i.e., market movements cannot be predicted).
- There are *no transaction costs* in buying the option.
- The **risk-free rate and volatility** of the underlying are *known and constant*.
- The **return** on the underlying asset *follows a lognormal distribution.*

Employee Stock Options Valuation

Sources of Inputs in the Black Scholes Model

Input	Source of Data
Striking Price (E)	In case of listed shares, market quotes; in unlisted cases based on a valuation of the shares as on date.
Time Until Expiration (T)	The price at which the option is exercisable as per the contract / scheme.
Stock Price (S_0)	As per the scheme or contract.
Volatility (σ)	Market prices of similar stock.
Dividends	Based on historic trend or estimate for the future.
Risk- Free Interest Rate (r)	Market data on Government Security yields.

Employee Stock Options Valuation

Derivation: Black Scholes Model (BSM)

BSM is an analytical model which takes 5 inputs.

- Underlying Price (S)
- Strike/Exercise Price (E)
- Standard Deviation (S.D.) (σ)
- Time to maturity (t) – 2 Year
- Risk Free Rate (r) (Continuous Compounding)

Put it in a formula and gives the option value

Discussion of BSM Formula

Stage 1 :-

$C_p = S_0$ – PV of E ($E \times \boldsymbol{e^{-rt}}$) => This is the minimum value of call option i.e. intrinsic value. We still need to incorporate volatility premium.

Employee Stock Options Valuation

Derivation: Black Scholes Model (BSM)

Stage 2 :-

We bring volatility into picture by taking probability from normal distribution such that final formula becomes

$C_p = [S_0 \text{ x } N(d1)] – [E \times e^{-rt} \text{ x } N(d2)]$ $\quad$ $P_p = [E \times e^{-rt} \text{ x } N(-d2)] - [S_0 \text{ x } N(-d1)]$

Let us analyse the formula

$$C_p = [S_0 \text{ x } \underbrace{N(d1)]}_{\text{Call Option Delta}} – [E \times e^{-rt} \text{ x } \underbrace{N(d2)]}_{\text{Probability that call will land in the money}}$$

Intuition:

- *Call option is equivalent to leveraged stock buying. We borrow present value of E and buy stocks.*

- *Also we can think of a call option as buying delta stock by paying E, however E will be paid only in the cases when the option lands in the money*

Employee Stock Options Valuation
Derivation: Black Scholes Model (BSM)

Stage 3 :-

Formula of d1 and d2

- $$d1 = \frac{\ln\left(\frac{S_o}{E}\right)+\left(R_f+\frac{\sigma^2}{2}\right)t}{\sigma\sqrt{t}}$$

- $$d2 = \frac{\ln\left(\frac{S_o}{E}\right)+\left(R_f-\frac{\sigma^2}{2}\right)t}{\sigma\sqrt{t}}$$ **Or** $$d2 = d1 - \sigma\sqrt{t}$$

Note:

- ***For finding N(x), use excel function =NORMSDIST(Value of x)***
- ***N(-x) = 1 – N(x)***

Employee Stock Options Valuation

Illustration: Black Scholes Model (BSM)

Illustration:

A company has granted 100,000 employee stock options with a exercise price of INR 10 on April 1, 2020. Vesting period is 4 years. Calculate the value of employee stock option on March 31, 2021 considering the following information as of the valuation date.

Underlying Stock Price (S) – 100
Strike/Exercise Price (E) – 10
Standard Deviation (S.D.) (σ) – 50%
Time to maturity (t) – 3 years
Risk Free Rate (r) (Continuous Compounding) – 5%

Compute the Call option premium using BSM Model.

Employee Stock Options Valuation

Illustration: Black Scholes Model (BSM)

Solution:

Grant Date: April 1, 2020

Stock Price: Based on the equity valuation of the company.

Exercise Price: Based on the employee stock option plan INR 10.

Risk Free Interest Rate: 5%

Time to Maturity: Difference between the valuation date (March 31, 2021) and Exercise Date (March 31, 2024) = 3 years

Exercise Date: 4 years from the grant date (March 31, 2024)

Standard Deviation: 50%

Inputs:	
Spot Price (P)	100.00
Exercise Price (EX)	10.00
Time to Maturity (t)	3.00
Risk-Free Rate (rf)	5.00%
Volatility (annualized s)	50.00%
Outputs:	
Present Value of Exercise Price (PV(EX))	8.61
s*t^.5	0.87
d1	3.27
d2	2.40
Delta N(d1) Normal Cumulative Density Function	1.00
Bank Loan N(d2)*PV(EX)	8.54
Fair Value of Call Option	**91.41**

Employee Stock Options Valuation

Variables Impact on Valuation

Stock Price:

Change in Stock Price	Impact on Value of Call Option	Impact on Value of Put Option
Increase	Increase	Decrease
Decrease	Decrease	Increase

Given the relation, Intrinsic value (call) = Underlying price – Strike price, when the stock price increases, the value of a call option increases and vice versa.

Given the relation, Intrinsic value (put) = Strike price – Underlying price when the stock price increases, the value of a put option decreases and vice versa.

Employee Stock Options Valuation

Variables Impact on Valuation

Strike Price:

Change in Strike Price	Impact on Value of Call Option	Impact on Value of Put Option
Increase	Decrease	Increase
Decrease	Increase	Decrease

The intrinsic value of a call is underlying price minus strike price. Thus, a higher strike price results in a lower intrinsic value of a call option and vice versa.

The intrinsic value of a put is strike price minus underlying price. Thus, a higher strike price results in a higher intrinsic value of a put option and vice versa.

Employee Stock Options Valuation

Variables Impact on Valuation

Time to Expiration:

Time to Expiration	Impact on Value of Call Option	Impact on Value of Put Option
Higher	Increase	Increase
Lower	Decrease	Decrease

A higher time to expiration means there is a greater probability that the option will end up in-the-money. Thus, both call and put options have a higher value when the time to expiry is longer and the value erodes as expiration approaches

Employee Stock Options Valuation

Variables Impact on Valuation

Volatility of Stock Price:

Volatility	Impact on value of Call Option	Impact on Value of Put Option
High	Increase	Increase
Low	Decrease	Decrease

Higher volatility implies higher expected movement in the stock price, both on the upside and downside. Thus, higher volatility implies a higher probability of the options being in the money.

Employee Stock Options Valuation

Variables Impact on Valuation

Risk Free Rate of Interest:

Rate of Interest	Impact on Value of Call Option	Impact on Value of Put Option
High	Increase	Decrease
Low	Decrease	Increase

In a call option, one makes a payment at expiry. A higher interest rate implies that the present value of the payment is lower and thus the option value is higher and vice versa.

In a put option, one receives a payment at expiry. A higher interest rate implies that the present value of the receipt is lower and thus the option value is lower and vice versa.

Employee Stock Options Valuation

Variables Impact on Valuation

Expected Dividend:

Expected Dividend	Impact on Value of Call Option	Impact on Value of Put Option
High	Decrease	Increase
Low	Increase	Decrease

As the ex-dividend date approaches, a higher dividend leads to a drop in the stock price which in turn decreases the call option value.

As the ex-dividend date approaches, a higher dividend leads to a drop in the stock price which in turn increase the put option value.

Employee Stock Options

Summary of Change in Key Inputs on ESOP Valuation

Input	Description
Striking Price (E)	The **lower the striking price** for a given stock, **the more the option should be worth**, because a call option lets you buy at a predetermined striking price.
Time Until Expiration (T)	The longer the time until expiration, **the more the option is worth**. The **Option premium increases for more distant expirations for puts and calls.**
Stock Price (S_0)	The **higher the stock price**, **the more a given call option is worth.** A call option holder **benefits from a rise in the stock price.**
Volatility (σ)	The greater the price volatility, **the more the option is worth.** The volatility estimate Sigma **cannot be directly observed and must be estimated.** Volatility plays a major role in determining time value.
Dividends	A **Company that pays a large dividend will have a small option premium** than a Company with a lower dividend, everything else being equal. **Listed options don't adjust for cash dividends.** The **stock price falls on the ex-dividend date.**
Risk- Free Interest Rate (r)	The **higher the risk-free interest rate**, **the higher the option premium**, everything else being equal.

Employee Stock Options Valuation

Binomial Model

Overview:

- A binomial model is **based on the idea** that, **over the next period**, the value of an asset *will change to one of two possible values*.

- To construct a binomial model we need know:
  - The beginning asset value
  - The size of the two possible changes
  - The probability of the changes occurring

- The binomial model **can be used** to *value a European as well as an American option.*

- The **number of nodes** in the binomial model **is determined** *by the time to expiry of the option.*

- The **life of the option** *is divided into a large number of small time intervals*, i.e. the binomial model values options in discrete time.

Employee Stock Options Valuation
Assumptions: Binomial Model

- The option is European and *can only be exercised at expiration.*
- *No dividends are paid* out during the life of the option.
- Markets are *efficient* (i.e., market movements cannot be predicted).
- There are *no transaction costs* in buying the option.
- The risk-free rate and volatility of the underlying *are known* and *constant.*
- The returns on the underlying *are normally distributed.*

Employee Stock Options Valuation

Inputs to Binomial Model

1. The exercise price of the option
2. The current price of the underlying stock
3. The expected term of the option
4. The expected dividends on the underlying stock for the expected term of the option
5. The quantum of the expected price up and down move in the stock
6. The probability of the up and down move

Employee Stock Options Valuation

Illustration: Binomial Model

Binomial Model says, there are only 2 possible values that stock price can take after 1 year is upside possibility and another downside possibility.

Illustration:

Consider the following information:
Underlying Price (S)– 500
Strike/Exercise Price (E) – 520
Standard Deviation (S.D.) (σ) – 10%
Time to maturity (t) – 2 Year
Risk Free Rate (r) (Continuous Compounding) – 6%

Compute the Call option premium using Binomial Model.

Employee Stock Options Valuation

Illustration: Binomial Model

Solution:

Up move factor (U) = $e^{\sigma\sqrt{t}}$ = Exp((0.06)*(SQRT(1)) = 1.1052
Down move factor (D) = 1/U = 0.9048

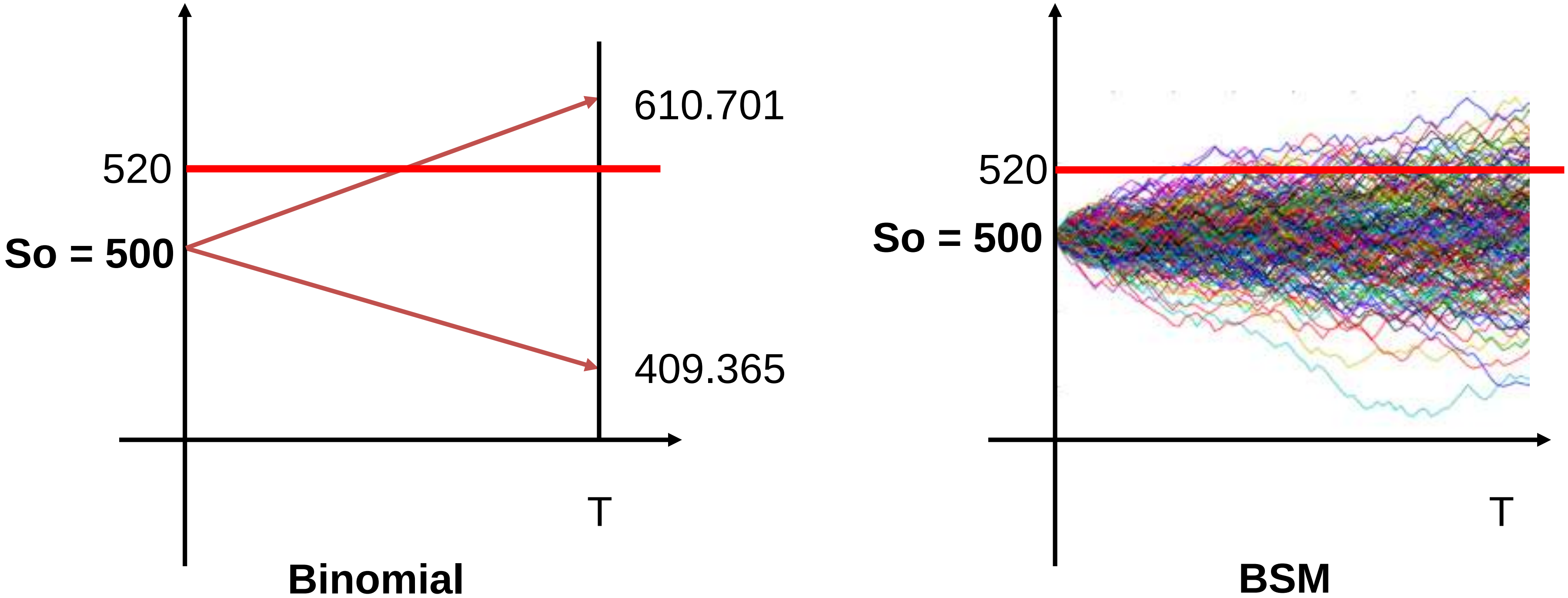
Su = S*U = 500*1.1052 = 552.585
Sd = S*D = 500*0.9048 = 452.419
Su^2 = S*U*U = 500*1.1052*1.1052 = 610.701
Sud = S*U*D = 500*1.1052*0.9048 = 500
Sd^2 = S*D*D = 500*0.9048*0.9048 = 409.365
(These are presented in binomial tree on following slides)

This process is not realistic, in fact we can have binomial process at each movement such that underlying price can take infinite possibilities on a continuous scale.

This is achieved using Black Scholes Model (BSM).

Employee Stock Options Valuation
Illustration: Binomial Model

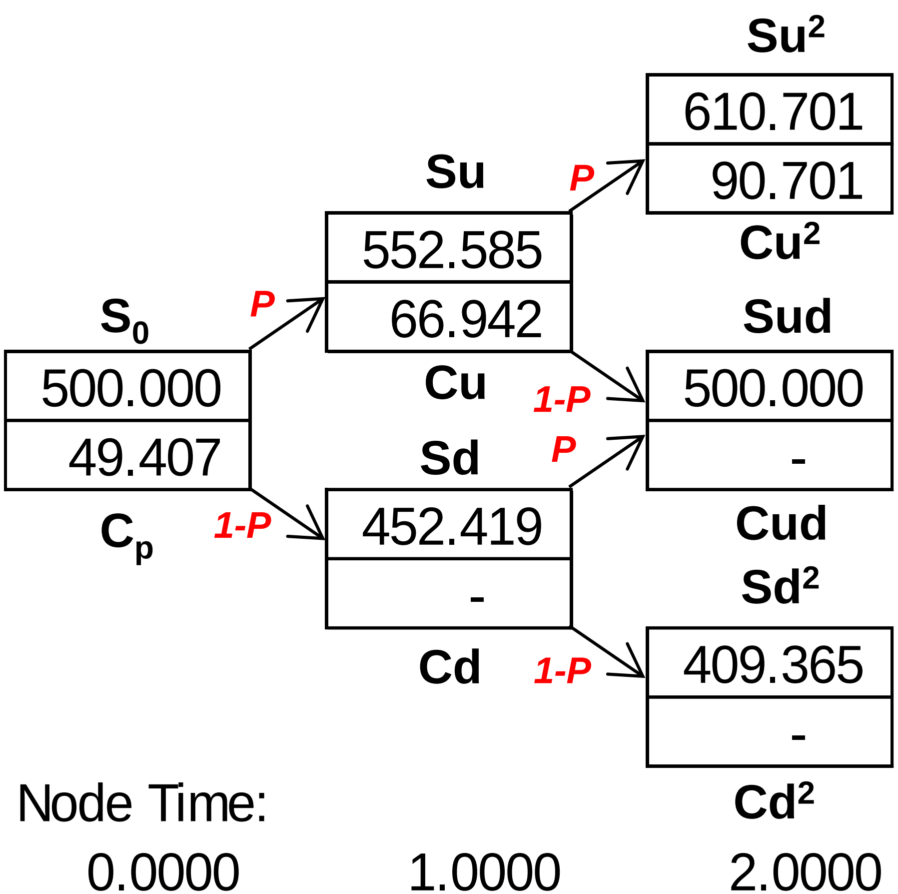
So Binomial is a discrete process and BSM assumes continuous time case.



Employee Stock Options Valuation

Illustration: Binomial Model

Valuation of Call Option Premium



P = Probability of going up which comes out to be 0.7837
(1-P) = Probability of going down comes out to be 0.2163

Under this approach, price of an option is the PV of expected payoff discounted at Rf

$$C_p = \frac{P \times C_u + (1-P) \times C_d}{e^{rt}}$$

C_p comes out to be 49.407

How to find P?

P should be found in such a way that expected value of stock yields risk free rate of return.

$$P \times S \times U + (1-P) \times S \times D = S \times e^{rt}$$

As a result, P comes out to be:

$$P = \frac{e^{rt} - D}{U - D}$$

Employee Stock Options Valuation

Monte Carlo Simulation

Overview :

.

- Monte Carlo Simulations involves assigning a probability distribution to each variable factor

- Based on the probability distributions assigned, ***it generates*** using random numbers, ***a range of values for each variable factor***

- Types of probability distributions include:

  - Normal distribution
  - Log normal distribution
  - Uniform distribution

- The model then ***calculates the results over and over,*** each time ***using a different set of random values from the probability functions***

Employee Stock Options Valuation
Use of Monte Carlo Simulation in BSM

For example,

BSM model is based on normal distribution.

We may do multiple simulations by simulating N(d1) and N(d2) using =NORMSDIST(RAND()) function in excel.

Calculate n number of call option premium value by putting N(d1) and N(d2) derived using Monte Carlo Simulation in the equation given by BSM.

After that, simple average of all call option premiums computed will be the concluded price for the call option.

Please note – highly sophisticated software are required to run Monte Carlo simulations because, it requires around 10 million iterations to get the best scenario which may be difficult to do in excel.

Employee Stock Options Valuation

Monte Carlo Simulation: Pros and Cons

The primary advantage of the Monte Carlo method is also its primary disadvantage.

It can incorporate ***any assumptions*** regarding return patterns, correlations, and other factors the analyst believes are relevant. For some portfolios it may be the only reasonable approach to use.

That leads to its ***downside***: the output is only as good as the input assumptions.

This ***complexity*** can lead to a false sense of overconfidence in the output among the less informed.

It is data and ***computer intensive*** which can make it ***costly*** to use in complex situations (where it may also be the only reasonable method to use).

Thank You

CA. Gandharv Jain
M: +91 9899931962
E: gjain@finvoxanalytics.com

Finvox
VOICING GROWTH

Gurugram - India

108, 2nd Floor,
Udyog Vihar Phase I,
Gurugram - 122016, India

New York - USA

355 Lexington Avenue,
Ste 401 New York,
NY 100017

Toronto - Canada

18 King Street East,
Suite 1400 Toronto,
ON M5C, 1C4, Canada

Singapore

143 Cecil Street
25-04B GB Building
Singapore - 069542

www.finvoxanalytics.com

Recognition Timing for Types of Settlements

- **Equity-Settled Share-Based Payment Transactions**

Measure the goods or services received, and the corresponding increase in equity:

- **Direct Measurement:** **at the fair value of the goods or services received.**
- **Indirect Measurement:** **by reference to the fair value of the equity instruments granted.**

- **Cash-Settled Share-Based Payment Transactions**

Entity shall measure the *goods or services acquired and the liability* incurred at the **fair value of the liability**.

Until the liability is settled, the entity shall **remeasure** the fair value of the liability at the **end of each reporting period and the date of settlement**, with any **changes** in fair value **recognized in profit and loss** for the period.

- **Share-Based Payment Transactions with Cash Alternatives**

Terms of the arrangement: the entity or the counterparty with the **choice** of whether the entity settles the transaction in cash (or other assets) or by issuing equity instruments, **then,**
the *entity shall account* for that transaction or the components of that transaction,

- as a **cash-settled** share-based payment transaction to the **extent liability** has been incurred,
- *otherwise*, as an **equity-settled** share-based payment transaction.

Employee Stock Options

IGAAP V/S IND-AS 102

IGAAP	IND AS 102
Share-based payment to employees have an option to measure based on the **grant date fair value or intrinsic value** of the equity instruments issued.	Share-based payment to employees are measured based on the **grant date fair value** of the equity instruments issued. Intrinsic value approach is permitted only when the fair value of the equity instruments cannot be estimated reliably.
For measuring share-based payment to **non-employees there is no specific guidance.**	Share-based payment to **non-employees** are generally, measured based on the **fair value** of the goods or services received.
In case of graded vesting i.e. where share options or other equity instruments granted vest in instalments over the vesting period, entity may choose to measure on a **straight-line basis as a single award or an accelerated basis** as though **each separately** vesting portion of the award is a separate award.	Awards with graded vesting is measured as, in substance, **multiple awards**.

Employee Stock Options

Guidance Note V/S IND-AS 102

Regulation	Intrinsic Value	Fair Value
Guidance Note	• Intrinsic value is the amount by which the quoted market price of the underlying share in case of listed enterprise or the value of the underlying share determined by an independent valuer in case of an unlisted enterprise, exceeds the exercise price of an option. • Intrinsic Value = Quoted market price or value determined by the valuer **less** exercise price.	• The amount for which an asset could be exchanged, a liability settled, or an equity instrument granted could be exchanged, between knowledgeable, willing parties in an arm's length transaction. • Using valuation techniques like Black Scholes Option Pricing Model.
IND-AS 102	• The difference between the fair value of the shares to which the counterparty has the (conditional or unconditional) right to subscribe or which it has the right to receive, and the price the counterparty is (or will be) required to pay for those shares. • Intrinsic Value = Fair value of share **less** exercise price.	Same as Guidance Note definition