

11th Capacity Building Seminar on Retirement Benefits (11th CBRB)

Ramada By Wyndham, Gurugram

Date: 31st January 2025

Share Based Payments (ESOP) Valuation Process and Methodology

Arpaan G Begdai and Dribjot Singh



Agenda

What are Share Based Payment?

Why?

Types of share based payments?

Life cycle of an ESOP

Share based payment (ESOP) valuation process

Why?

Process Overview

Key Assumptions

Methodology

Case Study

What are Share-Based Payment Plans? and Why?



- In exchange of services rendered, the payment to the employees is equity linked (either issuing instruments or cash, which is linked with equity),
- *Solves Agency Problem* - Align the interests of employees with shareholders.
- *Employee retention* – Assured retention over the vesting term, i.e., 3-5 years approximately.
- *Paternalistic objectives* – Wealth creation for employees.



**Reward
Performance
and Loyalty**



**Deferred
Compensation
Plan**



**Enhance Job
Satisfaction**



Attract Talent



**Sense of ownership
amongst employees**



**Enhance Employee
Retention**

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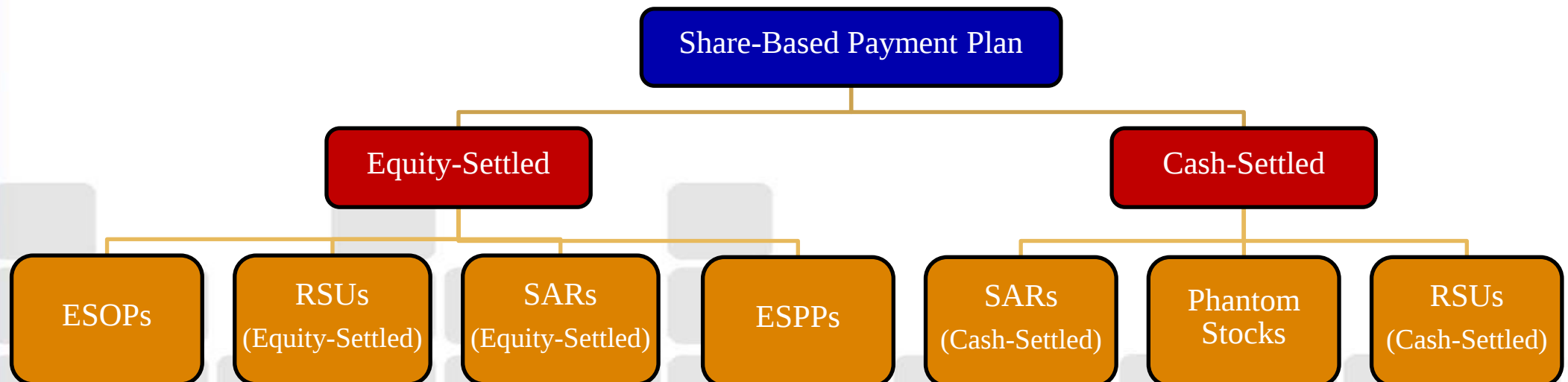
Types of Share-Based Payments

Equity - Settled

- In exchange of goods/services received, payment is settled by issuing equity instruments (i.e., shares or share options).
- Example – ESOPs – entitles employees to acquire shares

Cash – Settled

- Settled by issuing cash rather than equity.
- Example - Share Appreciation Rights (SARs) which entitle employees to cash payments equal to the increase in the share price of a given number of the company's shares over a given period.



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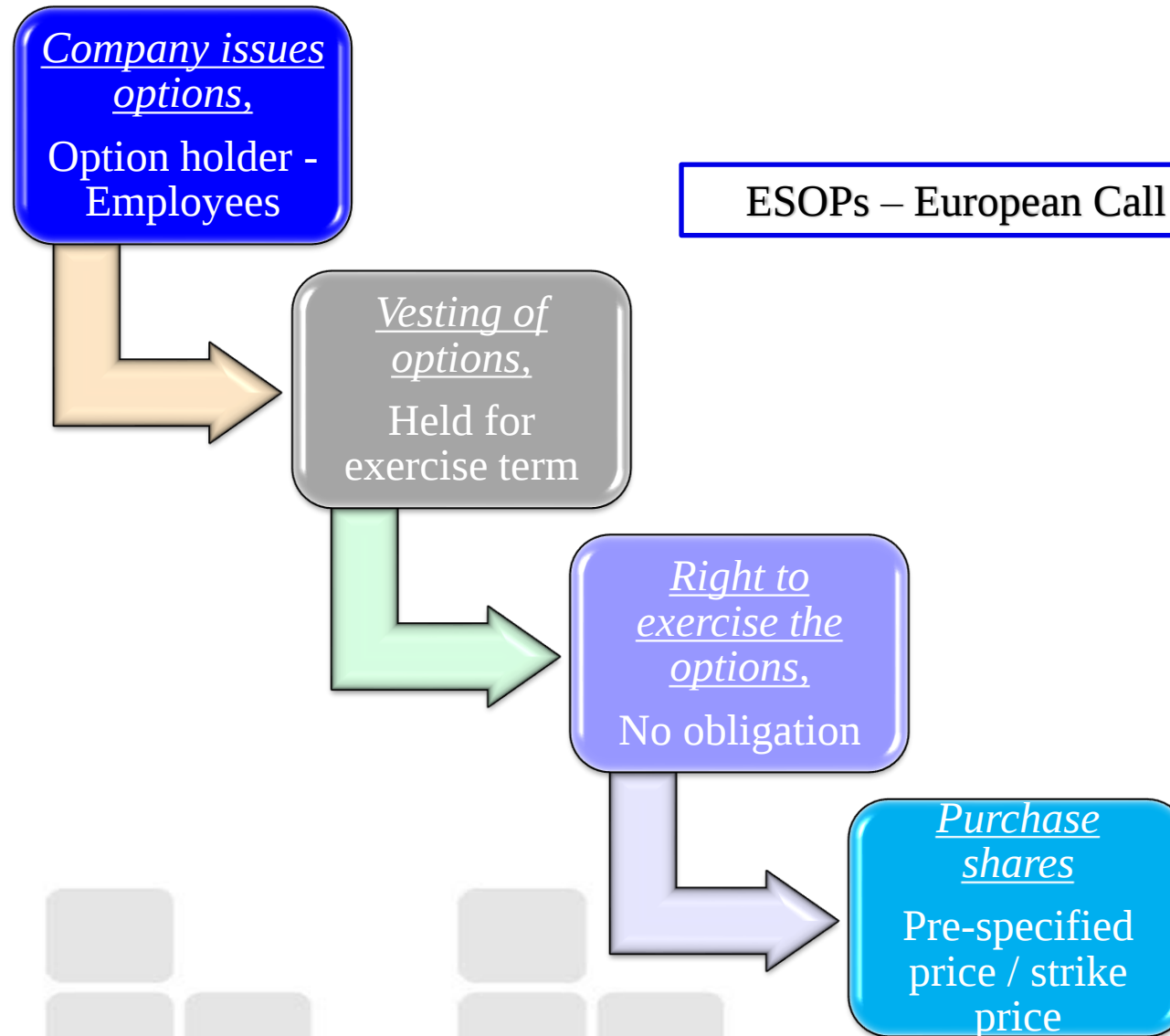
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Life cycle of an ESOP

ESOPs – European Call Options



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Why Share Based option payment valuation is necessary?



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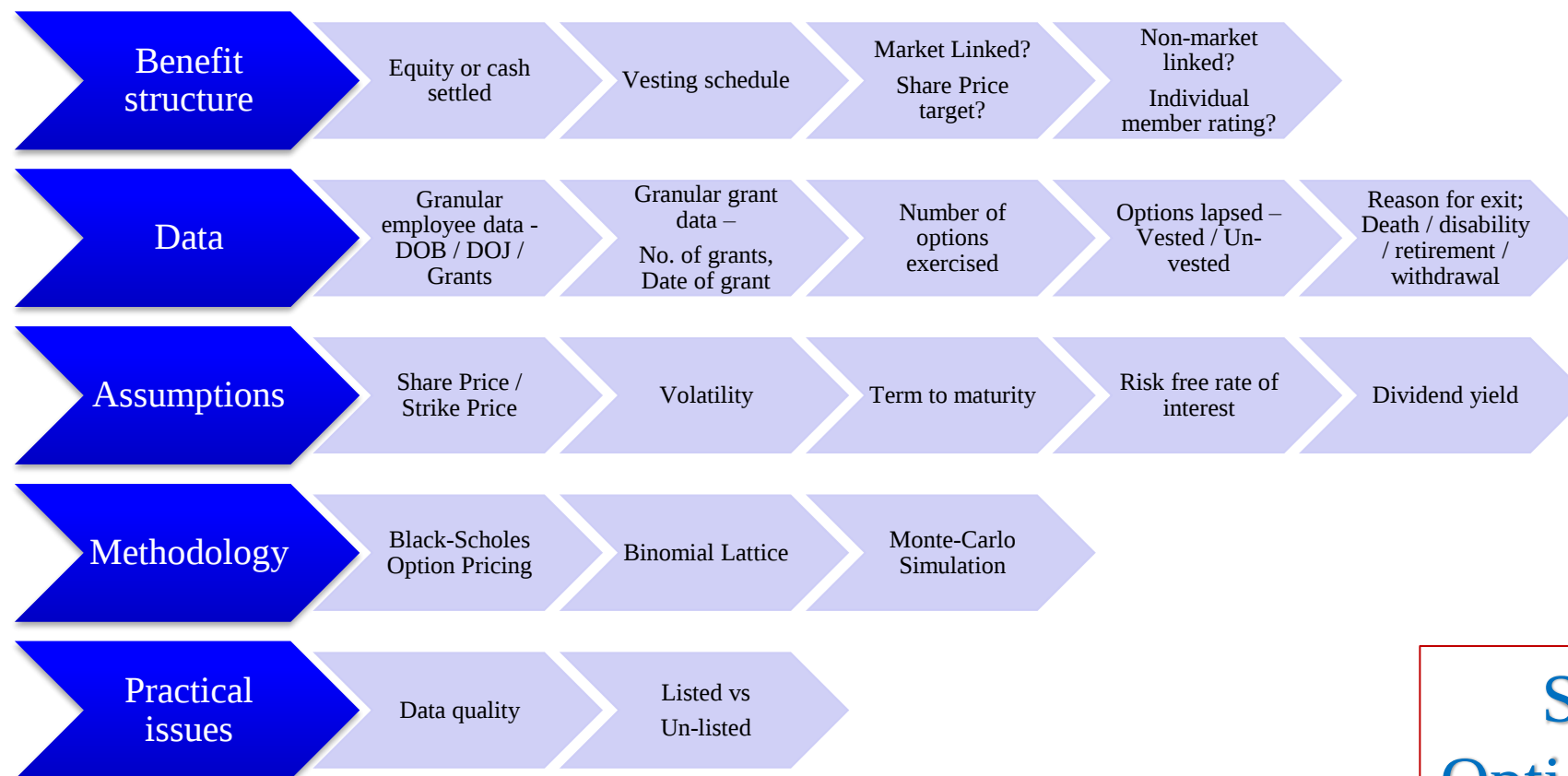
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Share-Based Payment Valuation Process – Overview



Share-Based Payment Valuation Process – Stage 1



Stage 1
Option Pricing

Share-Based Payment Valuation Process – Stage 2



IND AS 102 - Recognize services received as when it is actually received.

Grant Date	1 April 2024
Option Price	20
Number of options expected to vest	5000
Total expense	100,000

Vesting Date	1 April 2025	1 April 2026	1 April 2027
Vesting Pattern	33.33%	33.34%	33.33%
Options to vest	1,666	1,667	1,666
Expense for each vesting tranche	33,333	33,334	33,333

Recognition schedule

Valuation Dates	Tranche 1	Tranche 2	Tranche 3
1 April 2025	100%	50%	33.33%
1 April 2026	N/A	50%	33.34%
1 April 2027	N/A	N/A	33.33%

Stage 2
Expense Recognition

Valuation Dates	Tranche 1	Tranche 2	Tranche 3	Total expense	% Expense
1 April 2025	33,333	16,667	11,111	61,111	61%
1 April 2026	0	16,667	11,111	27,778	28%
1 April 2027	0	0	11,111	11,111	11%
Total	33,333	33,334	33,333	100,000	

Share-Based Payment Valuation Process – Stage 2

Scenario 2 – Non market linked vesting condition – Performance rating

Current Date – 31 March 2026

Vesting Date	1 April 2025	1 April 2026	1 April 2027
Revised expectation	1,666	1,000	500

Particulars	Tranche 1	Tranche 2	Tranche 3
Initial expenses to be recognised	33,333	33,334	33,333
Expenses recognised – Before April 26	33,333	16,667	11,111
Outstanding Expenses	0	16,667	22,222
Revised cumulative expenses	33,333	20,000	10,000
Changes to the recognition pattern	0	3,333	Y26: $[10,000 \times (2/3) - 11,111] = -4,444$ Y27: $[10,000 \times (3/3) - 6,666] = 3,333$ Reversed through P/L

Valuation Dates	Tranche 1	Tranche 2	Tranche 3	Total expense	% Expense
1 April 2025	33,333	16,667	11,111	61,111	96.5%
1 April 2026	0	3,333	-4,444	-1,111	-1.8%
1 April 2027	0	0	3,333	3,333	5.3%
Total	33,333	20,000	10,000	63,333	

Key differences – Valuation perspective only

	Equity Settled	Cash Settled
Determining Fair Value	Only at the Grant Date	At each Reporting Date till the date of settlement of the liability
Expense Determination	Valuation re-stated based on change in number of units expected to vest only	Valuation re-stated based on change in units expected to vest & change in fair value
Volatility of Charge to Income Statement	Relatively Stable	Relatively Volatile
Overall Charge over the entire vesting period	Expected to be higher	Expected to be lower (but can be either way depending upon ultimate settlement price)

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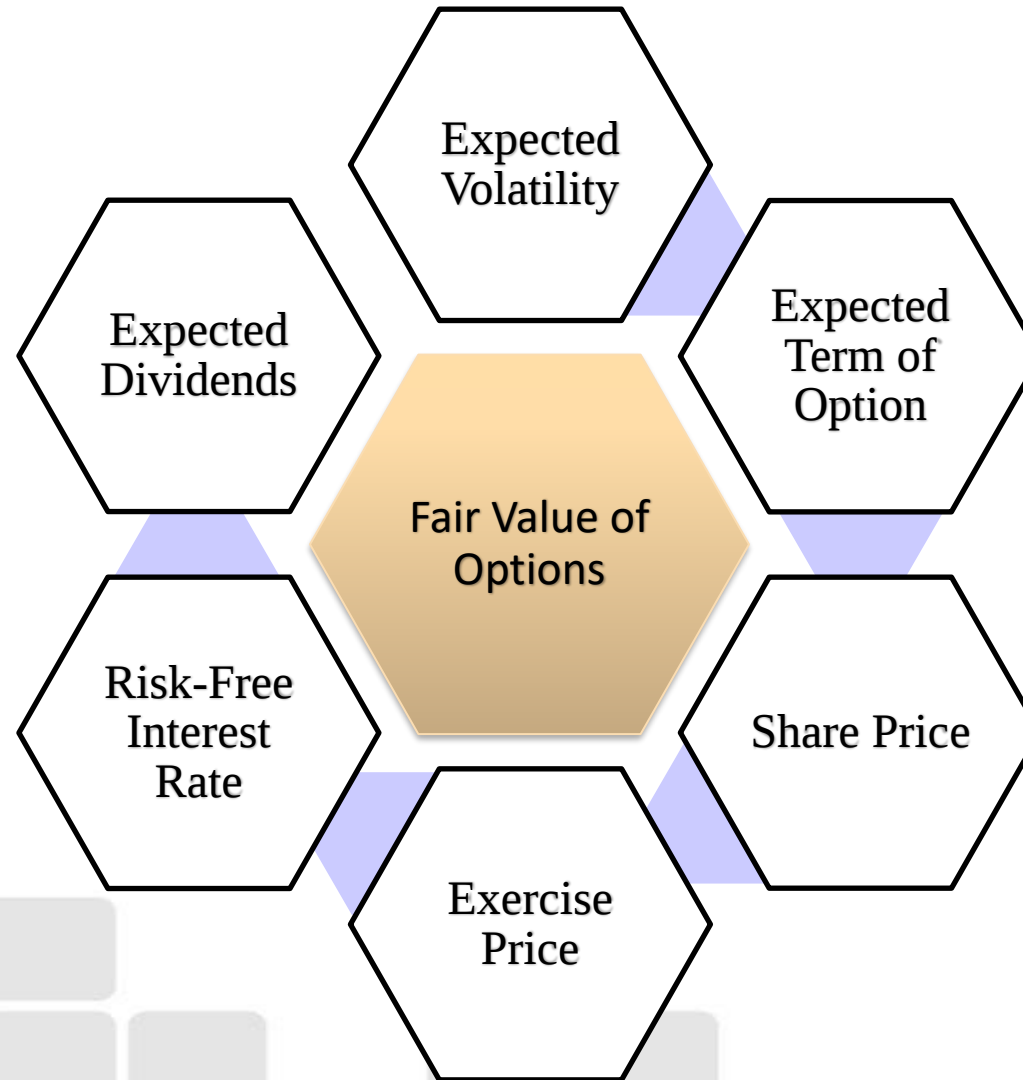
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Key Assumptions used in Option Pricing

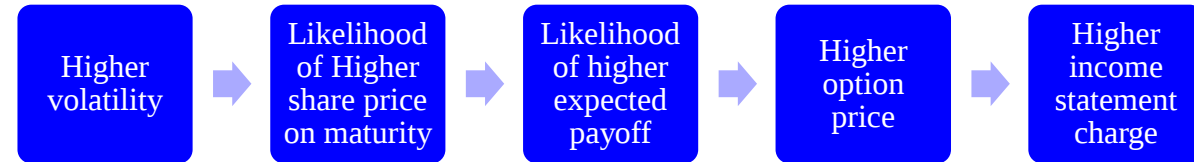


Expected Volatility

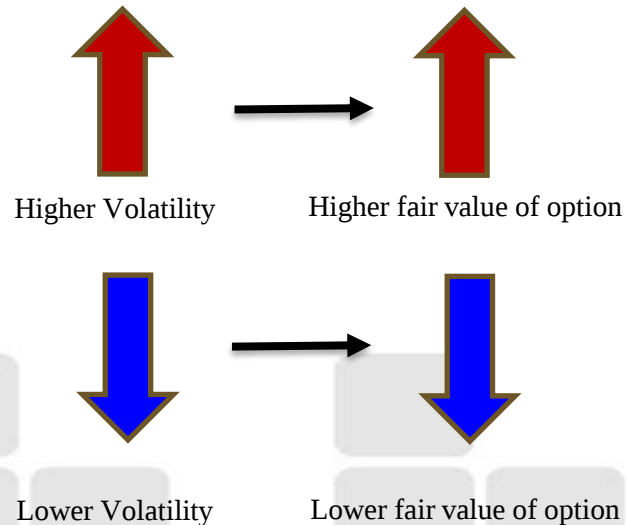
- Measure of the amount by which share price of company is expected to fluctuate during a given period, i.e., over the exercise term.

- Year 0 = 100
- Continuously compounded rate of return (r_s) = 12%

Year 1	30%	40%
Lower end	83.53	75.58
Upper end	152.20	168.20



- Year 1 = $100 * (\exp(r_s - \sigma) * t, \exp(r_s + \sigma) * t)$
only for approximation

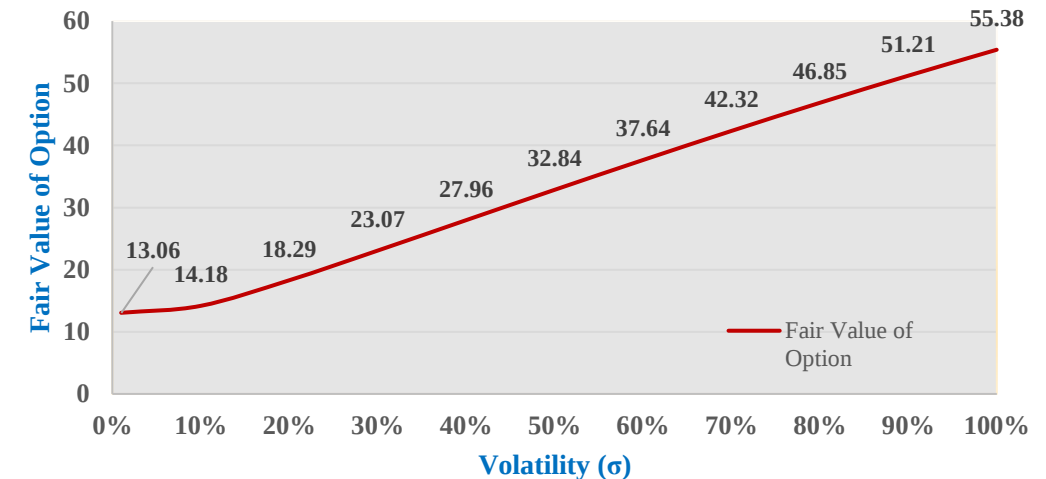


S_0	100.00
K	100.00
r	7.00%
$T-t$	2

Black Scholes option pricing

All other assumptions constant

Relationship between Volatility and Fair Value of Option



Expected Term to Exercise

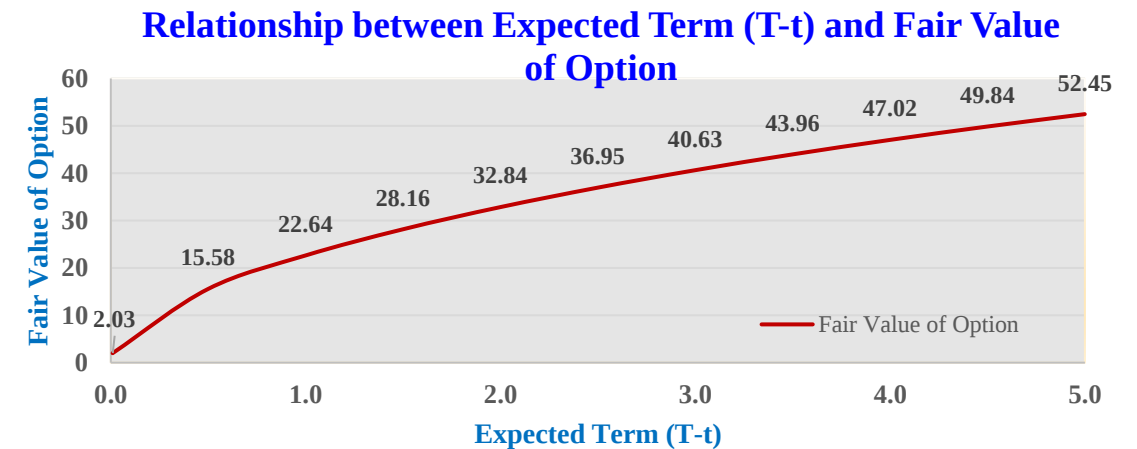
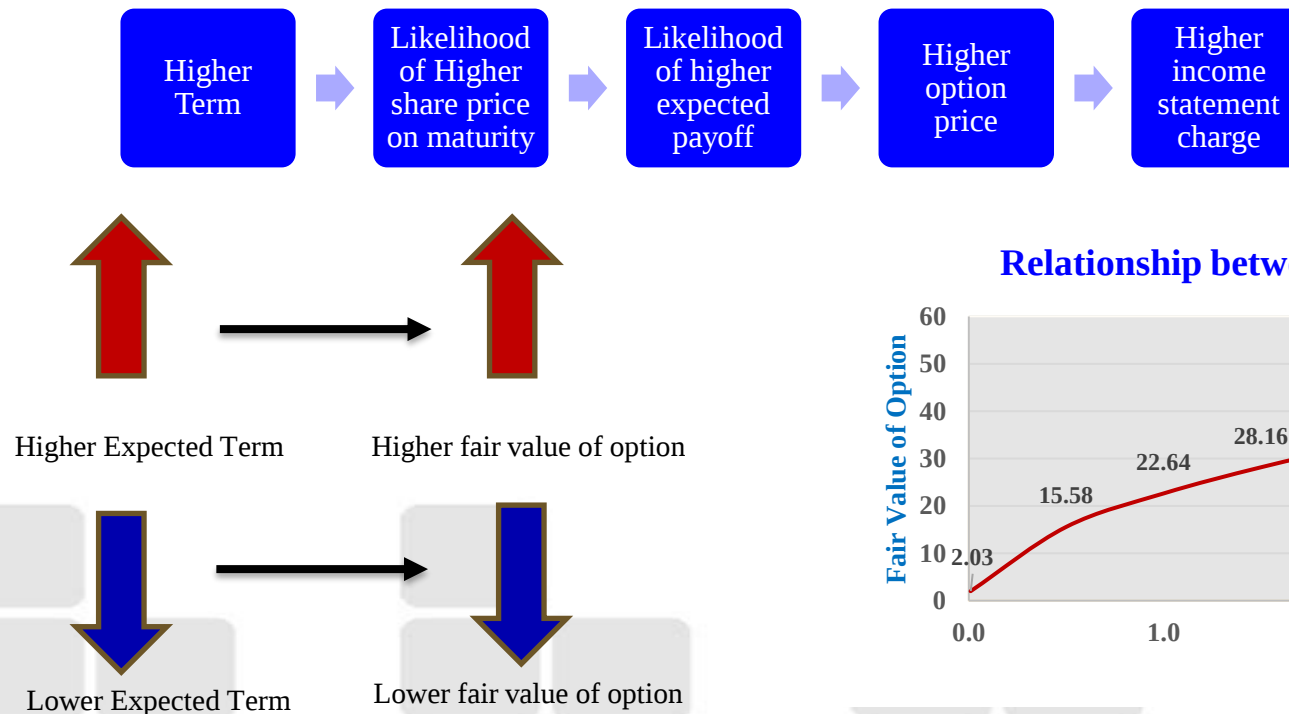
- Period between the Grant Date and expected date when the options are exercised,
- Duration the company anticipates options to remain active.

Year 2	30%	40%
Lower end	69.77	57.12
Upper end	231.64	282.92

S_0	100.00
K	100.00
r	7.00%
σ	50%

Black Scholes option pricing

All other assumptions constant



Share Price

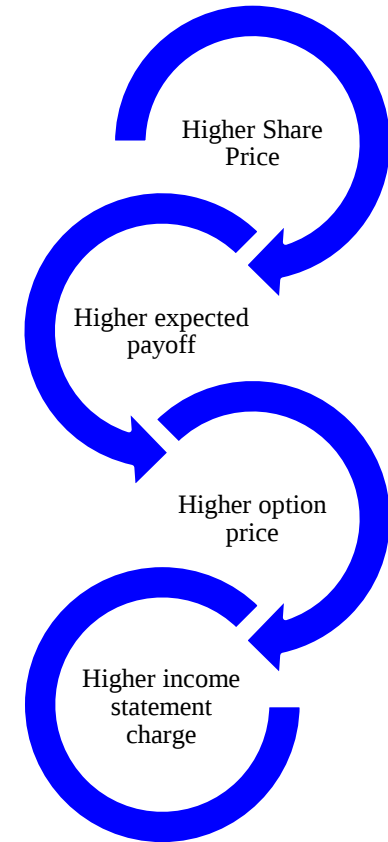
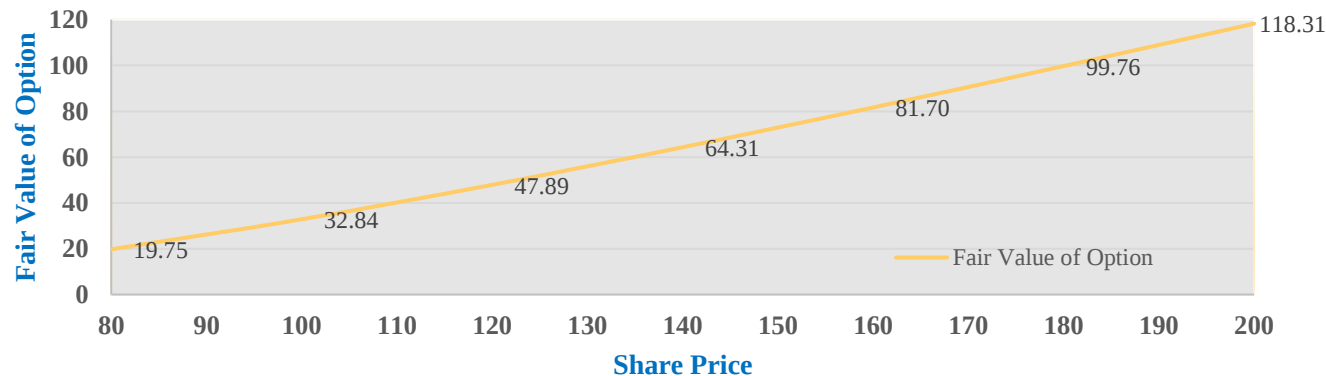
Listed Entity

Share price – publicly available

Unlisted Entity

- Reference to share price certificate
- Accounting multiplier – Peer benchmarking,
- Discounted cashflow models,
- Dividend discount model

Relationship between Share Price and Fair Value of Option



T-t	2
K	100.00
r	7.00%
σ	50%

Black Scholes option pricing

All other assumptions constant

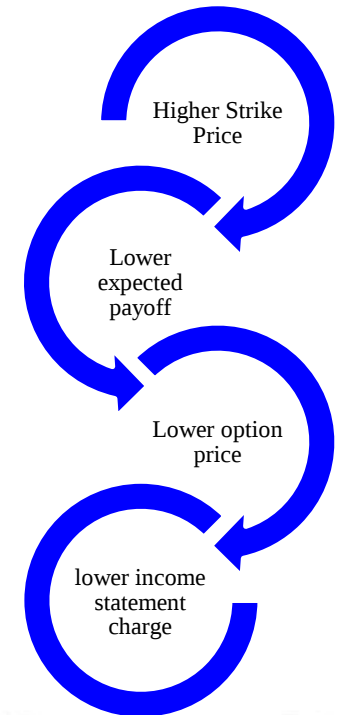
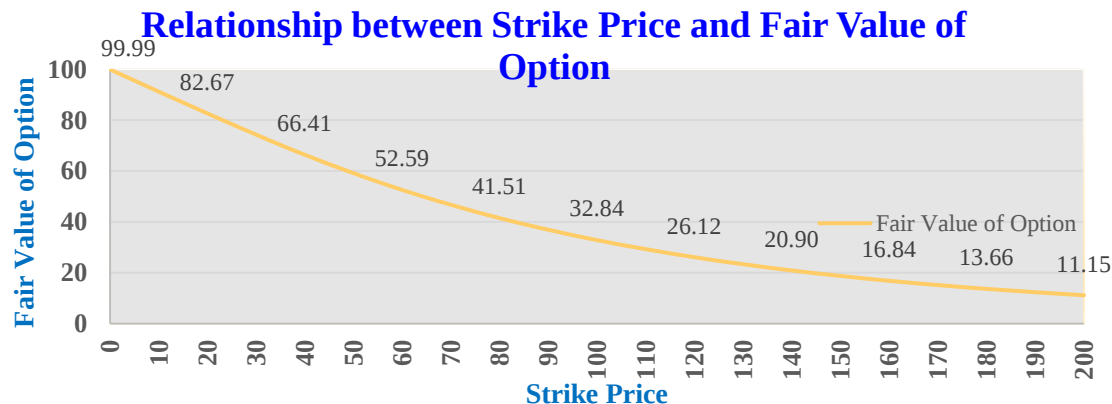
Exercise Price

- Employees must pay to execute the option granted.
- Outlined in the ESOP scheme or individual grant letters.
- While setting the exercise price, the company must adhere to accounting policies and regulatory requirements.
- For example - Companies Act of 2013, the exercise price cannot fall below the face or nominal value of the underlying share.

T-t	2
S	100.00
r	7.00%
σ	50%

Black Scholes option pricing

All other assumptions constant



Risk Free Interest Rate



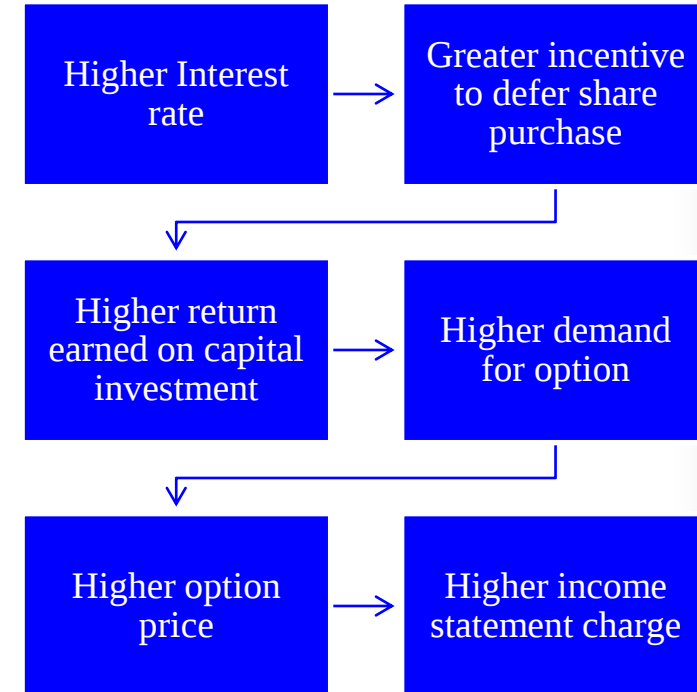
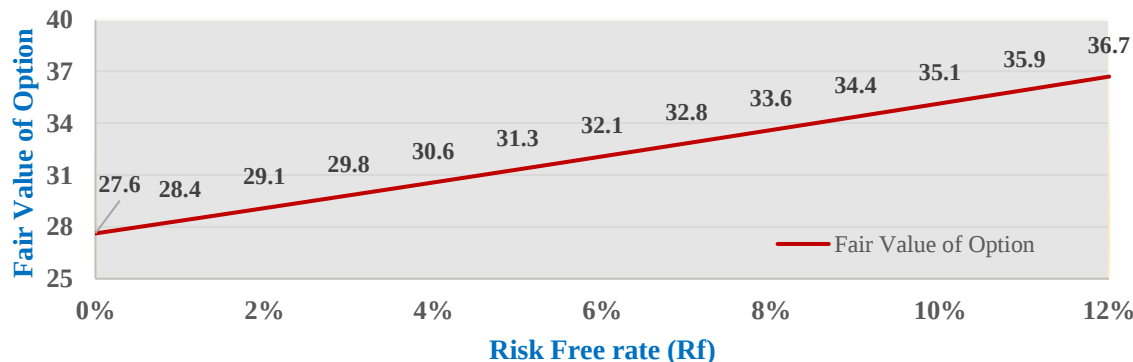
- Implied yield on zero-coupon government bonds matching the option's currency.
- Bond duration consistent with option's expected life.
- Appropriate substitute - permissible
- Methodology remains consistent for both listed and unlisted entities.

S	100.00
K	100.00
T-t	2
σ	50%

Black Scholes option pricing

All other assumptions constant

Relationship between Risk free rate and Fair Value of Option



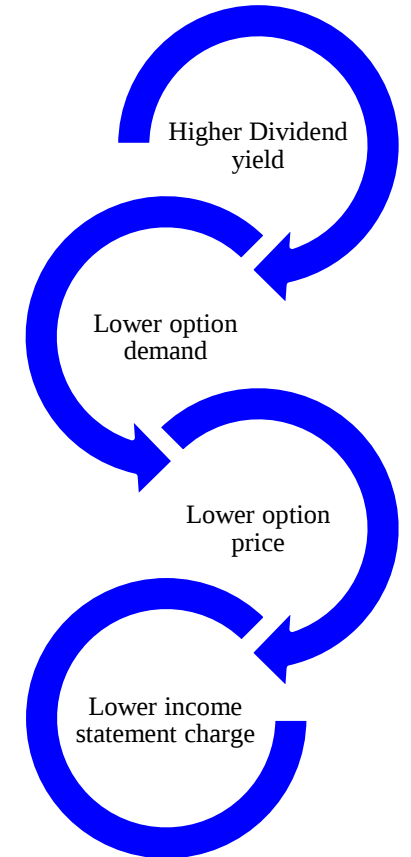
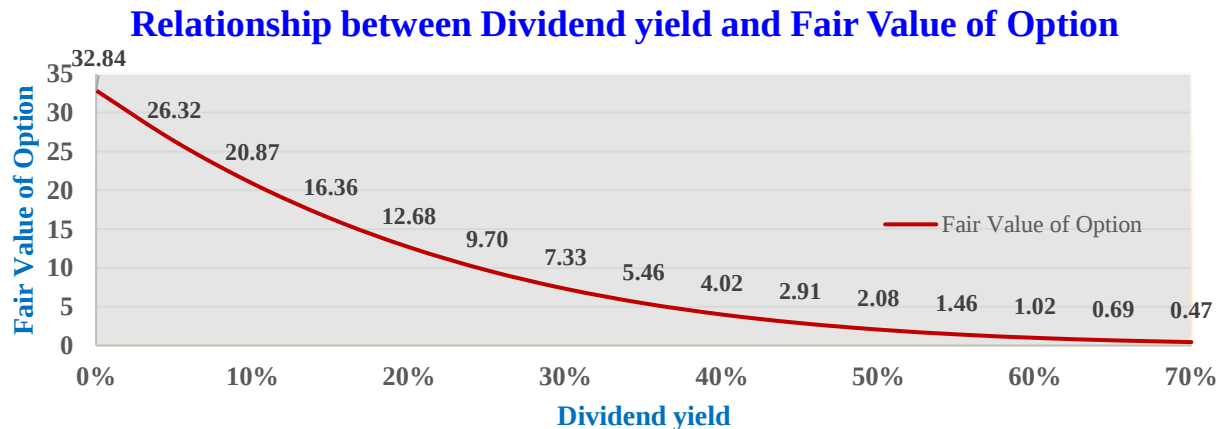
Dividend Yield

- Option holders – not eligible for dividends
- Listed entities - Publicly available information.
- New entities - can use an average of the past dividend yield and / or the mean dividend yield of a relevant peer group.
- If expected dividend information isn't provided, it's assumed to be zero.

S	100.00
K	100.00
T-t	2
σ	50%

Black Scholes option pricing

All other assumptions constant



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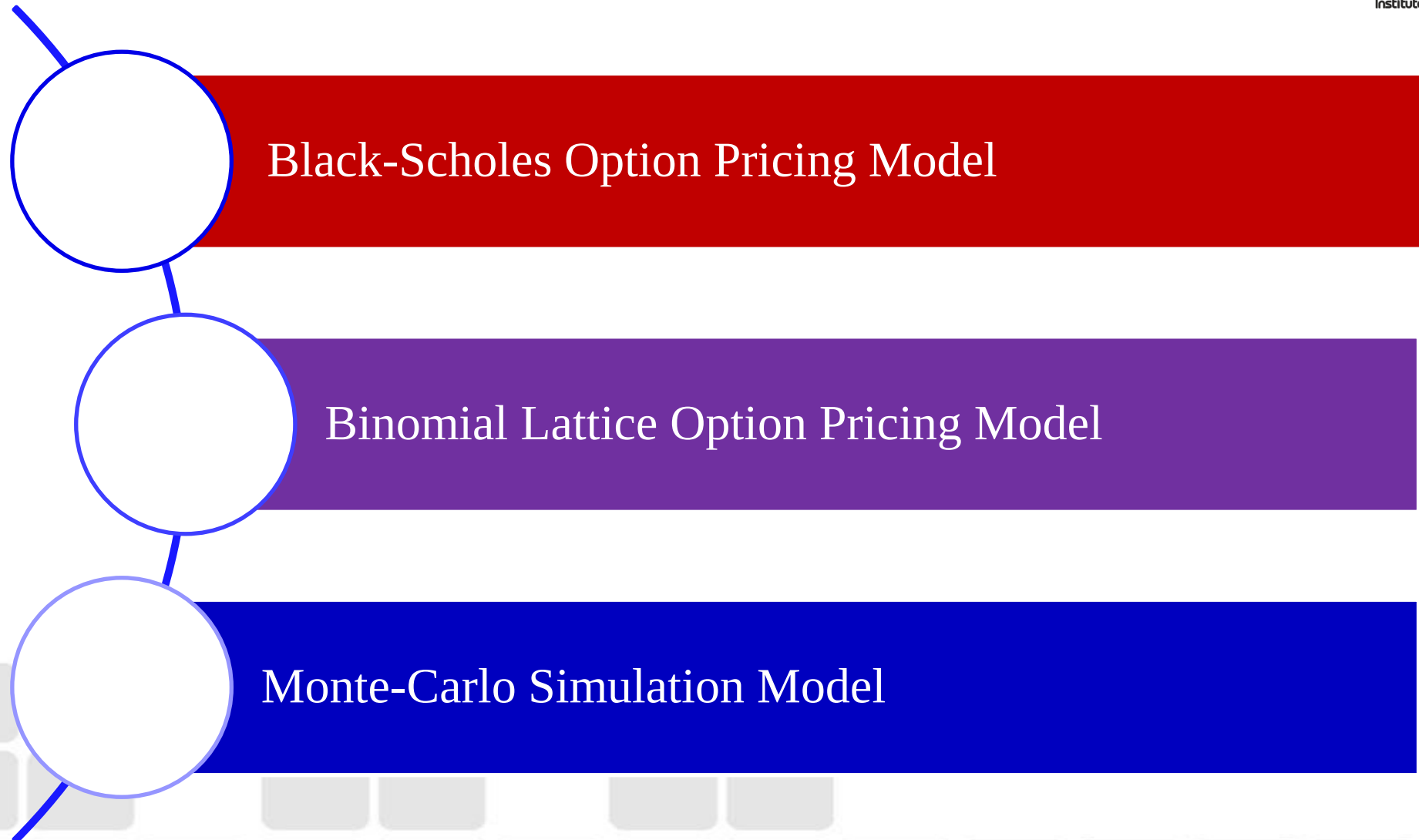
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The three common option pricing models used to determine the fair valuation of the options.



❑ Black-Scholes Option Pricing Model

- It is a **mathematical model** used to calculate the theoretical price of the option. It assumes that **share prices follow a log-normal distribution**, meaning they have a constant volatility and are independent of each other.
- The Black-Scholes model is relatively **easy to use** and is widely used by companies to estimate the fair value of options. However, it's important to note that the model has its limitations and **may not perfectly capture the complexities of real-world financial markets**, especially for options with features such as market-based vesting conditions.

$$\text{Price of Call Option (C)} = S_0 \times N(d_1) \times e^{-q \times (T-t)} - K \times N(d_2) \times e^{-r \times (T-t)}$$

STEP 1
Define Model
Parameters



STEP 2
Calculate d_1 and
 d_2



STEP 3
Compute the
Option Price

Step 1: Define Model Parameters

S_0	INR 100	<< Stock Price
K	INR 100	<< Strike Price of Call Option
r	7.00% p.a.	<< Risk Free Rate of Return
σ	50.00% p.a.	<< Annualised Volatility of the Stock
$T - t$	2 years	<< Expected Term to Maturity in Years
q	0.00% p.a.	<< Expected Dividend Yield of the Stock

*Equity Settled Options: Valued only once, as on the **Grant Date***

*Cash Settled Options: Valued at each **Valuation Date***

Step 2: Calculate d_1 and d_2

$$d_1 = \frac{\ln\left(\frac{S_0}{K}\right) + \left(r - q + \left(\frac{\sigma^2}{2}\right)\right) \times (T - t)}{\sigma \times \sqrt{T - t}}$$

$$d_1 = 0.5515$$

$$d_2 = \frac{\ln\left(\frac{S_0}{K}\right) + \left(r - q - \left(\frac{\sigma^2}{2}\right)\right) \times (T - t)}{\sigma \times \sqrt{T - t}}$$

$$d_2 = -0.1556$$

Step 3: Compute the Option Price

$$\begin{aligned}
 &= S_0 \times N(d_1) \times e^{-q \times (T-t)} - K \times N(d_2) \times e^{-r \times (T-t)} \\
 &= 100 \times N(0.5515) \times e^{-0 \times (2-0)} - 100 \times N(-0.1556) \times e^{-0.07 \times (2-0)} \\
 &= 100 \times 0.7094 \times e^0 - 100 \times 0.4382 \times e^{-0.14} \\
 &= 70.94 - 43.82 \times 0.8694 \\
 &= 32.84
 \end{aligned}$$

Where,

$N(d)$ is the cumulative distribution function of the standard normal distribution

Option Price = Intrinsic Value + Time Value; where,

The Intrinsic Value is equal to the difference between Stock Price and Strike Price and,

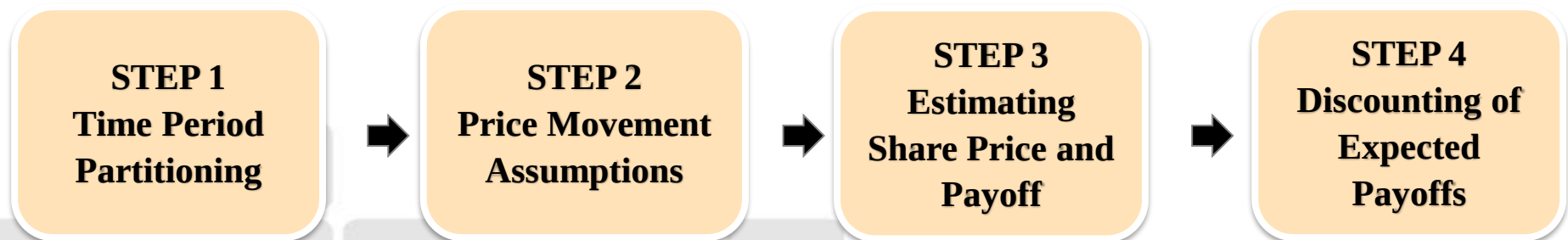
The Time Value represent the additional value due to the time left until expiration, considering factors such as volatility, risk-free interest rate, and time to maturity.

In the above example, since the intrinsic value is NIL, 32.84 represent the time value.

❑ Binomial Lattice Option Pricing Model



- It is based on the assumptions that the **share price can move up or down over time** according to a binomial distribution.
- It is **represented by a binomial tree**, where **each node represents the possible share price** at a particular point in time.
- For each node, an **expected payoff** which is the difference between the share price at that node and the exercise price is determined. This is then **discounted** to determine the fair value of the option.
- It provides a **flexible** framework to value ESOPs, however, it is **complex to implement and understand**, and **requires significant computational resources**, especially with long-time periods



Step 1: Define Parameters and Time Period Partitioning

The first step is to divide the option's life into discrete time steps (nodes).

In this example we have considered the time step to be 1 year for simplicity.

S_0	INR 100	<< Stock Price
K	INR 100	<< Strike Price of Call Option
Δt	1 year	<< Time step (Δt) between each node
r	7.00% p.a.	<< Risk Free Rate of Return
σ	50.00% p.a.	<< Annualised Volatility of the Stock
$T - t$	2 years	<< Expected Term to Maturity in Years
q	0.00% p.a.	<< Expected Dividend Yield

It should be note that the time step can be bi-annually, quarterly, monthly, daily.

Step 2: Share Price Movement Assumptions



Assume the share price can either move up or down at each step:

Upward Movement (u): The **up movement factor** represents the proportional increase in the underlying asset price during a single time step.

$$u = e^{\sigma \times \sqrt{\Delta t}} = 1.6487$$

At step 1, Stock Price may move upward to $S_u = S_0 \times u = 164.87$

Downward Movement (d): The **down movement factor** represents the proportional decrease in the underlying asset price during a single time step.

$$d = \frac{1}{u} \text{ or } e^{-\sigma \times \sqrt{\Delta t}} = 0.6065$$

At step 1, Stock Price may move downward to $S_d = S_0 \times d = 60.65$

Upward Probability (p): The **upward probability** represents the likelihood of the asset price moving up in a risk-neutral world. It ensures that the model remains arbitrage-free and reflects the expected return at the risk-free rate.

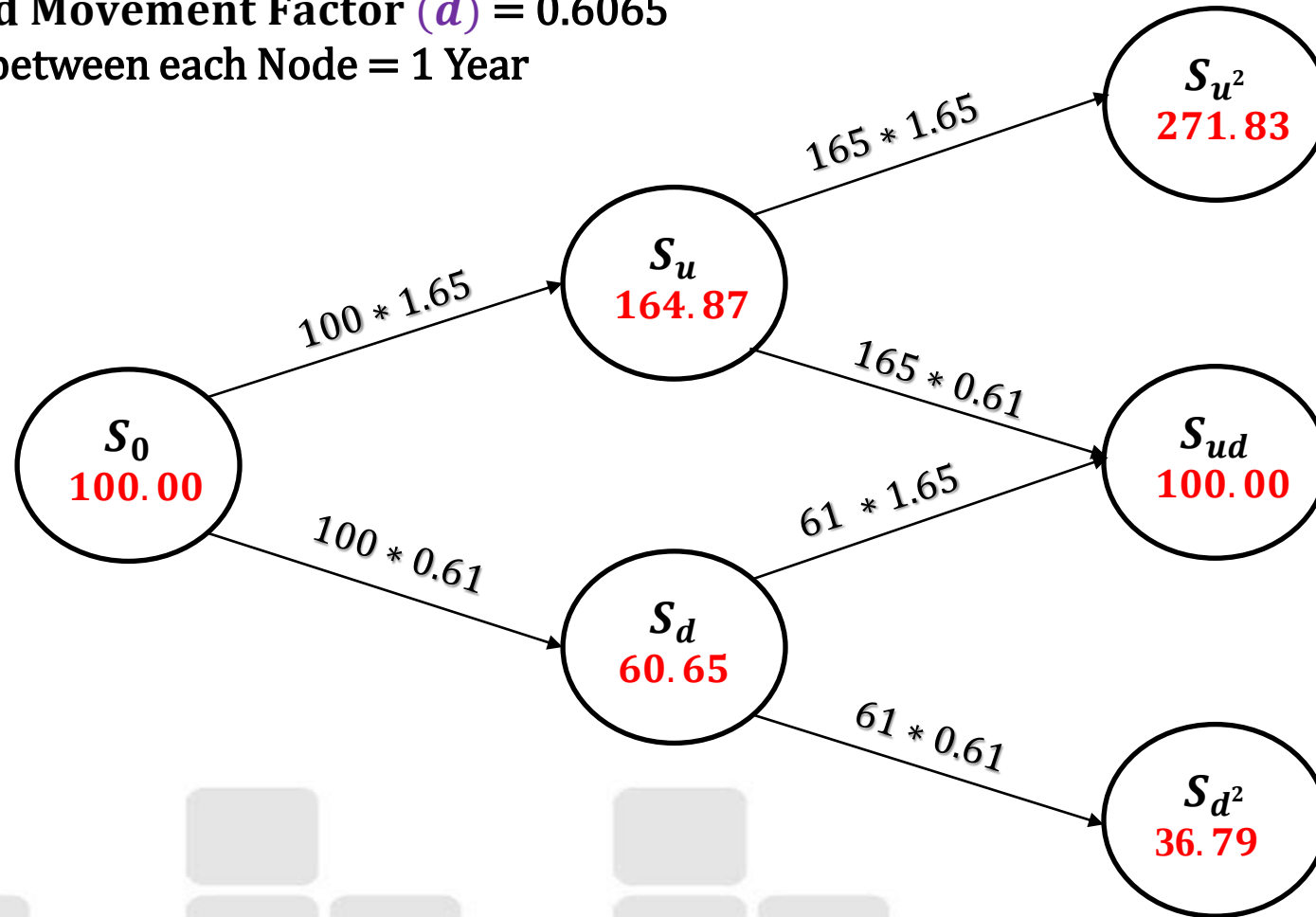
$$p = \frac{e^{(r-q) \times \Delta t} - d}{u - d} = 44.71\%$$

Step 3: Calculating Share Price

Upward Movement Factor (u) = 1.6487

Downward Movement Factor (d) = 0.6065

Time Step between each Node = 1 Year

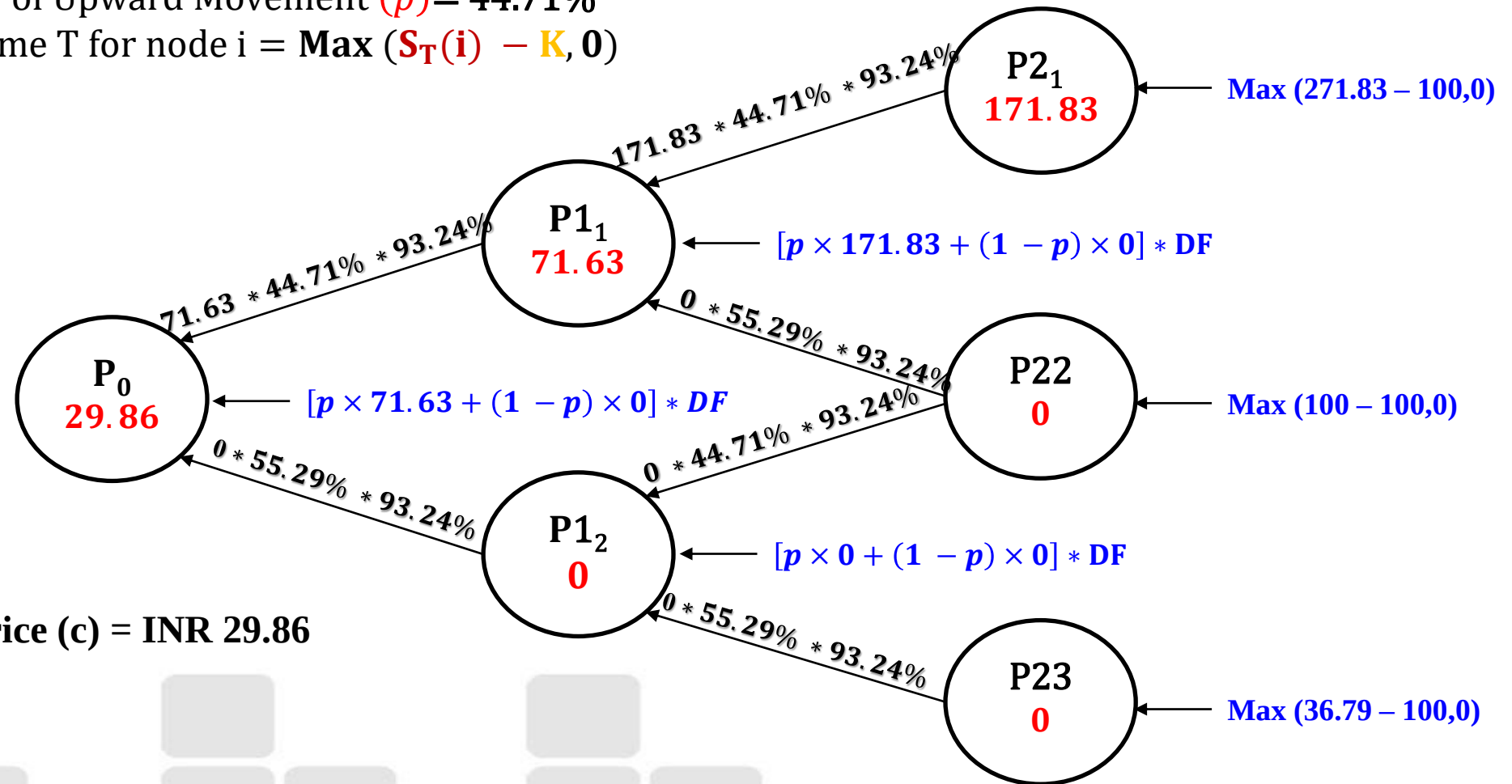


Step 3: Discounting Expected Payoff

Discounting Factor (DF) = $e^{-r \times \Delta t} = 93.24\%$

Probability of Upward Movement (p) = 44.71%

Payoff at time T for node i = $\text{Max} (S_T(i) - K, 0)$



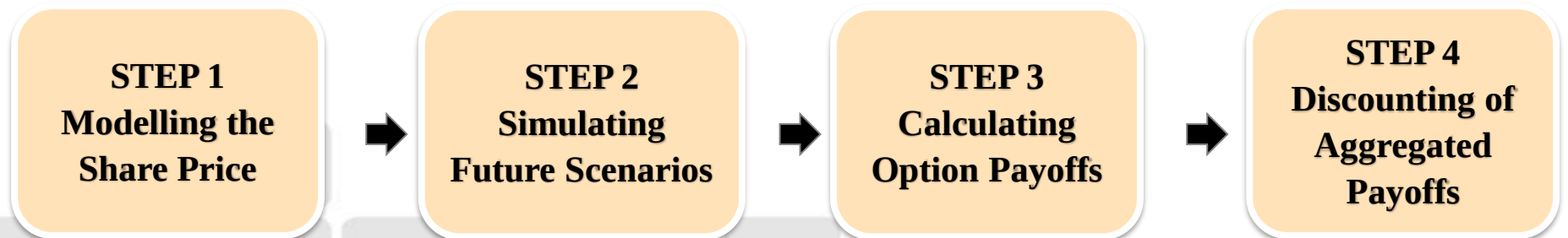
Result:

Option Price (c) = INR 29.86

❑ Monte-Carlo Simulation Model



- It is a technique used to value options by **simulating the various possible paths of the underlying share price** over time.
- For each simulated scenario, an **expected payoff**, i.e., the difference between the simulated share price and the exercise price is determined, which is **then discounted** to determine the fair value of the option.
- It provides a **more flexible and realistic framework** for option valuation.
- It allows for the incorporation of various sources of uncertainty and volatility in the valuation process, which **can provide a more realistic and robust estimate** of the options' value compared to more simplistic valuation methods.



Step 1: Modelling the Discounted Share Price

S_0	INR 100
K	INR 100
$r_{\text{annualised}}$	7.00% p.a.
r_{daily}	0.0206% (approx.)
$\sigma_{\text{annualised}}$	50.00% p.a.
σ_{daily}	2.617% (approx.)
$T - t$	2 years
q	0.00% p.a.

The below formula is used to calculate the expected Share Price at each time step from the Grant Date to the Exercise Date

$$S_t = S_0 \times e^{\left(r - q - \frac{\sigma^2}{2}\right) \times \Delta t} + \sigma \times \sqrt{\Delta t} \times \epsilon$$

Δt : time step

ϵ : Standard Normal Random Variable

Where,

Δt : represents a small time step or time interval in the model. It divides the total time period (T) into smaller intervals for step-by-step calculations of the share price evolution.

ϵ : In stochastic processes, ϵ is used to model the random changes in the share price over a small time step (Δt). During Monte Carlo simulations multiple values of ϵ are drawn for each time step to simulate different possible paths of the share price using the following formula in excel:

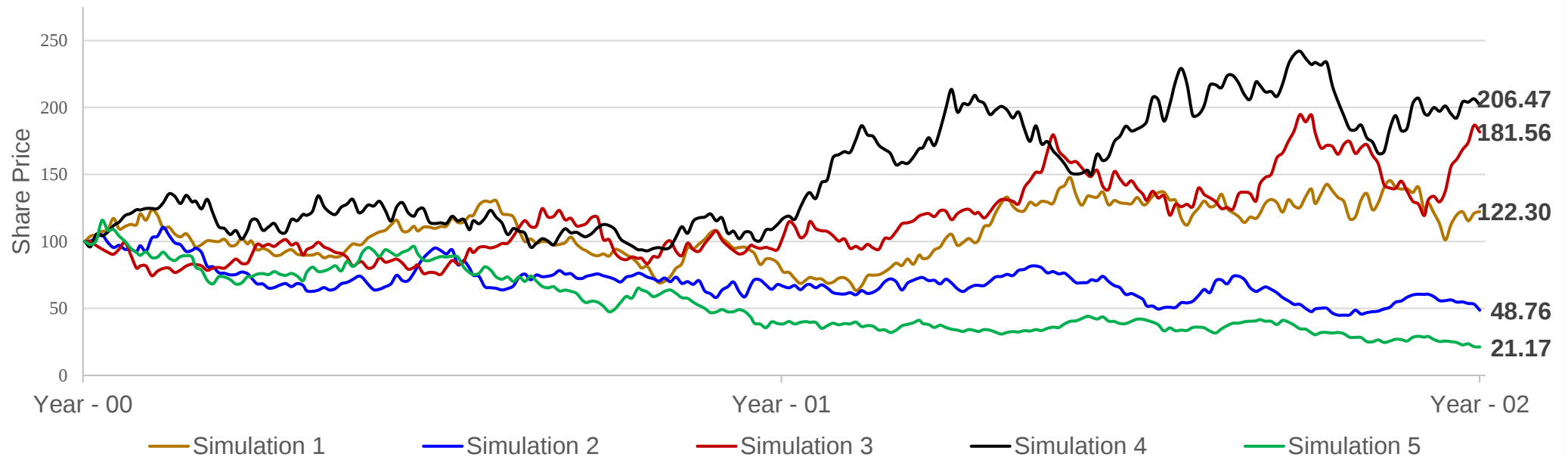
NORM.S.INV(RAND())

Step 2: Stimulating Future Scenarios

Multiple random scenarios are generated for future stock prices. Here are a few random simulated stock price paths over time

Total Number of simulations carried out – 100,000

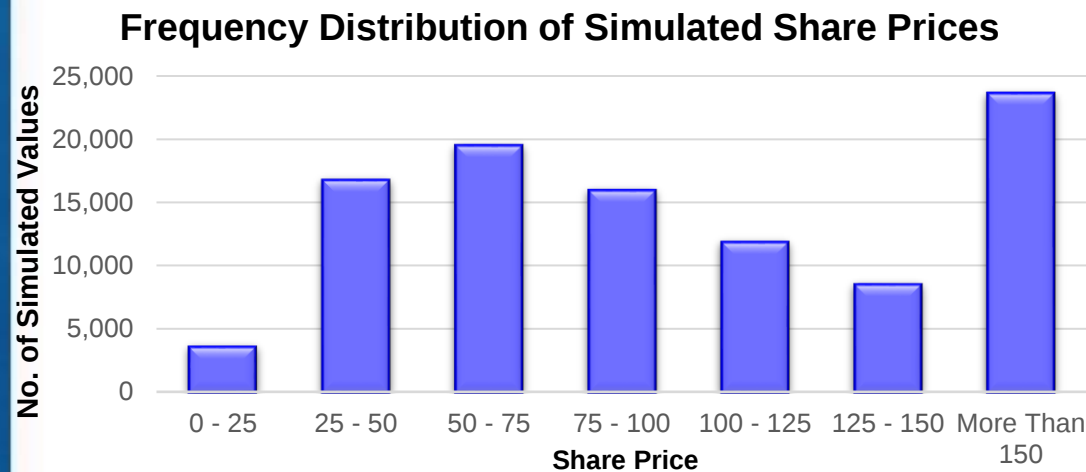
Movement in Simulated Share Price



Step 3: Calculating Option Payoffs

For each scenario, the expected payoff is determined based on the simulated share price using the formula:

$$\text{Payoff} = \text{Max} (\text{Share Price at time T} - \text{Exercise Price}, 0)$$



Simulation	Share Price at time T	Payoff at time T
1	104.37	4.37
2	86.34	-
....		
99999	167.19	67.19
100000	55.45	-
Average Payoff		38.09

Step 4: Discounting of aggregated Payoffs

Average of the payoffs across all the simulations at time T

Average Payoff = 38.09

Which is then discounted back using the risk-free rate to arrive at the final Option Price.

Option Price (c) = Average Payoff $\times e^{-rT}$ = 32.78

Summary Results – Plain Vanilla ESOP Scheme



Particulars	Black-Scholes	Binomial Model (Yearly Time Step)	Monte Carlo Simulation (10,000 Simulations)
CASE A	32.84	29.86	32.15
% Change		-9.07%	-2.10%

Binomial Model: Shows a significant underestimation (-9.07%) due to large time steps, leading to fewer price adjustments and higher approximation errors.

Monte Carlo Simulation: Provides a closer estimate (-2.10%), but limited simulations introduce statistical noise.

Particulars	Black-Scholes	Binomial Model (Quarterly Time Step)	Monte Carlo Simulation (50,000 Simulations)
CASE B	32.84	32.04	32.67
% Change		-2.44%	-0.52%

Binomial Model: Improves accuracy (-2.44%) by increasing time steps, reducing discretization errors.

Monte Carlo Simulation: Closer to Black-Scholes (-0.52%) due to a higher number of simulations.

Particulars	Black-Scholes	Binomial (Daily Time Step)	Simulation (100,000 Simulations)
CASE C	32.84	32.83	32.78
% Change		-0.03%	-0.18%

Binomial Model: Almost matches Black-Scholes (-0.03%) with high precision due to fine granularity.

Monte Carlo Simulation: Also achieves accurate results (-0.18%), benefiting from a large number of simulations

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Question:

XYZ Private Limited has granted 100 equity-settled stock options each to 10 employees on December 1, 2023 at an exercise price that is 80% lower than the company's share price on the grant date. According to the ESOP policy, the vesting schedule follows a 3-year period, where 50% of the options vest at the end of Year 1, and 25% vest at the end of Year 2 and Year 3. The options granted have an expiry date of 10 years from the grant date, after which they will be considered as lapse. However, the company anticipates a liquidity event on December 1, 2030. Additionally, the company does not expect to pay dividends in the near future.

Lastly, the share price of ABC Limited, a close competitor of XYZ Private Limited, has a historical implied volatility of 40%. Also, the industry's implied volatility is 50%.

The following additional details have also been provided:

- Company's Stock price as on 1st Dec 2023: ₹500
- Company's Stock price as on 31st Mar 2024: ₹530
- Risk-free rate as on 1st Dec 2023: 7.2% p.a.
- Risk-free rate as on 31st Mar 2024: 7.5% p.a.

Case Study



Part a)

Calculate the fair value of the option using the Black-Scholes model

Part b)

Determine the ESOP Outstanding balance and the P&L expense to be recognized for the Financial Year 2023-24, considering that the company expects 10% of the unvested options to lapse annually.

Part c)

By the end of Financial Year 2024-25, all outstanding options from the first vesting tranche have vested, and no employees have left the organization.

Calculate the ESOP Outstanding balance and the P&L expense for FY 2024-25, incorporating the company's updated expectation of a 5% p.a. lapse rate for future years.

Part d)

During Financial Year 2025-26, all outstanding options from the second tranche have vested. Further, two employees left the company voluntarily, leading to the forfeiture of their unvested options (50 options from Tranche 3). However, the estimated lapsation rate remains unchanged at 5% p.a. Determine the ESOP Outstanding balance and the P&L expense to be recognized for FY 2025-26.

Part e)

During Financial Year 2026-27, all outstanding options from the last tranche have vested. Determine the ESOP Outstanding balance and the P&L expense to be recognized for FY 2026-27.

Thank You!