# FINANCIAL ENGINEERING PROJECT
# OPTION PRICING

॥ त्वं ज्ञानमयो विज्ञानमयोऽसि ॥


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## M21CS007

# Assets Used:

1. AAPL - Apple Inc.
2. AMZN - Amazon corporation
3. TSLA - Tesla

Closing prices of a year till 4th April were used

# Black Scholes Model:

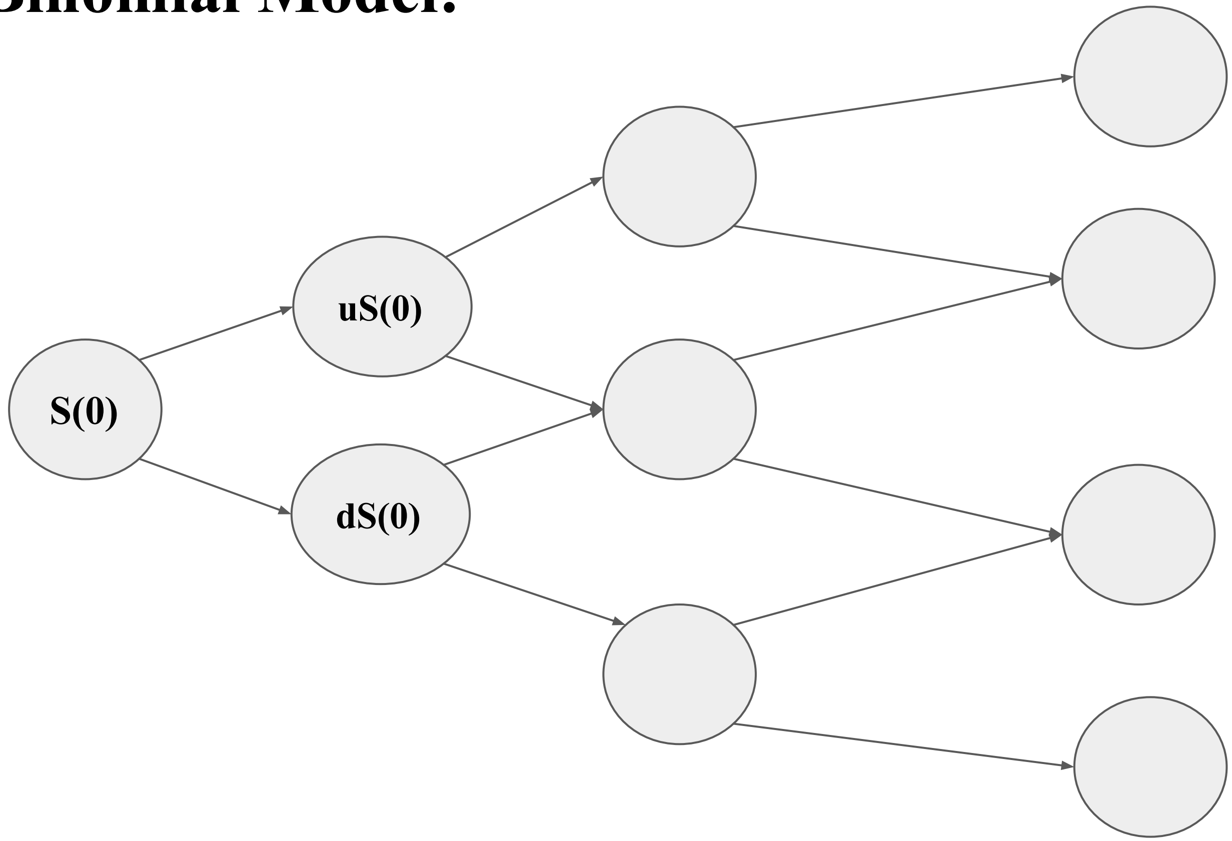
$$C = N(d_1)S_t - N(d_2)Ke^{-rt}$$

$$\text{where } d_1 = \frac{\ln\frac{S_t}{K} + (r + \frac{\sigma^2}{2})t}{\sigma\sqrt{t}}$$

$$\text{and } d_2 = d_1 - \sigma\sqrt{t}$$

| | | | |
|---|---|---|---|
| **St** | **= Option price at time t** | **t** | **= Time** |
| **K** | **= Strike price** | **σ** | **= Volatility** |
| **r** | **= Rate of Interest** | **n** | **= No. of Steps** |
| **d** | **= 1/u** | **u** | **= $\sigma\sqrt{t/n}$** |

# Binomial Model:



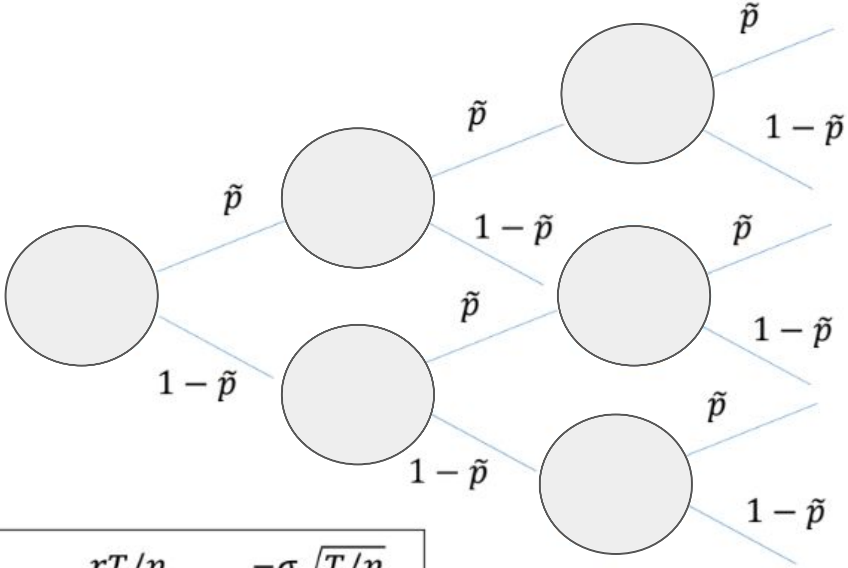

$u^nS(0)$

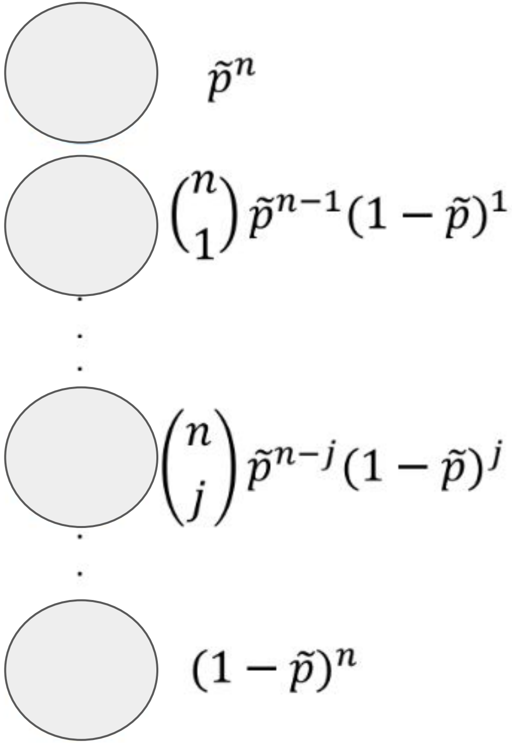
$d^1u^{n-1}S(0)$

$d^iu^{n-i}S(0)$

$d^nS(0)$

# Binomial Model:




$$\boxed{\tilde{p} = \frac{e^{rT/n} - e^{-\sigma\sqrt{T/n}}}{e^{\sigma\sqrt{T/n}} - e^{-\sigma\sqrt{T/n}}}}$$

# Example of Models:

**Initial Parameters**

r : 0.05

d : 0.9934032966389761

T : 0.17857142857142858

s0 : 100

u : 1.006640508827928

k : 80

sigma: 0.35

n : 500

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**c0 : 21.040408287845587**

**p0 : 0.32885454990966423**

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**For Black Scholes Model:**

**c0 : 21.039971395137954**

**p0 : 0.3284176572020243**

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As we can see the difference between them is : **0.00043689270763280774**

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Sigma Implied is Calculated as : 0.35000000000000026

# Apple option :

**Implied Volatility for week 1 is 0.3640000000000027**
**Implied Volatility for week 2 is 0.3370000000000024**
**Implied Volatility for week 3 is 0.3200000000000023**
**Implied Volatility for week 4 is 0.293000000000002**
**Implied Volatility for week 5 is 0.297000000000002**
**Implied Volatility for week 6 is 0.293000000000002**
**Implied Volatility for week 7 is 0.3460000000000025**
**Implied Volatility for week 8 is 0.303000000000002**
**Implied Volatility for week 9 is 0.296000000000002**
**Implied Volatility for week 10 is 0.287000000000002**

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**For week 1 the strategy or delta t value is : 0.7276043549615879**
**For week 2 the strategy or delta t value is : 0.6102747069137797**
**For week 3 the strategy or delta t value is : 0.6030538299370662**
**For week 4 the strategy or delta t value is : 0.6020968477746342**
**For week 5 the strategy or delta t value is : 0.5985939298734981**
**For week 6 the strategy or delta t value is : 0.597290868616928**
**For week 7 the strategy or delta t value is : 0.5879344498119585**
**For week 8 the strategy or delta t value is : 0.5947016460342616**
**For week 9 the strategy or delta t value is : 0.5992360372793886**
**For week 10 the strategy or delta t value is : 0.6064230382476257**

# Amazon option :

Implied Volatility for week  1  is  0.4070000000000003
Implied Volatility for week  2  is  0.43200000000000033
Implied Volatility for week  3  is  0.2770000000000002
Implied Volatility for week  4  is  0.36700000000000027
Implied Volatility for week  5  is  0.35900000000000026
Implied Volatility for week  6  is  0.4220000000000003
Implied Volatility for week  7  is  0.3950000000000003
Implied Volatility for week  8  is  0.2730000000000002
Implied Volatility for week  9  is  0.32500000000000023
Implied Volatility for week  10  is  0.32100000000000023

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For week  1  the strategy or delta t value is :  0.5583917648712073
For week  2  the strategy or delta t value is :  0.5402997497044508
For week  3  the strategy or delta t value is :  0.5490249207261282
For week  4  the strategy or delta t value is :  0.5465805551753147
For week  5  the strategy or delta t value is :  0.548483690543196
For week  6  the strategy or delta t value is :  0.5503525658632864
For week  7  the strategy or delta t value is :  0.5527561244877338
For week  8  the strategy or delta t value is :  0.5661938374116376
For week  9  the strategy or delta t value is :  0.5723834865260085
For week  10  the strategy or delta t value is :  0.5826735081020818

# Tesla option :

**Implied Volatility for week 1 is 0.9990000000000008**
**Implied Volatility for week 2 is 0.6910000000000005**
**Implied Volatility for week 3 is 0.6450000000000005**
**Implied Volatility for week 4 is 0.6020000000000004**
**Implied Volatility for week 5 is 0.6100000000000004**
**Implied Volatility for week 6 is 0.5810000000000004**
**Implied Volatility for week 7 is 0.6670000000000005**
**Implied Volatility for week 8 is 0.5820000000000004**
**Implied Volatility for week 9 is 0.5510000000000004**
**Implied Volatility for week 10 is 0.5430000000000004**

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**For week 1 the strategy or delta t value is : 0.5280755925128532**
**For week 2 the strategy or delta t value is : 0.5369521617909147**
**For week 3 the strategy or delta t value is : 0.5411393868749876**
**For week 4 the strategy or delta t value is : 0.5454469935695029**
**For week 5 the strategy or delta t value is : 0.5486024183187258**
**For week 6 the strategy or delta t value is : 0.5512336687719799**
**For week 7 the strategy or delta t value is : 0.5581543668844152**
**For week 8 the strategy or delta t value is : 0.5688199319849676**
**For week 9 the strategy or delta t value is : 0.5779997707849255**
**For week 10 the strategy or delta t value is : 0.590062408687981**

# Thank You