Module 307 - Options trading strategies :

Options :

① Call option
② Put option

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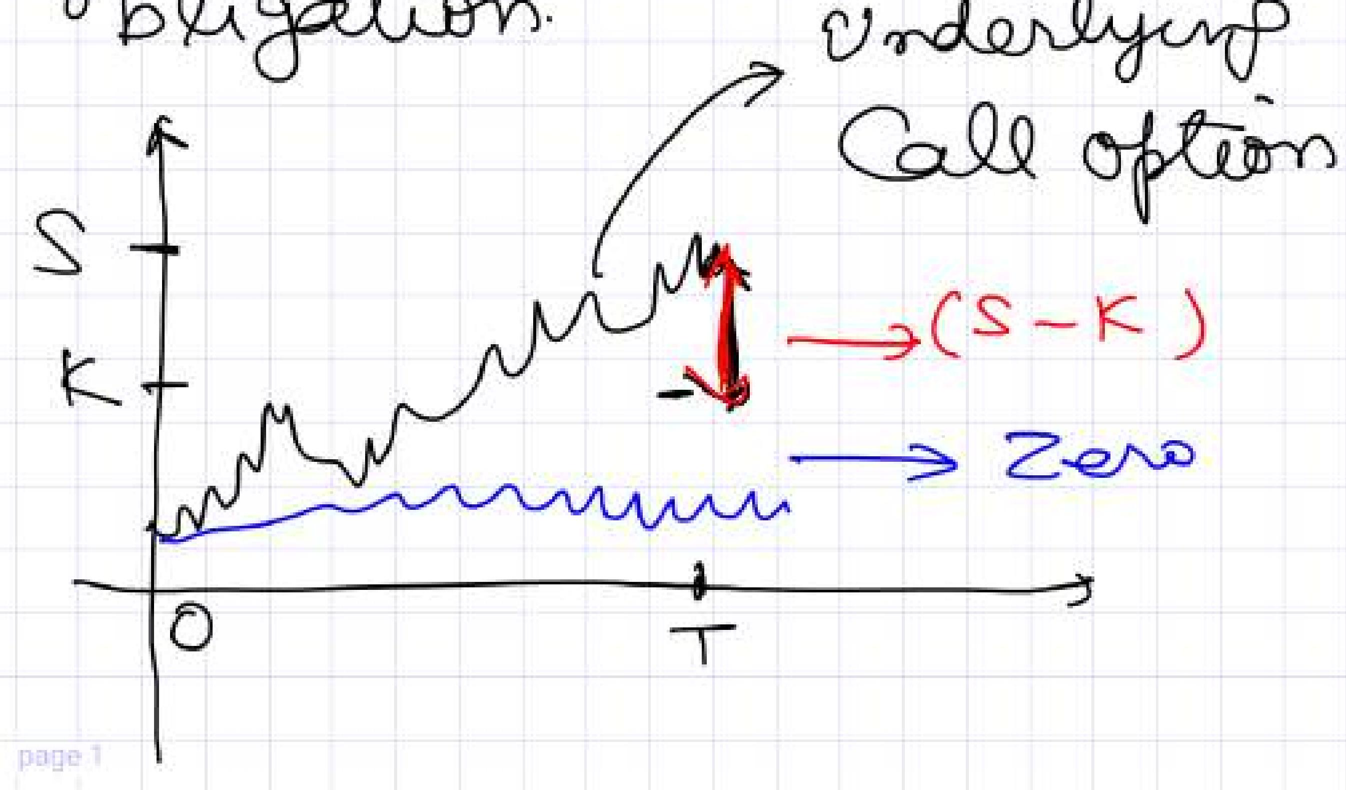
① Expiry time (T)
② Strike price (K)
③ Underlying.

Option is a contract where we have option but not obligation.



Call option :

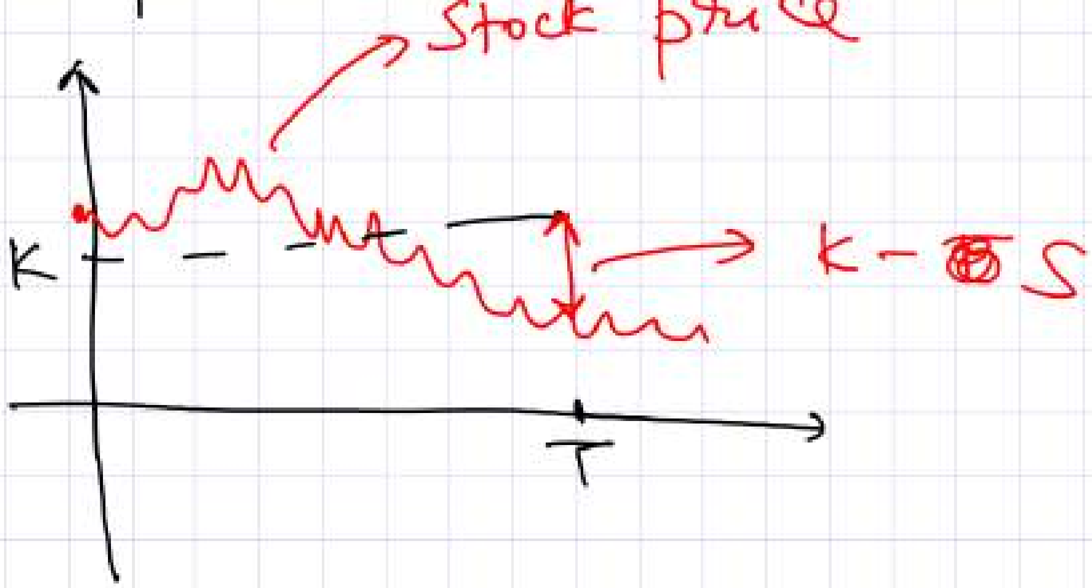
$$\max(S-K,0) \rightarrow (S-K)^+$$

This is a notation.

$$\max(4,5)=5$$
$$\max(-5,7)=7$$
$$\max(2,-1.73)=2$$

$$\max(S-K,0)=\begin{cases} S-K & \text{if } S>K \\ 0 & \text{o.w.} \end{cases}$$

Put option :



Put option $\longrightarrow \max(K-S, 0)$

Call option (K, T)

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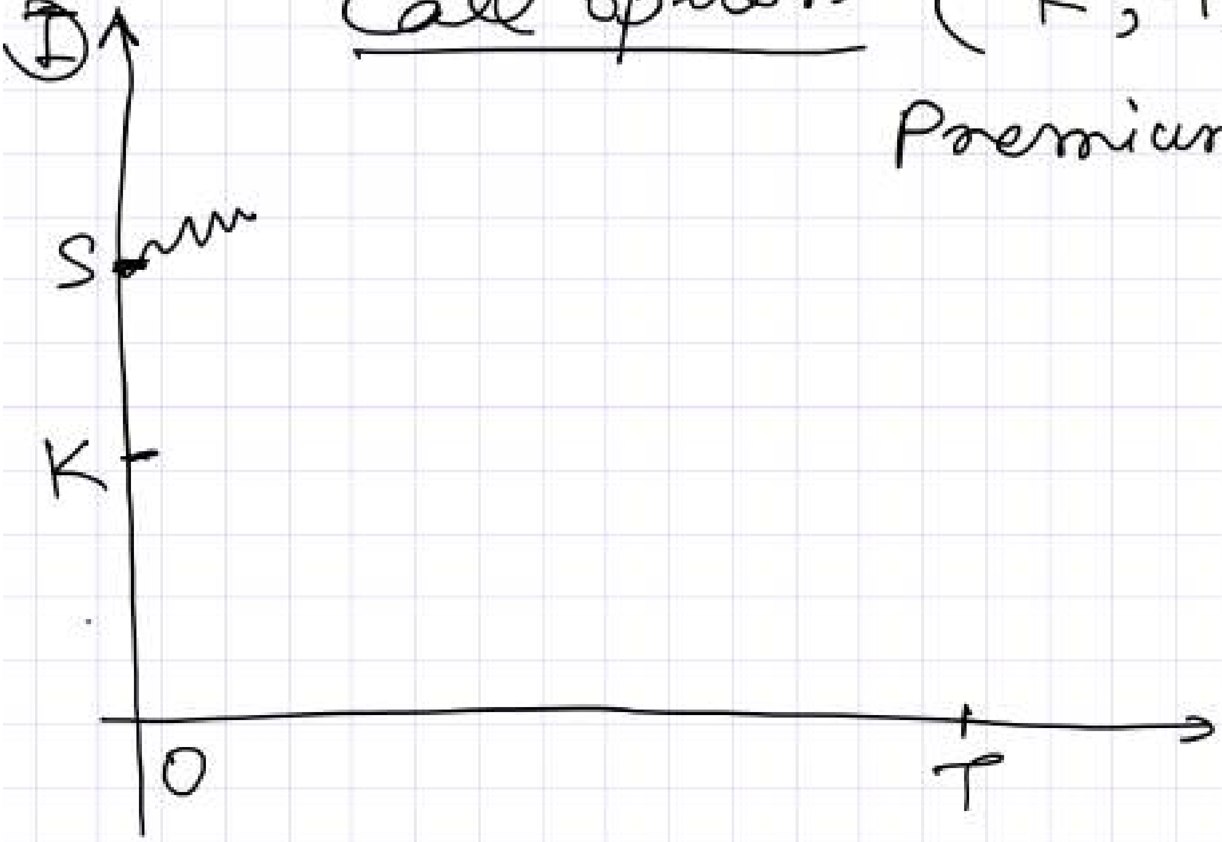
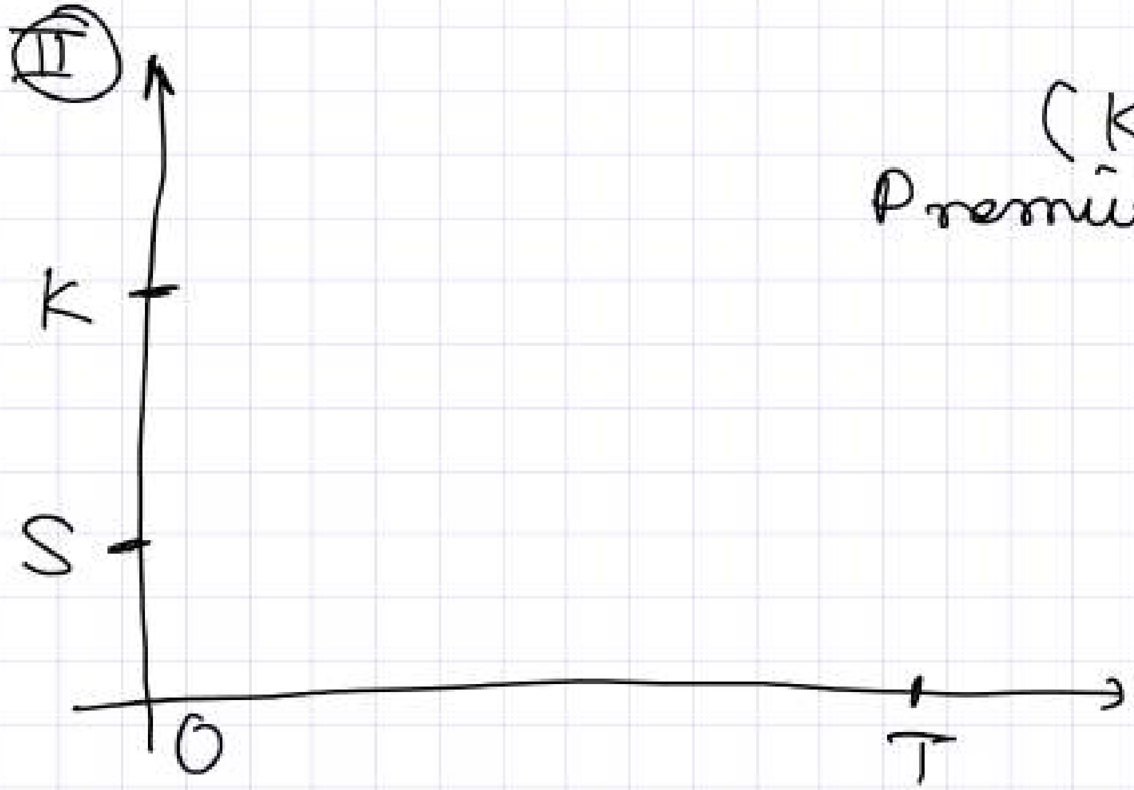


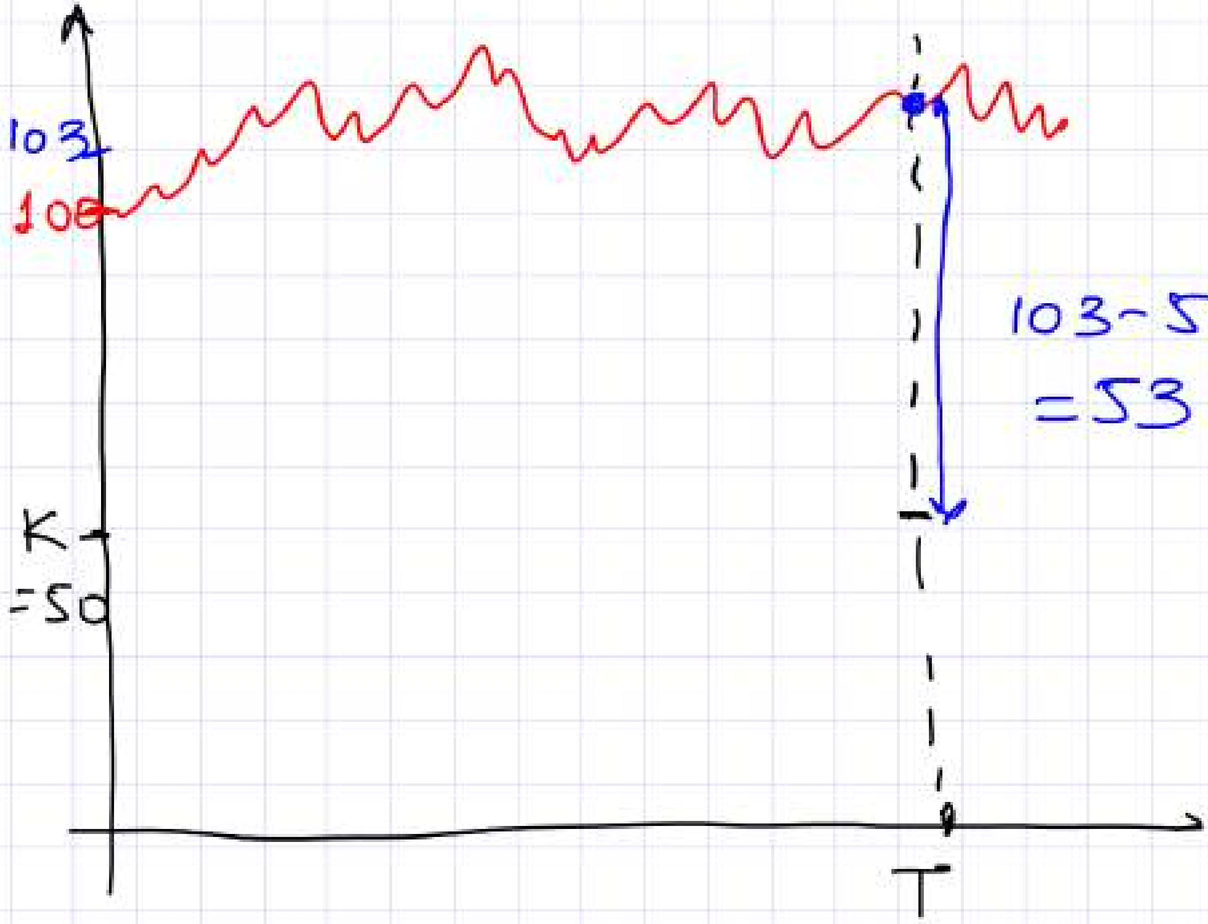
Premium $= (S-K)$

II



(K, T)

Premium $= 0$



Call option:

$K \longrightarrow$ Strike price = ~~100~~ 1200

$T \longrightarrow$ last day of June 2023

Underlying = Infosys.

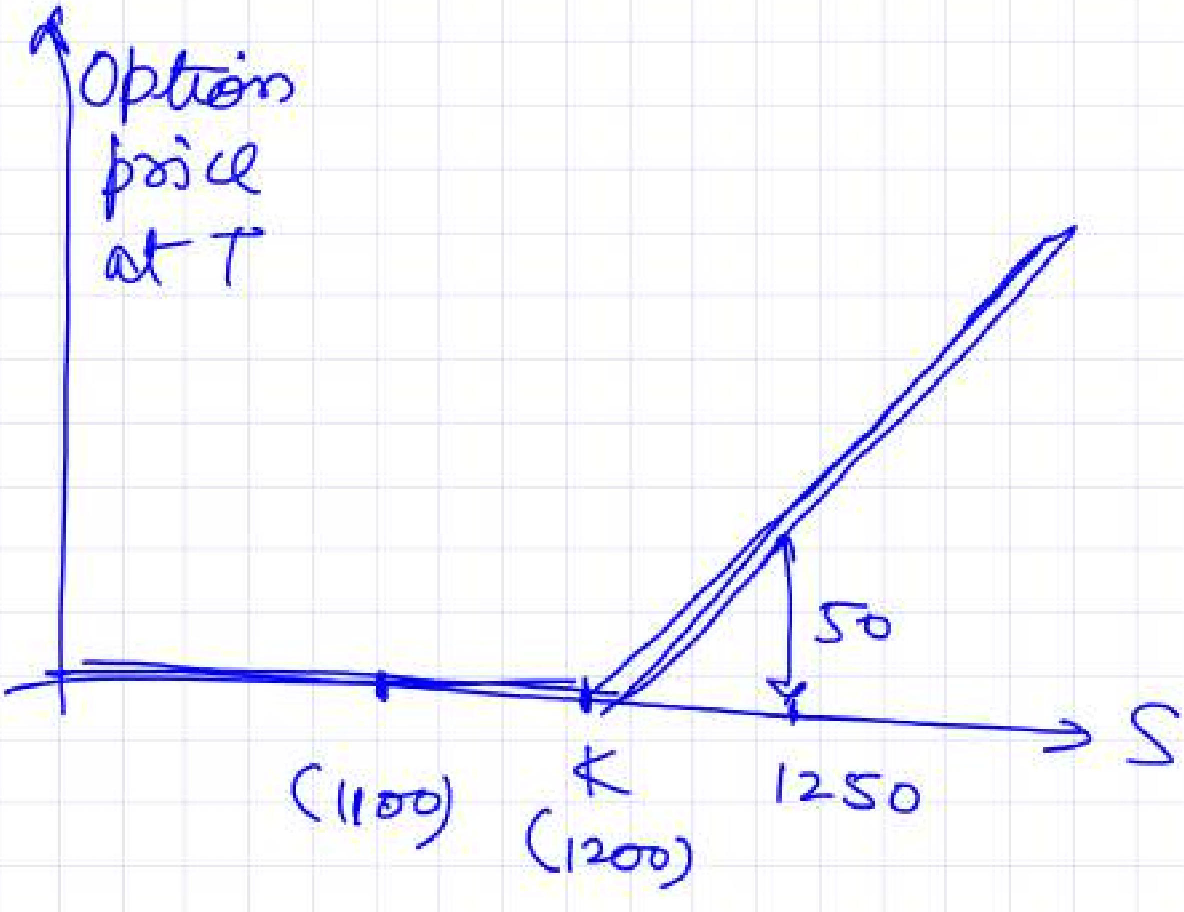
Contract says-

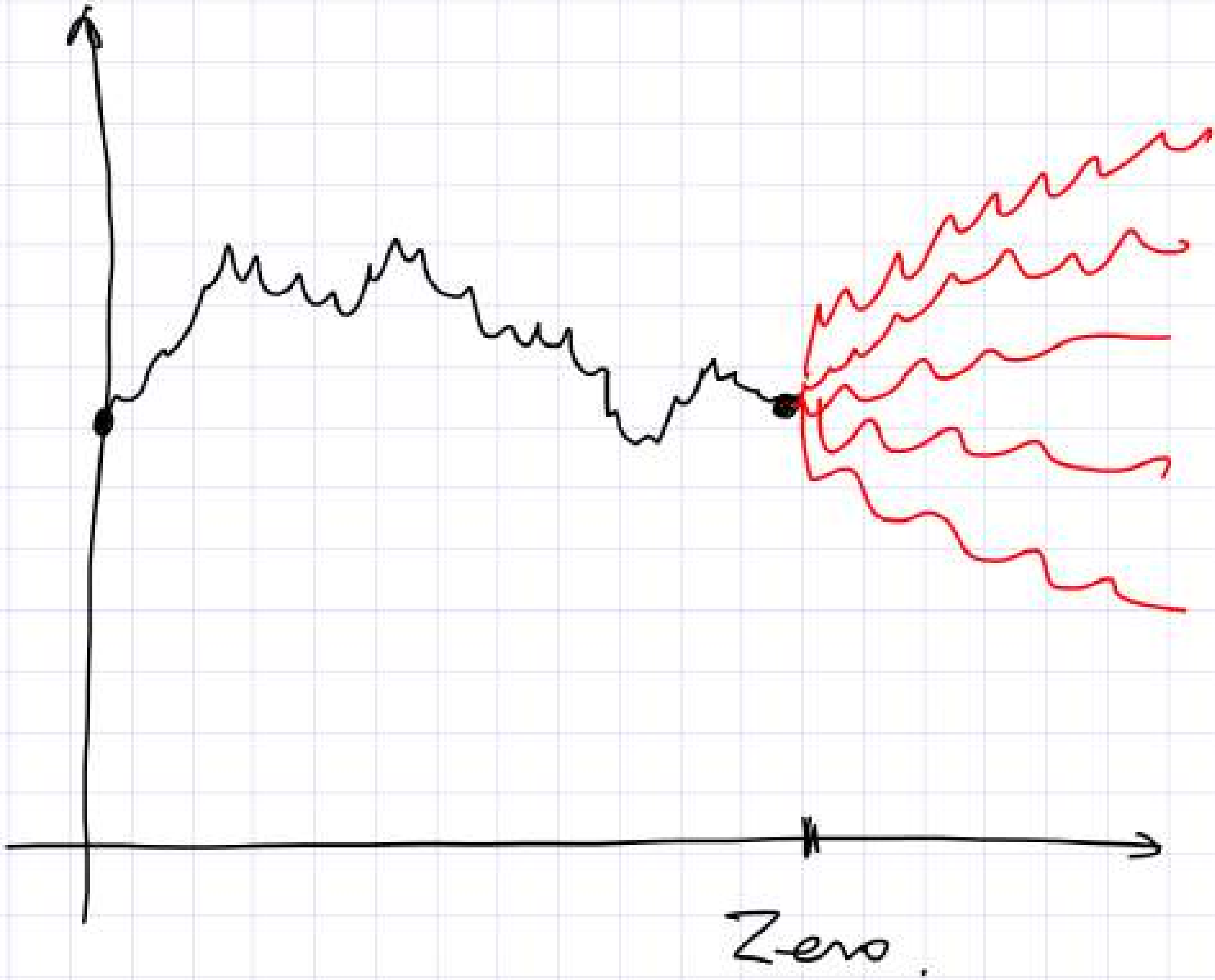
The owner of the contract can ~~by~~ buy 1 stock of Infosys from seller of the contract in 1200/- at time T.

But there is no obligations.
If he doesn't want to
buy it is ok.

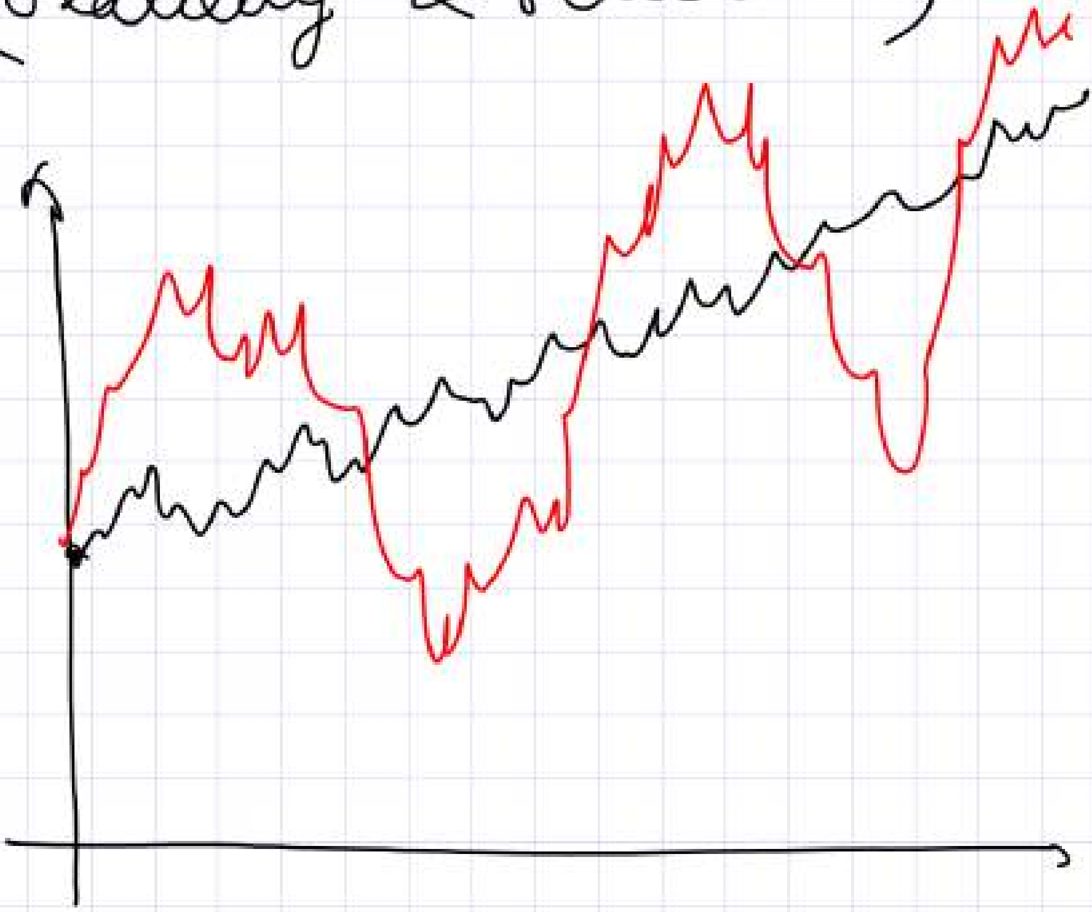
If Infosys price at last
day of June 2023
= 1250

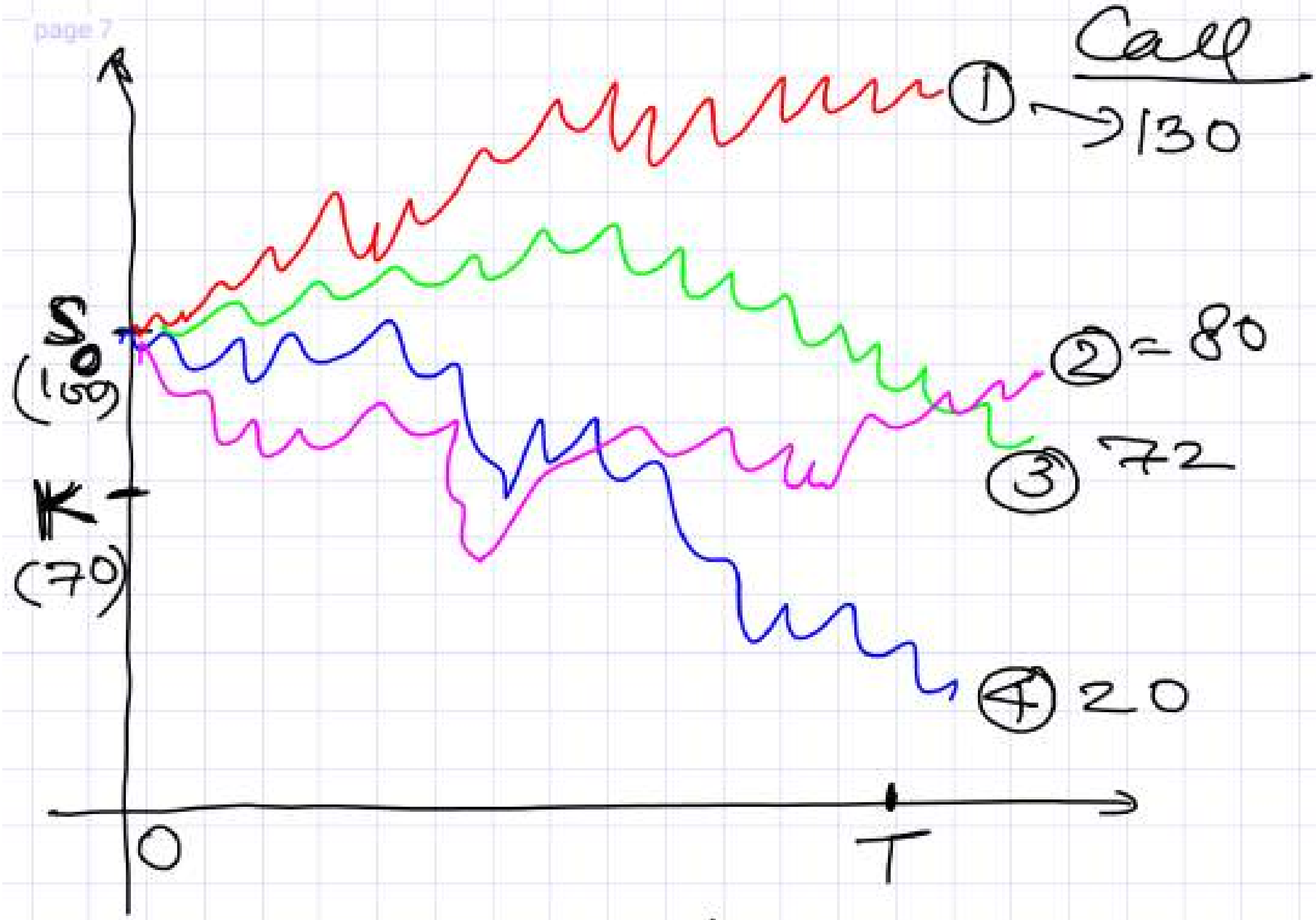
$$\max(S - K, 0)$$





(Volatility & returns.)





$$① \longrightarrow (S_1 - K)^+ = 130 - 70 = 60$$

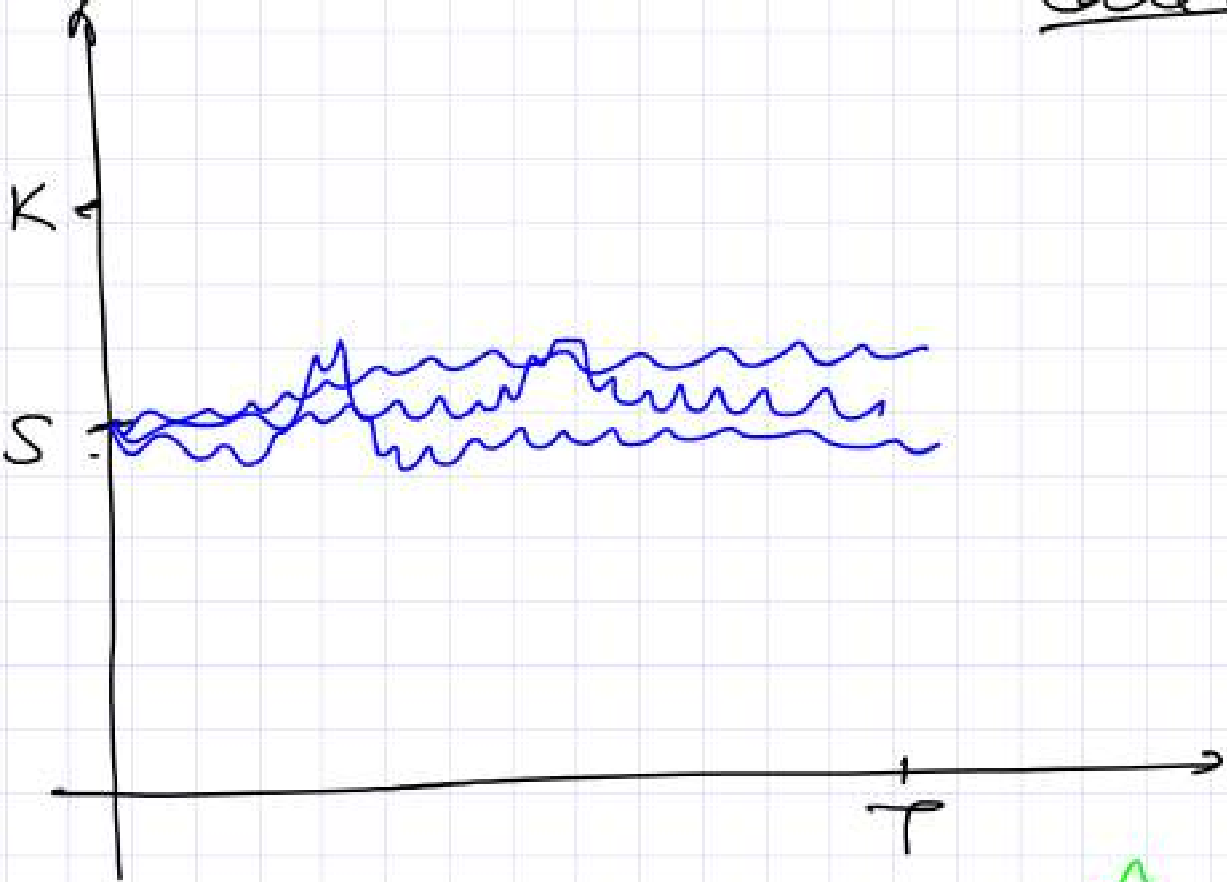
$$② \longrightarrow (S_2 - K)^+ = 80 - 70 = 10$$

$$③ \longrightarrow (S_3 - K)^+ = 72 - 70 = 2$$

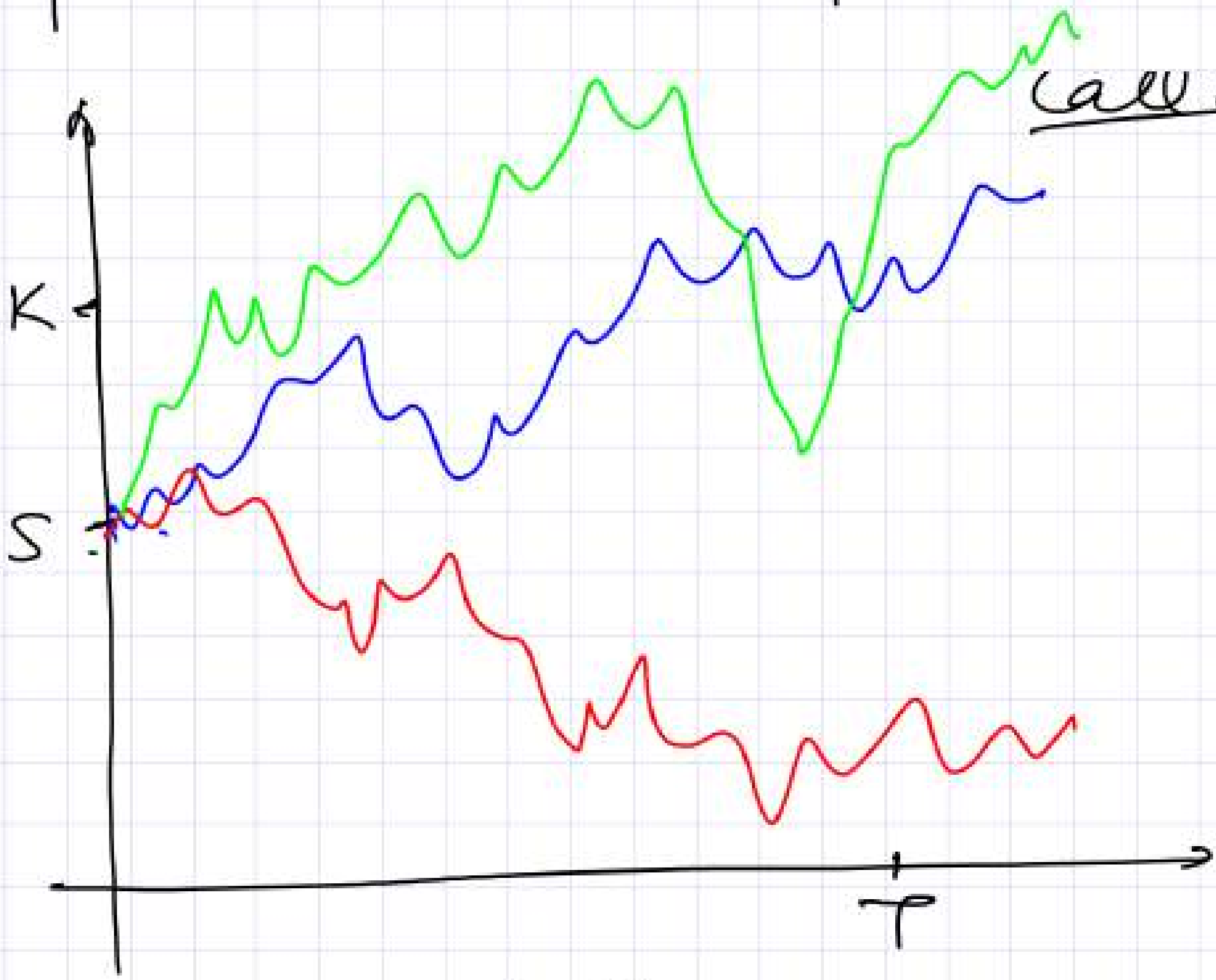
$$④ \longrightarrow (S_4 - K)^+ = 0$$

$$\frac{60 + 10 + 2 + 0}{4} = \frac{72}{4} = 18$$

Call option

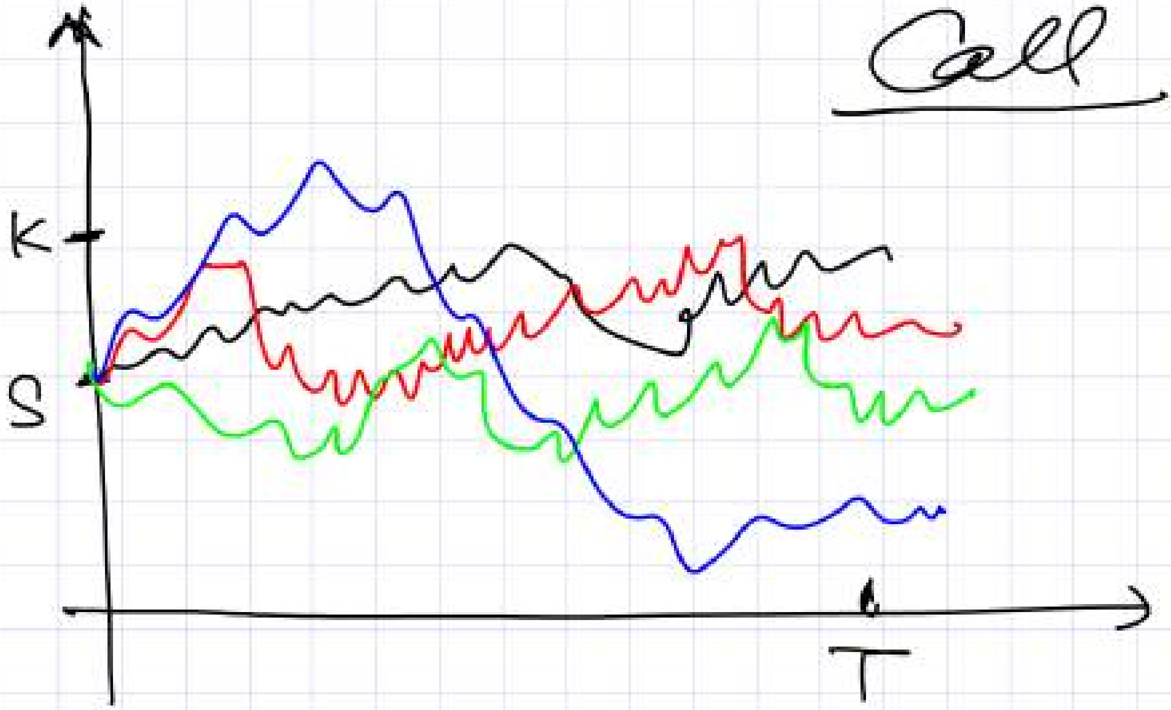


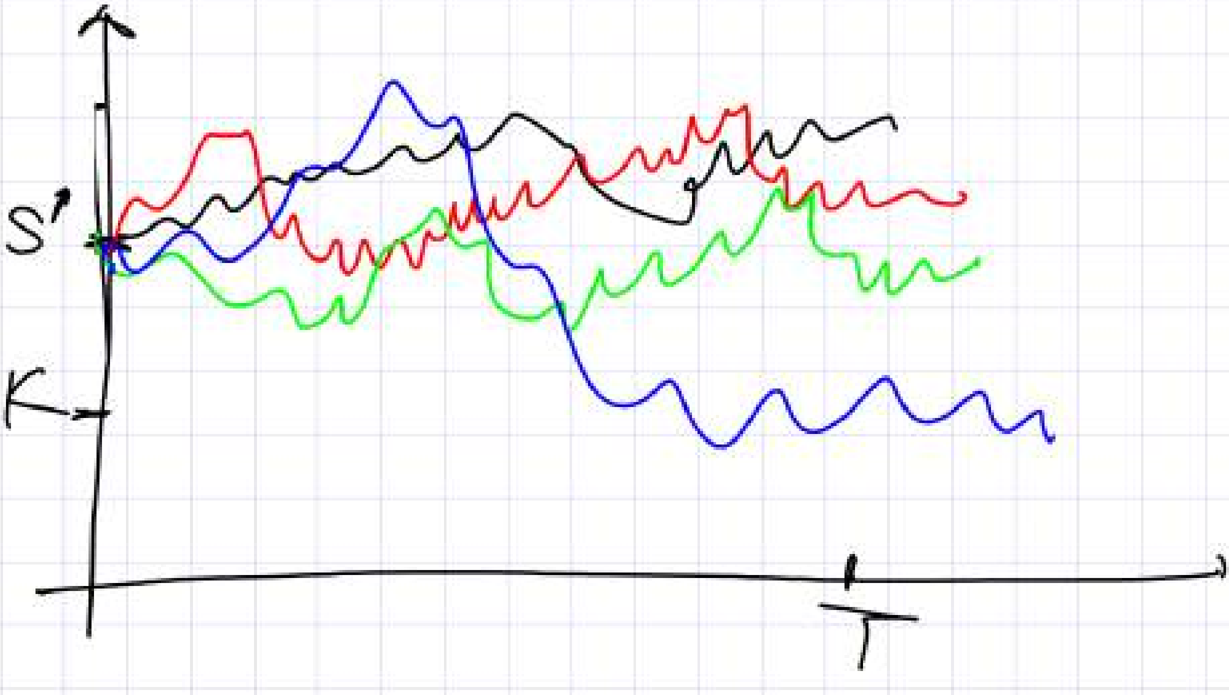
Call op



(Volatility ↑)(Option premium ↑)

Call





$(S-K)\uparrow$, (Option premium)$\uparrow$

Long position → Owner of option contract

Short position → Writer of option contract.

Option → Zero sum game

It is a type of game where one's profit is equal to someone's loss

Why option trading happens.

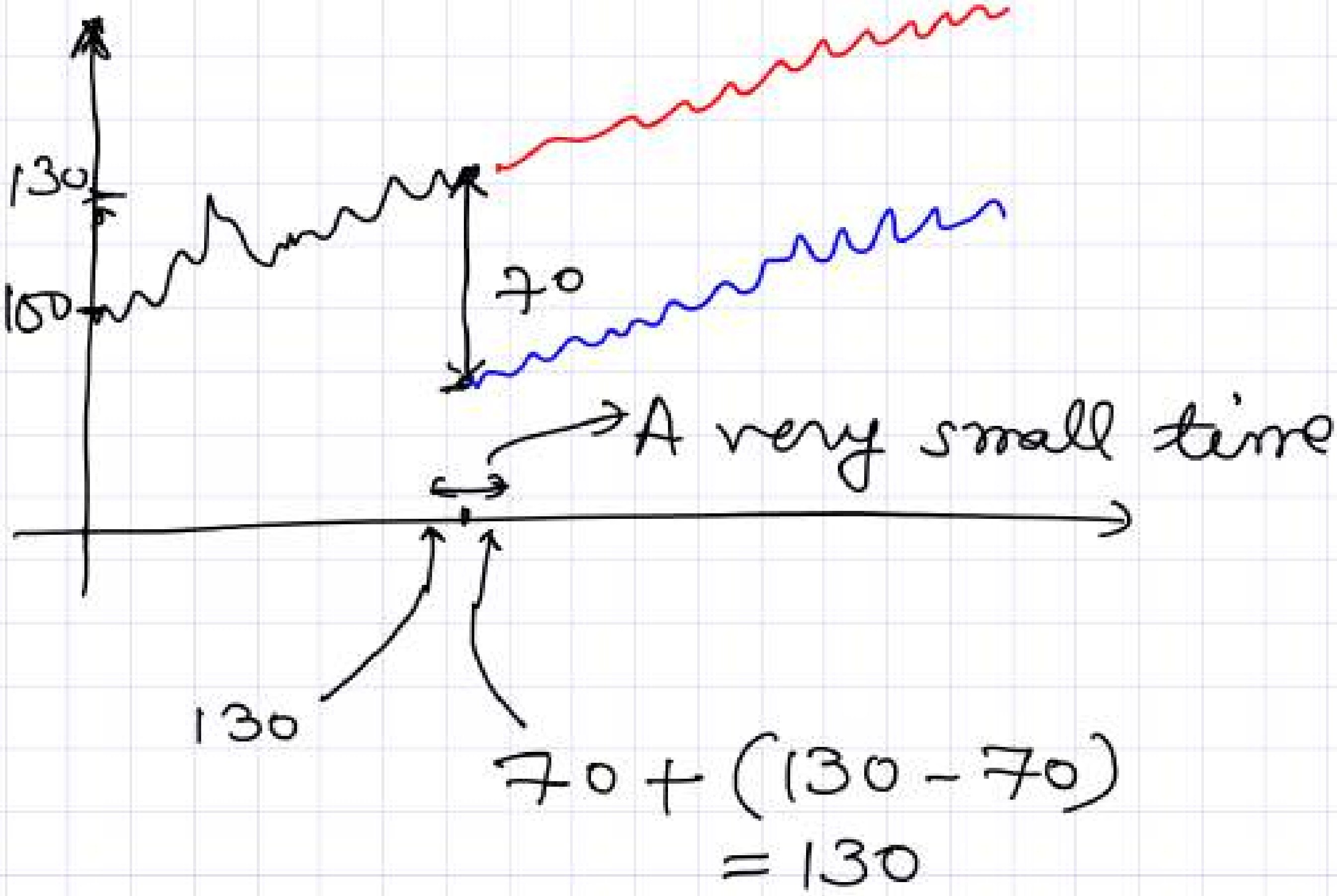
→ Hedging

→ Speculation.

The option premium is INDEPENDENT of ones views about future market scenarios.

Dividend:

(Dividend ↑↓) (option premium) ↓↑



Call

Option Greeks:

① **Delta:** It is the rate of change of the option price with respect to the price of the underlying asset.

$$\Delta = \frac{\text{change in option price}}{\text{change in stock price}}$$

$$= \frac{\partial C}{\partial S} \quad \text{or} \quad \frac{\partial P}{\partial S}$$

$$S\uparrow \begin{cases} \longrightarrow C\uparrow \\ \longrightarrow P\downarrow \end{cases}$$

$$\Delta = \begin{cases} \text{Positive for call option} \\ \text{Negative for put option} \end{cases}$$

The δ value is between -1 & $+1$

<u>Call option:</u>

① Deep in the money

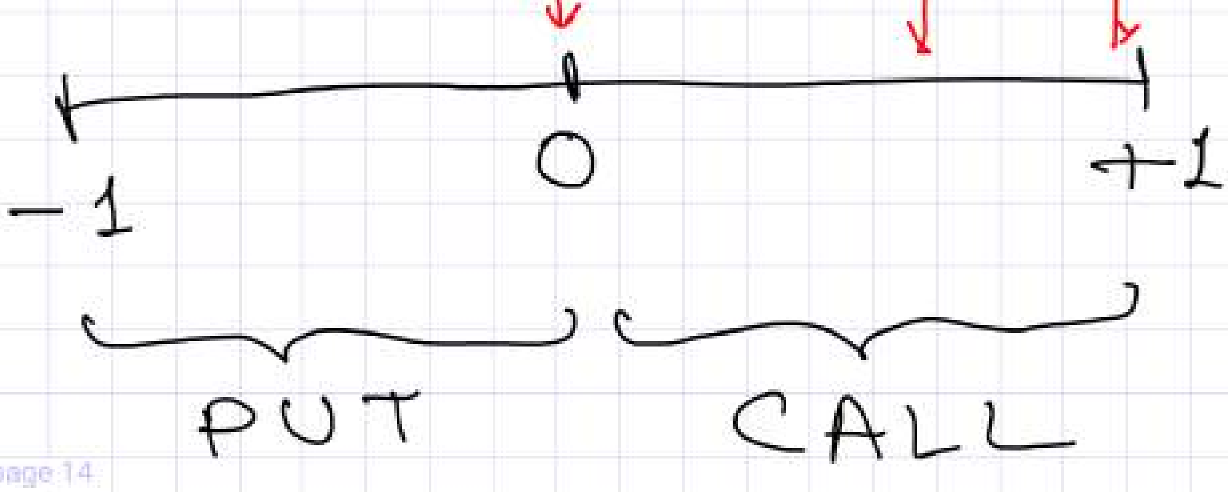
$$S_0 >> K$$

② At the money

$$S_0 \simeq K$$

③ Out of the money

$$S_0 < K$$



Deep in the money
Call option

$$\left[\begin{array}{l} K = 100 \\ S = 200 \end{array}\right.$$

$$\left[\begin{array}{c} \cancel{1}00 \\ + \\ \epsilon \end{array}\right] \longrightarrow \text{option premium}$$

$$\simeq S - K$$

$$S \longrightarrow (S - K) + \epsilon_1$$

$$S + \Delta S \longrightarrow (S + \Delta S - K) + \epsilon_2$$

$$\frac{(S + \Delta S - K) + \epsilon_2 - [S - K + \epsilon_1]}{\Delta S}$$

$$= \frac{\Delta S + \cancel{\epsilon_2} - \cancel{\epsilon_1}}{\Delta S} = +1$$

For out of the money option, We only have $\in$ component.

$$S \longrightarrow \in_1$$

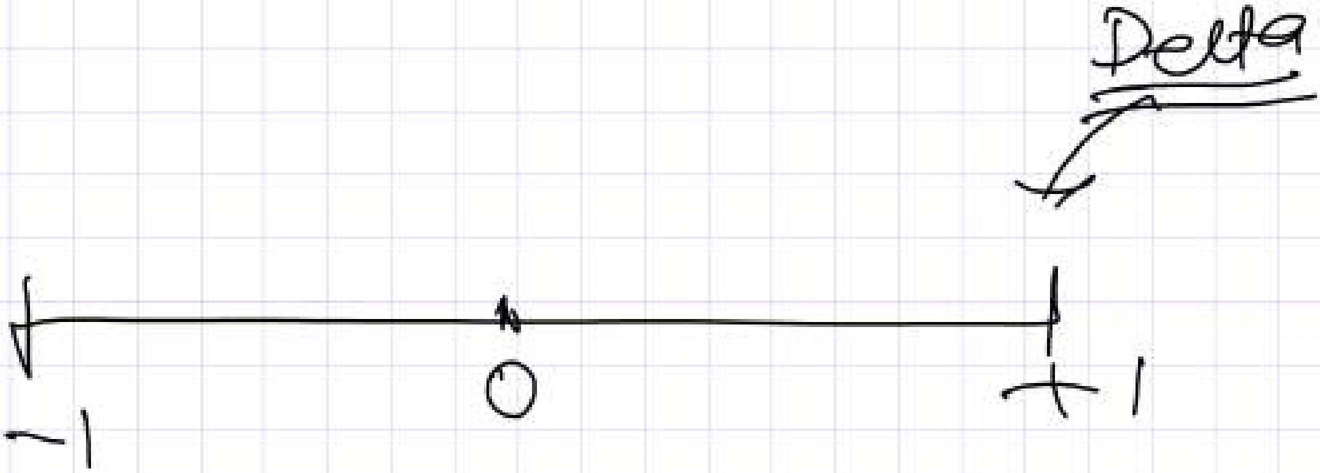
$$S + \Delta S \longrightarrow \in_2$$

$$\frac{\in_2 - \in_1}{\Delta S} \longrightarrow \text{small no.}$$

② Gamma:

Gamma is change in Δ w.r.t. the change in the price of the underlying stock.

$$\Delta = \frac{\partial c}{\partial S} \quad // \quad \gamma = \frac{\partial \Delta}{\partial S}$$



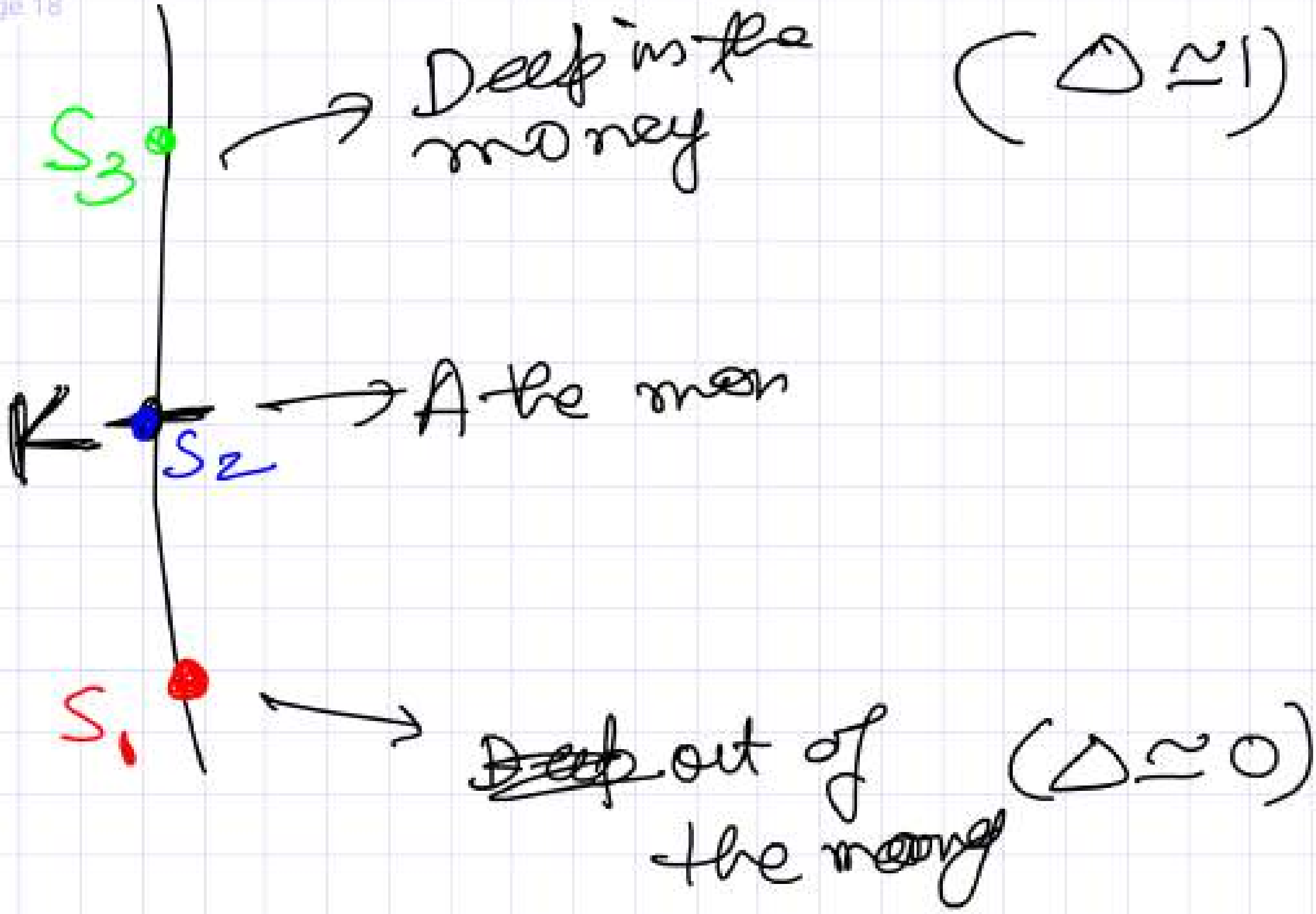
Call options:

① Deep in the money $= (\Delta \simeq 1)$

② Out of the money $= (\Delta \simeq 0)$

① $\longrightarrow$ $S >> K$

② $\longrightarrow$ $S << K$

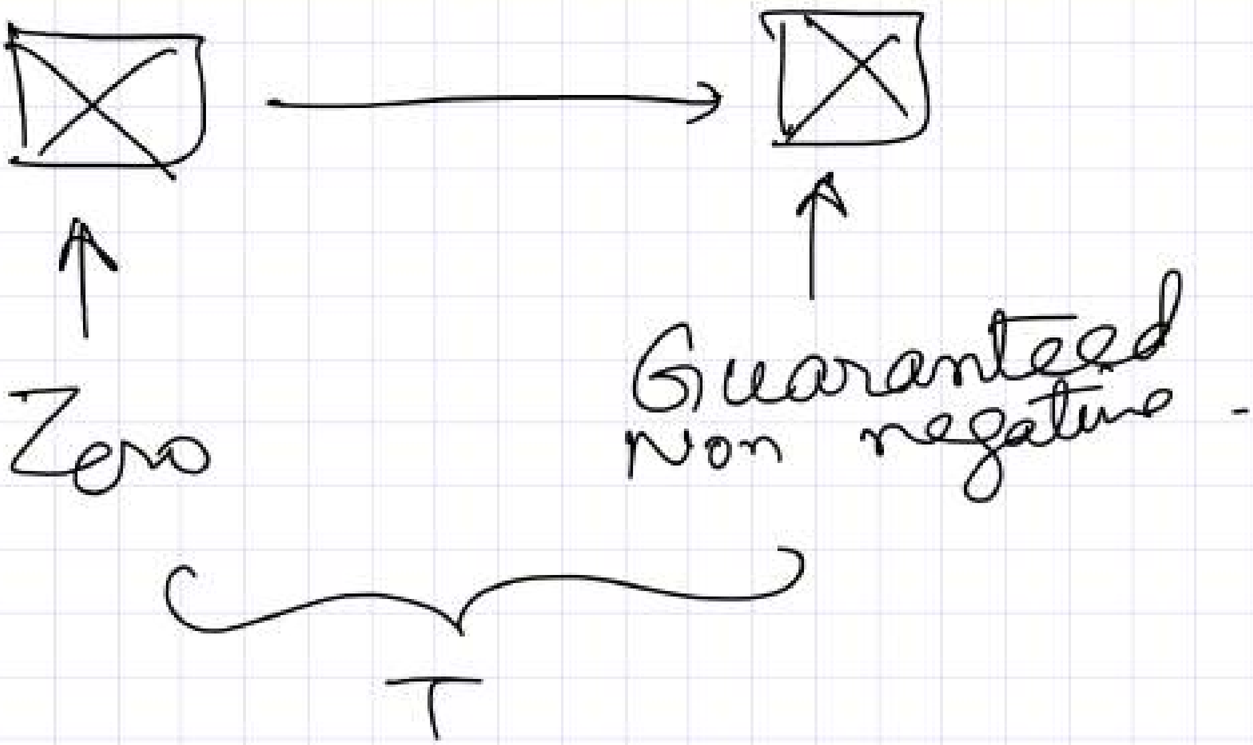


$$\left(S \uparrow \,,\quad \Delta \uparrow \right)$$

$\rightarrow \gamma$ is positive.

There is no free money:

Arbitrage is not possible:



Option price :

Option
- sell call
  + C

- Bank C_1
  Buy stock C_2

$(C_1 + C_2 = C)$

- long a stock
- Short a stock (Payment)
- Buy call . Buy Put option
  - sell call . sell put
- Put money in bank

- Take loan from bank

Delta of the option :

§ Delta Hedging :

$$\Delta = \frac{\partial c}{\partial S} = \frac{\text{change in option price}}{\text{change in stock price}}$$

① Stock price = 100 \$
Option price = 10 \$

Trader has sold 20 call option contracts. [Lot = 100]

$\rightarrow 20 \times 100 = 2000$

$\Delta = 0.6$

If stock price goes up then option price goes up.

$$\Delta = \frac{\text{change in portfolio value}}{\text{change in stock price}}$$

→ Stock price goes up by 1\$

→ Option price " 0.6\$

$$2000 \times 0.6 = 1200\$$$

For short call option

Δ is negative.

If the trader buys 1200 shares.

Then his P/L w.r.t. stock price movement is zero.

Delta neutral

$$\Delta = 0.6 \times (-2000) = -1200$$

$$\Delta = -1200 + 1200 = 0$$

$S \uparrow$, $\Delta \uparrow$

Δ changes from 0·6 to 0·65.

$$\Delta = 0.65 \times (-2000) + 1200$$
$$= -100$$

He will buy another 100 shares.

Dynamic Hedging.

Portfolio $\longrightarrow$

$-1 \longrightarrow$ Option
$+\Delta \longrightarrow$ Shares of the stock

$\hookrightarrow$ Delta neutral.

$t=0$:

Portfolio = -1 option
$+\Delta_0$ shares.

$t=T$:

Portfolio = -1 option
= Δ_T shares.

Limit order book:

Bid: This is the intention to buy ~~a~~ given no of stocks and at given price.

→ I want to buy 100 stocks at 500 Rs
→ " " 73 " at 499 Rs
→ " " 3000 " 497 Rs.

Ask :

→ I want to sell 300 stocks at 501 Rs

→ " 277 " 502 Rs

→ " 2348 " 505 Rs.

→ " :

505 — 2348 #

502 — 277 #

501 — 300 #

500 — 100 #

499 — 73 #

497 — 3000 #

:

I want to sell 500 shares Market order

100 × 500

73 × 499

(500 − 173) × 497

505 — 2348 #

502 — 277 #

501 — 300 #

497 — 327 #

~~497 — 3000 #~~

$\boxtimes \rightarrow$ 500.0001 Rs.

13	297	300	20

$\rightarrow$ 500 Rs.

$\rightarrow$ 499.01 Rs

160	192	300

$\rightarrow$ 499 Rs

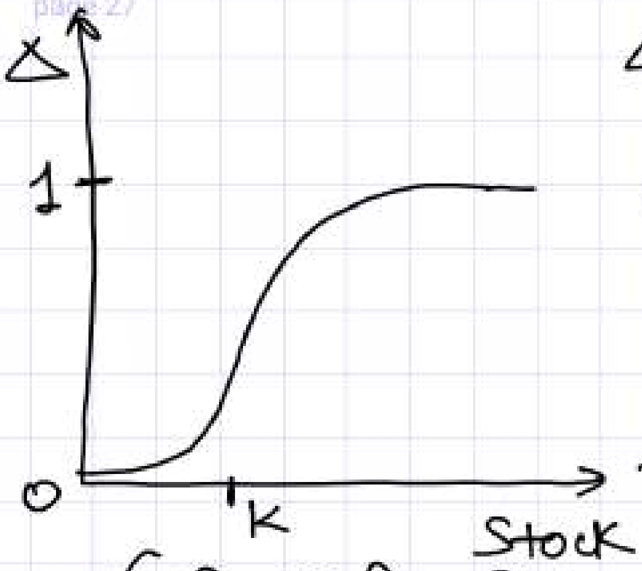
25	3000

$\rightarrow$ 497 Rs

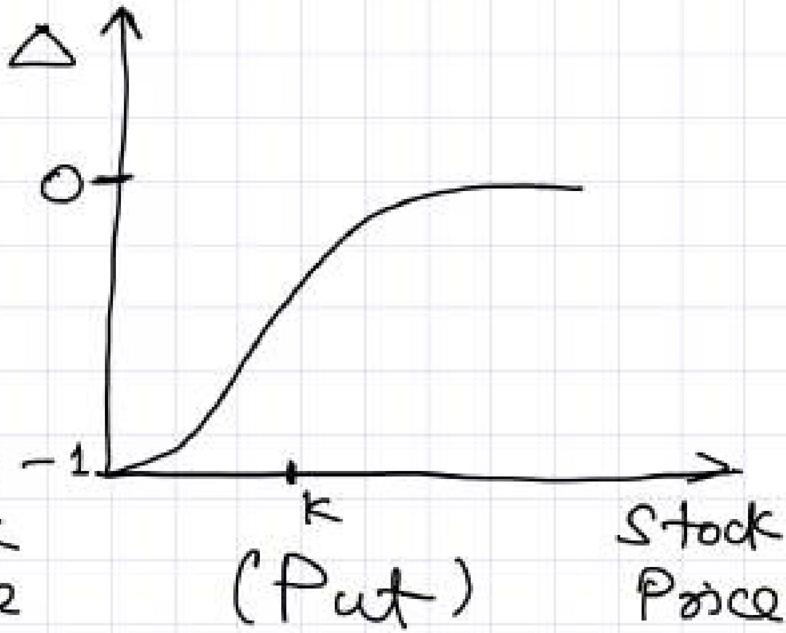
[Tick Size $\rightarrow$ 0.05 Rs.]

US $\longrightarrow$ Tick size = 1 cent
= 0.01 \$

Old Tick size = 1/8 \$



(Call)

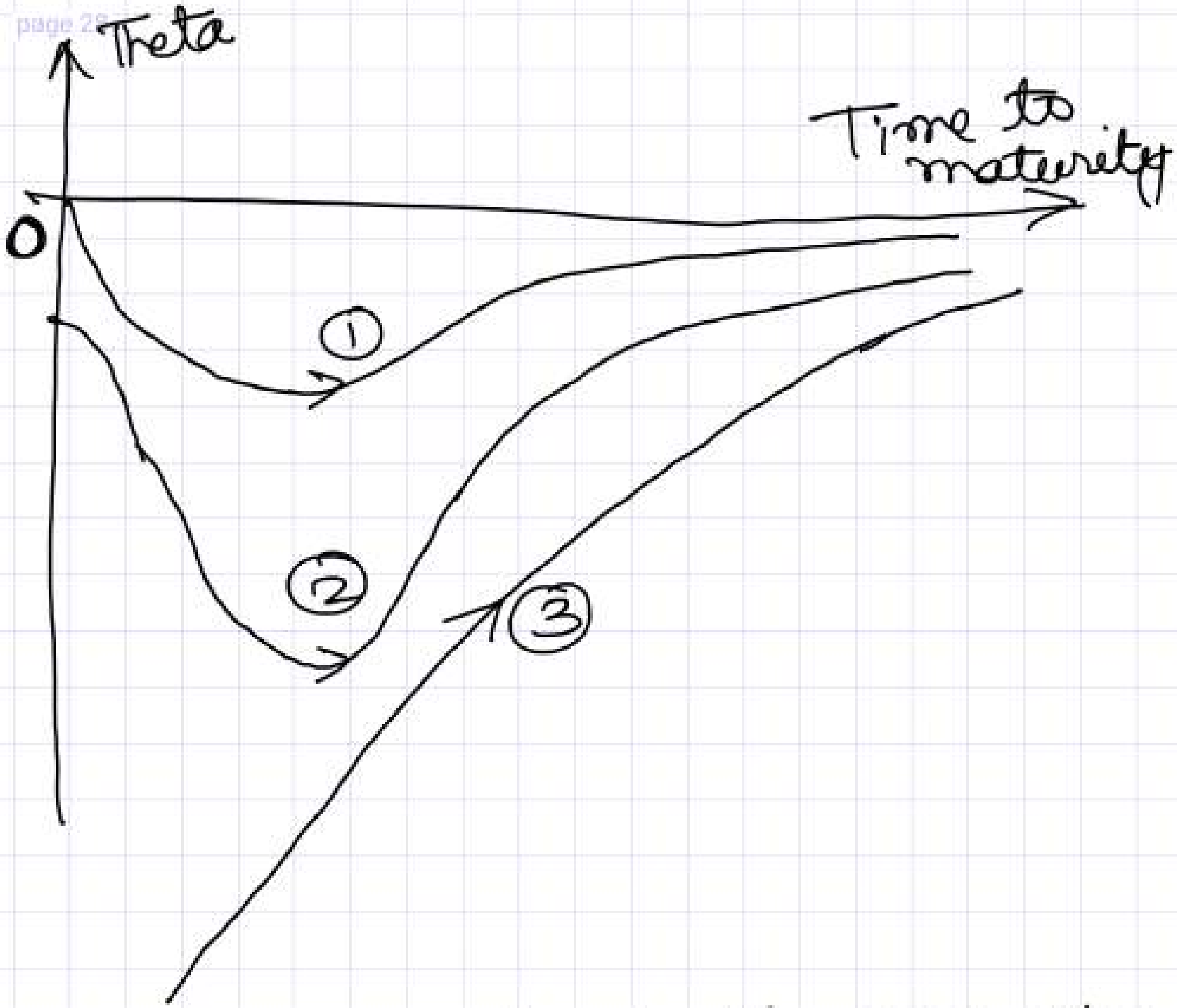


(Put)

Theta: (Θ): Theta of a portfolio of options is rate of change of the value of portfolio w.r.t. passage of time.

$$\Theta = \frac{\text{change in option price}}{\text{change in time to expiry}}$$

$\Theta \longrightarrow$ is always negative



1 → Out of the money

2 → ~~A~~ In the money

3 → At the money

$$N'(x) = \frac{1}{\sqrt{2\pi}} e^{-x^2/2}$$

$$N'(d_1) = \frac{1}{\sqrt{2\pi}} e^{-d_1^2/2}$$

$$\Theta(\text{call}) = -\frac{S_0 N'(d_1)\sigma}{2\sqrt{T}} - rKe^{-rT}N(d_2)$$

<u>Black Scholes:</u>

$$c = S_0 N(d_1) - Ke^{-rT}N(d_2)$$

$$p = Ke^{-rT}N(-d_2) - S_0 N(-d_1)$$

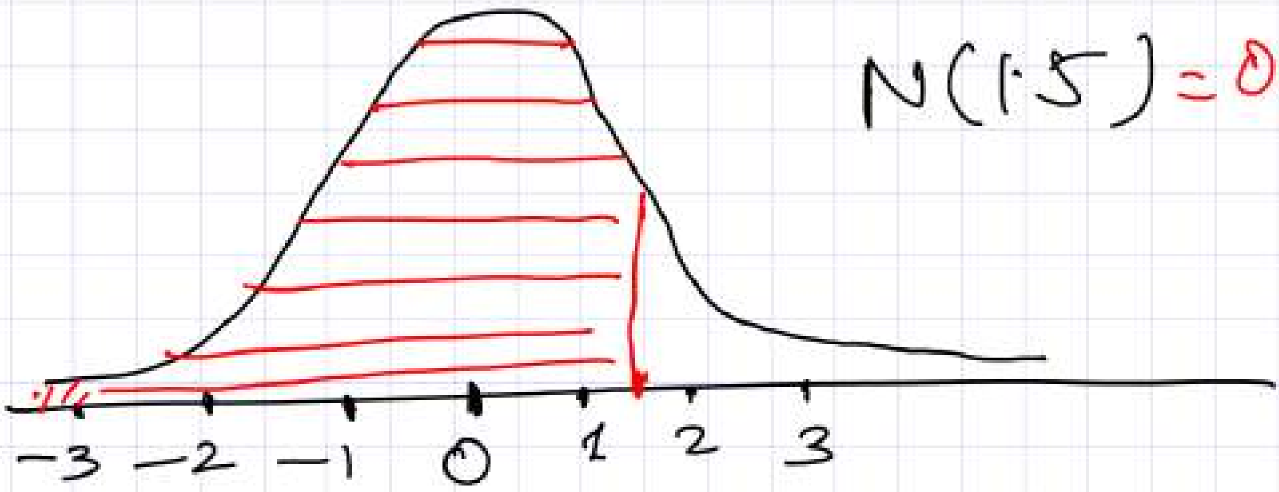
$$d_1 = \frac{\ln(S_0/K) + (r + \sigma^2/2)T}{\sigma\sqrt{T}}$$

$$d_2 = d_1 - \sigma\sqrt{T}$$

S_0 / T / r / σ / K

<u>Bell Curve.</u>

N(



N(1·5) = 0·73

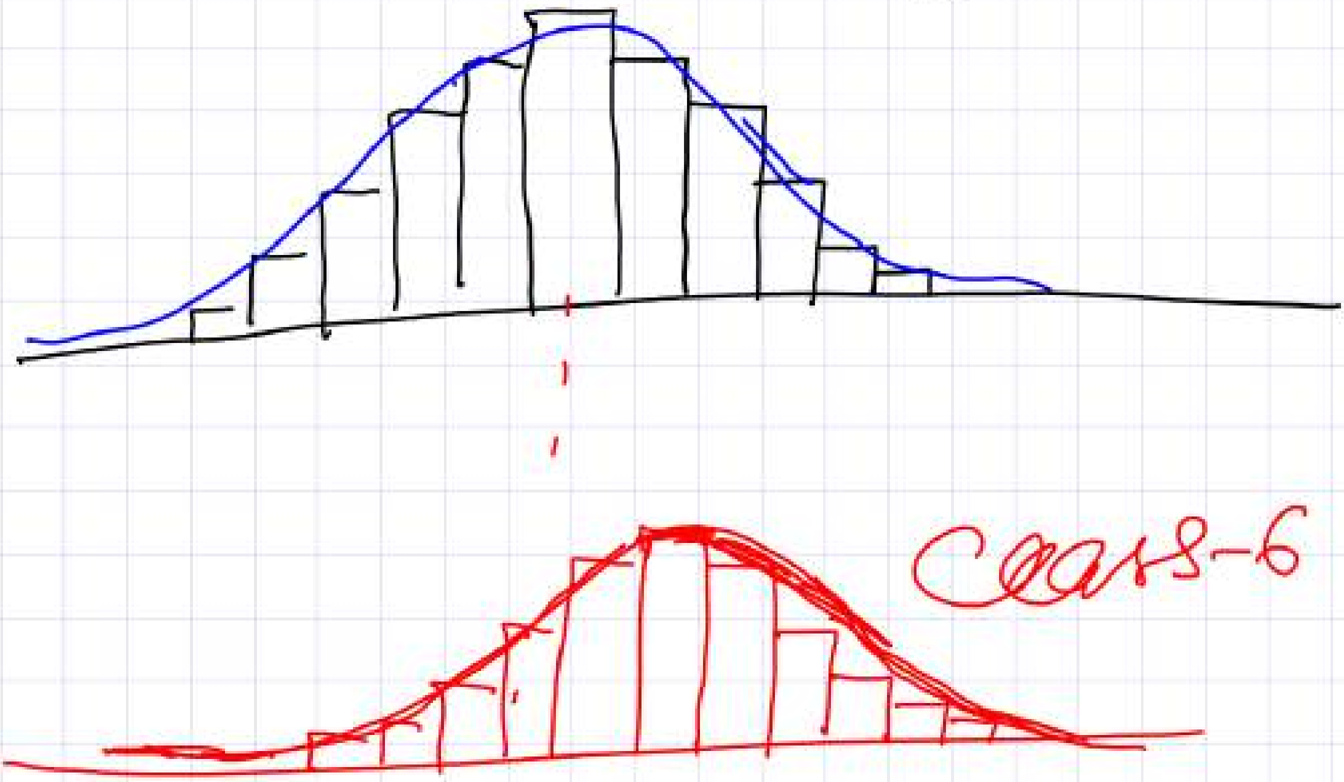
N(−1·3)

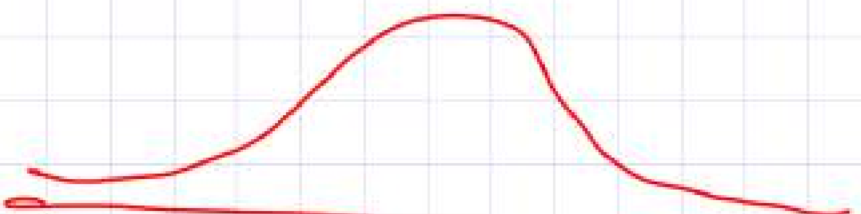
= 0·21

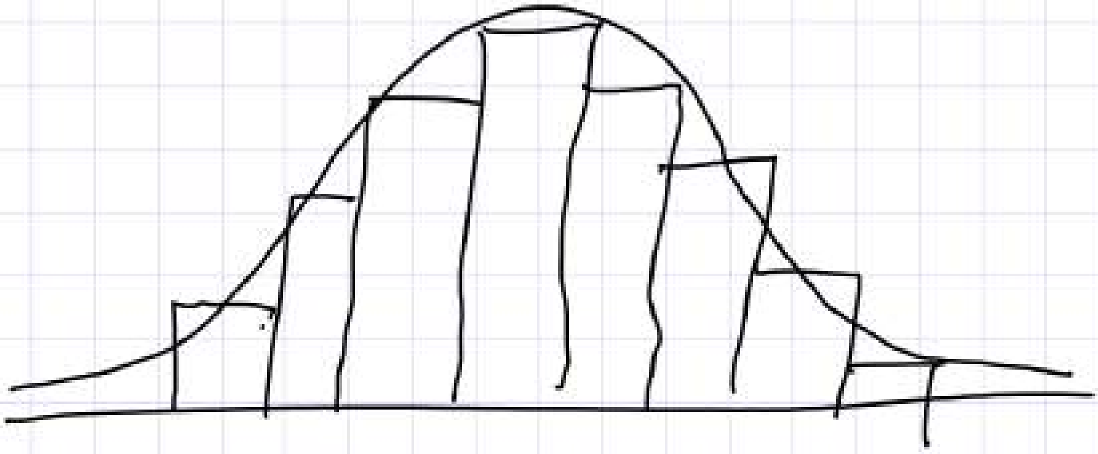
Carl Fredrick
Gauss

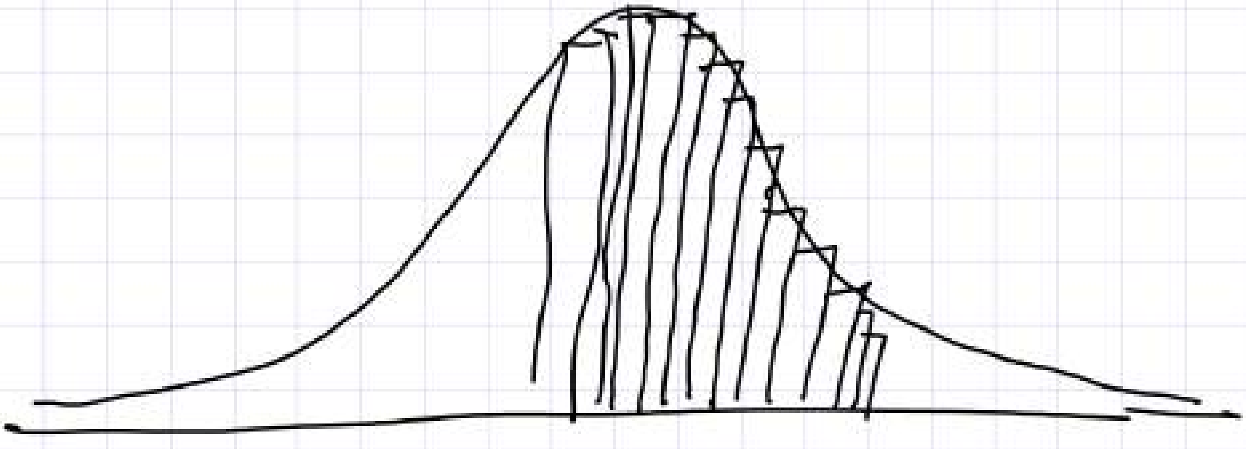
Gaussian Distribution OR Normal Distribution:

class 5 students.
Height. / Histogram









$92 \times 2 = 184$

~~100~~ students with ~~avg heig~~

~~92~~ 184 Avg height = 10

$$20 + (18 + 10 + 5 + 2 + 1) \times 2$$

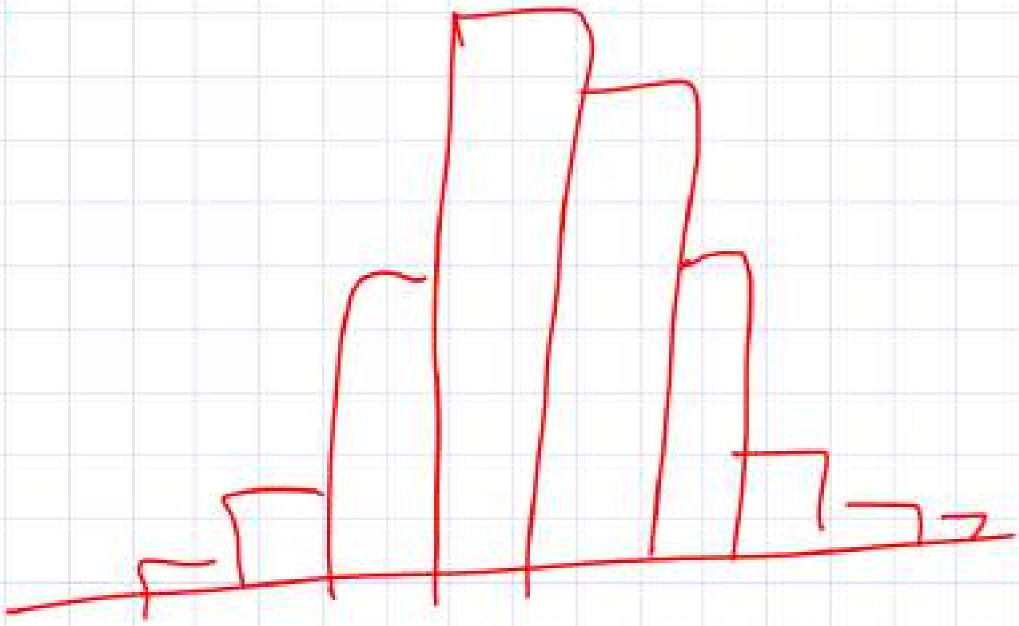
$$= 20 + (36) \times 2 = 20 + 72$$

$$= 92$$

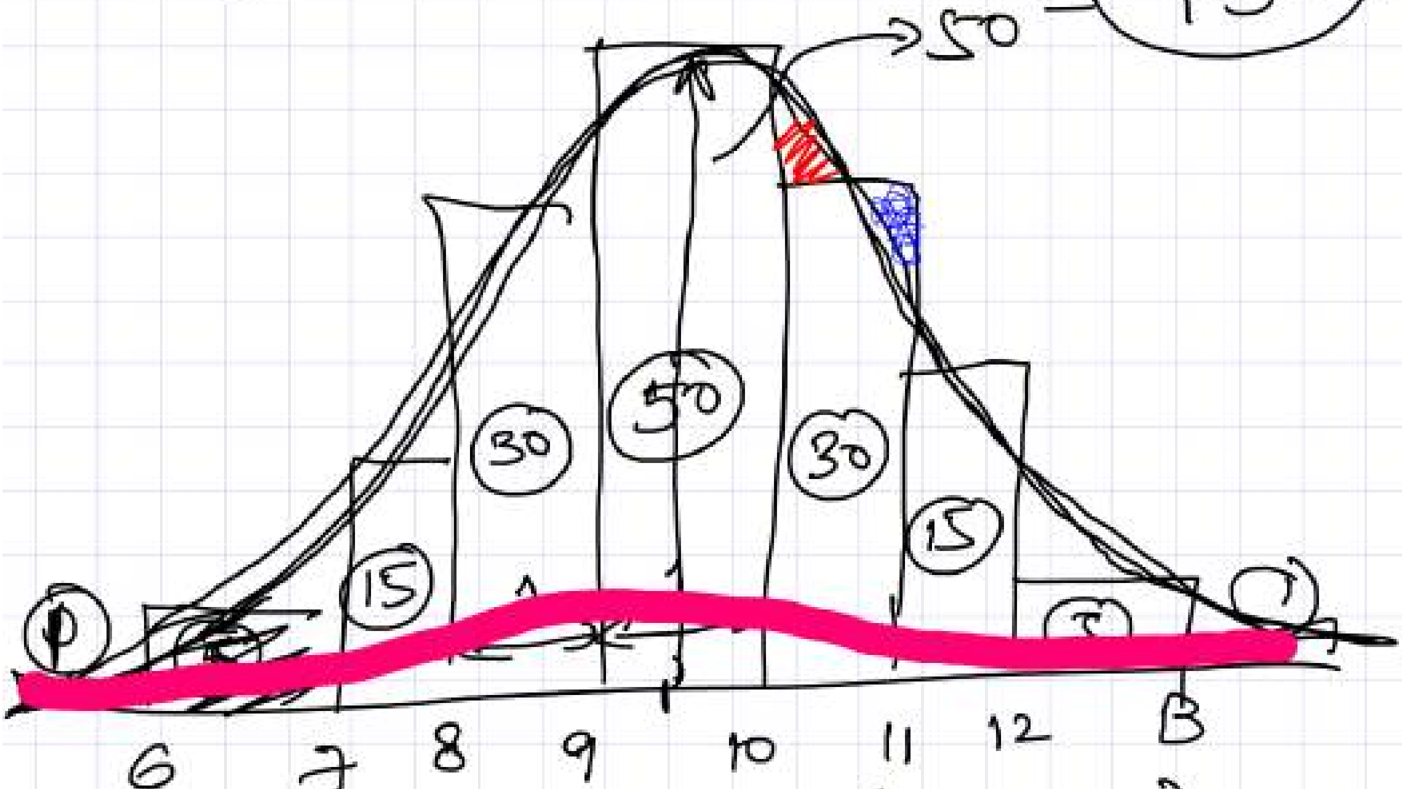
$$40 + (36 + 20 + 10 + 4 + 2) \times 2$$

$$= 184$$

100, 20000



$$50 + 2\times(30 + 15 + 5 + 1)$$
$$= 50 + 2(51) = 50 + 102$$
$$= 152$$



10

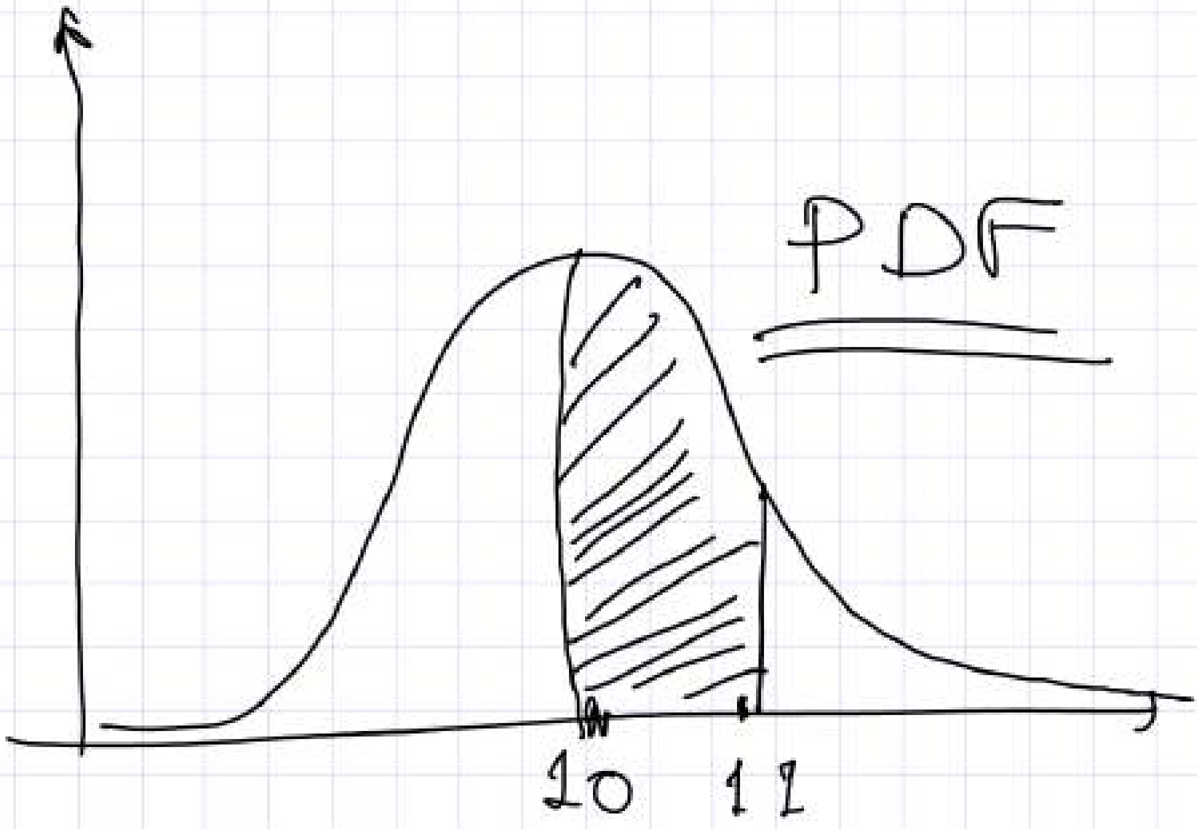
9.5

Area of histogram

$1 \times 1 + 5 \times 1 + 15 \times 1 + 30 \times 1$
$+ 50 \times 1 + 30 \times 1 +$

$= 152$

152



PDF

Option Greeks:

① **Delta:** Delta measures the change in the option price (premium) w.r.t. change in the underlying.

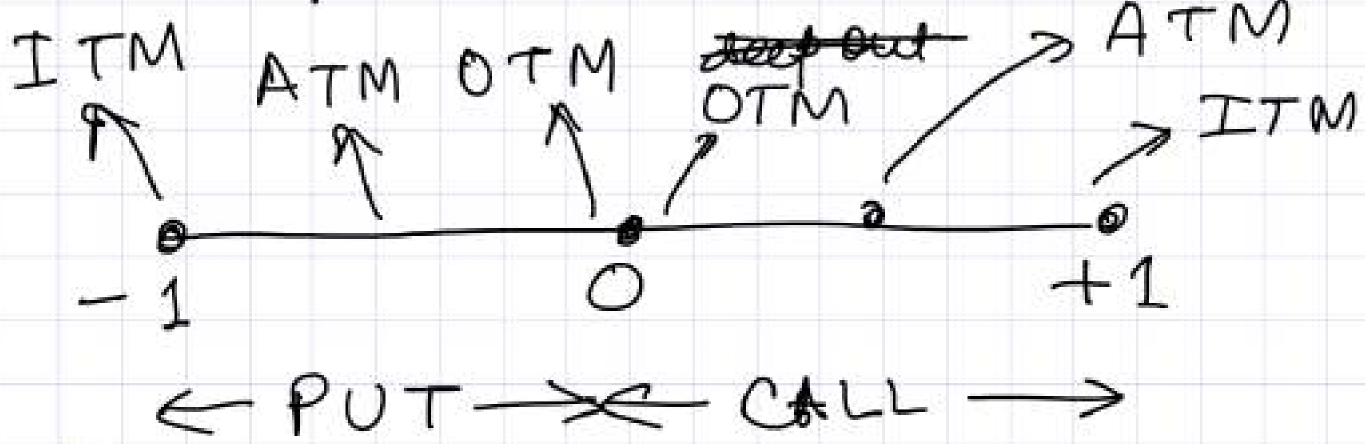
The range of Δ is $(-1, +1)$

P = Option price
S = Underlying stock price.

$$\Delta = \frac{dP}{dS} \qquad (+1, -1)$$

Call options → (0 to +1)

Put options → (0 to −1)



[ATM Put is same as ATM call] → Incorrect.

<u>If</u>: The time remaining to expiry is not much.

<u>Case 1</u>: ATM call option with expiry (T) = 2 weeks.

$\Delta = 0.4$ $\qquad$ $C_1 = 10\$$

<u>Case 2</u>: ATM call $\qquad$ $C_2 = 0.05\$$

Time to expiry (T) = ~~1 hour~~ 10 minute

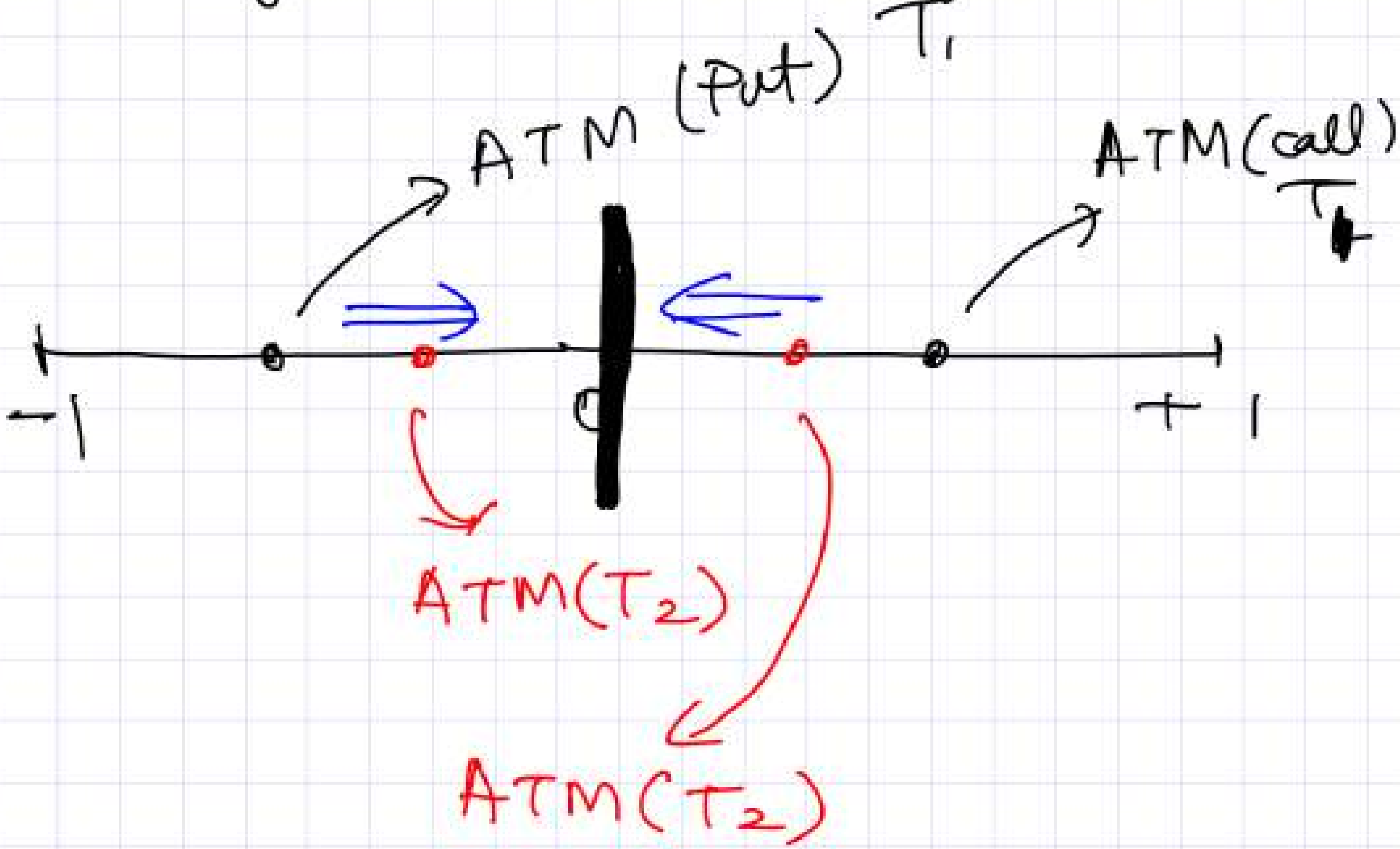
$\Delta = ?$] Δ is more than 0.4 or less than 0.4

$$\Delta = \frac{\text{change in option premium}}{\text{change in stock price}}$$

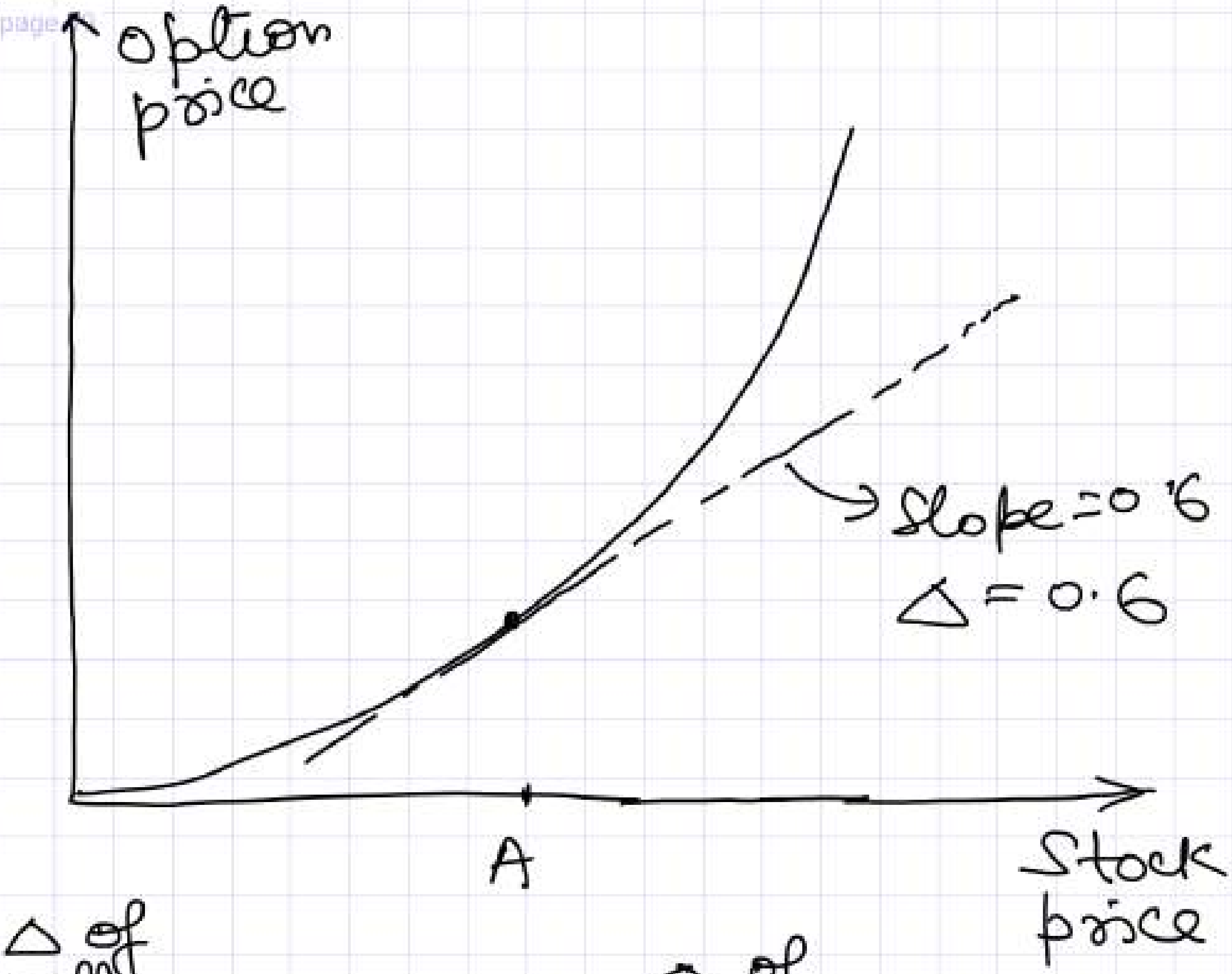
Stock price goes ~~up~~ down by 1\$

~~Sto~~

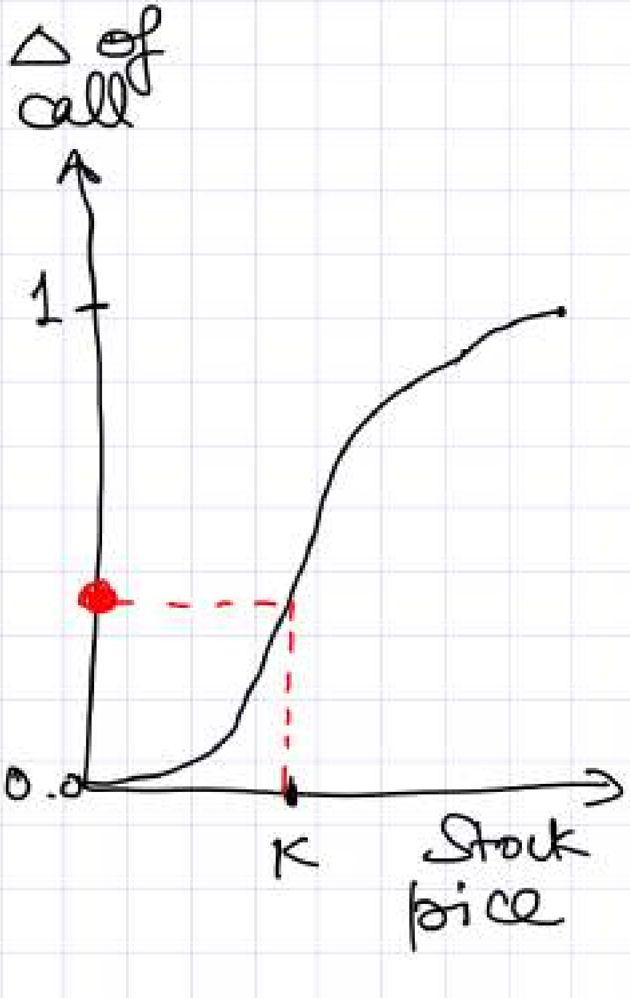
Change in stock price = 1\$



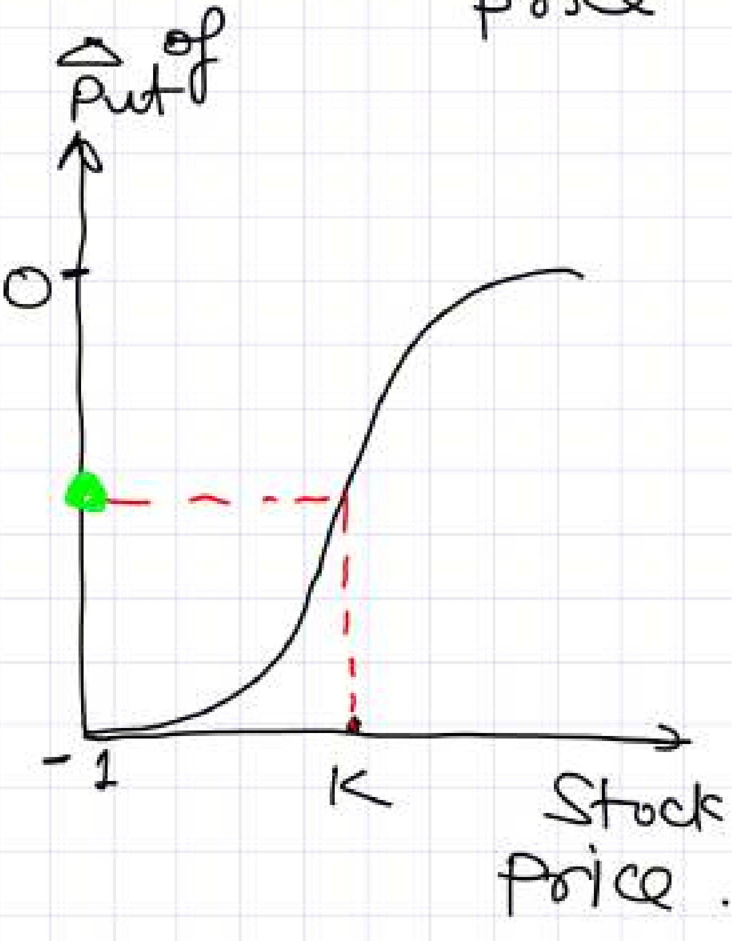
$T_2 < T_1$



Option price
slope = 0.6
$\Delta = 0.6$
A
Stock price



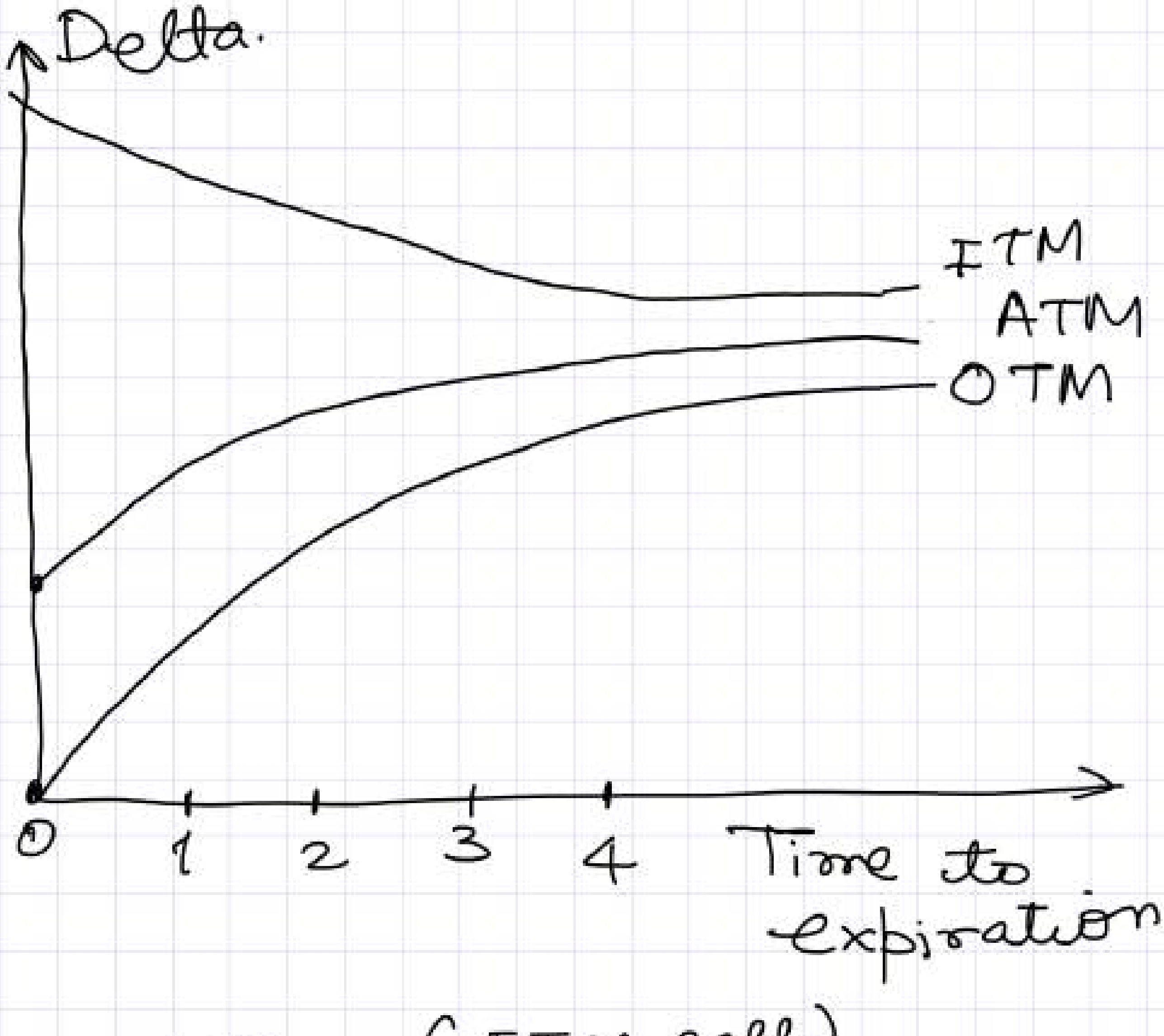
Δ of call
1
0.0
K
Stock price



Δ of Put
0
-1
K
Stock price.

K = Strike pr.

Fig: Typical patterns for variation of delta with time to maturity for call option:



① $T = 100$ (ITM call)

Call option price $(C) = C_1 + C_2$

C_1: $(S-K)$

C_2: uncertain factor

if $T \downarrow$ then $C_2 \downarrow$

$$\Delta_1 = \frac{\text{change in } C_1}{\text{change in stock price}} = +1$$

$$\frac{\text{Change in } C_2}{\text{change in stock price}} =$$ if T is less LHS is less

small

Δ_2

$$\Delta = \Delta_1 + \Delta_2$$

Δ_1: +1

Δ_2: reduces if T is less

Δ: reduces if T is less

Gamma:

Defⁿ: Gamma measures the rate of change in delta over time.

$$\text{Profit}(P_1) = \overset{B}{\text{Final value}} - \underbrace{\text{Investment}}$$

[Investment (ITM) = 2 components
(OTM/ATM) = 1 "]

$$\cancel{\gamma = \frac{\text{change in } \Delta}{\text{change in time}}}$$

① γ is highest for at the money and lowest for ~~OTM~~ OTM & ITM

② γ is more for those options which are close to expiry.

③ γ is the rate of change of an option's delta based on a unit movement in stock price.

④ γ → Gamma (small)
Γ → Gamma (large)

$$\Gamma = \frac{\partial^2 (\text{Option premium})}{\partial^2 (\text{stock price})}$$

$$= \frac{\text{change in } \Delta}{\text{change in stock price}}$$

(i) (Gap up opening + market keeps going up)

$\Downarrow$

Δ of call option increases.

(ii) (Gap up opening + market goes down).

$\Downarrow$

Δ of ~~call~~ put option does not increases.

$\gamma \uparrow$, $\longrightarrow$ More effect in premium ($\uparrow$)

$\uparrow$?

OI is more $\Longrightarrow$ more trades happens.

More options being created.

① OI increase ⇒ More trading

More trading $\not\Rightarrow$ OI increase

→ OI more

→ OI decrease.

(Option seller)

Sold a call option

$\Delta = 0.6$

Portfolio:

① Sold one call option (C_1)

② Purchase 0.6 shares. ($0.6S$)

⇓

Portfolio value $= -C_1 + 0.6S$

Price goes up by 1\$

$$C_1 \longrightarrow C_1 + \underbrace{0.6}_{\text{RISK}}$$

$$0.6S \longrightarrow 0.6(S+1)$$

$$= 0.6S + \underbrace{0.6}_{\text{PROFIT}}$$

$$0.6 \longrightarrow 0.8$$

$0.8S$ ✓

$0.2S$ More

~~92~~ → BUY

100 → ASK

101 → 1 LOT (VERY SMALL)

~~___~~ →

107 → 3 LOTS

110 → 9 LOTS.

LTP (107)

100 ↓ t=12:30:10S

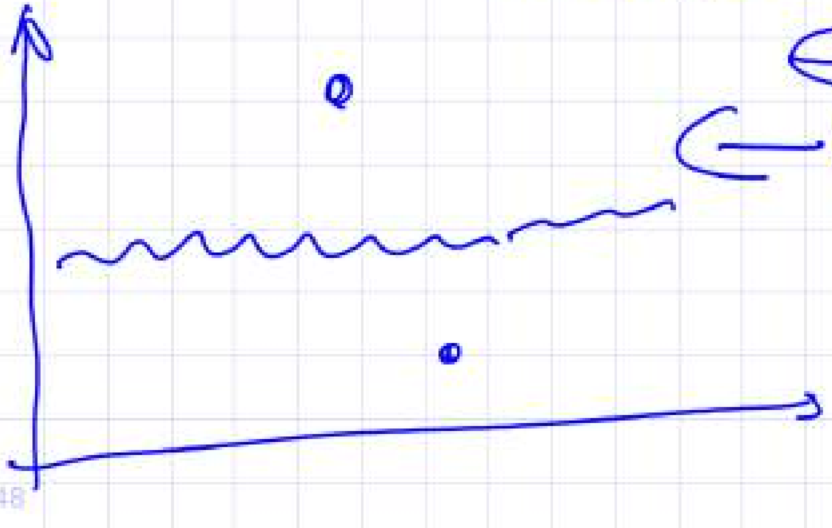
107 ↓ t=12:37:43:8 100 ms

1 LOT YOUR TRADE

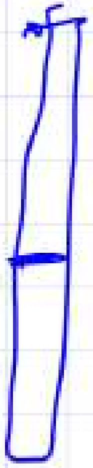
100 ↓ (1 LOT) MANIPULA

12:37:48

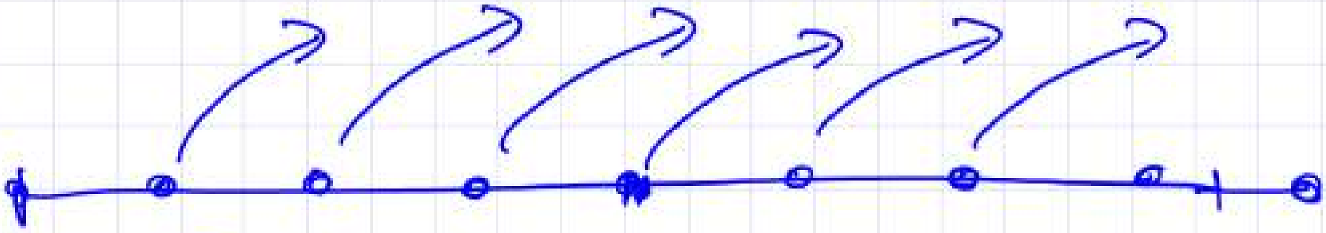
⟵ 1μs ⟶



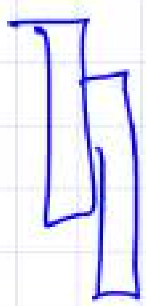
5 min

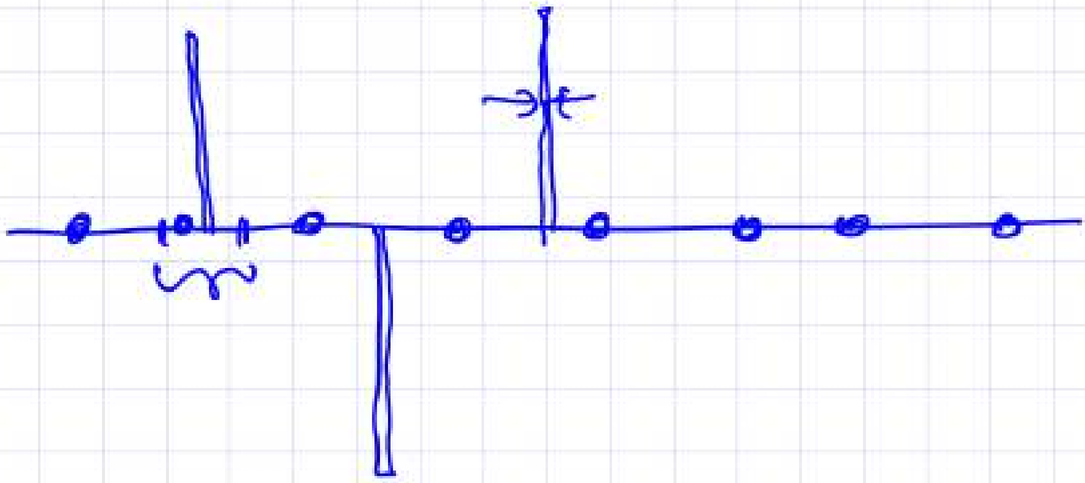


100 — 107 — 100



1ms 1ms





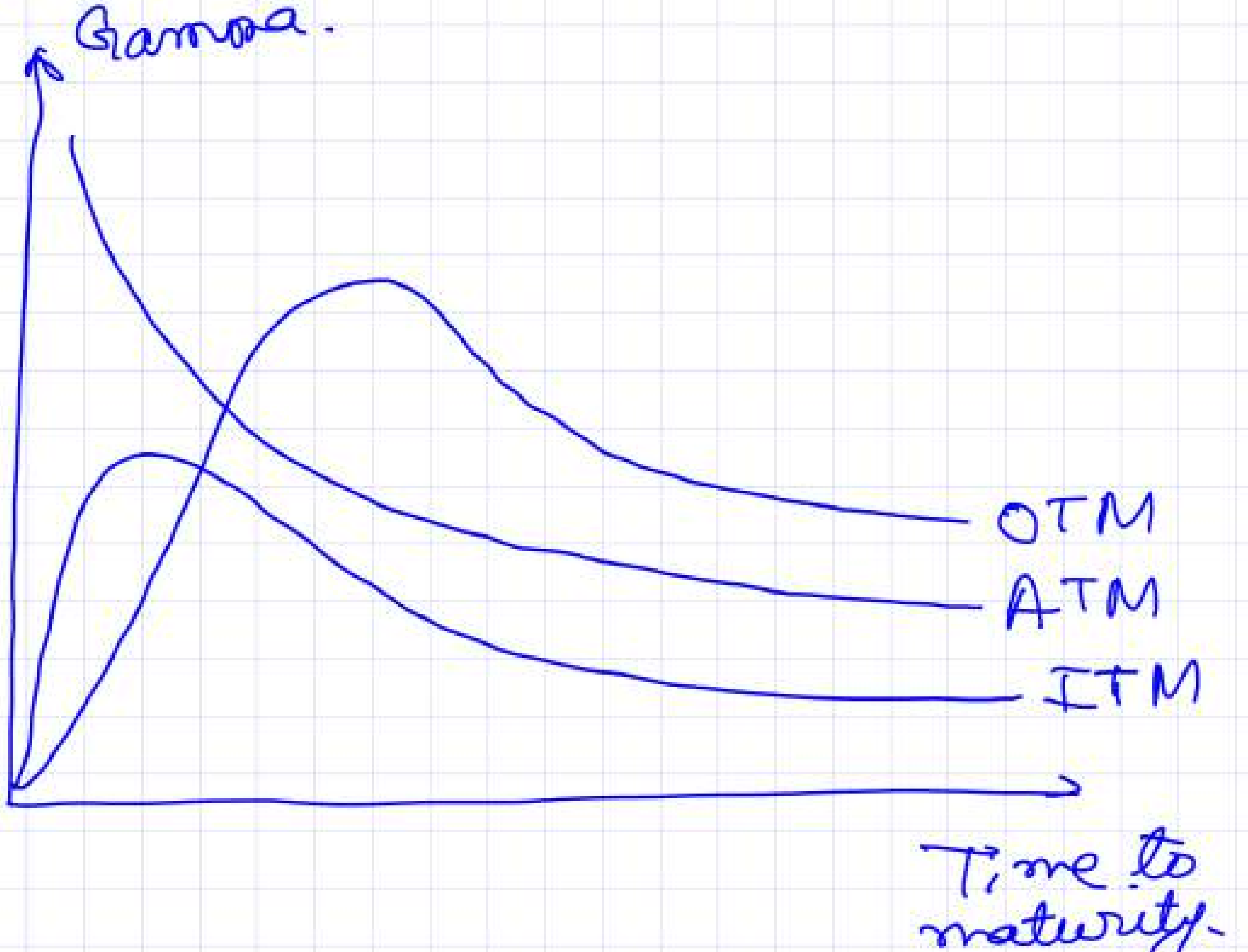
Gamma:

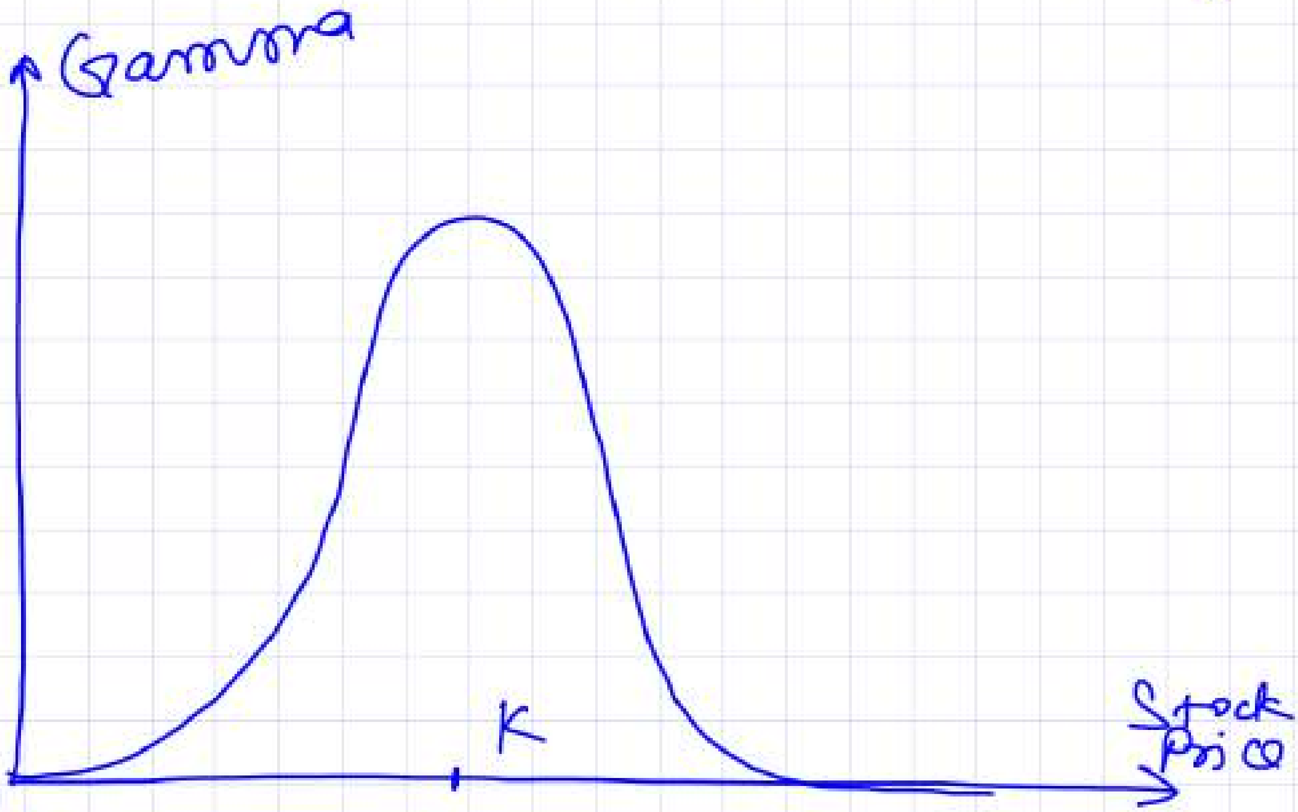
$$\Gamma = \frac{\partial^2(\text{Option price})}{\partial^2(\text{Stock price.})}$$

If Γ is small we have ~~to~~ rate of change of Δ w.r.t. stock price is not much.

AND SO,

Frequent hedging is not reqd. for naked positions





$$\Gamma = \frac{N'(d_1)}{S_0 \sigma \sqrt{T}}$$

§ Theta:

Theta measures the rate of time decay in the value of option premium.

$$\begin{pmatrix} \text{Option} \\ \text{Premium} \end{pmatrix} = f\begin{pmatrix} K, S, T, \\ \sigma, r \end{pmatrix}$$

$$\overset{\shortparallel}{C}$$

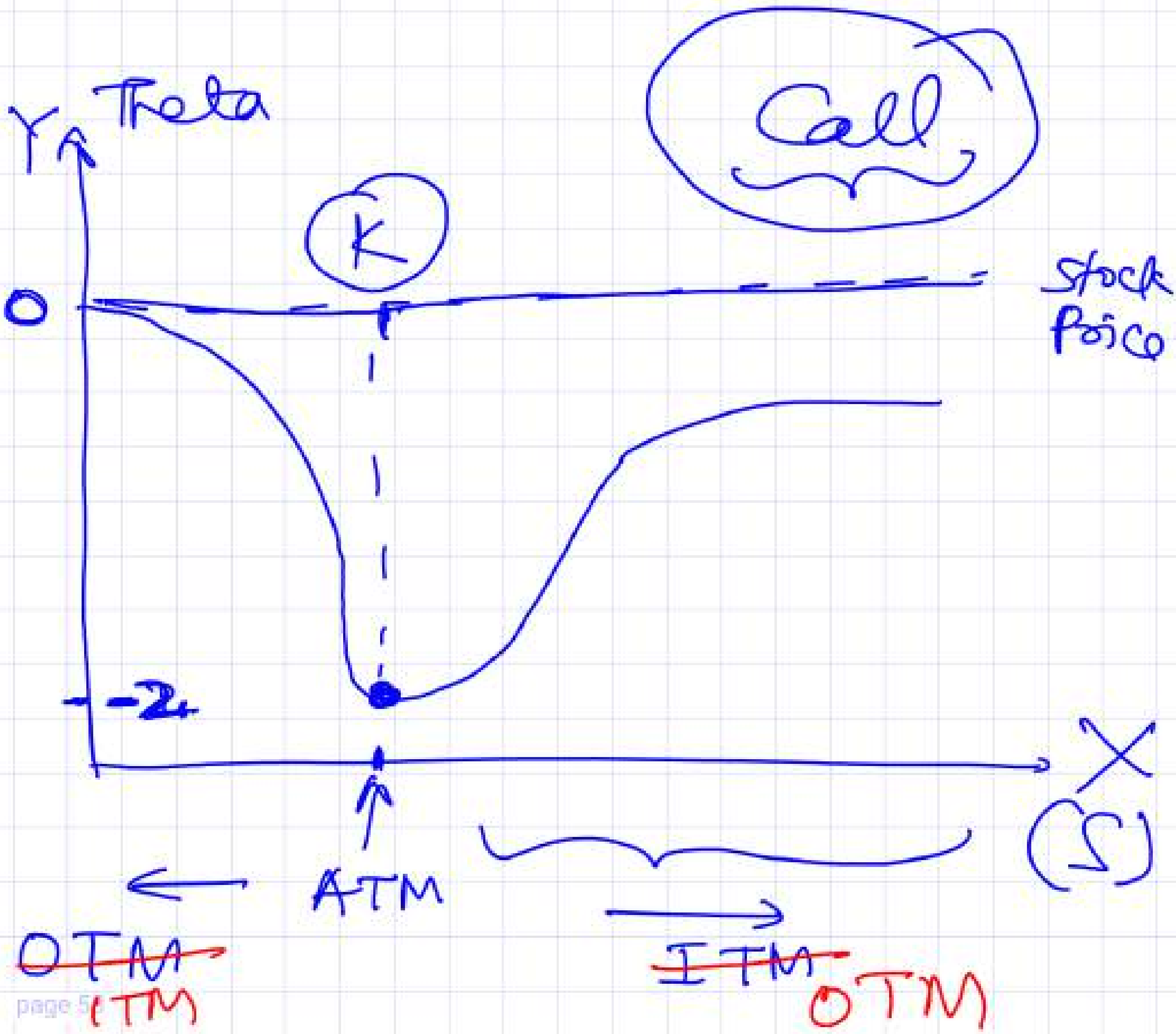
$$\Delta = \frac{dC}{dS} = \frac{\partial f}{\partial S} = \text{Black shcs..}$$

$$\frac{dC}{dT} = \frac{\partial f}{\partial T}$$

$$\Theta\,(\text{call}) = -\frac{S_0\, N'(d_1)\,\sigma}{2\sqrt{T}} - rKe^{-rT}N(d_2)$$

$$N'(x) = \frac{1}{\sqrt{2\pi}}\, e^{-x^2/2}$$

$$\Theta\,(\text{Put}) = -\frac{S_0\, N'(d_1)\,\sigma}{2\sqrt{T}} + rKe^{-rT}N(-d_2)$$



$$C_{ITM} = \underbrace{A_1}_{(S-K)} + \underbrace{A_2}_{RISK_{ITM}}$$

$$C_{ATM} = \cancel{B_1 + B_2}\ RISK_{ATM}$$

$$C_{OTM} = RISK_{OTM}$$

$$RISK_{ATM} > RISK_{OTM}$$

$$RISK_{ATM} > RISK_{ITM}$$

$$\cancel{R}\ RISK_{ATM} \longrightarrow 0$$
$$= C_{ATM}$$

$$C_{ITM} \rightarrow (A_1 + A_2) \longrightarrow A_1$$

$$C_{OTM} \Rightarrow RISK_{OTM} \longrightarrow 0$$

RISK → fluctuations in future stock price.

$$C_{ATM} = 0 + \alpha_1$$

↓

RIGT NOW

$$C_{OTM} = 0 + \alpha_2$$

$$C_{ITM} = (S-K) + \alpha_3$$

$$\alpha_1 > \alpha_2$$

$$\alpha_1 > \alpha_3$$

$\alpha_1 = 10\$ \longrightarrow ATM$

$\alpha_2 = 5\$ \longrightarrow OTM$

$$\cancel{K = S} \quad (S - K) + (10)$$

$$(S - K) + 7$$

Call option

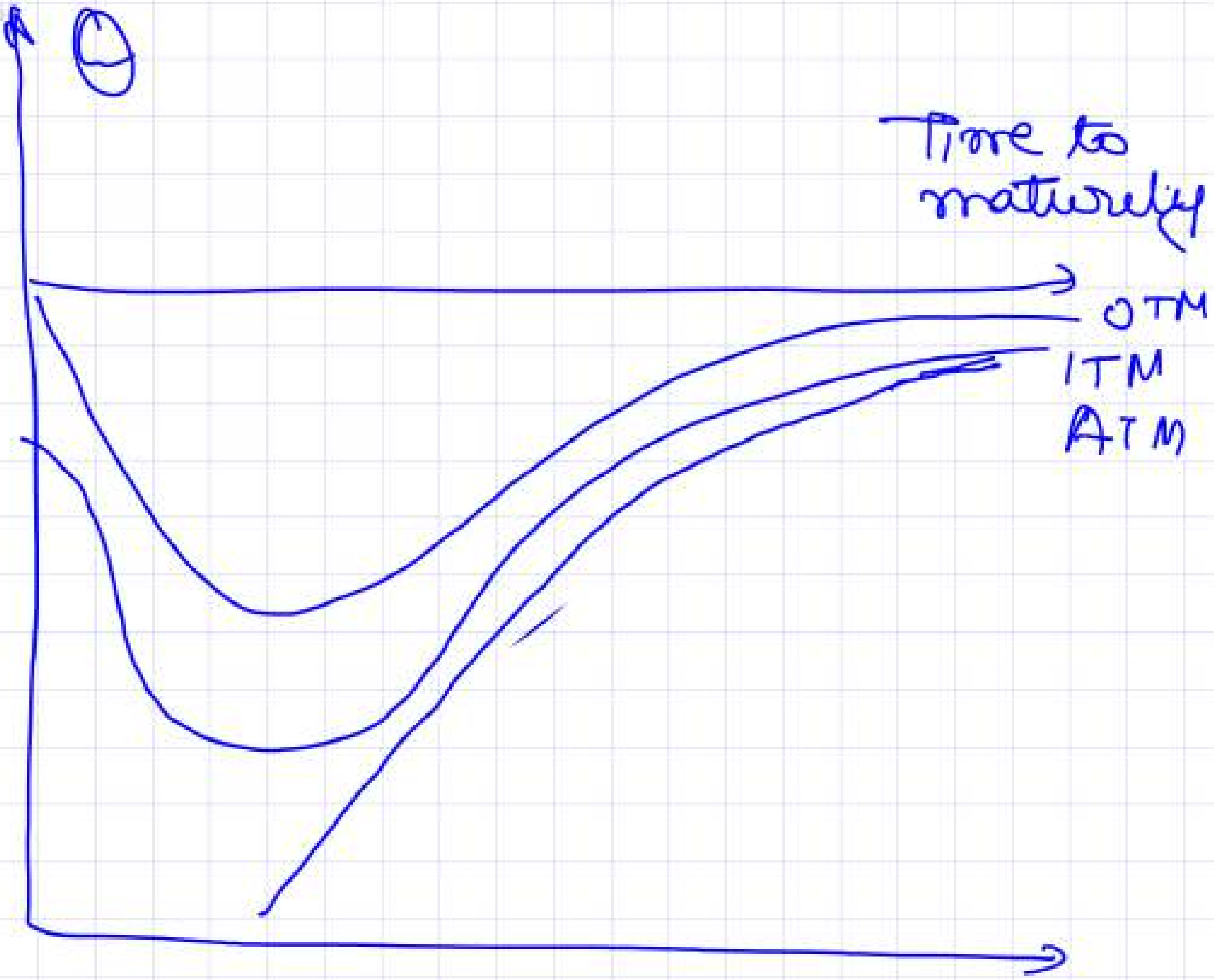
$S_0 = 100\$ \quad \cancel{K =}$

$K = 100\$ \longrightarrow C_1 = 10\$$

$K = 90\$ \longrightarrow C_2 < \cancel{10\$}$

$10 < \qquad 20\$$

$$\underset{(100-90)}{C_2 = 10} + \boxed{\times}$$



$$\Theta = \frac{d(\text{Option price})}{d(\text{Time to expiry})}$$

Suppose Time to expiry = very less

[3:29 PM Thus.

$C_1 = 2$ Rs. ATM.

ATM
$$\begin{cases} 3{:}29\,PM \longrightarrow C_1 = 2\,Rs \\ 3{:}00\,PM \longrightarrow C_1 = 5\,Rs. \end{cases}$$
$$3{:}30\,PM \longrightarrow C_1 = 0\,Rs$$

$$\Theta_{3:00PM} = \frac{5\,Rs}{30\,MINS} = 0.167$$

$$\Theta_{3:29PM} = \frac{2\,Rs}{1\,MIN} = 2$$

$$\Theta_{3:39}$$

Option trading strategies:

One of the simplest technique is writing or buying naked options.

Writing a covered call:

Portfolio is : → ~~long~~ covered call

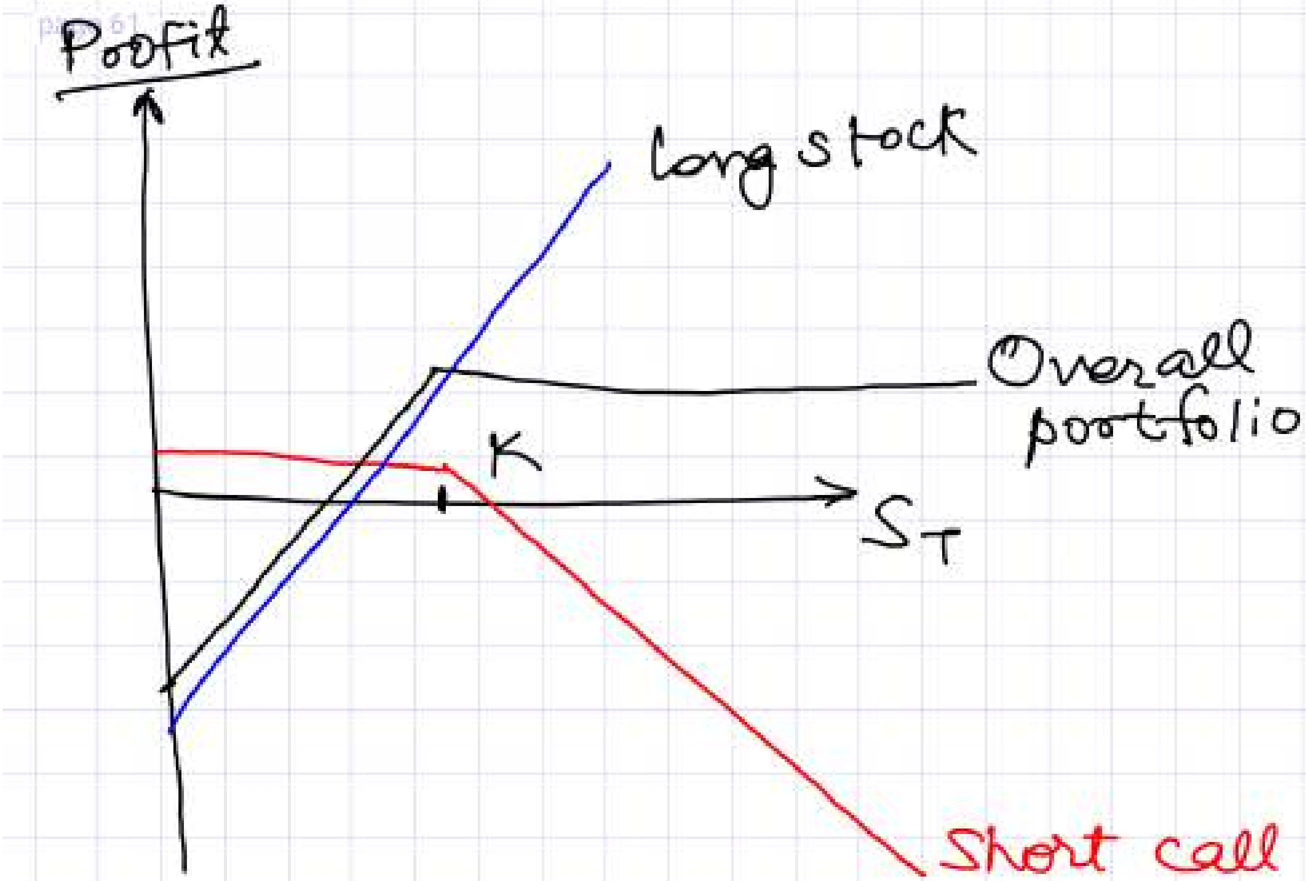
1. Long position in stock
+ Short position in ~~european~~ call option

→ long stock position covers or protects the investor.

2. ~~Bo~~ Covered Put:

1. Buy a put option
2. Buy a stock

→ long position in covered put



① You want to ~~buy~~ sell stock S_0

② You went ~~short~~ long on ~~call~~ put option (K)

→ Got premium

③ ~~S_T~~

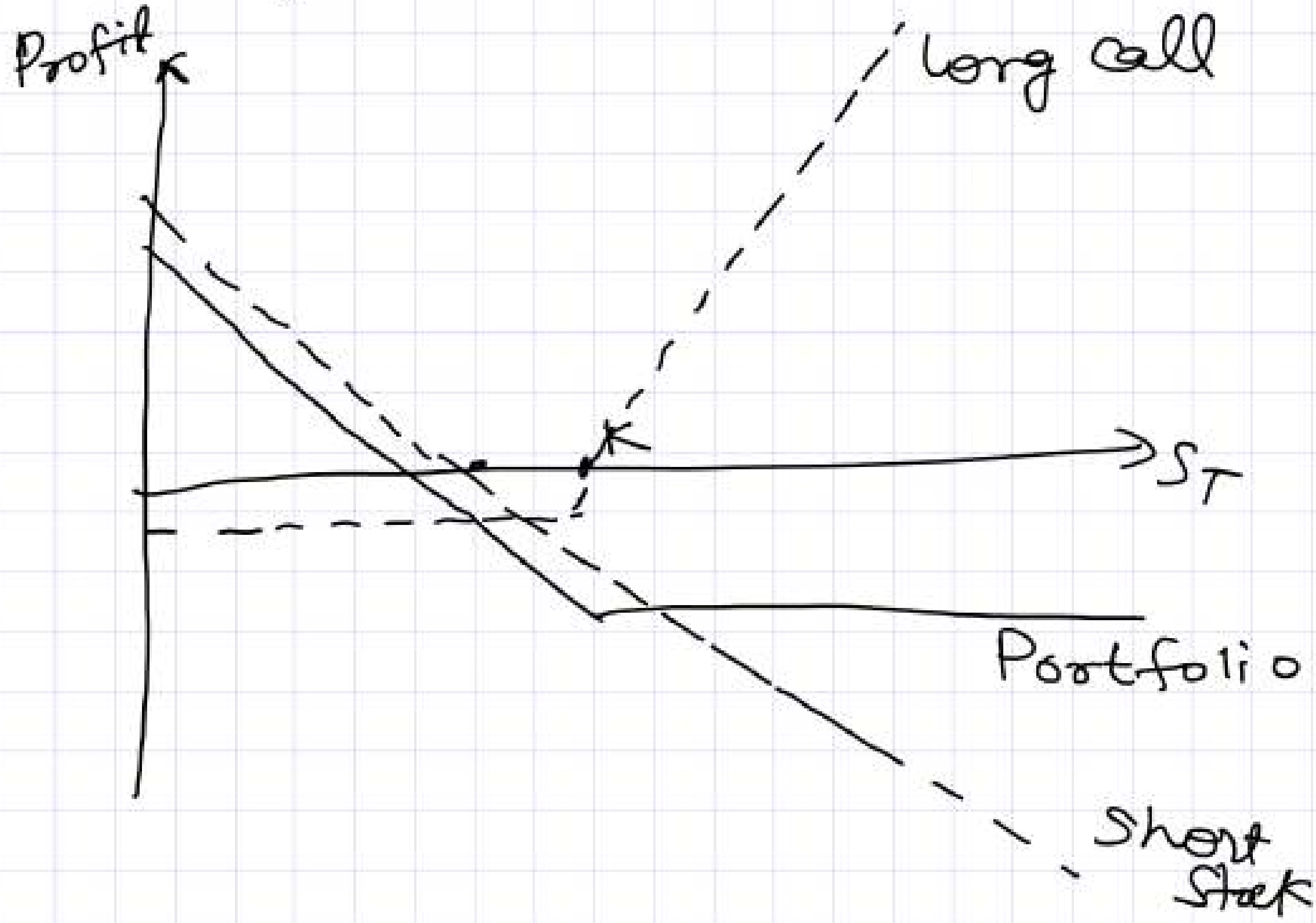
At time T:

① S_T → stock price at time T

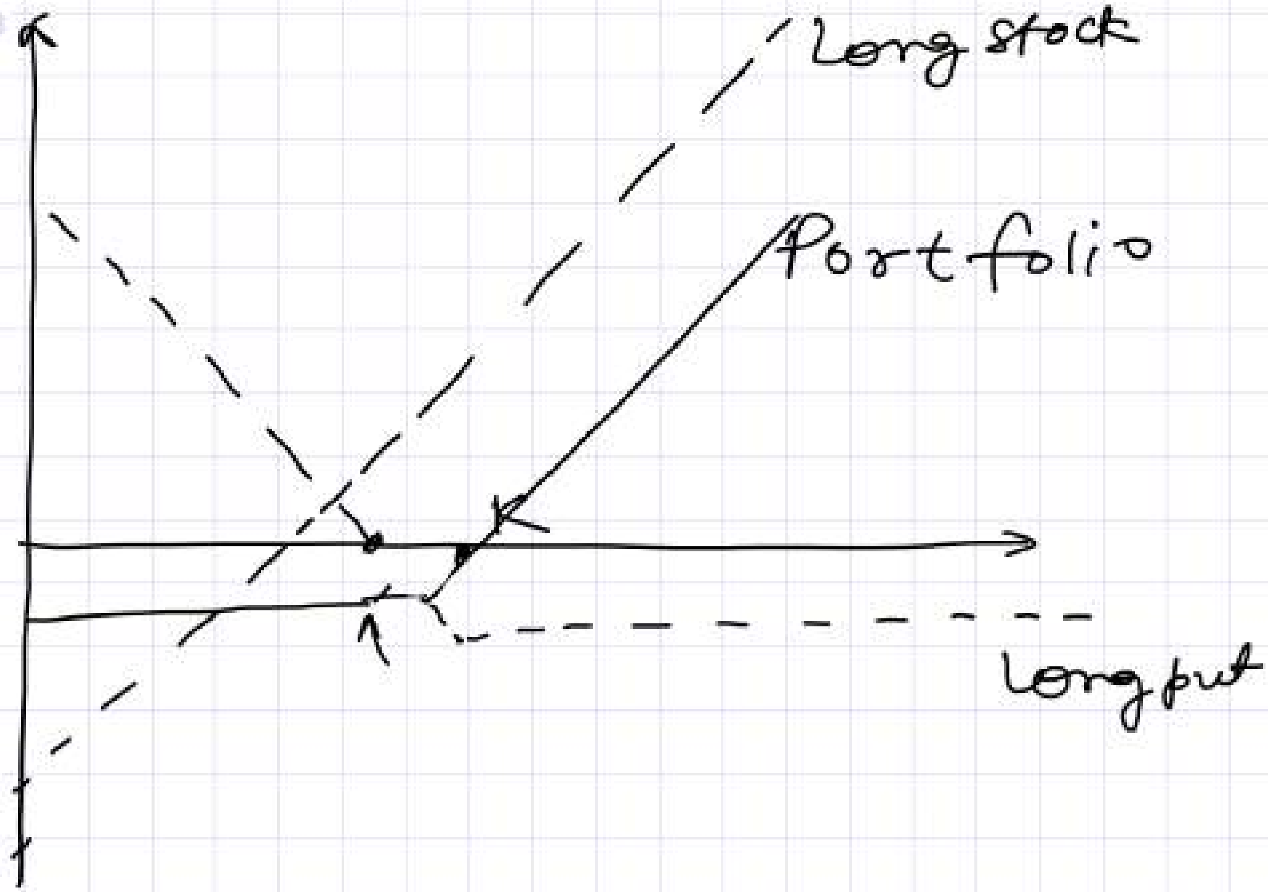
$(S_T > S_0) \Rightarrow$ It is OK.

② $(S_T < S_0) \Rightarrow$

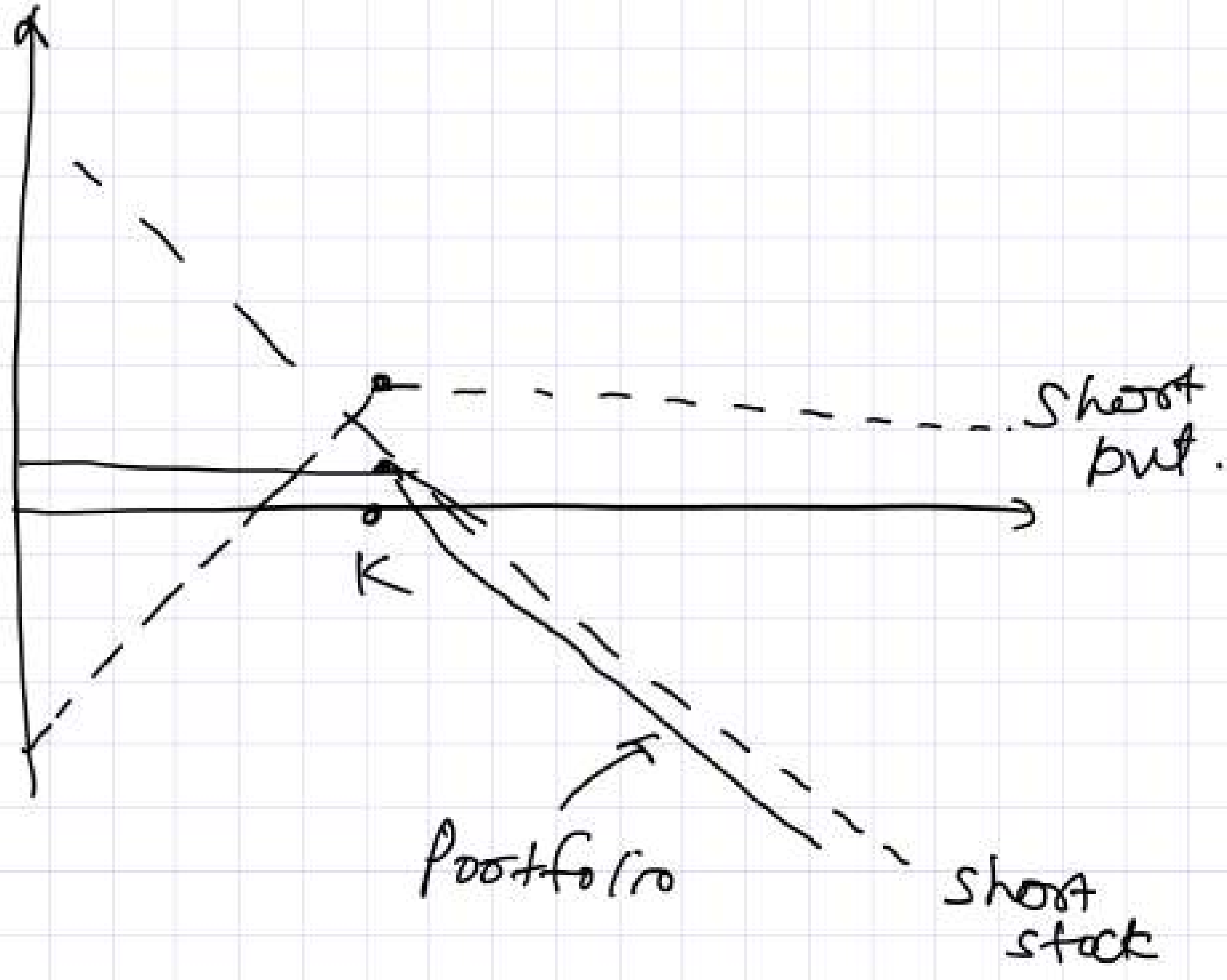
② (Short position in stock)
+
(long position in call)



③ long position in put
+
long position in stock



④ Short put + short stock



Spread techniques:

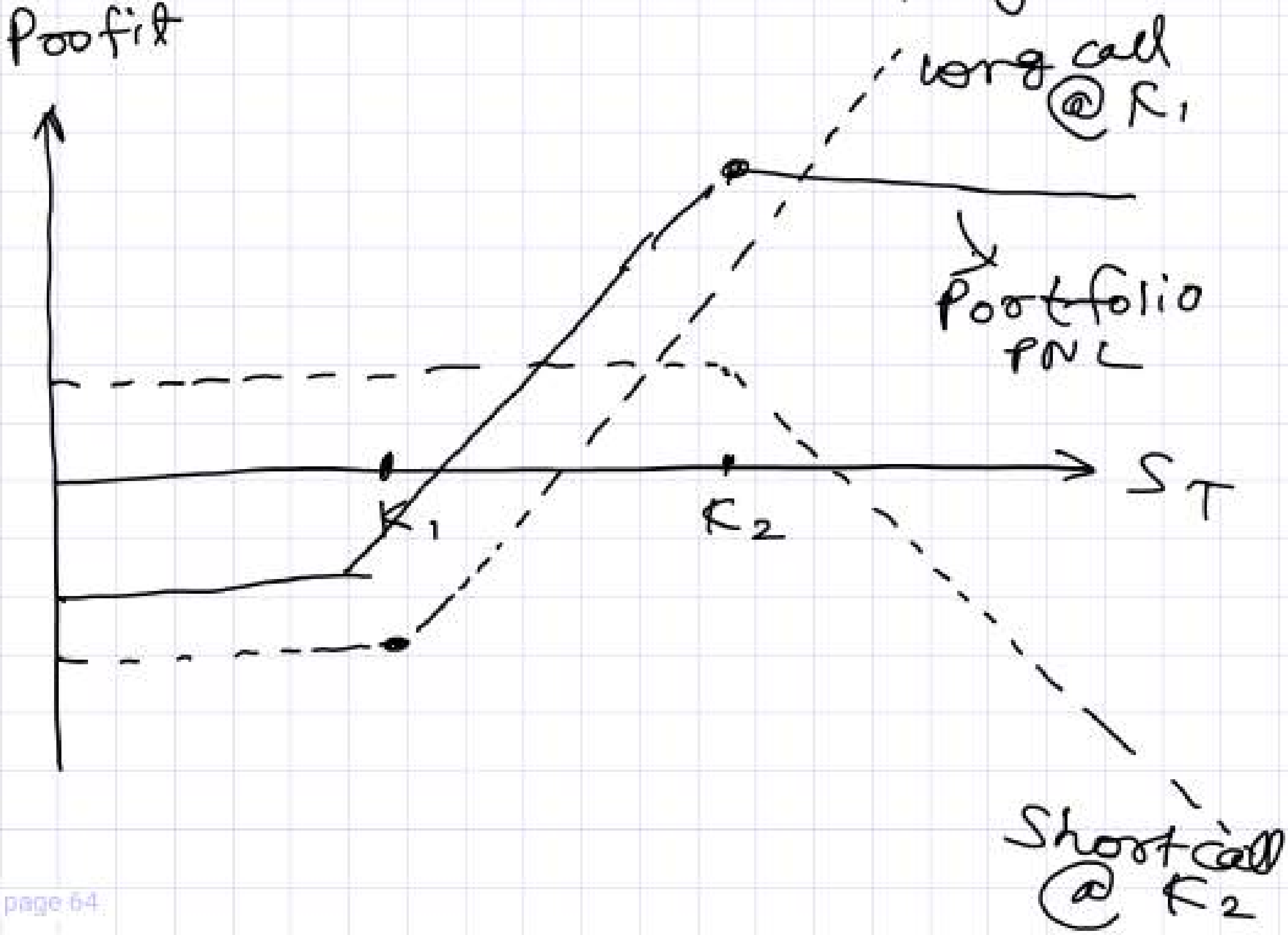
2 or more option positions of the same type.

① Bull spread:

① Buy a call option with strike K_1

② Sell a call option with K_2 $(K_2 > K_1)$

Both have same expiry date



3 types of bull spreads can be seen

① Both calls are ~~out of the~~ OTM

② One is ITM, one is OTM

③ Both are ITM

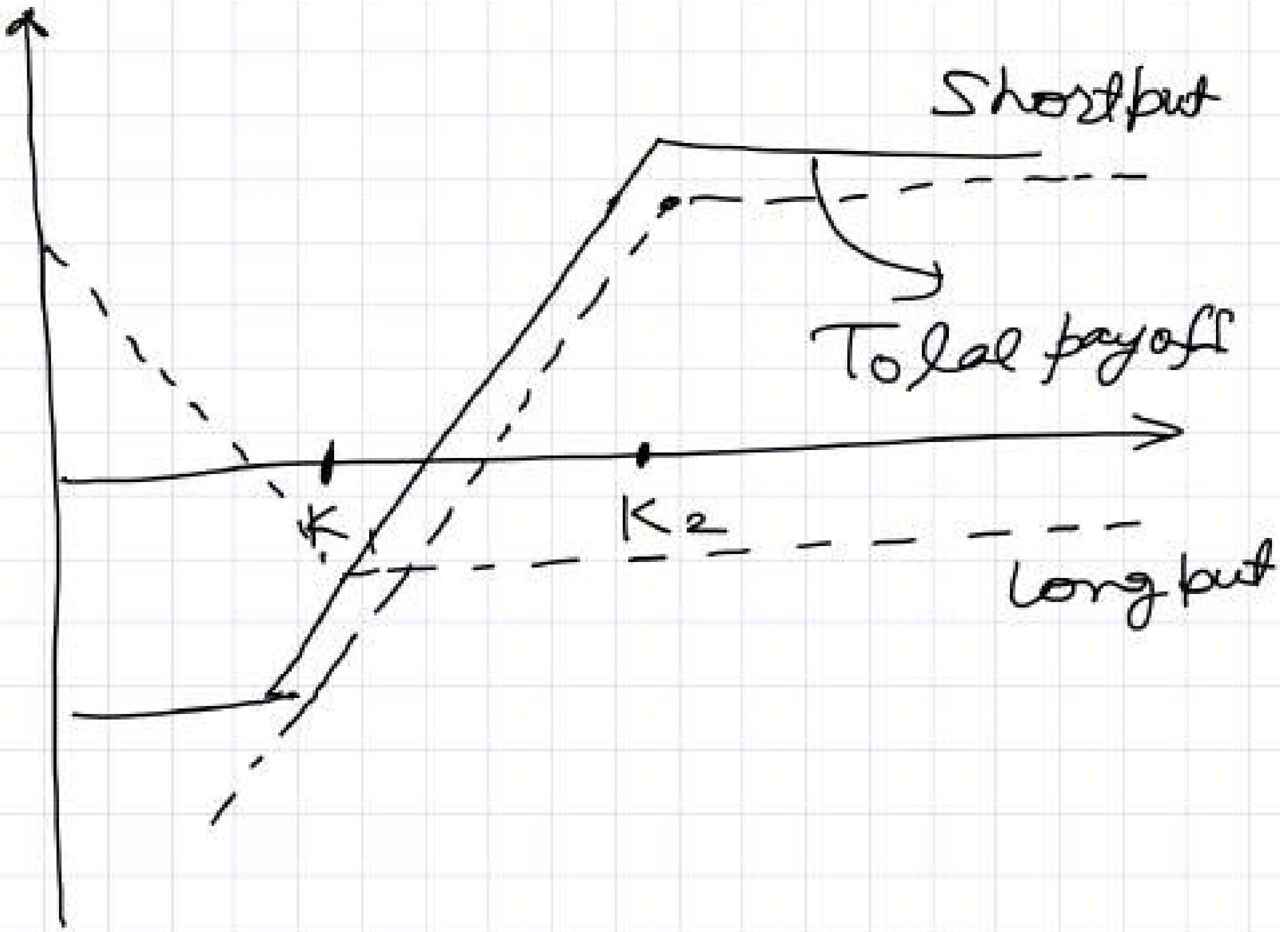
Stock Price range	Payoff from long call	Payoff from short call	Total Payoff
$S_T \le K_1$	0	0	0
$K_1 < S_T < K_2$	$S_T - K_1$	0	$S_T - K_1$
$S_T \geq K_2$	$S_T - K_1$	$-(S_T - K_2)$	$K_2 - K_1$

Bull spread can also be created using Put options:

① Long put with strike K_1

② Short put with strike K_2

$$K_1 < K_2$$



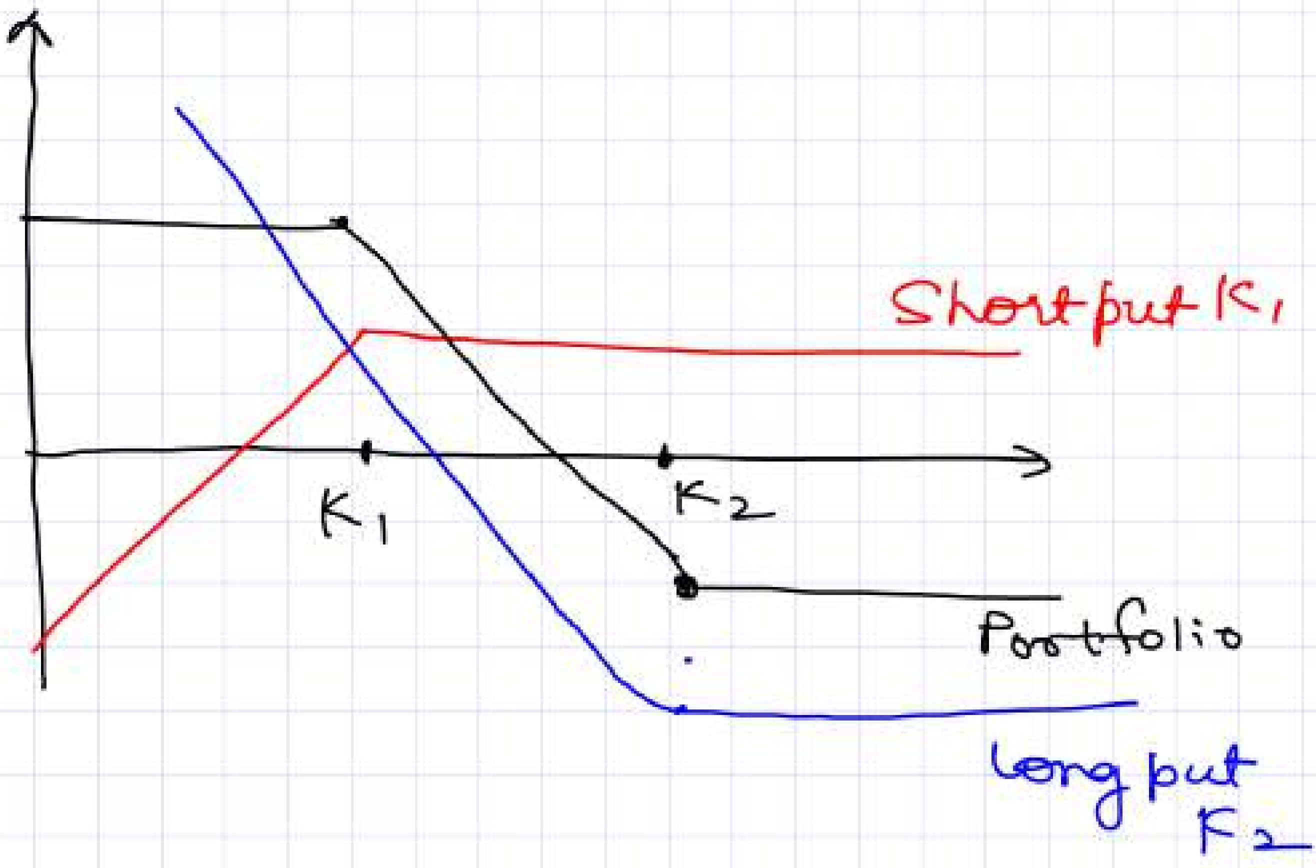
Bear Spread :

① Bear spread using Put options

Portfolio :

- → Long put strike price K_2
- → Short put strike price K_1

$$K_1 < K_2$$



Bea

Bear spread Payoffs:

Stock Price range	Payoff from long Put option	Payoff from short put option	Total Payoff
$S_T \leq K_1$	$K_2 - S_T$	$-(K_1 - S_T)$	$K_2 - K_1$
$K_1 < S_T < K_2$	$K_2 - S_T$	0	$K_2 - S_T$
$S_T \geq K_2$	0	0	0

§ Box Spread:

Combination of

1) Bull call spread with strike price K_1 & K_2

2) Bear put spread with strike price K_1 & K_2

The future payoff from the box spread is $K_2 - K_1$

Stock price range	Payoff from bull call spread	Payoff from bear put spread	Total payoff
$S_T \leq K_1$	0	$K_2 - K_1$	$K_2 - K_1$
$K_1 < S_T < K_2$	$S_T - K_1$	$K_2 - S_T$	$K_2 - K_1$
$S_T \geq K_2$	$K_2 - K_1$	0	$K_2 - K_1$

Current value of payoff is.

$$(K_2 - K_1)\, e^{-rT}$$

$\downarrow$

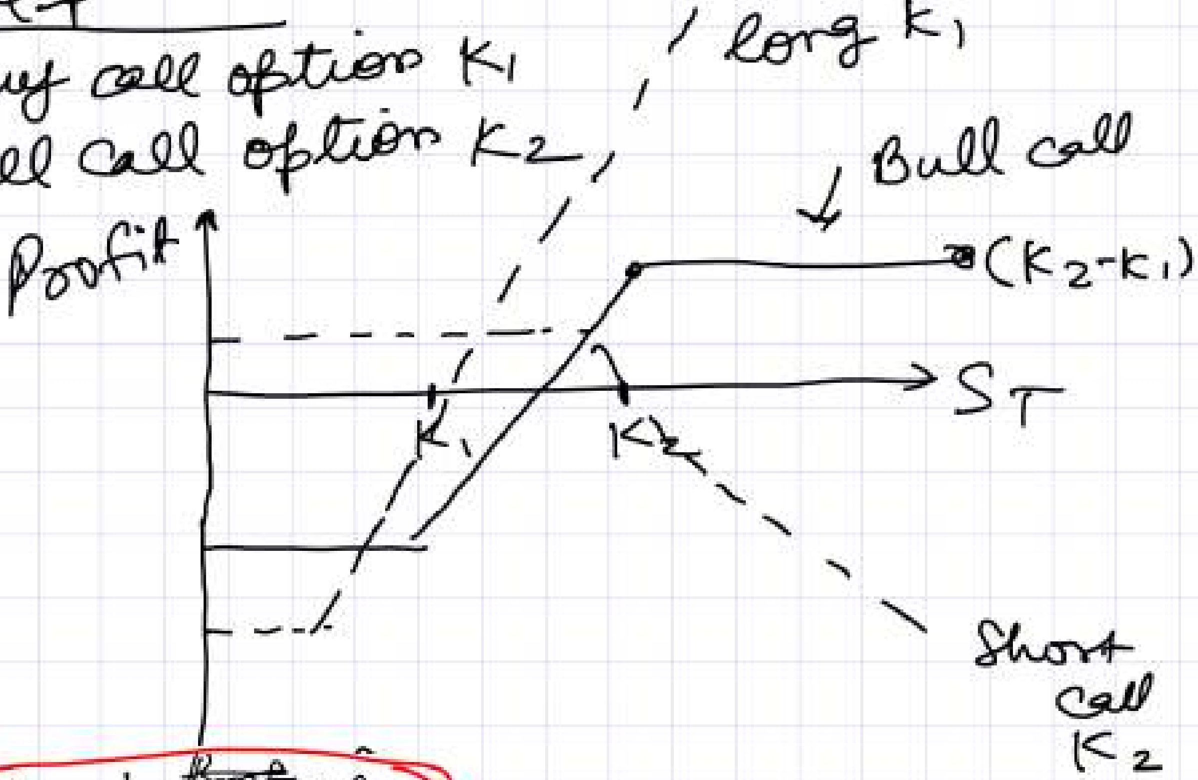
Reasonable Present price of the instrument

Box Spread:

① Bull call spread with K_1 & K_2
② Bear put spread with K_1 & K_2

Bull Call spread:

→ Buy call option K_1
→ Sell call option K_2



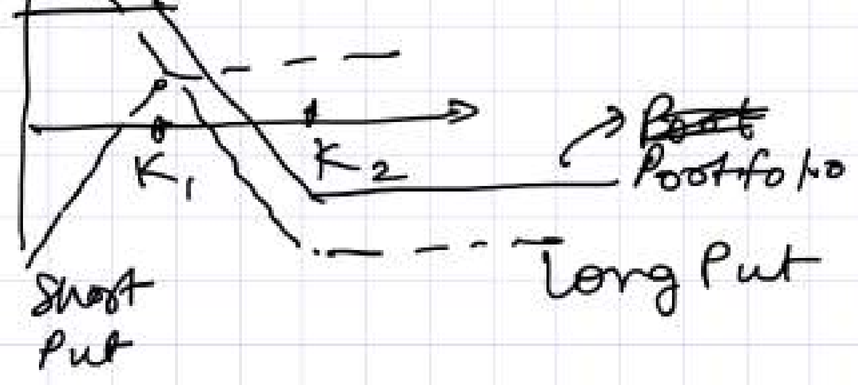
Stock price range at T	~~Prof~~ Payoff
$S_T \le K_1$	0
$K_1 < S_T < K_2$	$S_T - K_1$
$S_T \geq K_2$	$K_2 - K_1$

⇐ Bull call

Bear Put:

→ Buy Put K_2
→ Sell Put K_1

Long



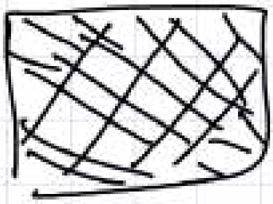
Stock price range at T	Total Payoff
$S_T \le K_1$	$K_2 - K_1$
$K_1 < S_T < K_2$	$K_2 - S_T$
$S_T \geq K_2$	0

$\leftarrow$ Bear Put

① $S_T \le K_1 \longrightarrow 0 + K_2 - K_1$

② $K_1 < S_T < K_2 \Rightarrow S_T - K_1 + K_2 - S_T$
$= K_2 - K_1$

③ $S_T \geq K_2 \longrightarrow K_2 - K_1 + 0$

$B =$ 

(BOX SPRED)

$B_T \longrightarrow K_2 - K_1$

$B_0 \longrightarrow (K_2 - K_1)e^{-rT}$

① Take loan from bank

$(K_2-K_1)e^{-rT}\$$,

② If $B_0 < (K_2-K_1)e^{-rT}$

③ Invest B_0 to buy Box spread

$+\left[(K_2-K_1)e^{-rT}-B_0\right]$ in my Pocket

④ At time T

$$\begin{bmatrix} B_T \longrightarrow (K_2-K_1) \\ \text{Loan to paid} = (K_2-K_1) \end{bmatrix}$$

No obligation

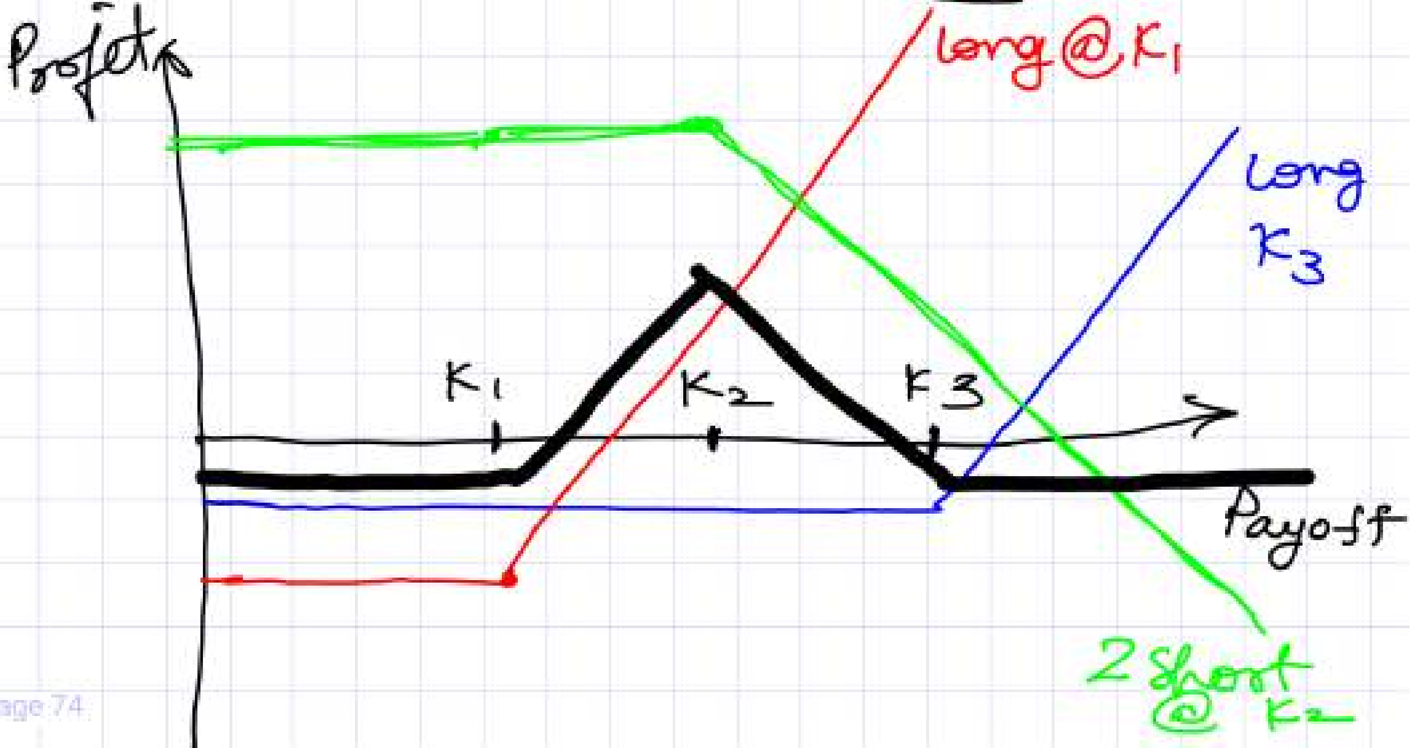
Butterfly spread:

This involves option postions with 3 different strike prices.

① 1 long call @ K_1
② 1 long call @ K_3
③ 2 short call @ K_2

s.t. $K_1 < K_2 < K_3$

and $K_2 \simeq \dfrac{K_1 + K_3}{2}$



Payoff.

Stock Price range	Payoff @ call K_1	Payoff call K_3	Payoff call K_2	Total
$S_T \leq K_1$	0	0	0	0
$K_1 < S_T \leq K_2$	$S_T - K_1$	0	0	$S_T - K_1$
$K_2 < S_T < K_3$	$S_T - K_1$	0	$-2(S_T - K_2)$	$K_3 - S_T$
$S_T \geq K_3$	$S_T - K_1$	$S_T - K_3$	$-2(S_T - K_2)$	0

$$K_2 = \frac{1}{2}(K_1 + K_3)$$

Butterfly @ Put :

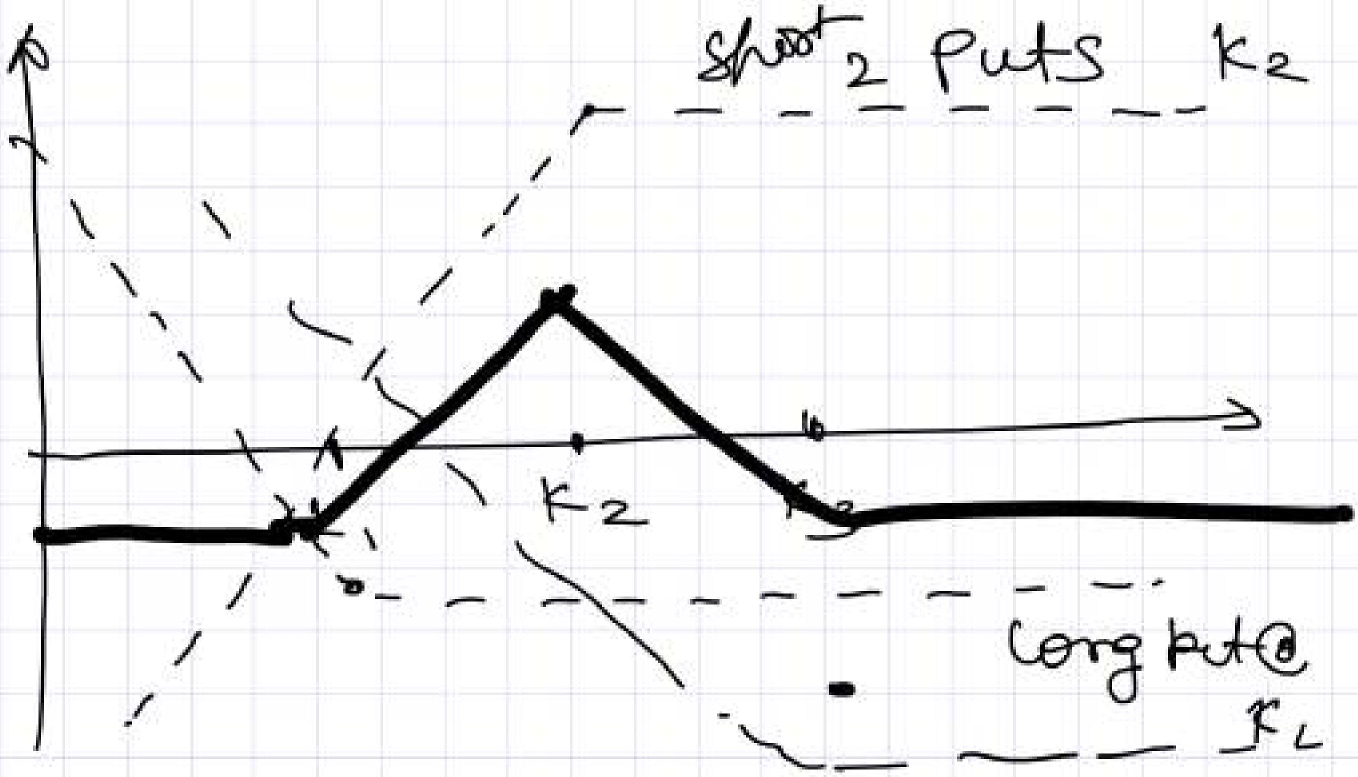
① 1 Long put @ K_3

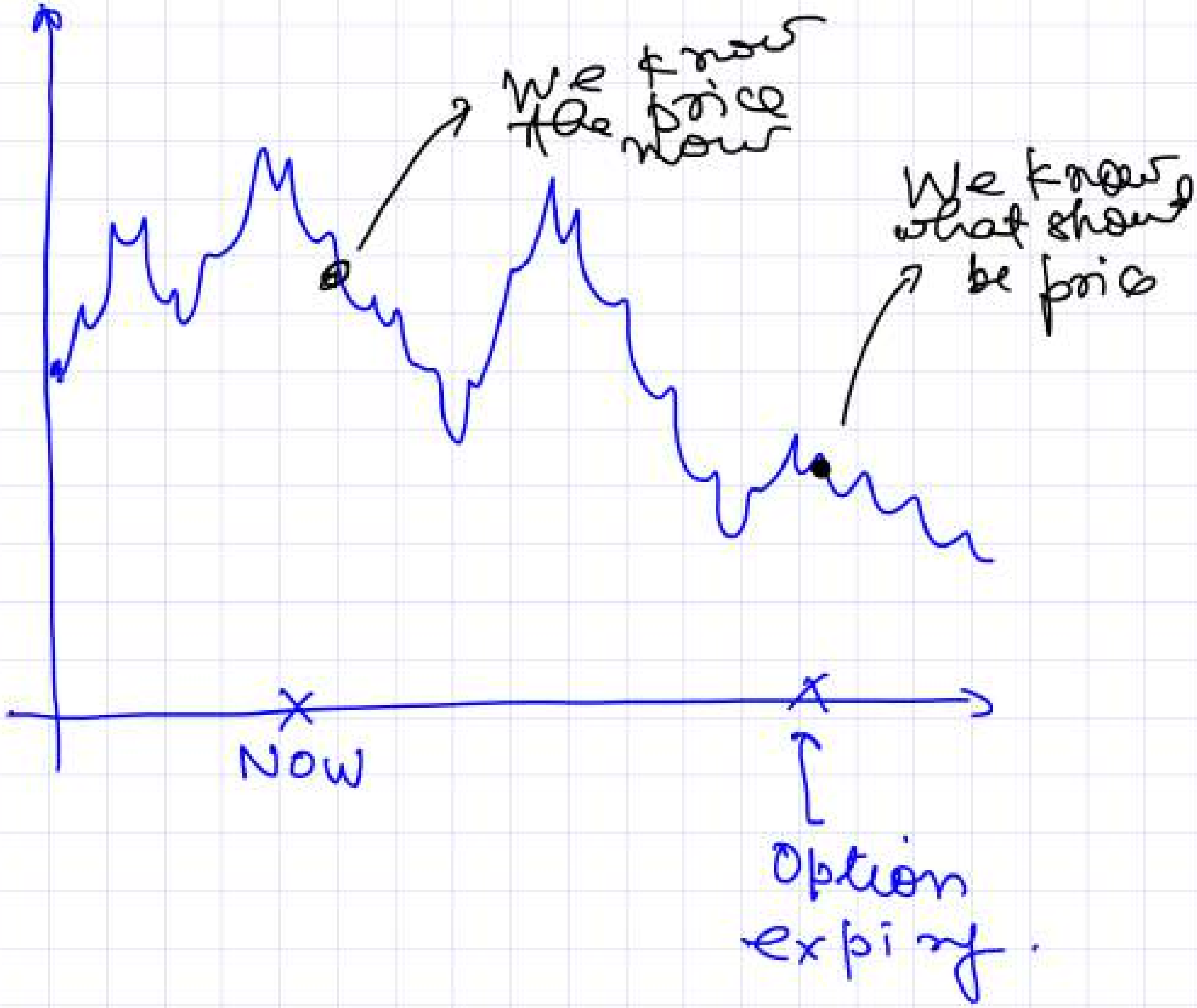
② 1 Long Put @ K_1

③ 2 Short put @ K_2

$$K_1 < K_2 < K_3$$

$$K_2 \simeq \frac{1}{2}(K_1 + K_2)$$




We know the price now
We know what should be price
NOW
Option expiry.

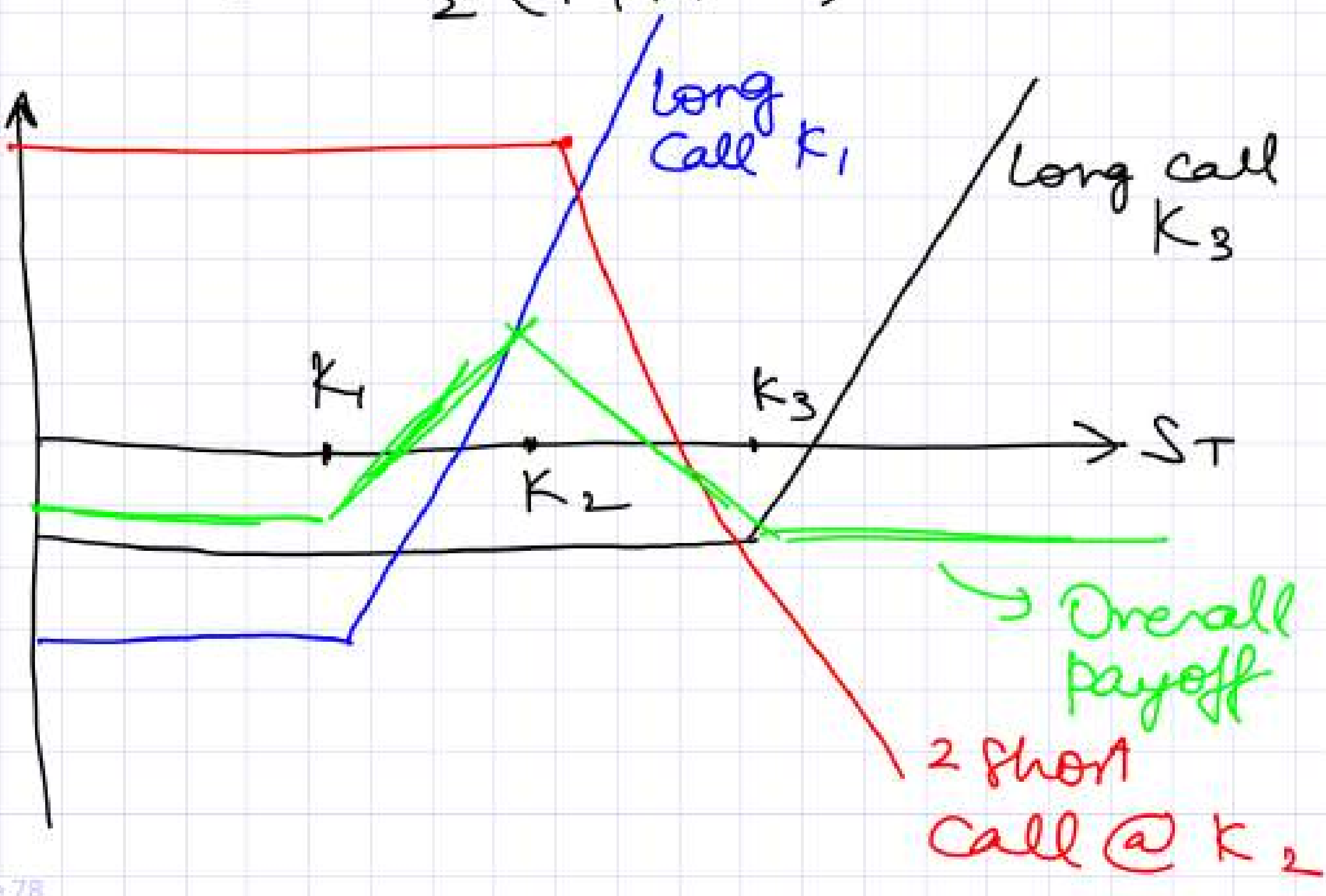
Butterfly spread (: Call options):

Involves options with 3 different strike prices.

① Buy a European call option with relatively low strike price K_1.

② Buy a European call option with a relatively high strike price K_3.

③ Sell 2 European call option with ~~st~~ strike price K_2 (such that $K_2 \simeq \frac{1}{2}(K_1+K_3)$)



Market View:

Large stock price moves are not likely.

→ Initial investment is ~~[illegible]~~ not much.

Payoff from Butterfly spread:

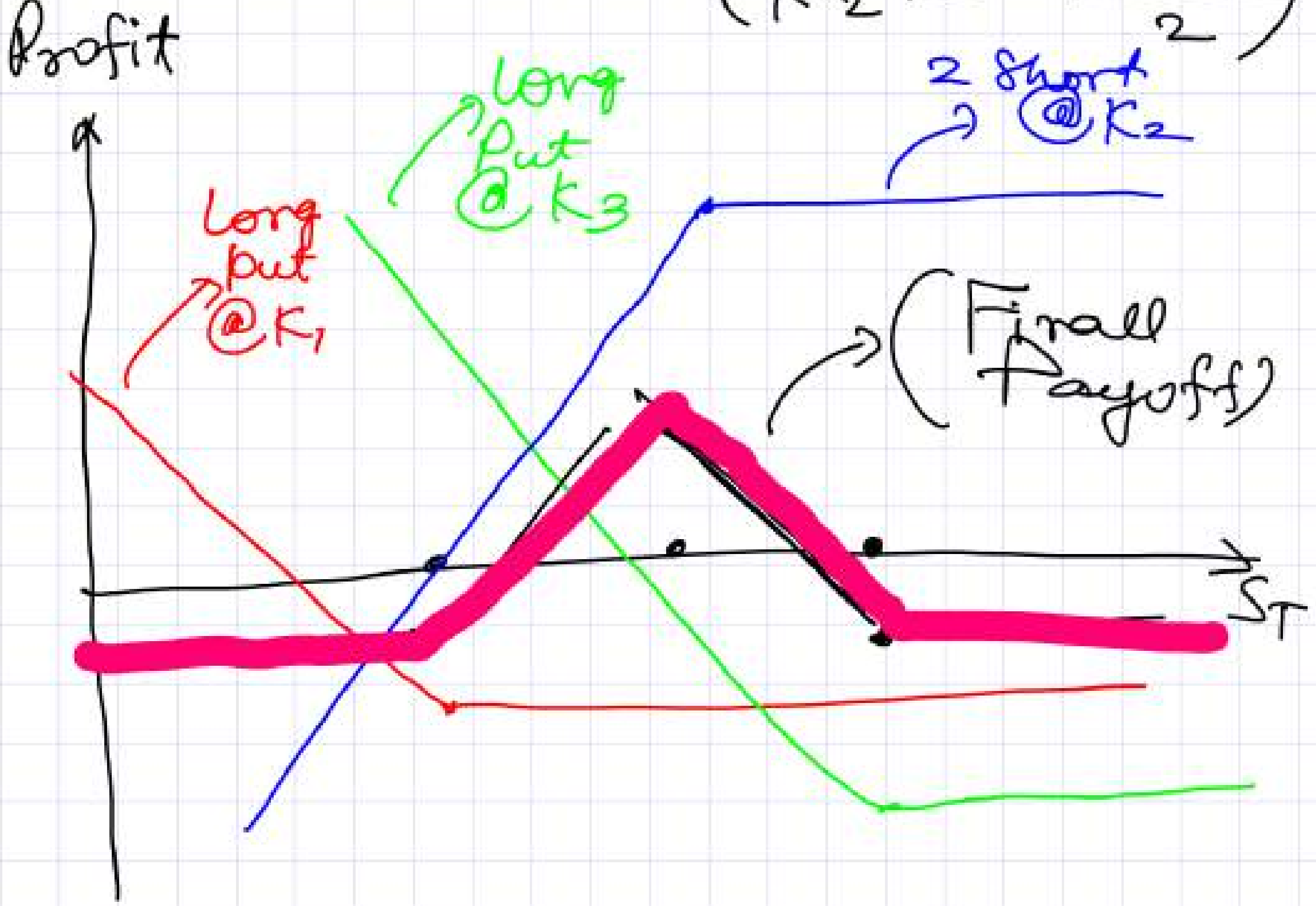
Stock price range	Total Payoff
$S_T \leq K_1$	0
$K_1 < S_T \leq K_2$	$S_T - K_1$
$K_2 < S_T < K_3$	$K_3 - S_T$
$S_T \geq K_3$	0

Butterfly spread (Put options):

① Sell options with strike price K_1 & K_3

② Buy 2 options at K_2

$$\left(K_2 \simeq \frac{K_1+K_3}{2}\right)$$



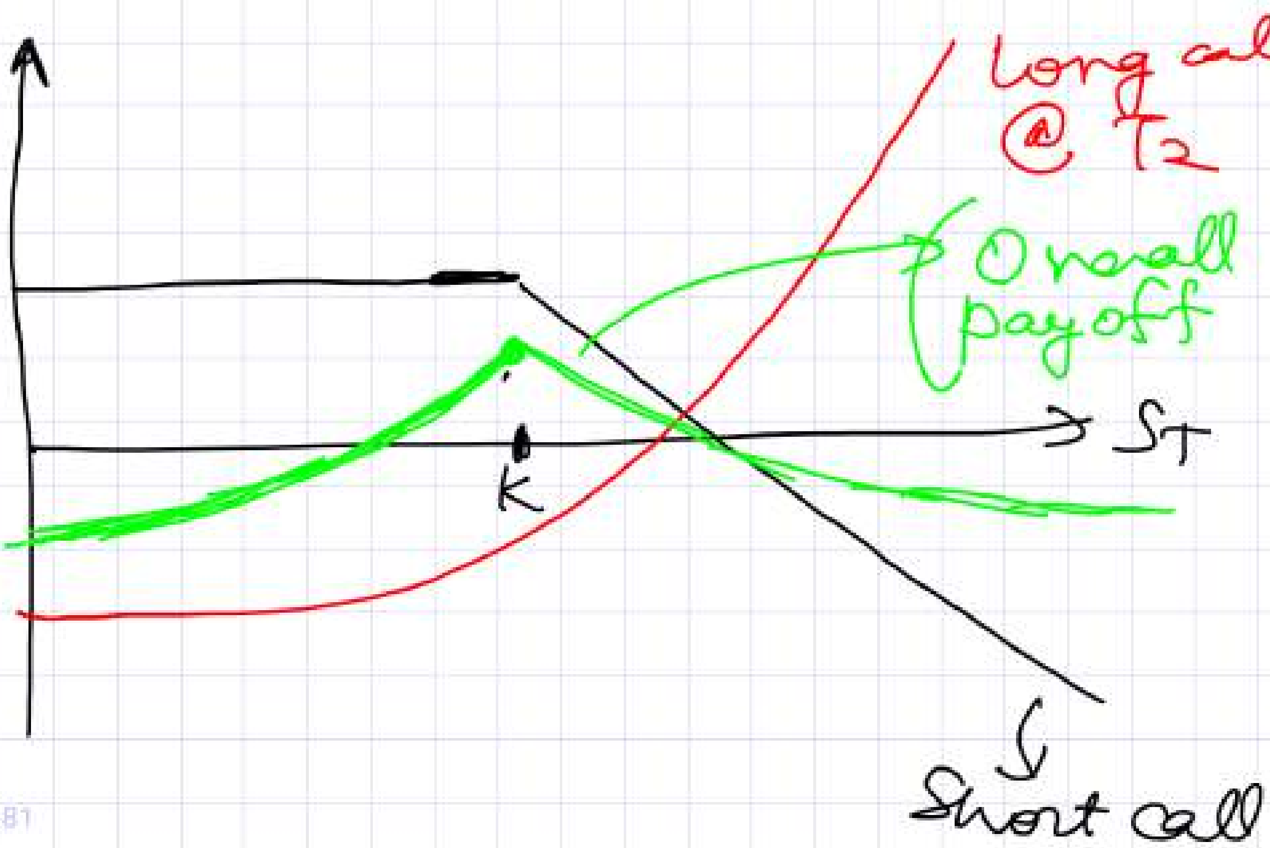
Calendar spreads:

Here options have same strike price but different expiration dates.

1. Sell call option with strike price (K) and time T_1
2. Buy call option with K & T_2 $(T_2 > T_1)$

$\longleftrightarrow$

So we need initial payment



Profit diagram show profit when short maturity option expires & long maturity option is closed out.

Diagonal Spread:

Here both expiration dates & strike prices are different

Straddle:

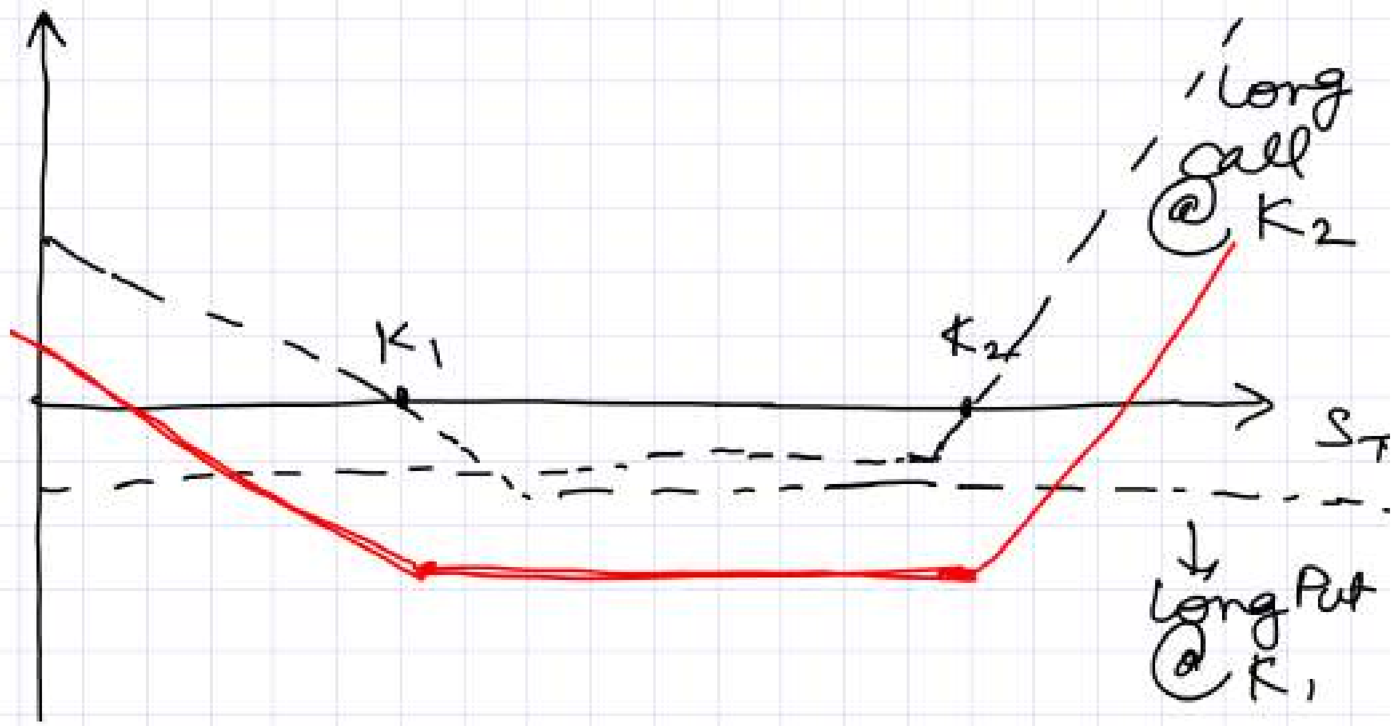
Buy call & put with same strike price & expiration data.

Strangle:

① Buy a put & call with same expiration date & different strike prices.

Long Put $\longrightarrow K_1$, T
long call $\longrightarrow K_2$, T

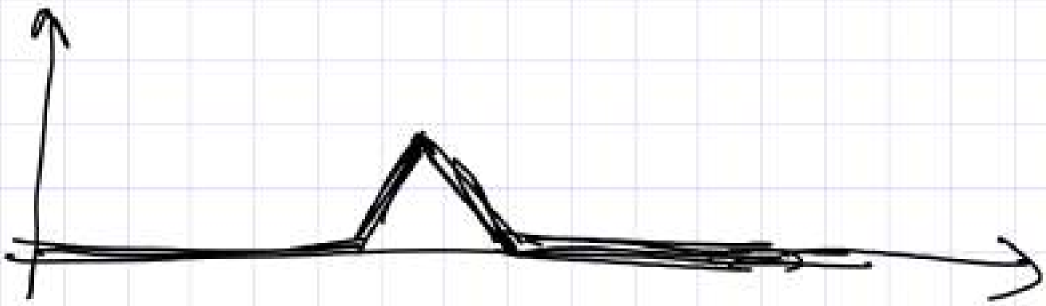
$(K_1 < K_2)$

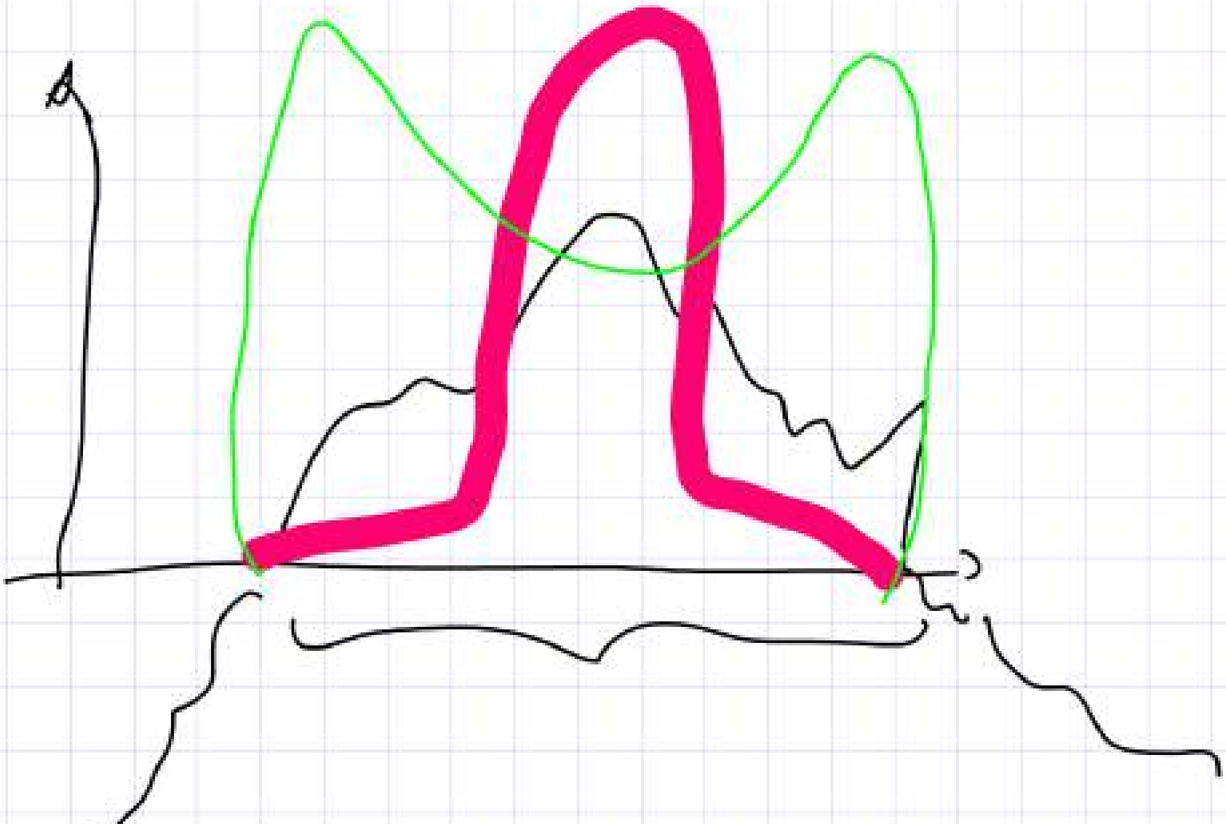


Other Payoffs:

① For all strike prices (K) for

a given expiration time (T) the options were available then any possible payoff pattern is possible





① Covered call & Protective put

Q:

Put-Call Parity

Consider the following two portfolios.

Portfolio A: (One call option + Zero coupon bond that provides a payoff K @ T)

$(c + Ke^{-rT})$

Portfolio C: (One put option + One share of stock)

$(p + S_0)$

All the options have same strike price (K) and time

time to maturity T.

Values of Portfolio @ T

Portfolio A	$S_T > K$	$S_T \leq K$
Call option ⟷	$S_T - K$	0
Bond	K	K
Total	S_T	K

Portfolio C	$S_T > K$	$S_T \leq K$
Put	0	$K - S_T$
Share	S_T	S_T
Total	S_T	K

Both the portfolio have same payoff at time T. So their ~~payoff~~ worth should be same now.

$$\boxed{c + Ke^{-rT} = p + S_0}$$

Put call parity.

This relates c with p.

The call option & put option premium right now

<u>Cash Future Arbitrage</u>:

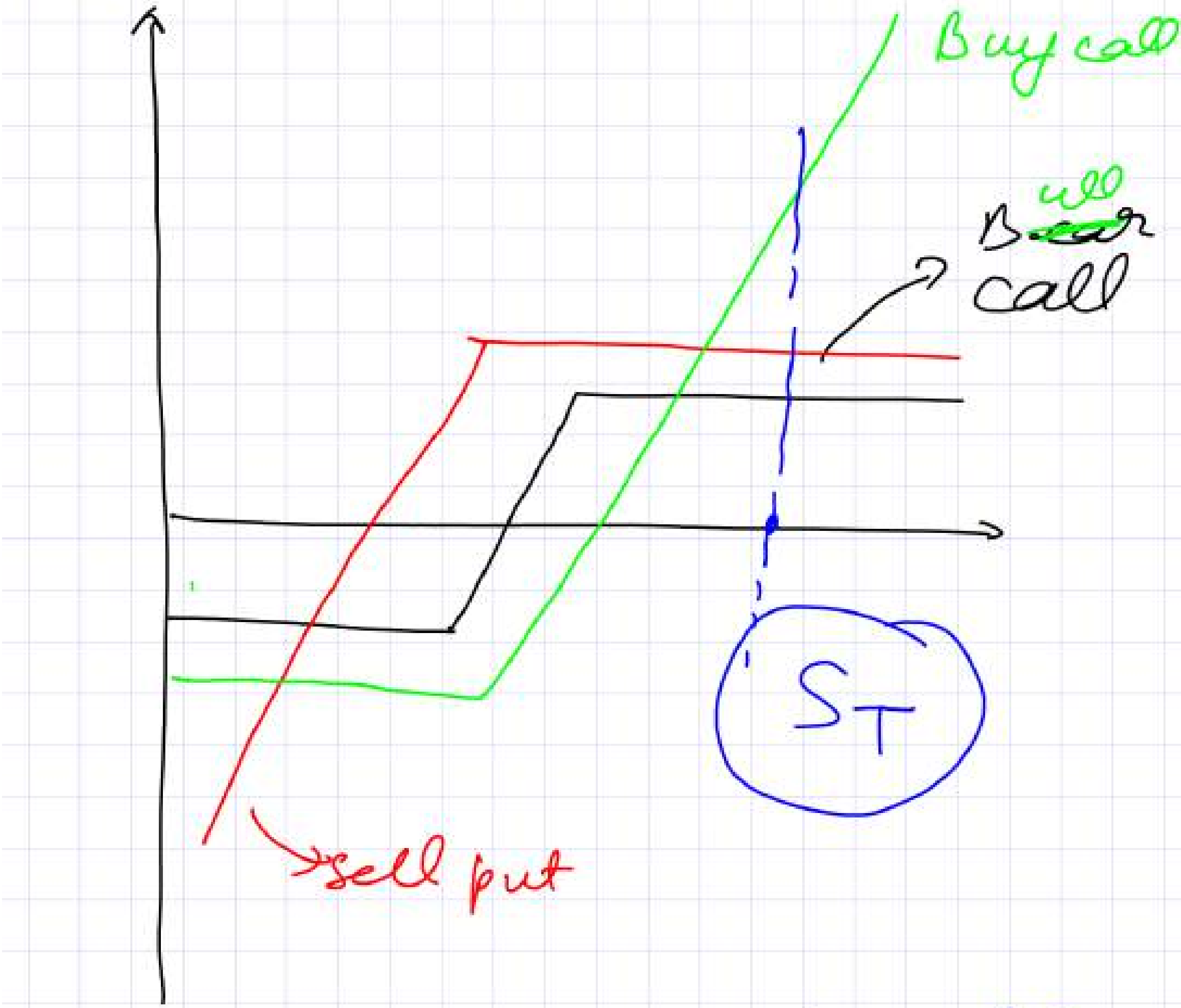
Underlying price = S_0

Future price = F

$$F = S_0 e^{-rT}$$

$r \rightarrow$ Cost to carry

$T \rightarrow$ Time remaining



Viewpoint	Strategy
Market will go up surely & will up more	Long call
Market will Surely NOT go down	Sell Put
Market will go up BUT not will more	Bull call spread