

## Module 312 - Quantitative Trading Strategies

- 1) If market  $\rightarrow$  will go up  $\rightarrow$  Buy call
- 2) " " down  $\rightarrow$  Buy puts

1) Market goes up by 200 pts in time  $T$

- 2) Buy a call option OTM  $\rightarrow$   $S_{opt}$
- 3) Worth of option at  $T \rightarrow 150$
- 4) Current premium  $\rightarrow C$

If  $C < 150 \Rightarrow$  BUY call opt  
 else  $\rightarrow$  NOT

<sup>page 2</sup> The most important thing is →  
To have a view of the market in future



(any thing I want to trade in)

Predicting market comes under the study of technical analysis

- ① Technical analysis of financial markets
  - John Murphy
- ② Encyclopedia of chart pattern
  - Bulkowski

{ Poing,  
Edward  
Murphy

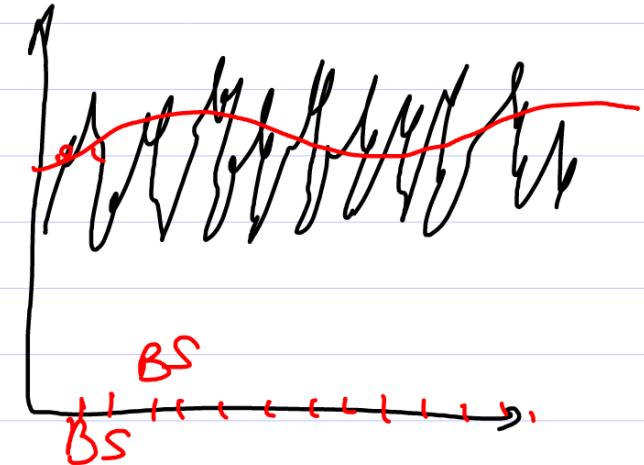
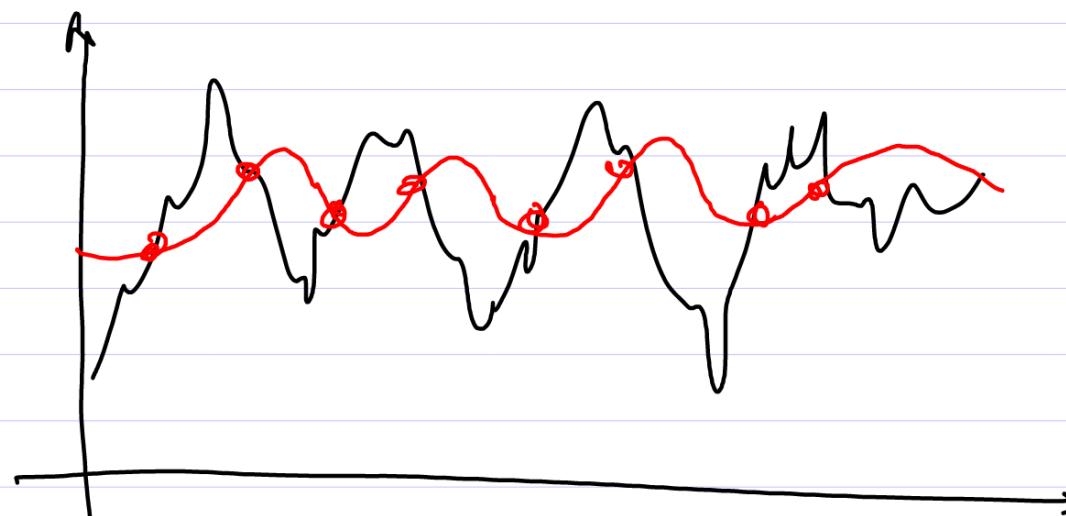
Bollinger band  
RSI  
MACD.  
Chalking money flow

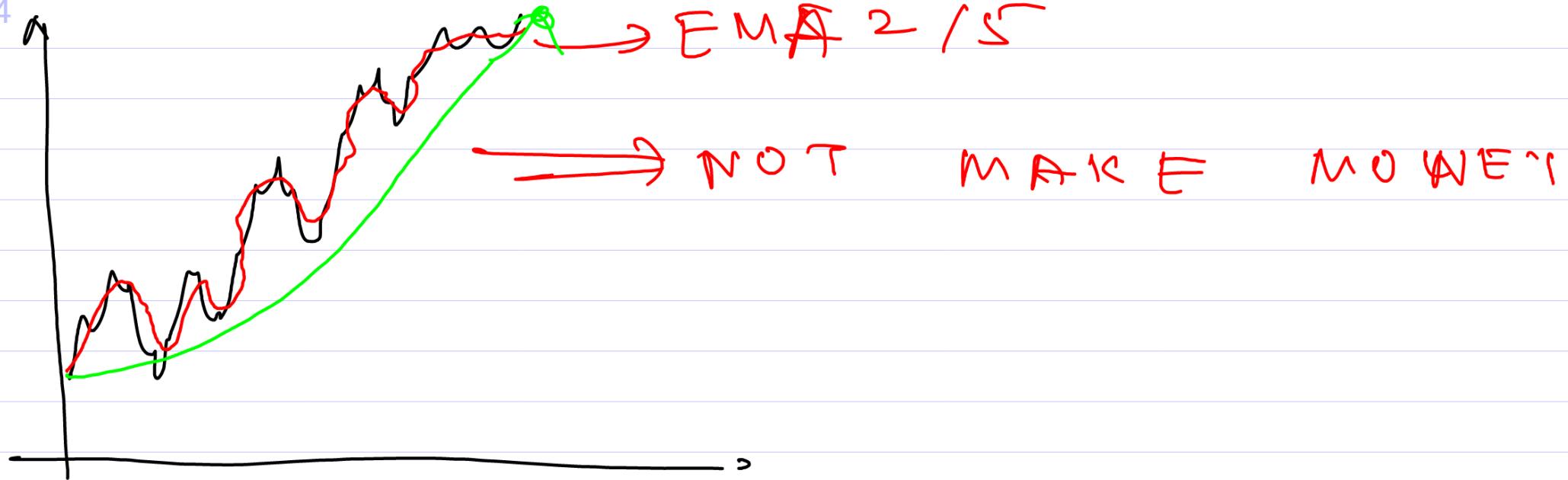
Keltner Channel  
KST (Know Sure Thing)

## Directional trading strategies :



→ EMA  
 → What EMA  
 we are using  
 How much smooth.  
 { 10, 20, 50 }





### Points :

- ① Predicting the market is the most difficult part. This needs lot of experience & lost money in bad trades.
- ② To take away human element and to ~~set~~ scale trading 24 x 7 we want to automate this process and want to come up with an

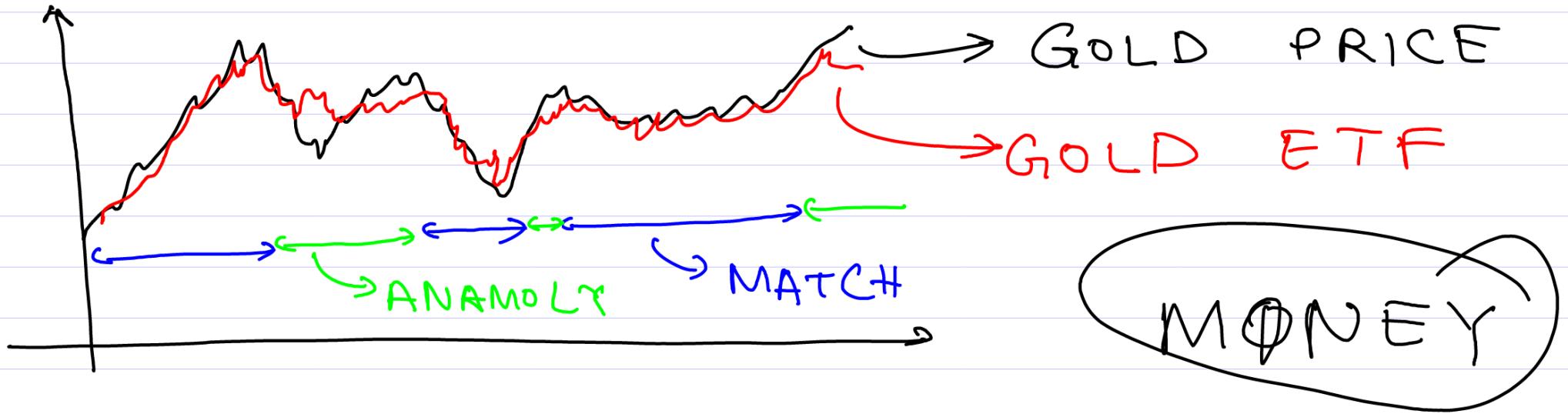
page 5 algorithm that will trade from our behalf.

- ③ For this traditionally TA indicators were helpful (RSI, MACD, EMA, KST). Look at Bulowiski book for automating this.
- ④ Even these indicators require some experience and also another problem is they need some parameters.
- ⑤ Here machine learning techniques come into picture to help us with techniques,

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## Arbitrage strategies :

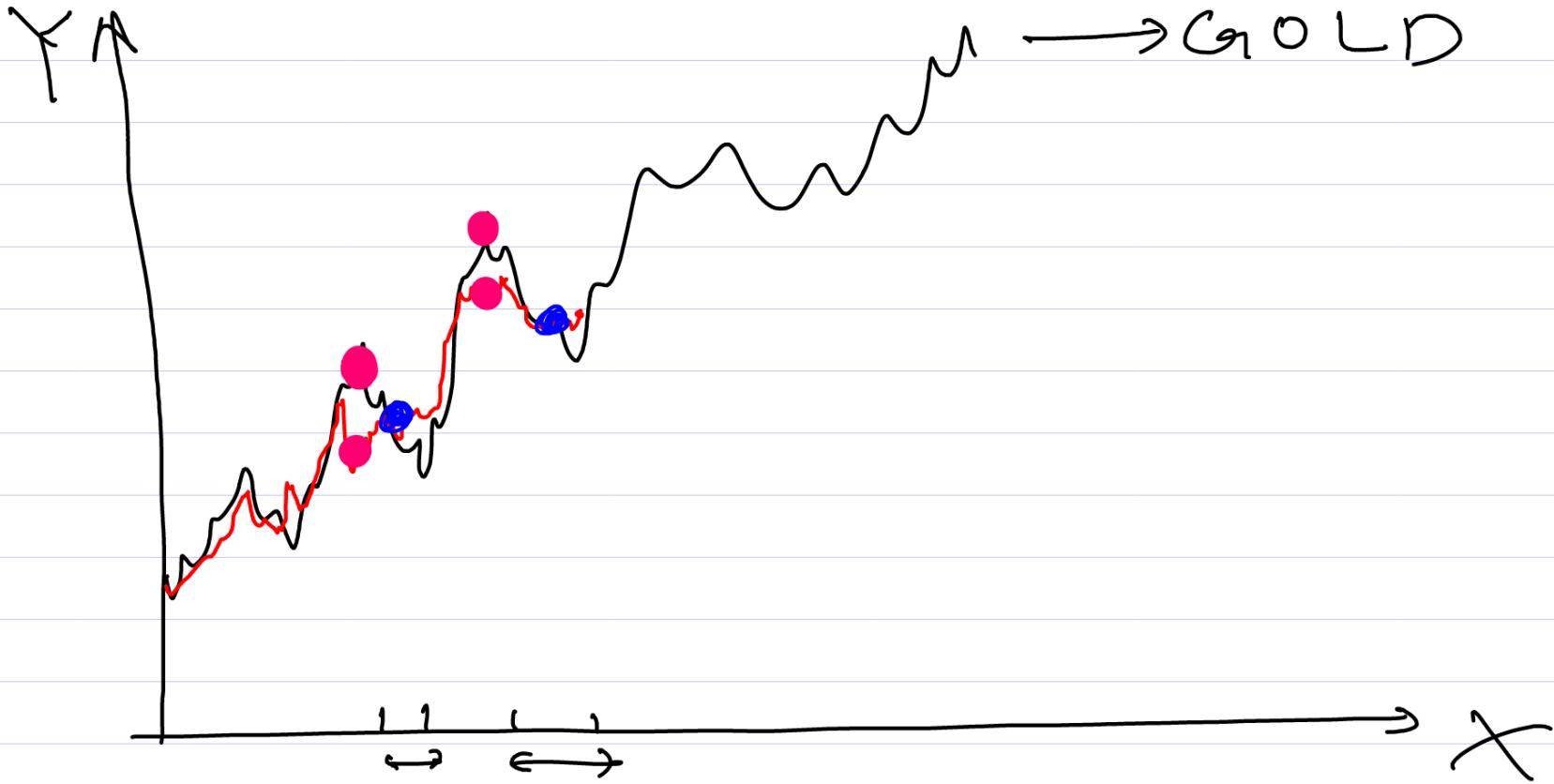
Arbitrage is a short term movement of an ~~instrument~~ instrument from its natural position , Arbitrage corresponds to free money.



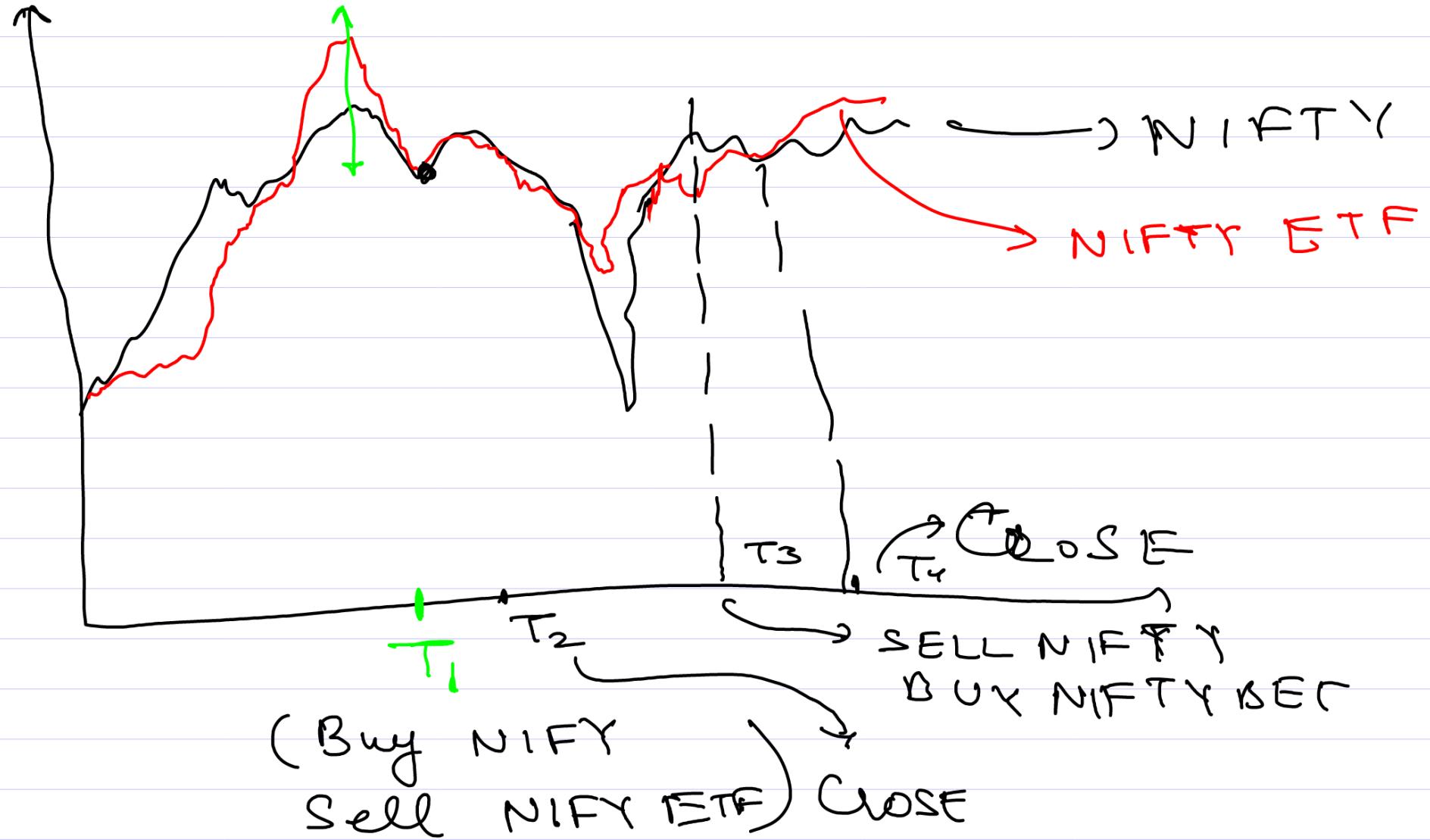
NIFTY / NIFTY BEES  
(ETF)

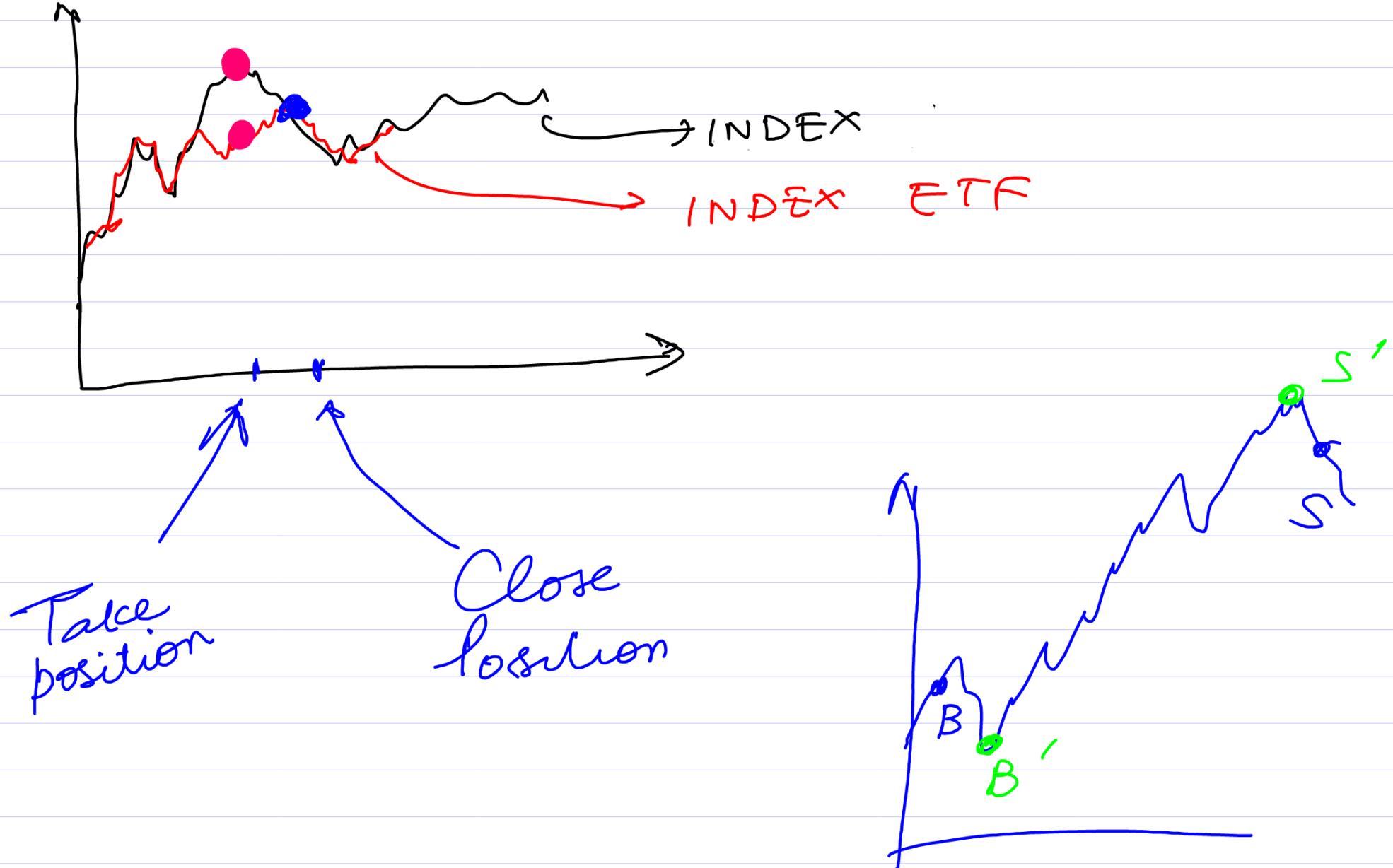
SPY / SPX ?

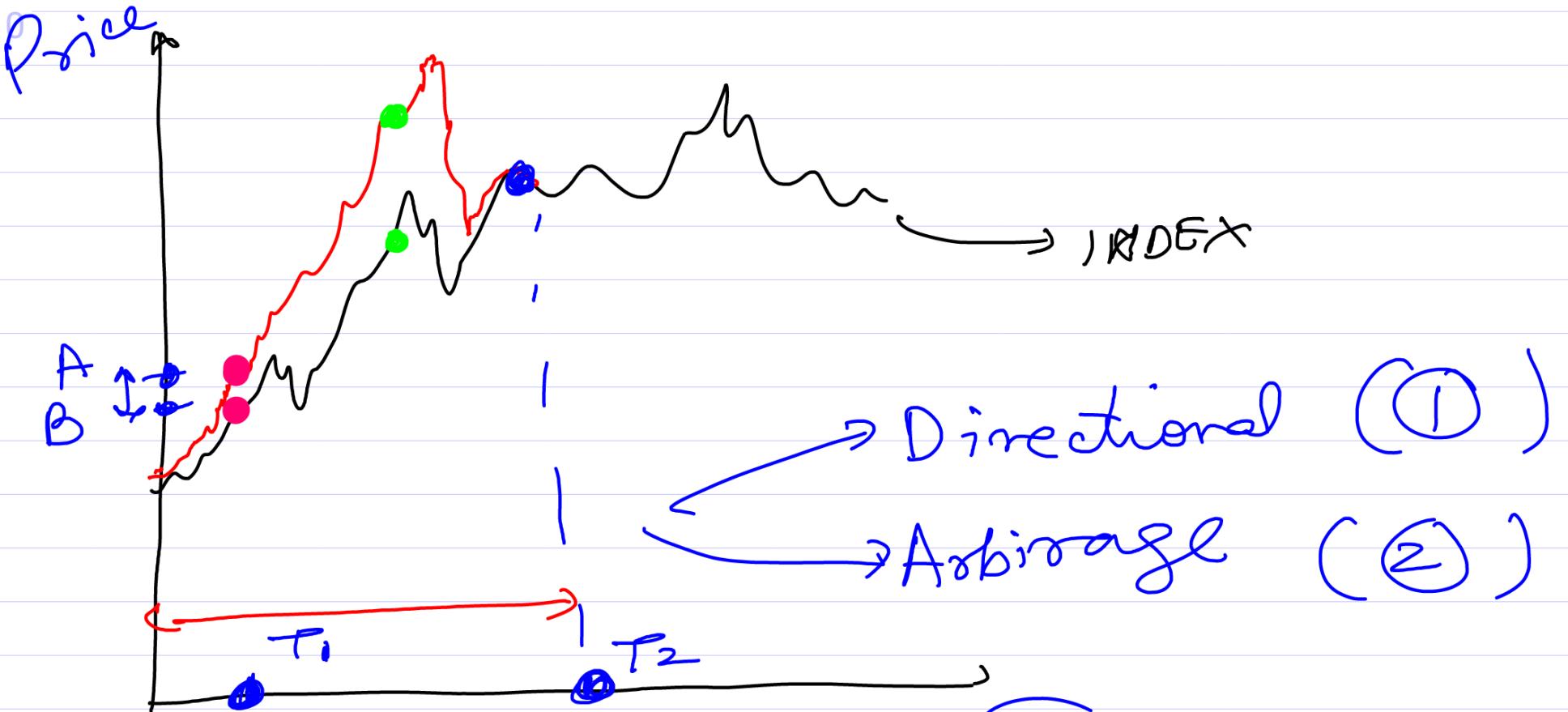
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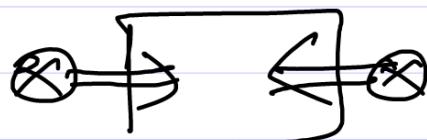
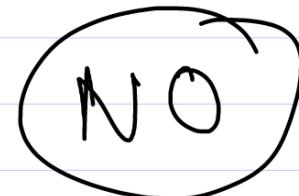


<del>Initial capital need</del>	(Directional) <del>High</del>	(Arbitrage) <del>Zero</del>
Return of capital	<del>High</del>	<del>Low</del>

<sup>6</sup> Profit	Low	V. High
Probability of profit	Low	High
Ease of manual execution	Easy	Difficult
Profit is nature	Profit at the end of trade	Profit is at beginning of trade

⇒ Become ~~quick~~ rich in short time.

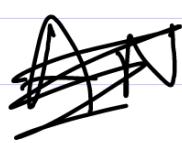
⇒ Does it happen?



What is the problem

GAME

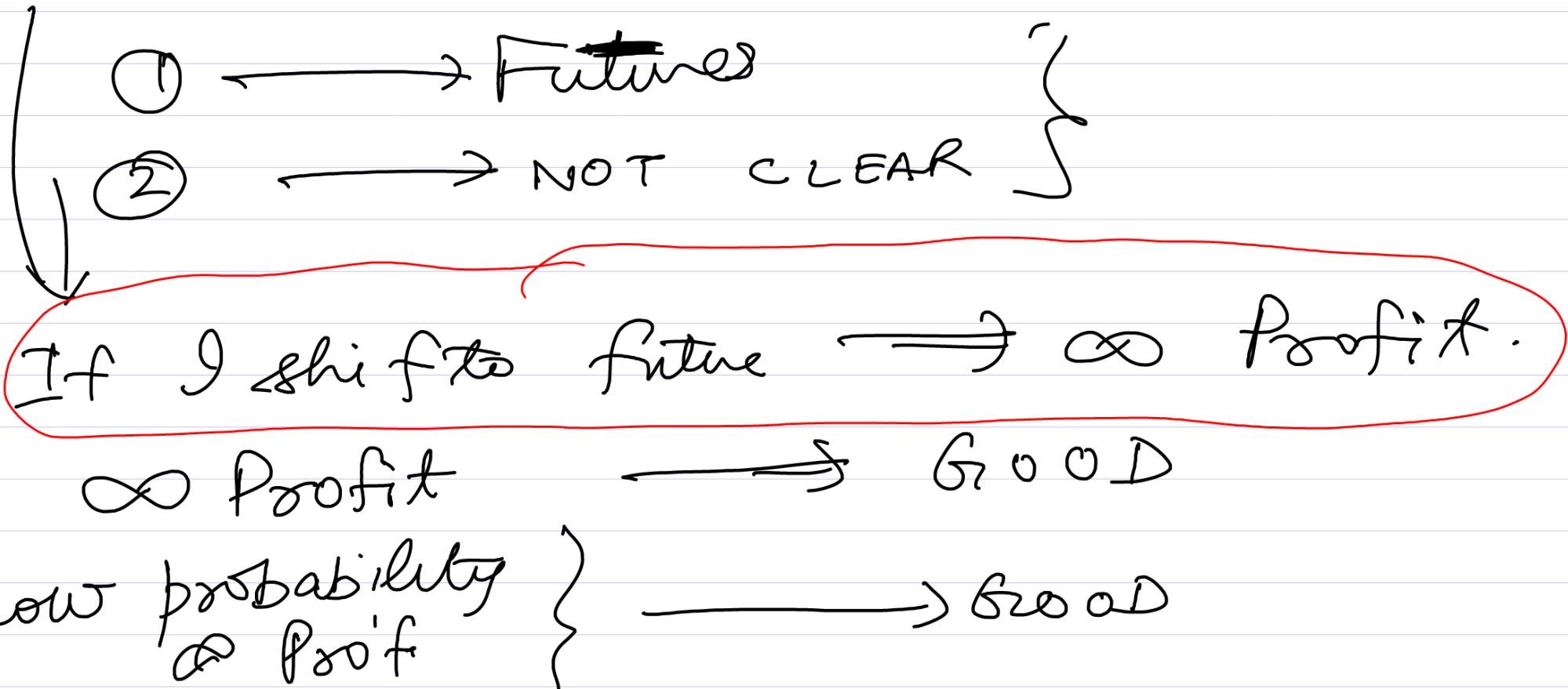
⇒ (Real world market restrictions.) BAD



- + low liquidity
- + short sell restrictions
- +

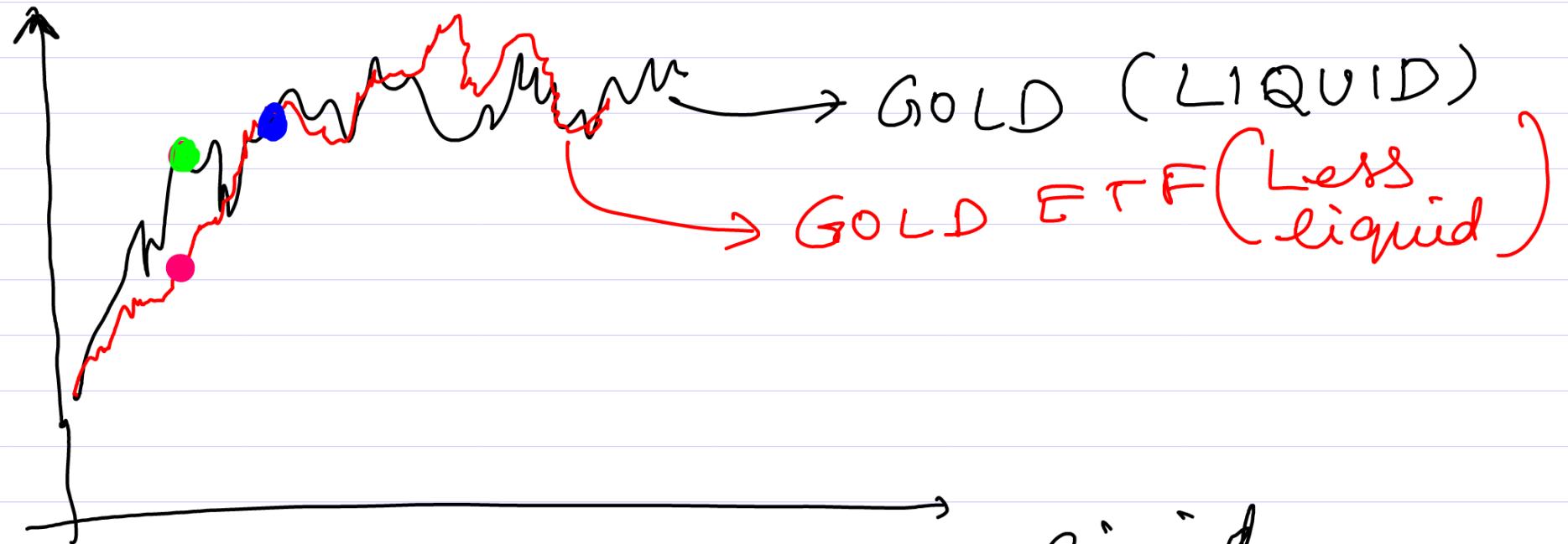
I as a player will try to simulate a setup where I am working as close to our hypothetical world as possible.

- ① We can't short in cash marker ~~mode~~ and hold beyond intraday.
- ② Margin requirements for short position.



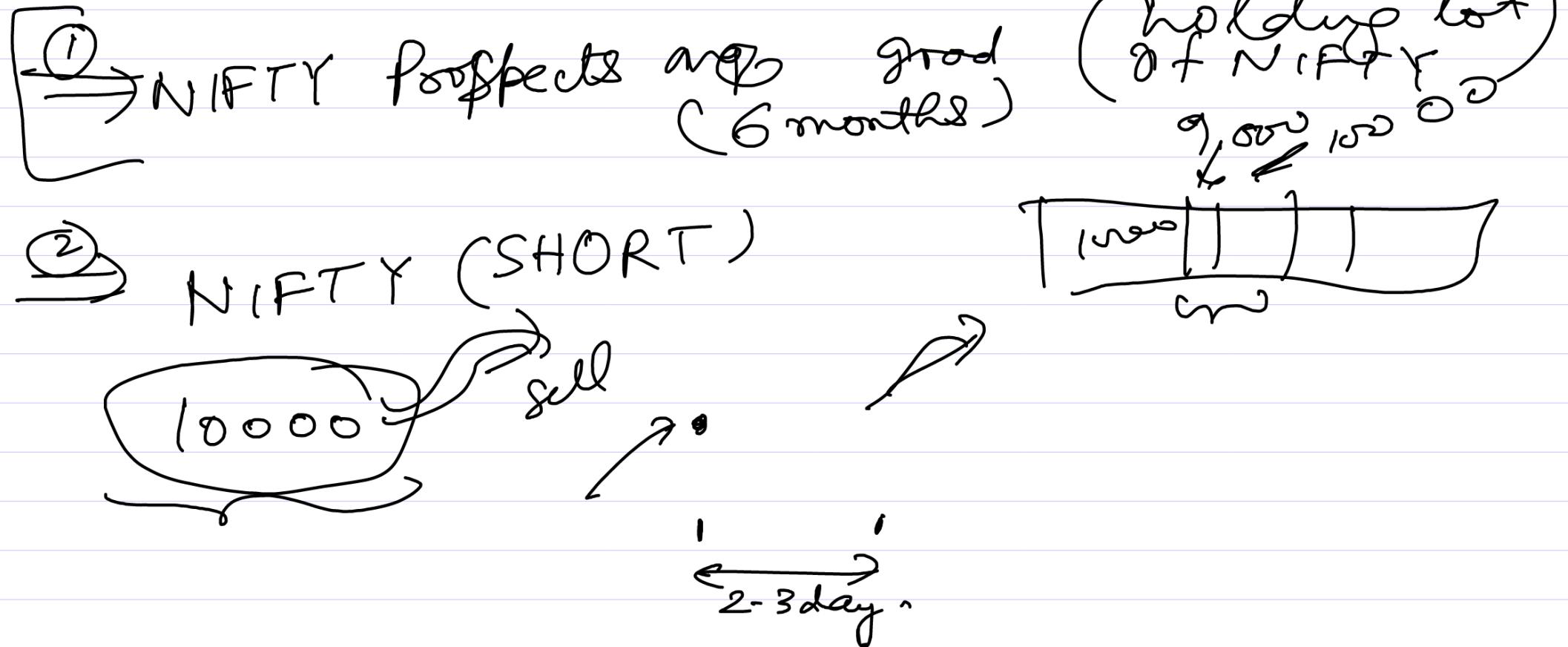
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## Practical issues with arbitrage trading :-

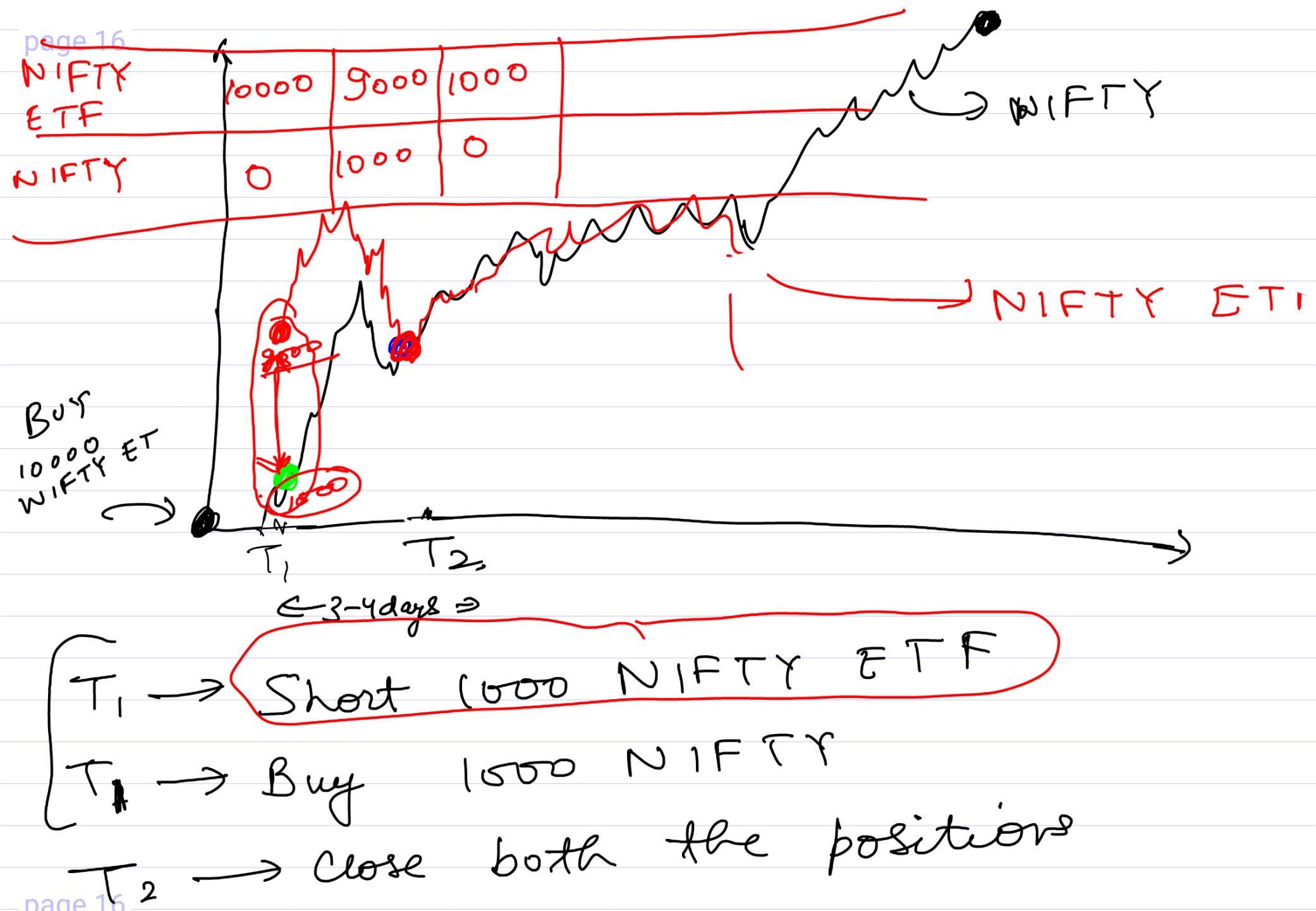


Liquidity. One item is less liquid.

page 1 Set up for trading short positions in cash beyond intraday :



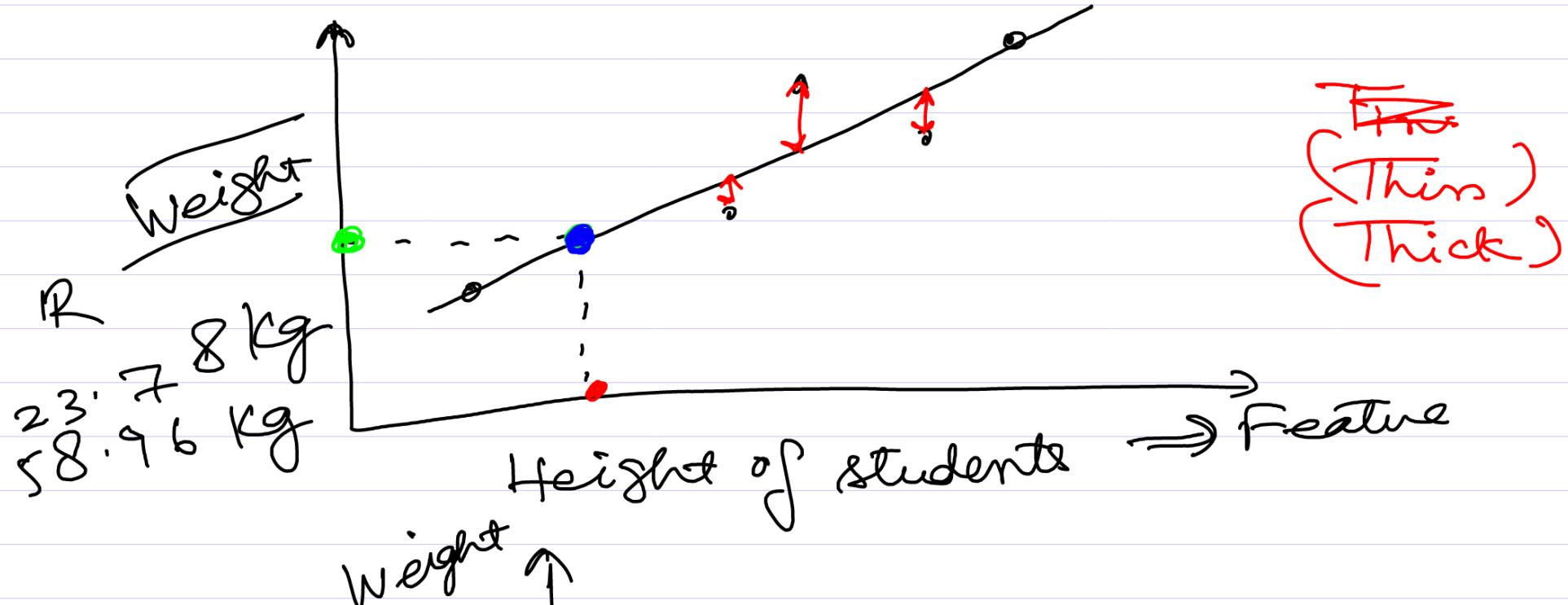
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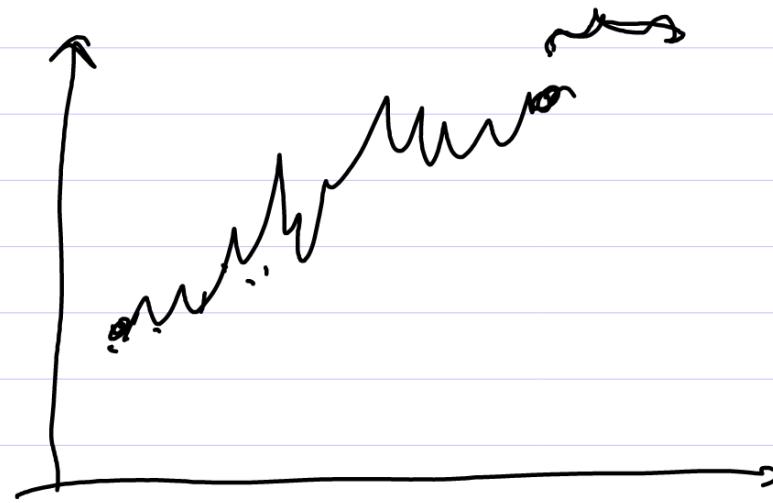
# Machine Learning

① Prediction about future from past data.

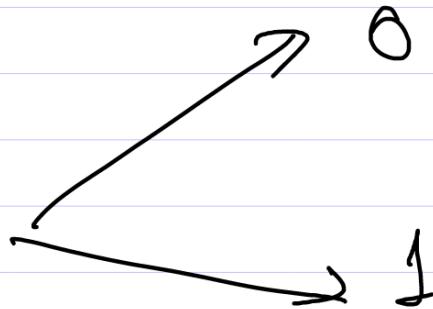


Econ status ↑↓  $\Rightarrow$  Weight ↑↓  
H eight ↑↓  $\Rightarrow$  Weight ↑↓

~~Econ~~  
Trading example

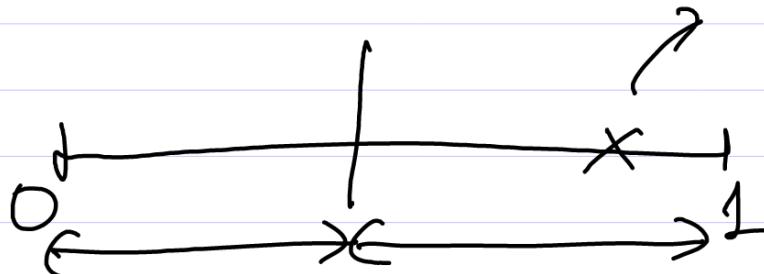


OHLC  $\rightarrow$  Tomorrow's close  
+ V



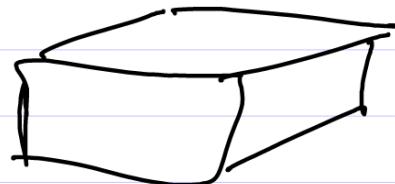
I might want to know?

① Tomorrow market will go up or Down



(Classification)

② What will be tomorrow close

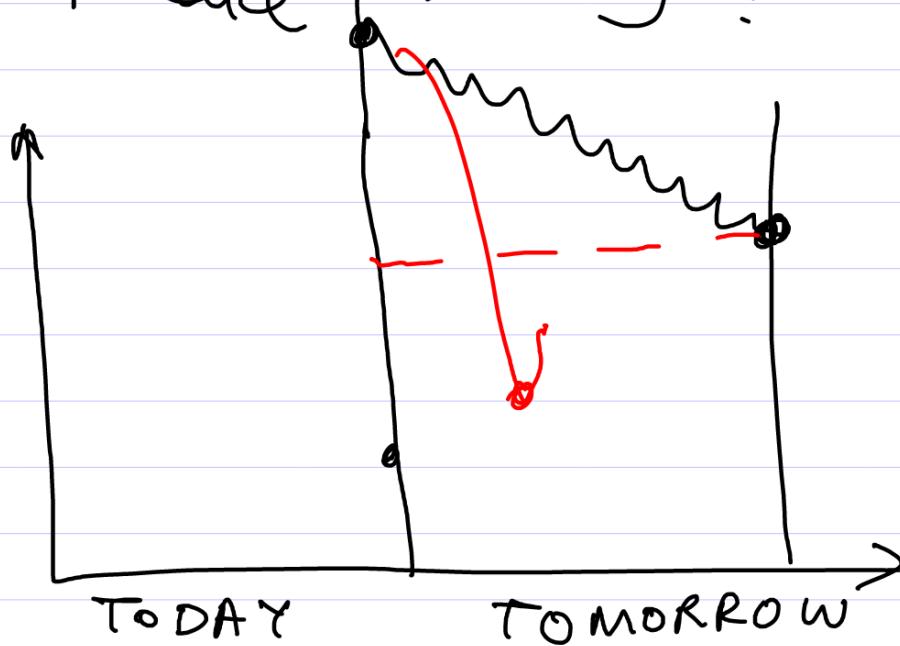


(Regression)

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At 7PM in India If you know.

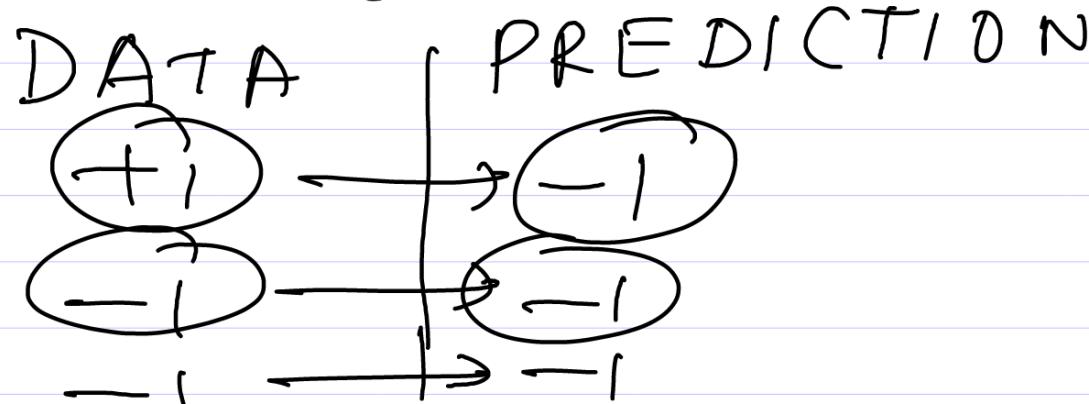
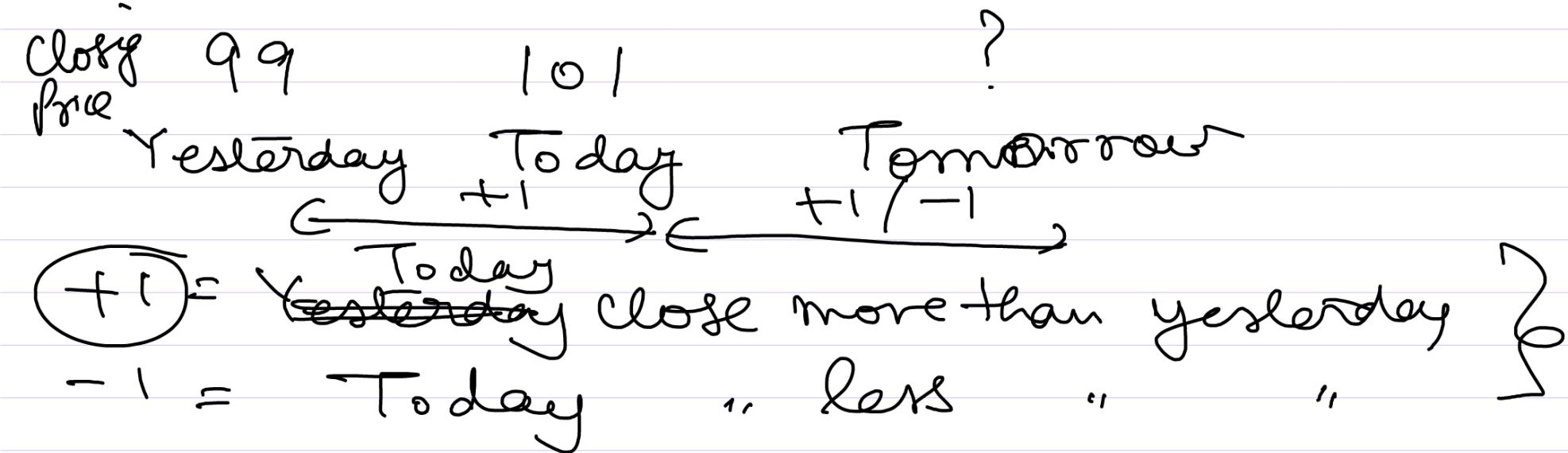
⇒ Tomorrow's close will be More/Less than today's close.

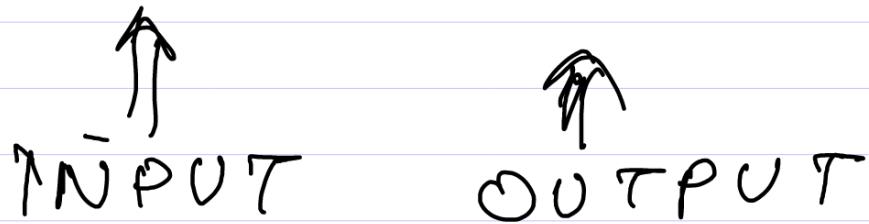
  
Make more?



Input data  $\rightarrow$  Tomorrow close is  
MORE/LESS

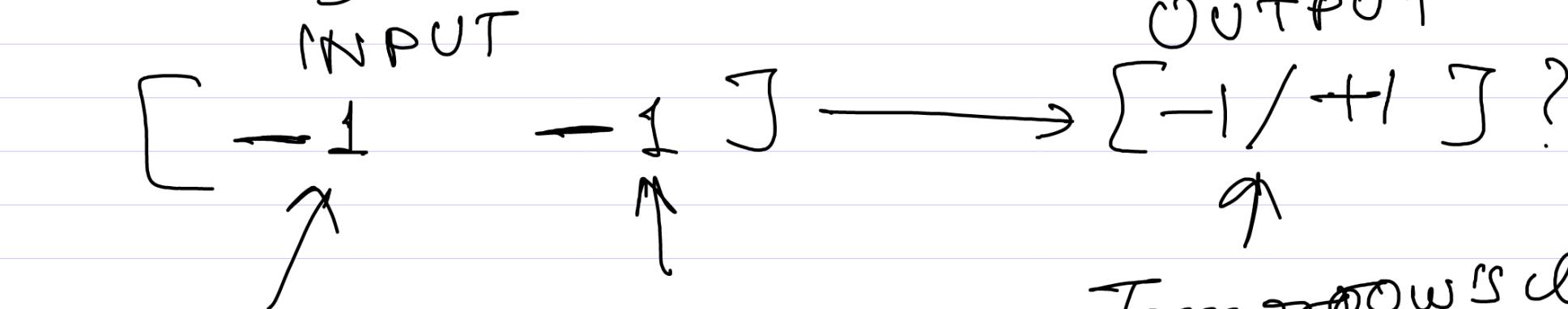
RZP  $\rightarrow$  Smth





① Today's close is more than yesterday close

② Yesterday " less than day before close.

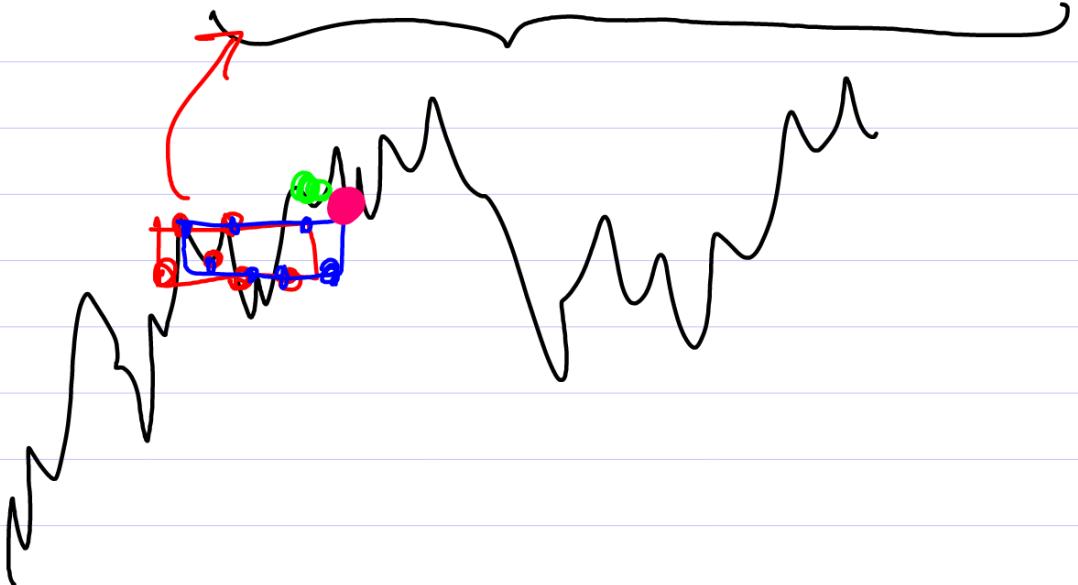


Yesterday  
&  
day before yesterday

Today &  
yesterday

Tomorrow's close  
with yesterday

$[-1, +1, -1, -1, +1, -1] \rightarrow [+1/-1]$



99, 101, 100.5, 100.6, 105, 104, 103.2, 106

$\downarrow$        $\downarrow$

+1    -1    +1    -1    -1    -1    +1

$$\begin{array}{c} +1 \quad -1 \\ -1 \quad +1 \end{array} \Rightarrow +1$$

$$\begin{array}{c} +1 \quad -1 \\ -1 \quad +1 \end{array} \Rightarrow -1$$

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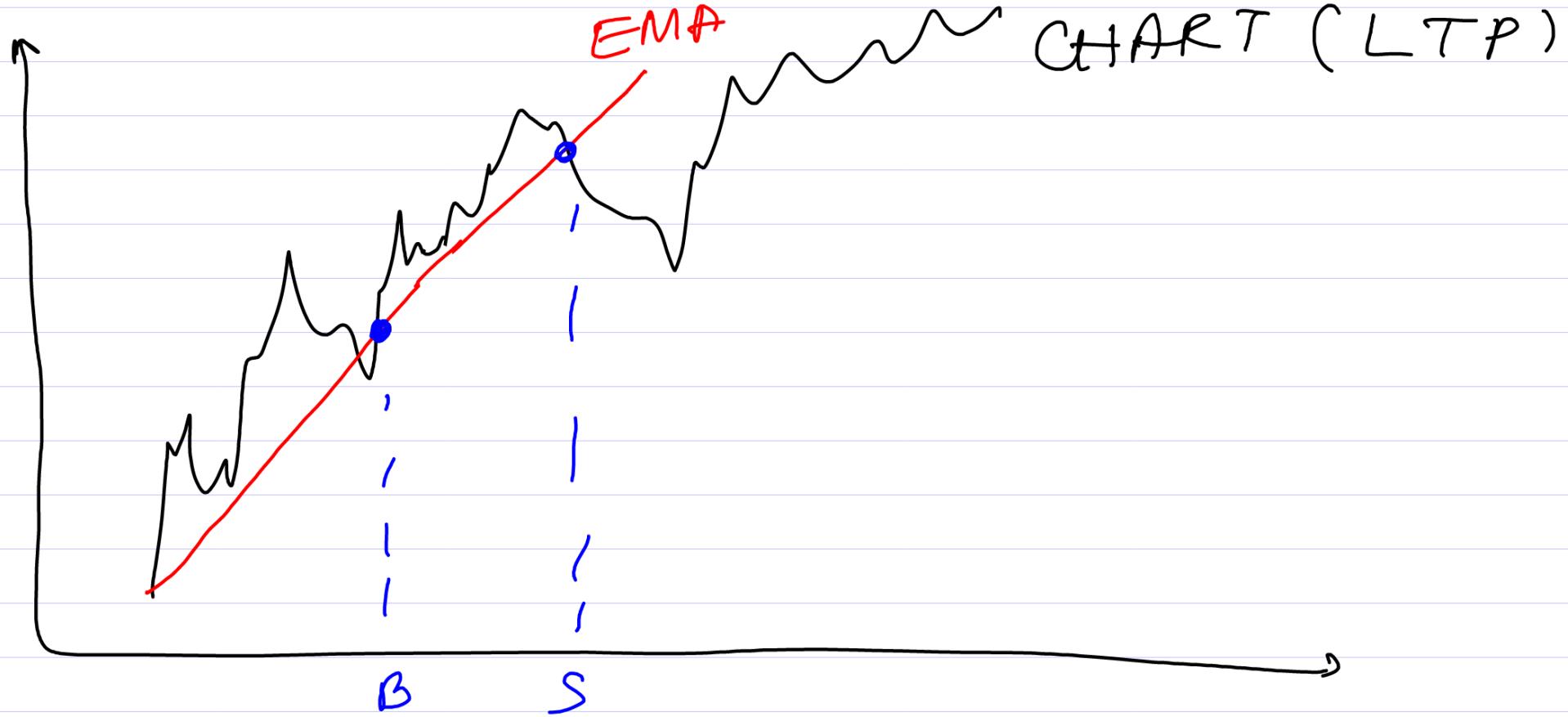
$$+ | - | \Rightarrow - |$$

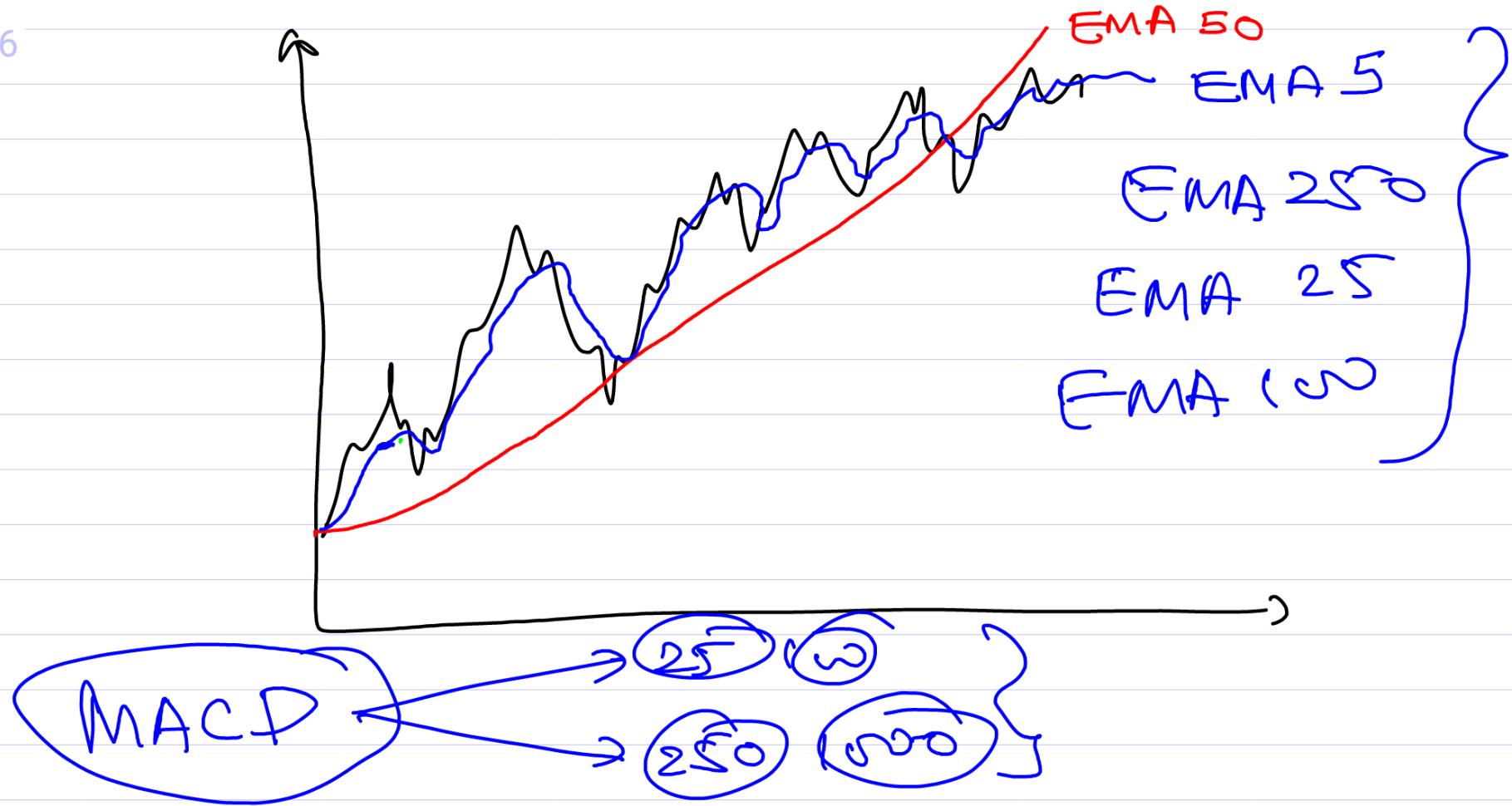
$$- | - | \Rightarrow - |$$

$$- | - | \Rightarrow + |$$

$$+ | + | \Rightarrow + | / - ) \quad ?$$

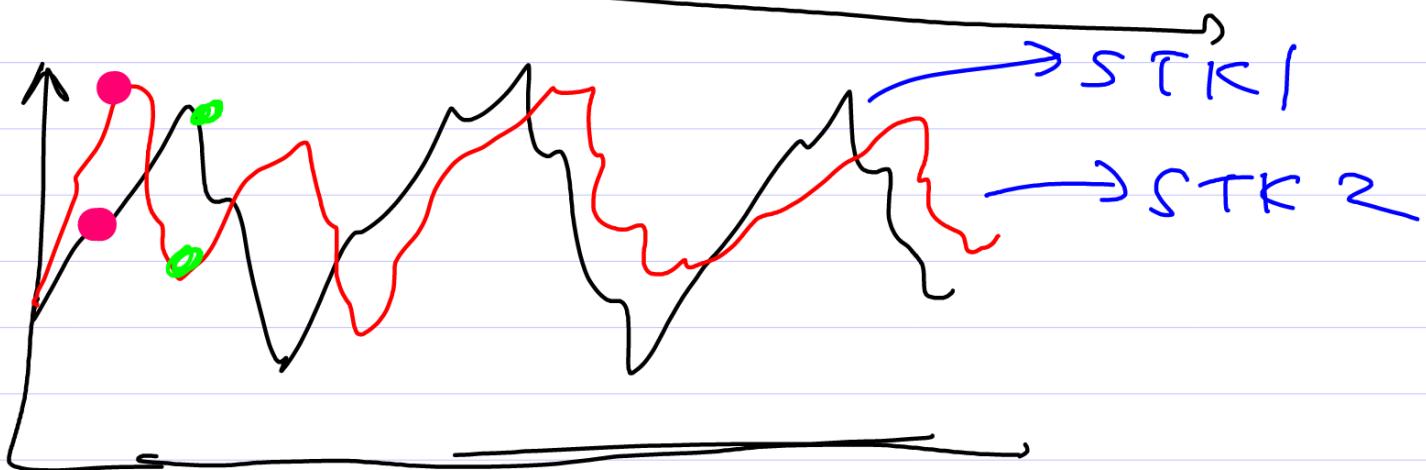
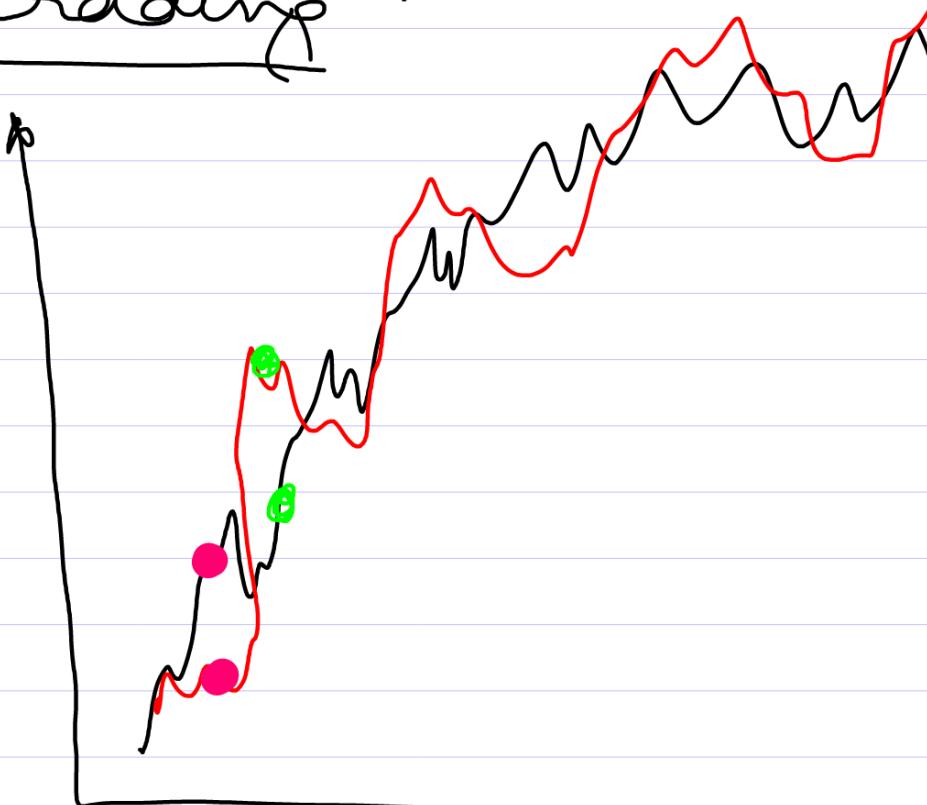
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## Pairs Trading :



## Gamma Scalping :

- ① Used by Professional traders
- ② One of the shortcomings is that this strategy requires a lot of / frequent trading. So for its success commissions

## Gamma of a stock option :

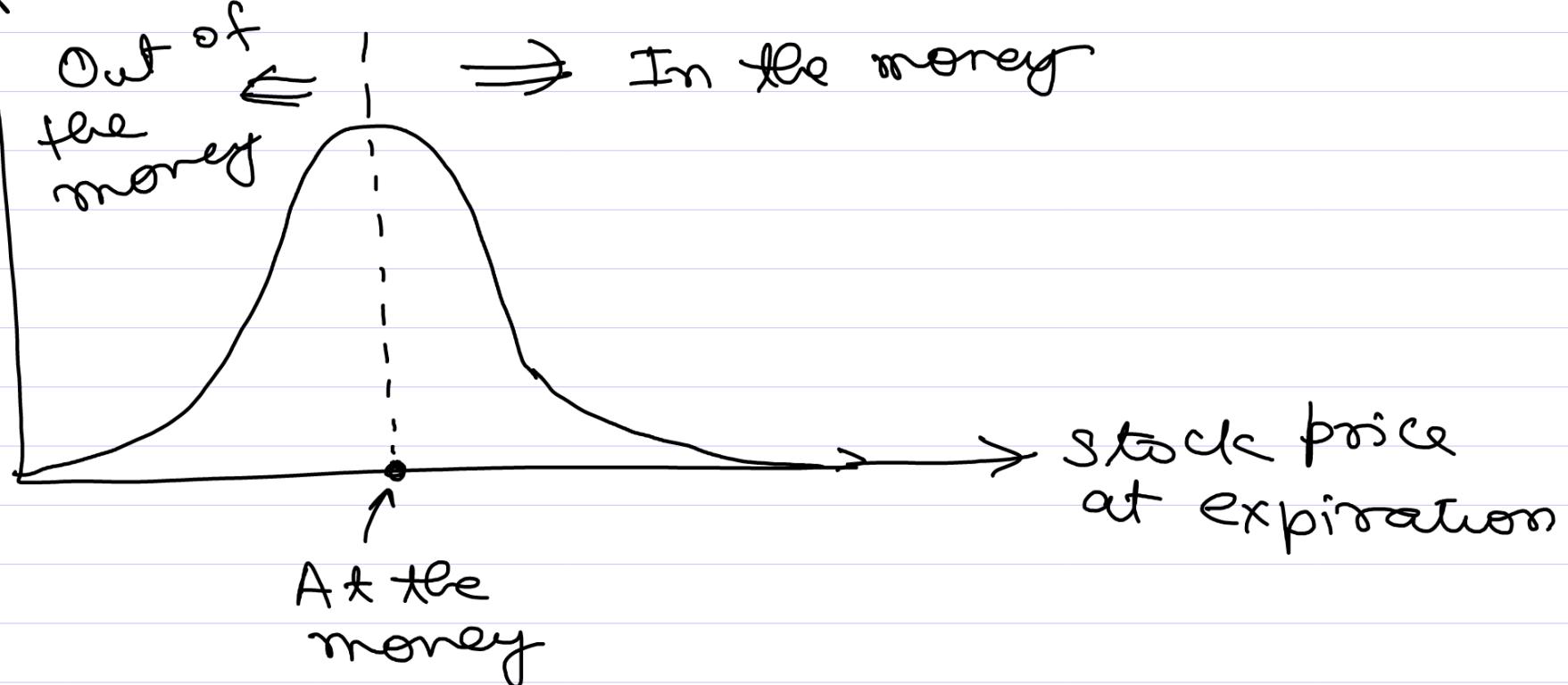
- ③ Gamma is the rate of change of options delta.

$$\gamma = \frac{d\Delta}{dS} = \frac{d^2C}{d^2S} = \frac{d^2P}{dS^2}$$

Here delta is the rate of change of option premium for every rupee change in underlying stock.

$$\Delta = \frac{dC}{dS} = \frac{dP}{dS}$$

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Gamma



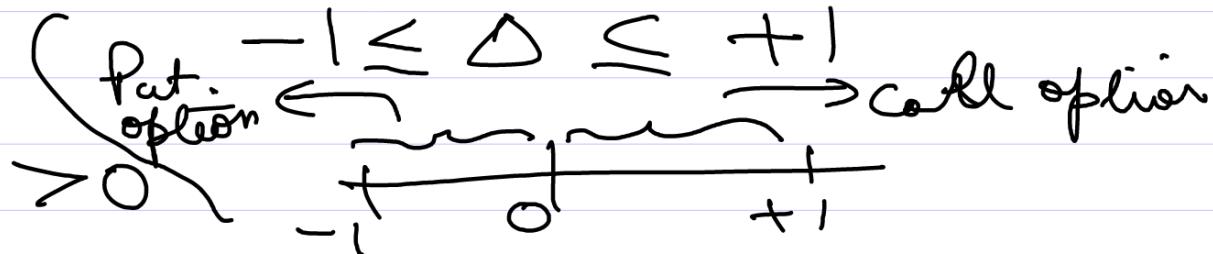
- ④ Gamma is highest for at the money options.
- Gamma approaches zero for out of the money options.
- By definition higher gamma indicates that options delta could change significantly with very small change in stock price.

page 30 → Gamma increase as we approach expiration date.

Understanding positive and negative gamma:

Positive Gamma:

$$\frac{d^2 C}{dS^2} \text{ or } \frac{d^2 P}{dS^2}$$



or

$$\frac{d\Delta}{dS} > 0 \Rightarrow$$

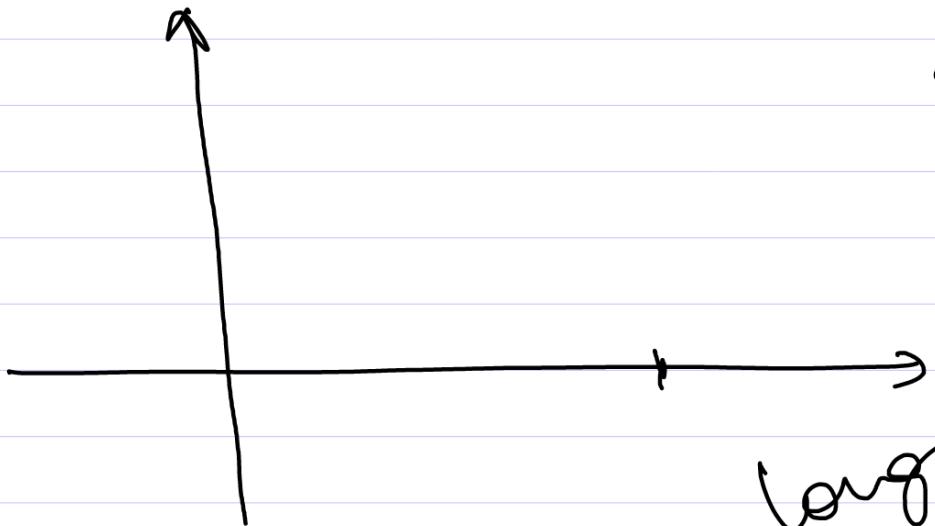
[As stock price increases  
Δ of call option becomes  
more positive.]

[As stock price decreases  
then Δ of call option  
becomes ~~more~~ less positive  
more closer to zero]

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Negative gamma:

⑤ When options are sold (short position), the gamma is negative.

→ short call option with negative



$$\Delta = \text{C} \rightarrow \text{ve} = \frac{d S^c}{d S}$$

$$\overbrace{S \uparrow \quad C \uparrow}^{S \uparrow \quad \Delta \uparrow}$$

~~long~~ long call  $\rightarrow \Delta = (+) \text{ve}$

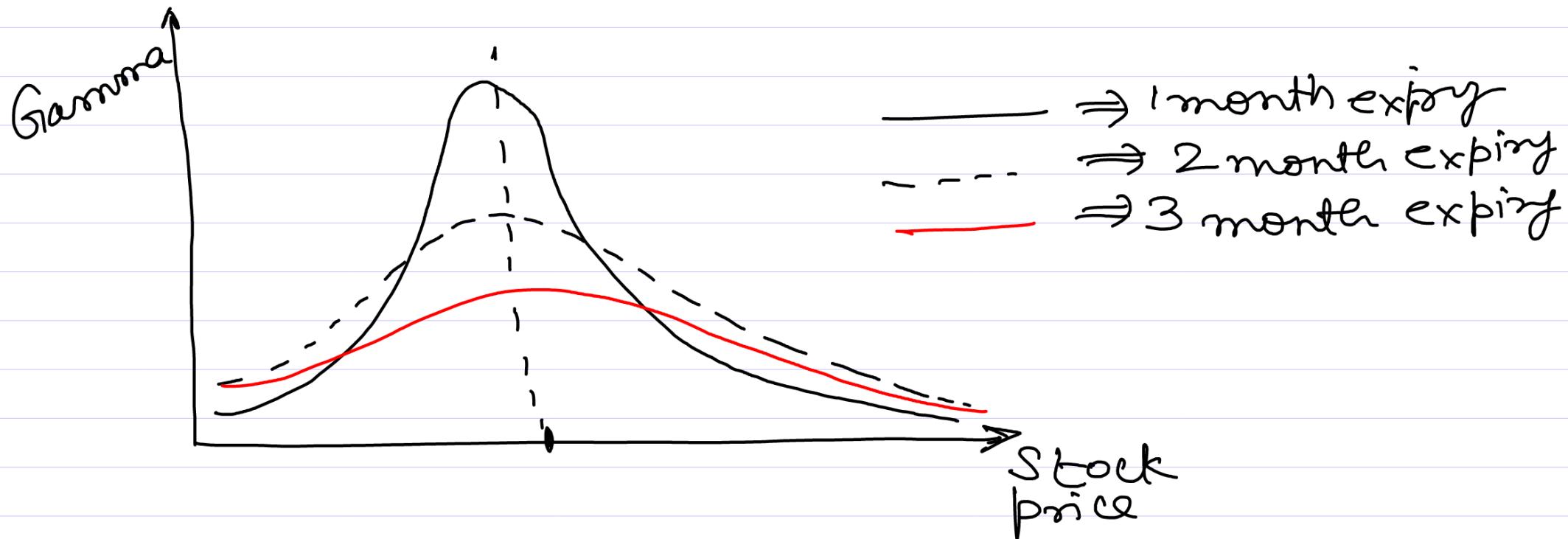
~~long~~  $S \uparrow \quad \Delta \uparrow \Rightarrow \gamma = (+) \text{ve}$

Short

$$\begin{cases} \Delta = (-) \text{ve} \\ \gamma = (-) \text{ve} \end{cases}$$

⑥ Another important relationship of  $\gamma$  is how it changes with time.

Gamma vs time to expiration:



This means as we approach time to expiry gamma of ATM option will increase & OTM " decrease

## Gamma and implied volatility :

Volatility / Implied volatility .(IV)

→ Historical / ~~current~~ current variability

IV: The volatility calculated from the options chart is called implied volatility .

Black Scholes.

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

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

Here

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

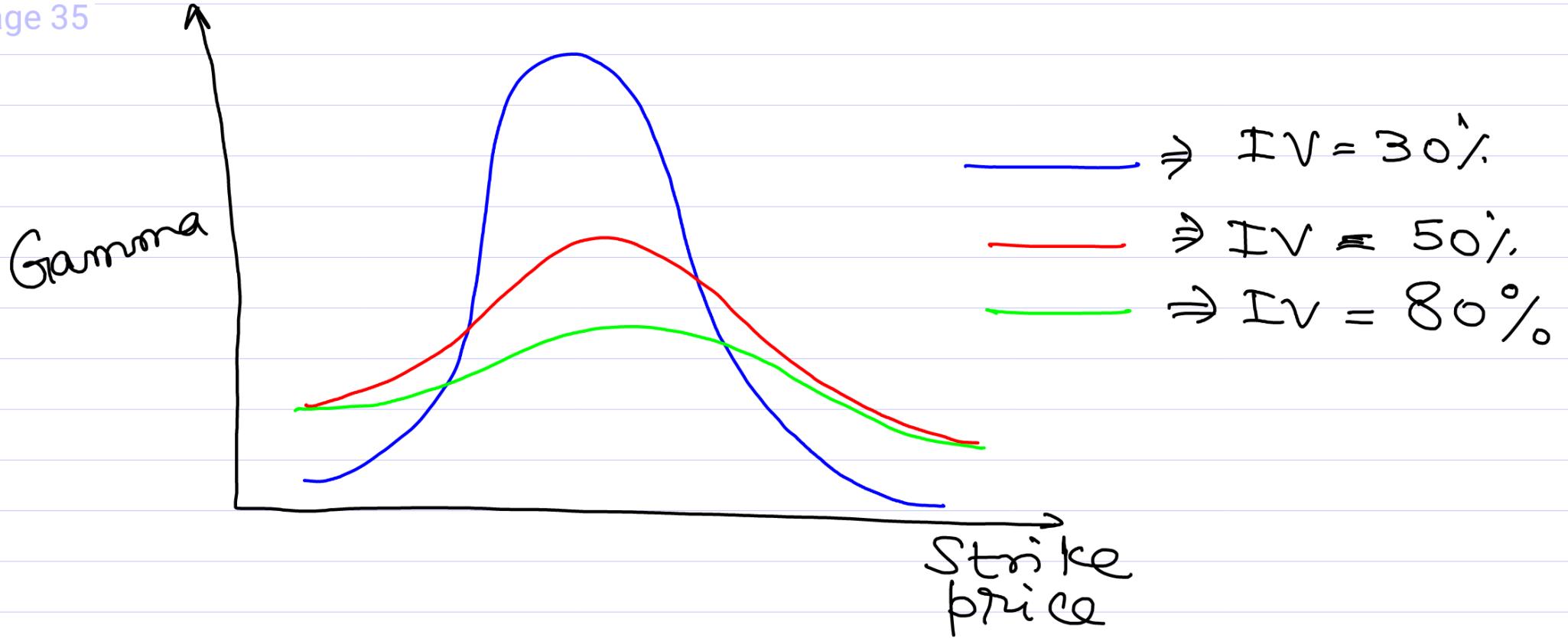
$C \rightarrow$  Known from LTF }  
 $S_t, K, \tau, t$  }

$\sigma \rightarrow$  Implied volatility

Gamma and implied volatility:

If volatility is high:

- ⑦ Then gamma will be more stable across all strike prices.
  - Because when volatility is high time value component of deep in the money or deep out of the money option is already very high.



High volatility  $\Rightarrow$  More stable and less sensitive gamma

If volatility is low:

There is a higher variability in gamma values for deep in the money, at the money or

deep out of the money option.

Low volatility  $\Rightarrow$  More sensitive gamma.

This is so because the time component of the option price is low

### Gamma scalping:

⑧ Gamma scalping is an option trading strategy that is used to offset theta decay on a delta neutral long option trade. ~~The process~~

⑨ ~~If~~ There is cost to holding long option values ~~because~~ because of the theta decay of the option.

Theta is always negative.

## Gamma scalping trade setup:

- ① Gamma scalping strategy starts with a long straddle and gets adjusted as the stock price goes up or goes down.

Initial setup:

- ⓐ long straddle (long call + long put)  
— Same strike price
- ⓑ The position should be delta neutral
- ⓒ There should be at least 45-90 day  
(sufficient time) to expiration.
- ⓓ There is a net debit paid to enter  
this position.

## Adjustments in the portfolio:

Stock price falls → Add long stock portfolio

Stock price rises → Sell short stock position

## Disadvantages/Risks of gamma scalping:

- ① Because frequent adjustments in the stock price, this strategy can be very cost intensive.
- ② ~~②~~ Careful monitoring of greeks is required.

## Advantages:

- ① It can be effective way to combat the effects of theta decay on a long straddle position.
- ② It can mitigate the portfolio risk for

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volatility.

- ③ It can help in mitigating risk associated with hedge directional exposure.

## Volatility trading strategy:

- ① Volatility arbitrage is a trading strategy that tends to take advantage of discrepancies in implied volatility levels of different instruments.  
(eg. options with different strike prices)
- ② Volatility is basically a degree of variation in the stock price of a financial instrument over a given period.

## Types of volatility arbitrage trading strategy:

- ① Dispersion trading : This trading strategy involves trading options in an index or a basket of securities.

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→ Go long on options with ~~the~~ low IV  
→ Go short " high IV

Here as we reach towards expiry IV of different options converge.

## ② Delta neutral trading:

These strategies tend to eliminate or minimize the directional exposure to the market. By constructing portfolios with ~~the~~ offsetting positions in underlying assets.

## ③ Calendar spreads:

We simultaneously Buy / Sell options with same strike price but with different

expiration dates.

Here we prefer those option trading strategies where we go long on underpriced options ( $\text{IV}$  is less) and go short on those options where  $\text{IV}$  is more.

$\text{IV}$  is more for → Farther away expiring options

Volatility skew trading:

Volatility skew refers to uneven distribution of implied volatility across different strike price of options for the same underlying asset.

→ here traders may buy options with lower implied volatility and sell options with higher

<sup>page 43</sup> implied volatility.

⇒ The expectation is as remain time to expiry reduces the discrepancy in volatility reduces.

### Risk associated and its management:

- ① IV induced over/under priced nature of options is not the only thing under consideration while taking positions. We also need to consider other factors.
- ② These strategies require a lot of background knowledge and deep understanding of options mechanism, Black-Scholes formula etc. So they

<sup>page 44</sup> have a limited audience.

Factors influencing volatility arbitrage strategies:

① Market conditions: The overall market environment impacts the effectiveness of these trading strategies. There are other factors which should also be taken into consideration

② Correlation analysis:

If correlation is not small, the advantage from divergence in implied volatility is not substantial.

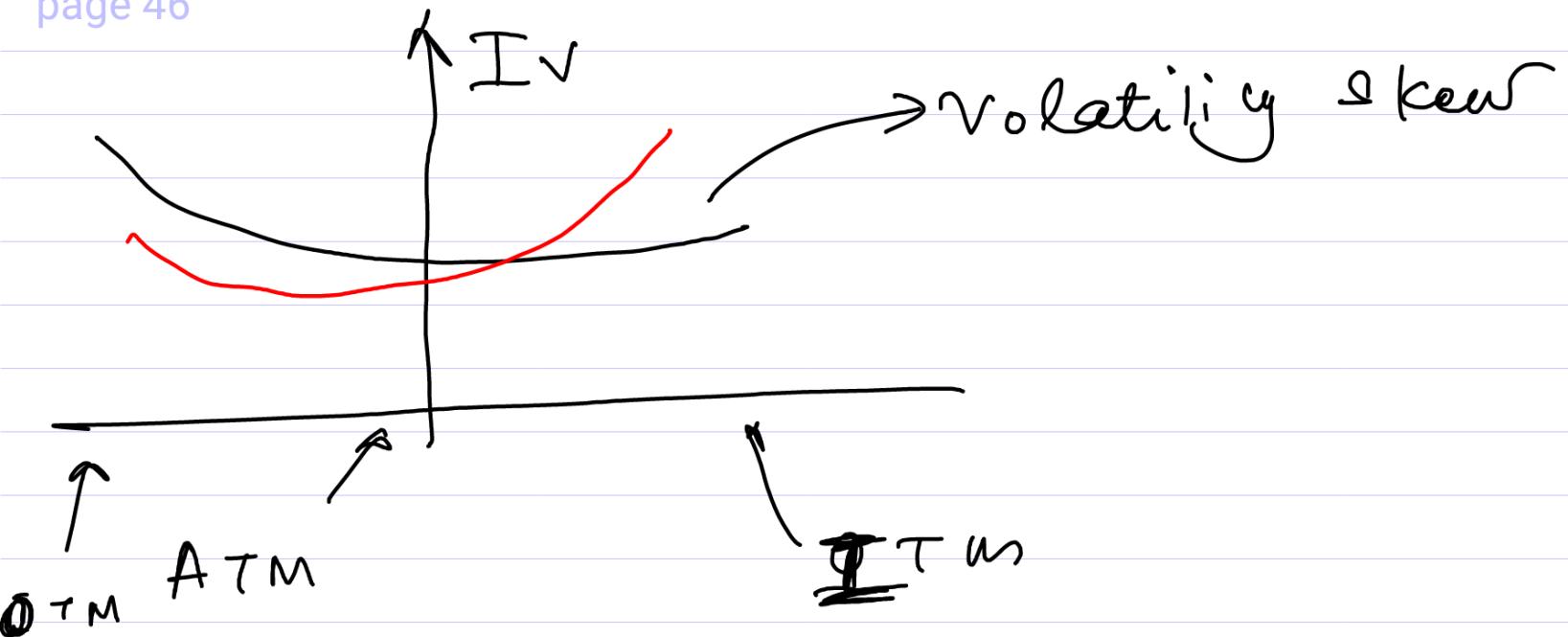
③ Option pricing models: Implied volatility

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is calculated from the option price formula of Black Scholes. In case there is a discrepancy / limitation in the black scholes formula then the advantage of the Volatility Trading will not be substantial.

#### ④ Volatility skew and term structure:

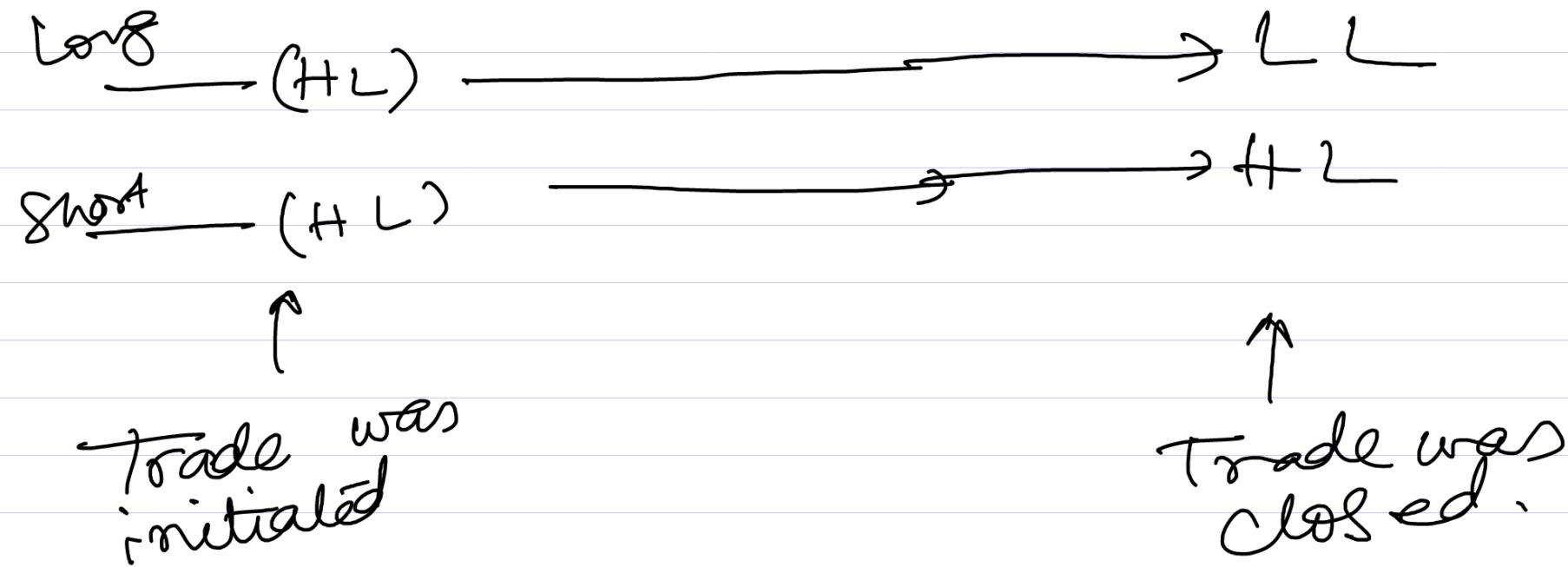
~~Volta~~ Volatility skew refers to difference in implied volatility between out of the money, at the money and in the money options.

The traders need to carefully analyze the skew patterns in identifying specific opportunities.



⑤ Liquidity consideration :

Liquidity is a vital factor to consider. If the liquidity of the overpriced option is less, it is difficult to take substantive short positions in it. Monitoring liquidity evolution over time is mandatory.



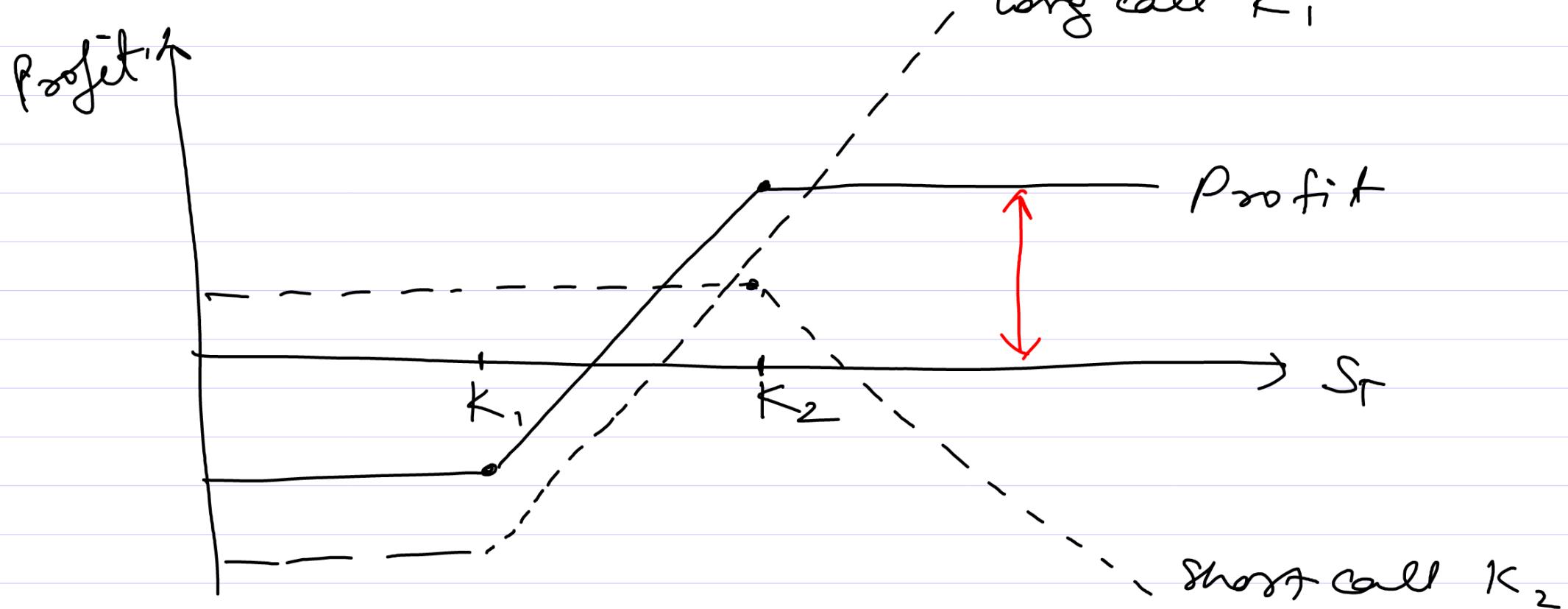
HL → High liquidity  
 LL → Low liquidity.

- ⑥ We need to develop a model for historical volatility and liquidity. Using the model for a particular underlying we can decide on

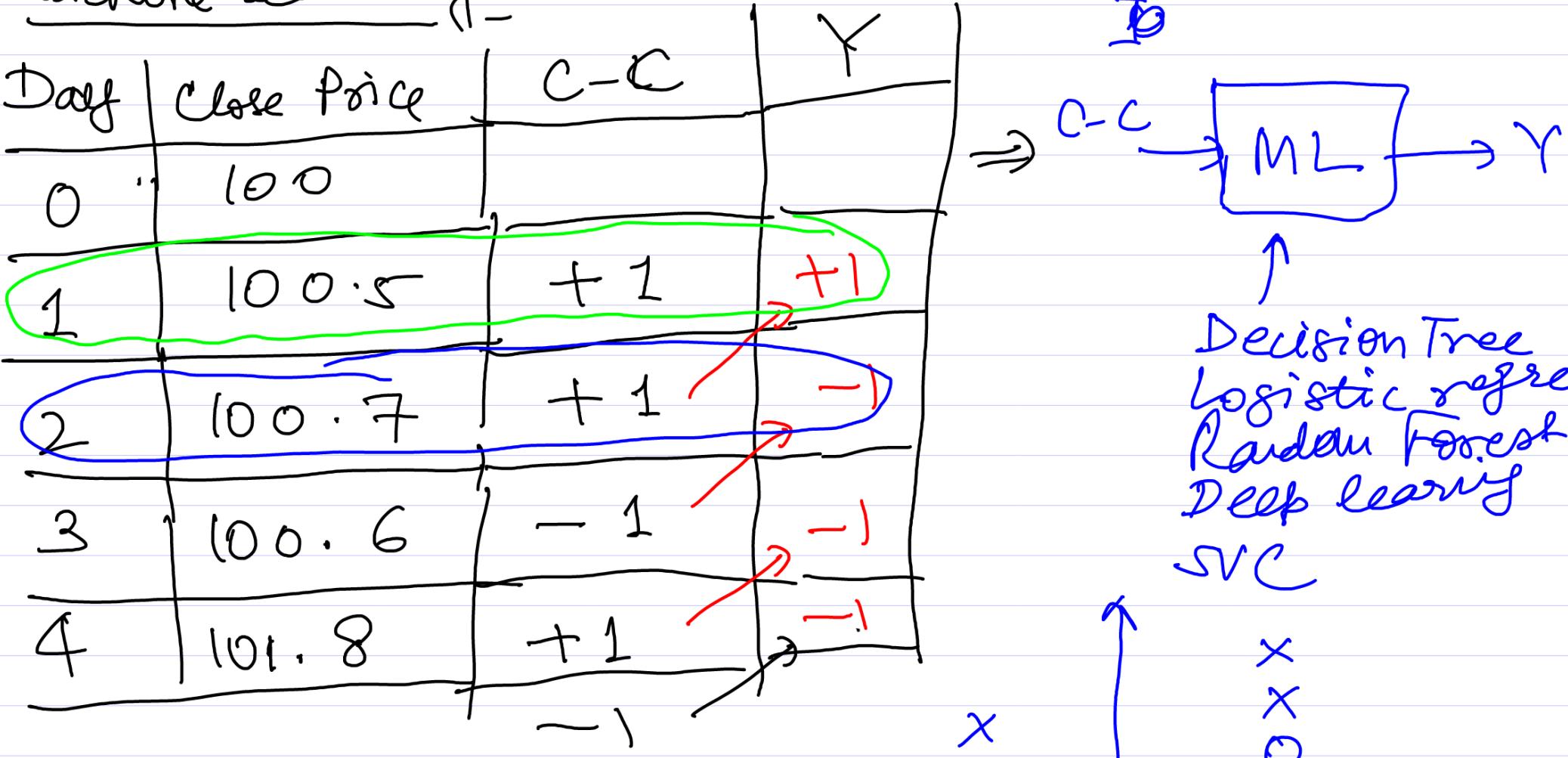
whether we should enter the trade.

## Bull Spread:

- ① Buy call with strike  $K_1$
- ② sell call with higher strike price.



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Machine Learning:



$0 \rightarrow +1$

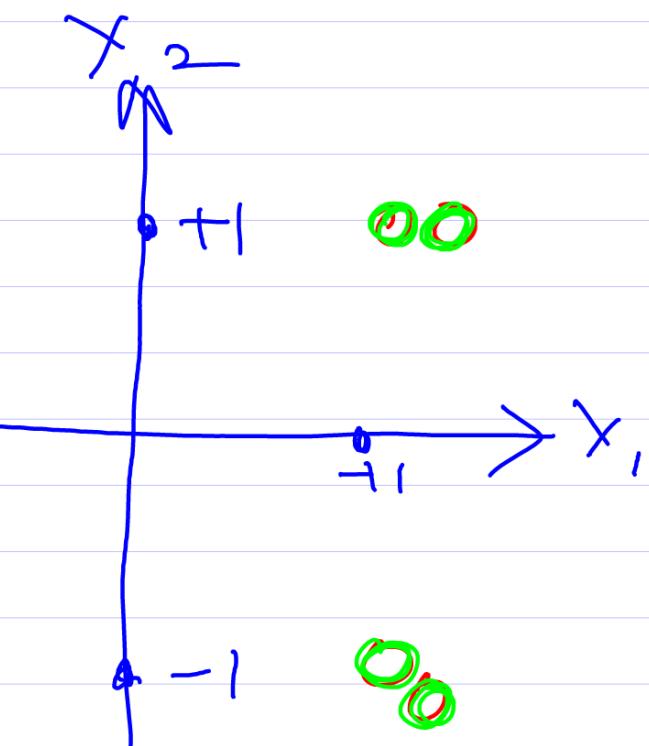
$X \rightarrow -1$

① If Input =  $-1 \Rightarrow 100\%$  chance that O/P =  $-1$

② If Input =  $+1 \Rightarrow 66\%$ .  $\Rightarrow$   $= -1$

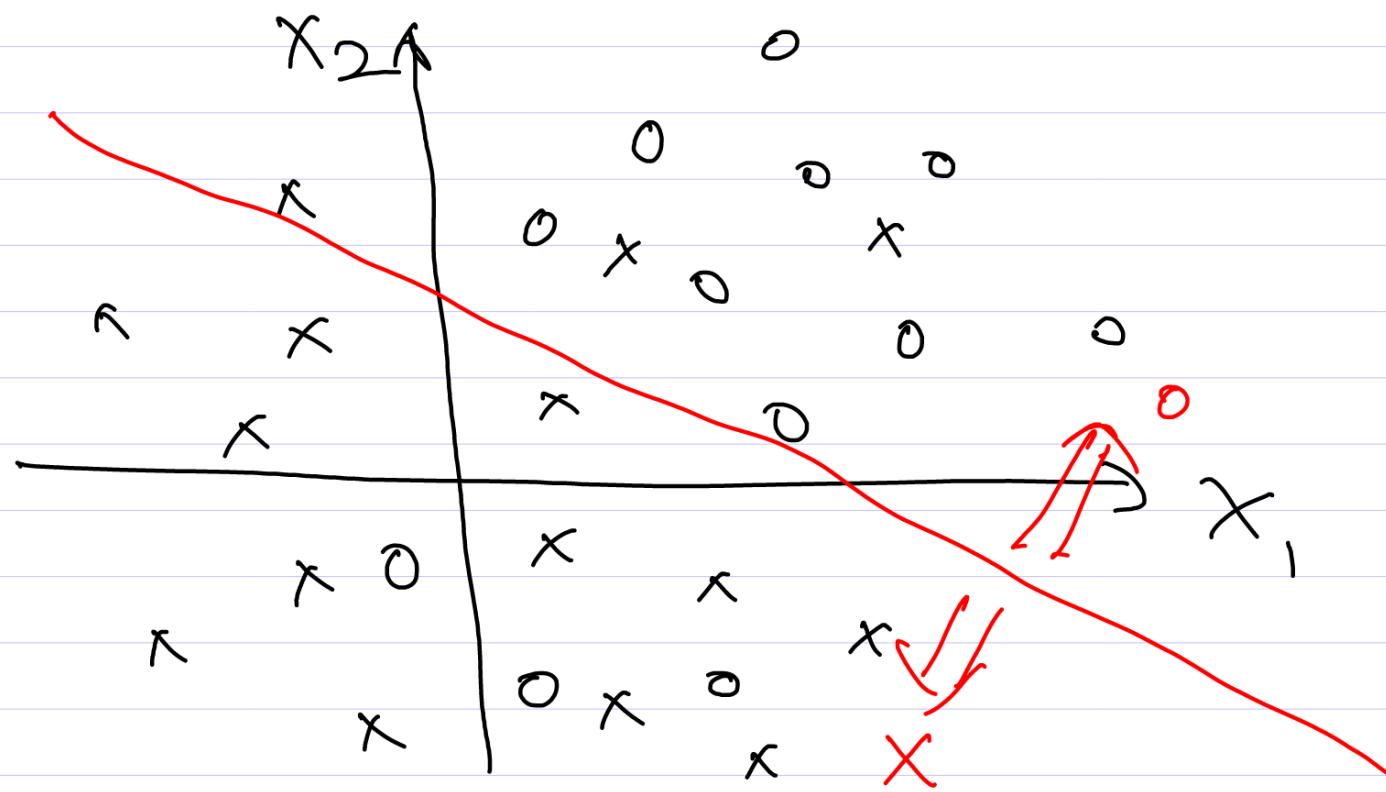
$(C-C)_1$	$(C-C)_2$	Future
-1	-1	+1 = X
-1	+1	-1 = 0
+1	+1	-1 = 0
+1	-1	-1 = 0
+1	+1	-1 = 0

$x_1$        $x_2$       Y



$$\begin{aligned} X &\rightarrow +1 \\ 0 &\rightarrow -1 \end{aligned}$$

100.7      100.8       $\rightarrow +1$



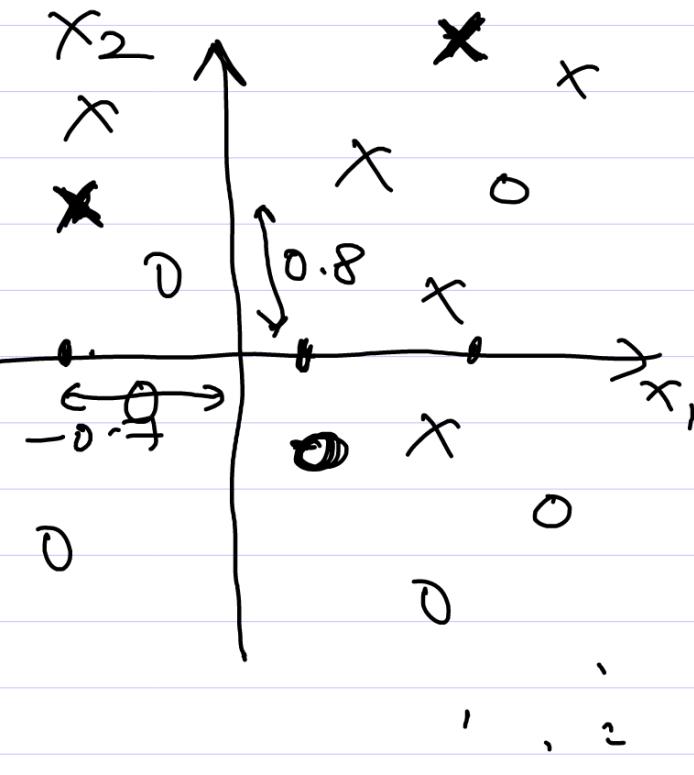
Input <sup>x<sub>1</sub></sup> <sub>1</sub>	Input <sup>x<sub>2</sub></sup> <sub>2</sub>	$\gamma$
-0.7	+0.8	+1(x)
+0.2	-0.3	-1(0)
+0.8	1.6	+1(x)
-0.7	+0.8	+1(x)

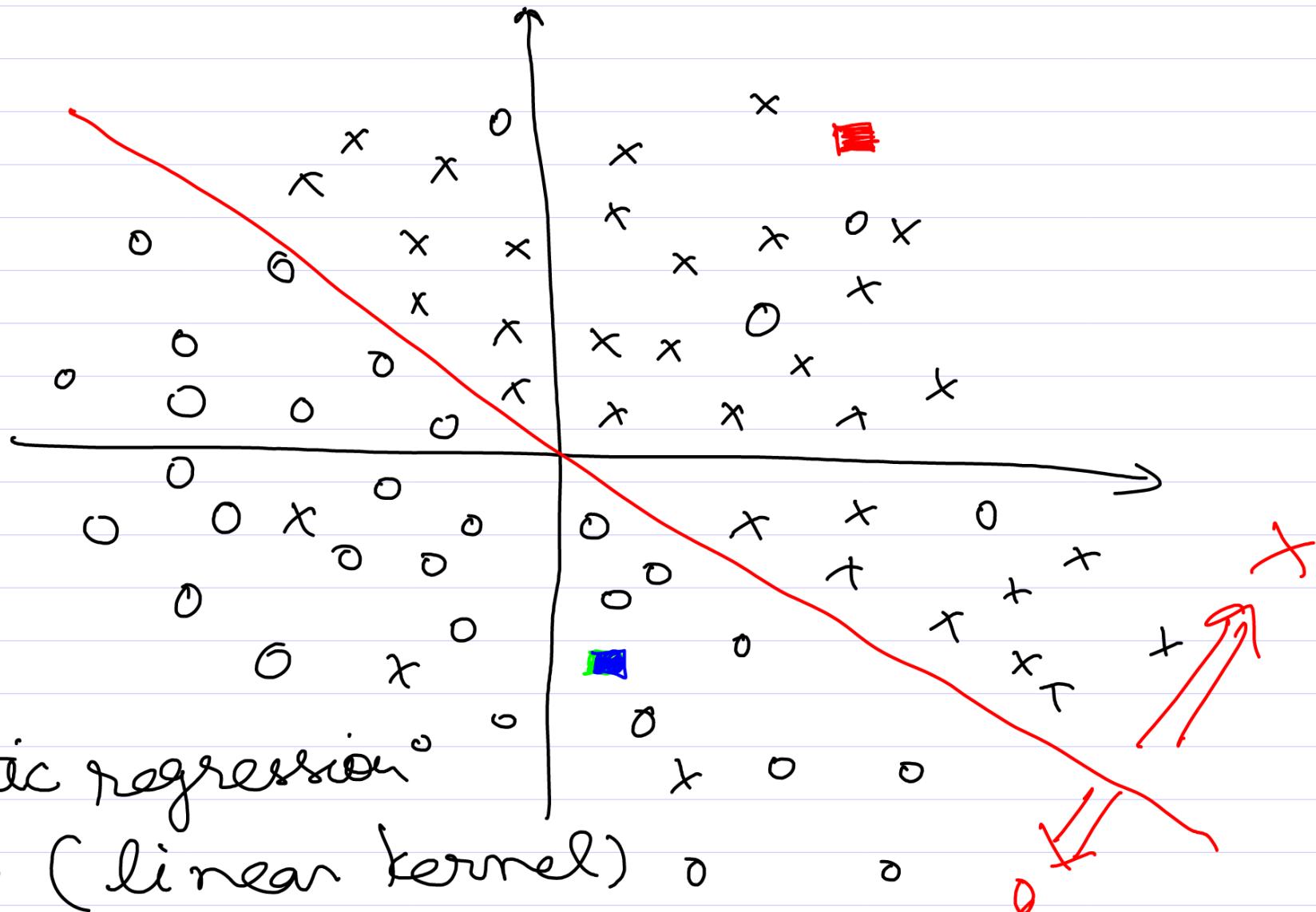
100, 99.3, 100.1  
100.6

PAST  $\Leftarrow \Rightarrow$  FUTURE

C-C

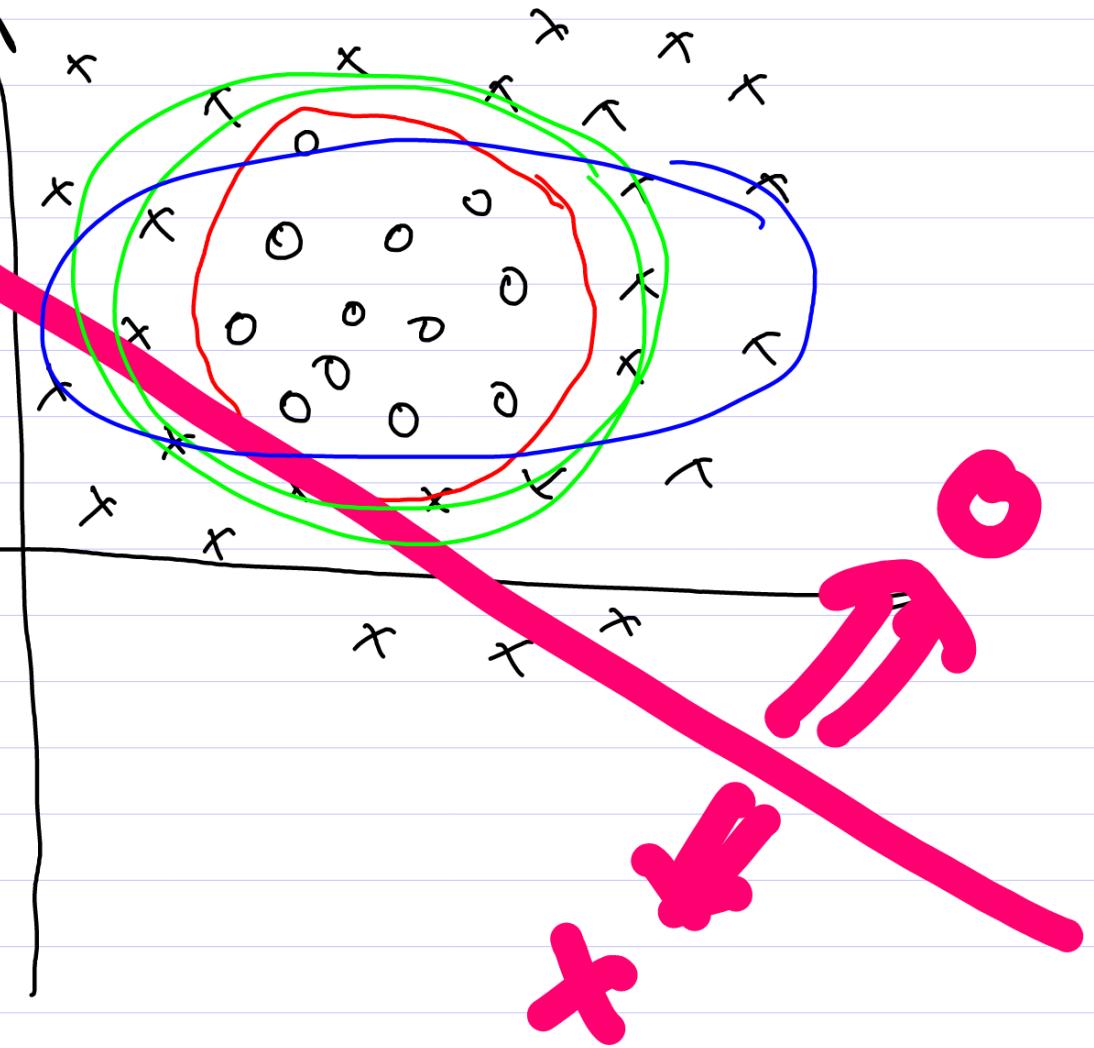
100, 99.3, 100.1, 100.

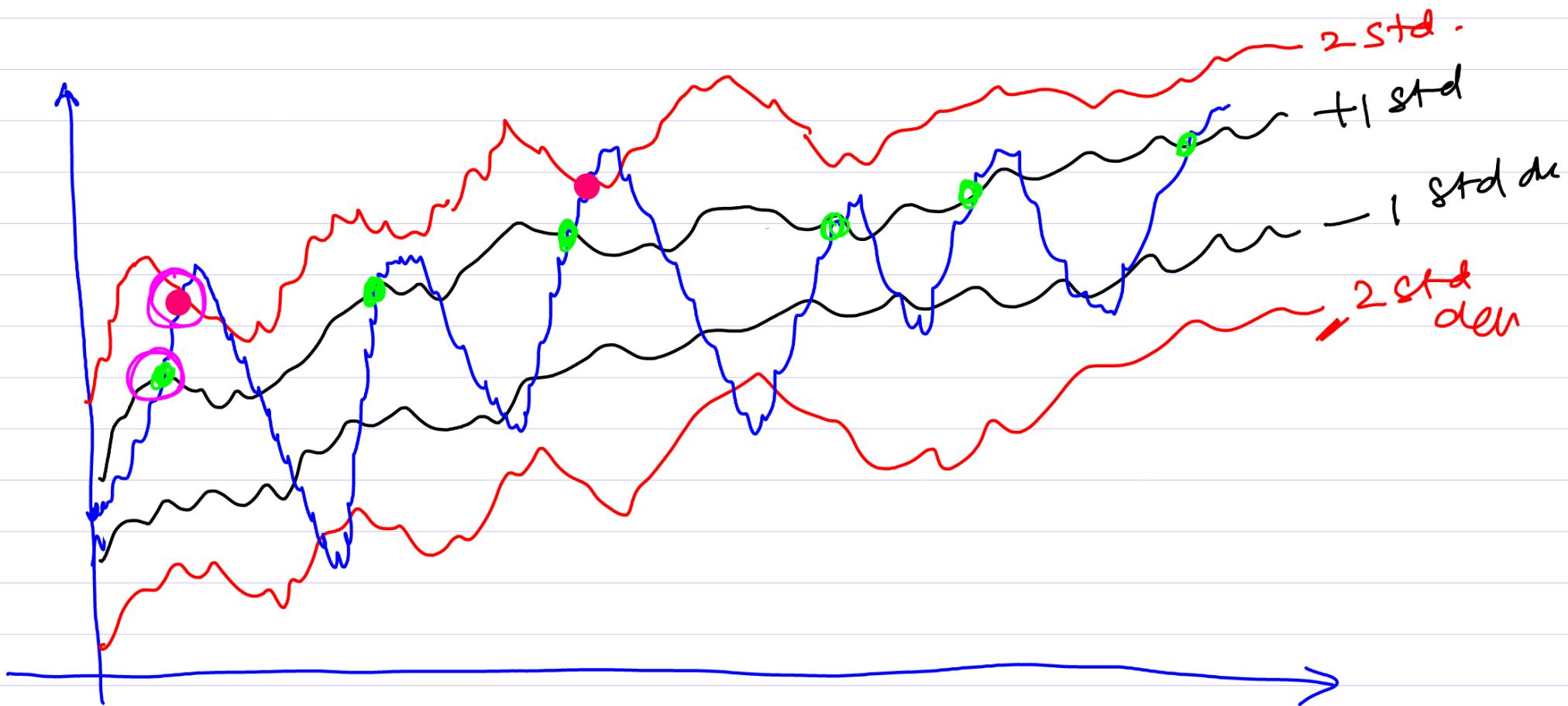


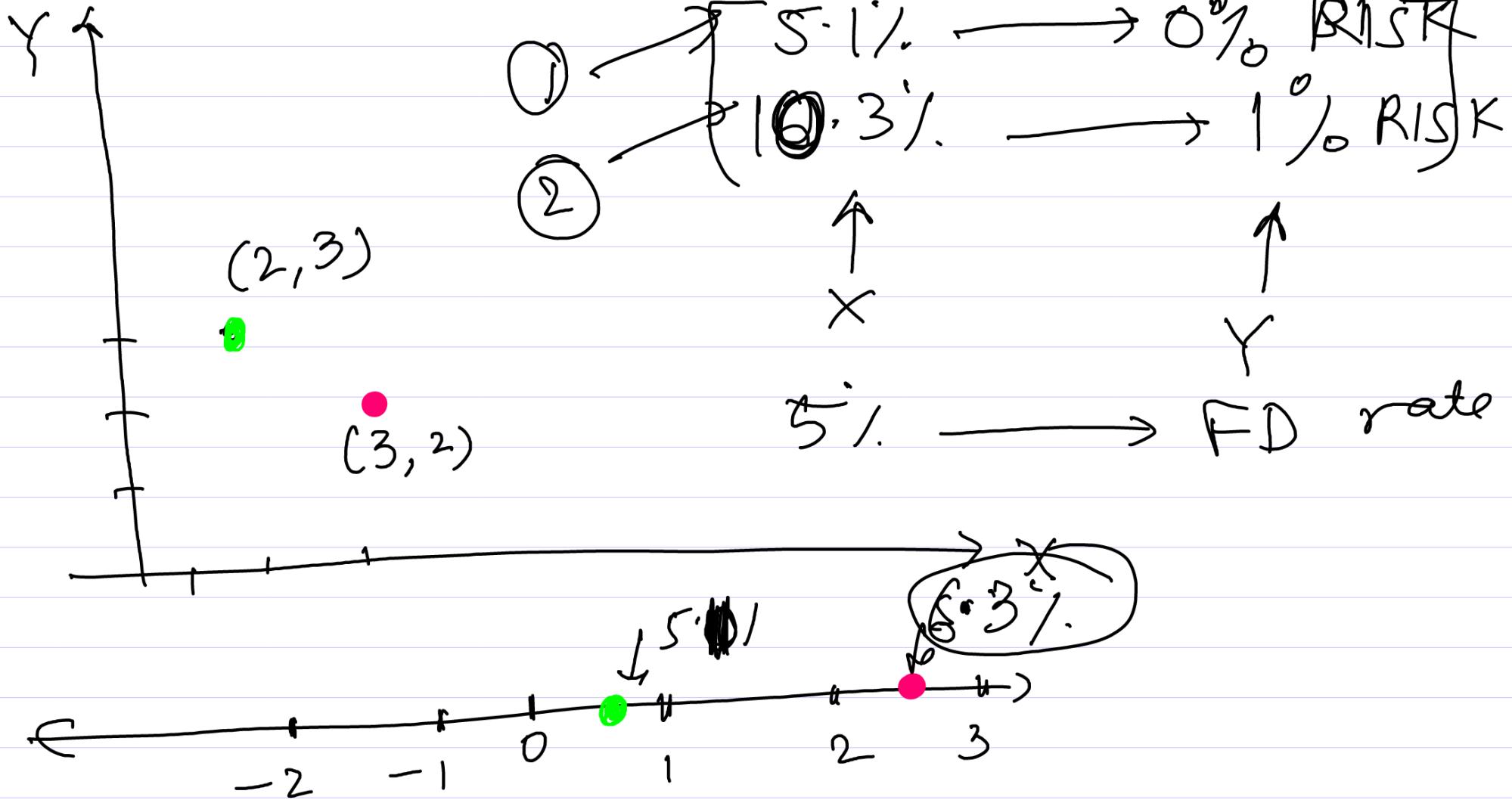


→ logistic regression  
→ SVC (linear kernel)

Deep learning  
SVC (gaussian)  
Random Forest







(A)

5%).  $\rightarrow$  0%. risk

(B)

5%).  $\rightarrow$  0%. risk

using B

C 5%

- Arbitrage:
- ① Take loan  $\hat{\wedge}$  C 5%
  - ② Use money to invest in A  
and get 5% return
  - ③ Use this return to pay back  
loan and keep 0.1% in pocket

L2 Data : ~~RELIANCE~~ RELIANCE (~~2580~~ 2581)

BID	ASK	
2580.9 → 100	2581 → 100	
2580.75 → 900	2581.5 → 700	
2580.70 → 630	2581.7 → 1000	
2580.65 → 1000	2581.75 → 600	
2580.60 → 970	2582.1 → 790	

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