SVM
Clustering.
Hier
Kmeans
} Yesterday

TS concepts
Recomm engine.
} Today.

Time series

hourly temperature

-> 10:00 AM 20th August 2017
-> 10:00 PM 30th April 2022

unit of time (hour)
regular intervals

(2) short term interest rates (6 months)
(3) Airline capacity
(4) seasonal energy demands
(5) future sales (online mode)

Analysis??

-> understand the trend.
-> predict the future values.

Deterministic Model	statistical model	complex deep learning technique
theory	theory practice	X

Time Series Analysis vs Forecasting

identifying the intrinsic structure of your data.

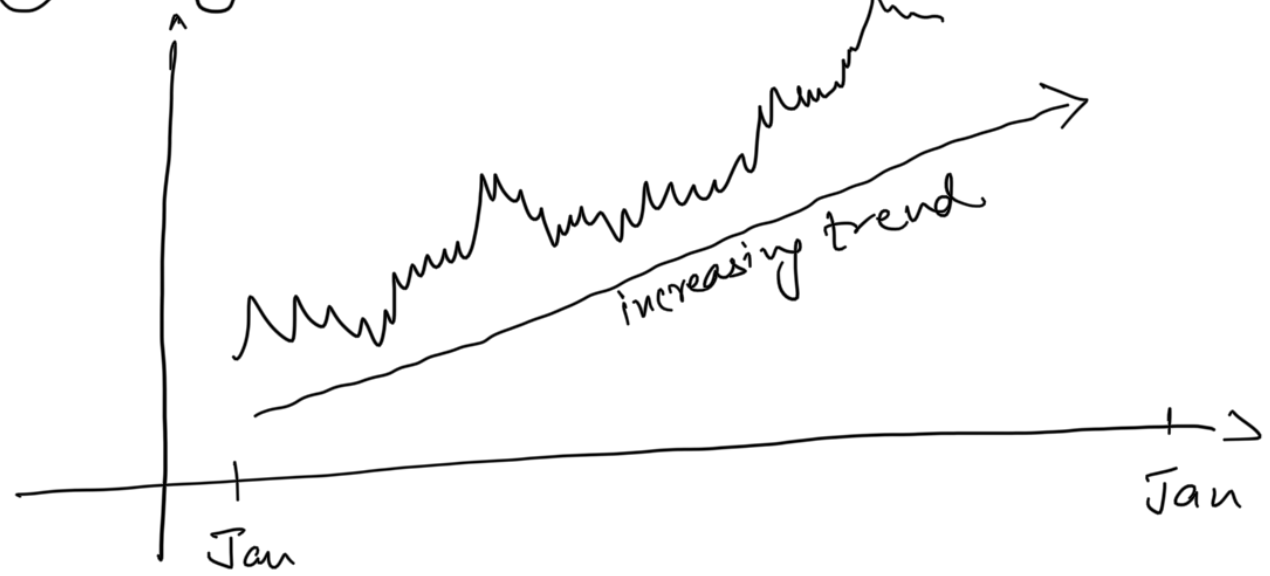
extrapolate (trend, seasonal variations)

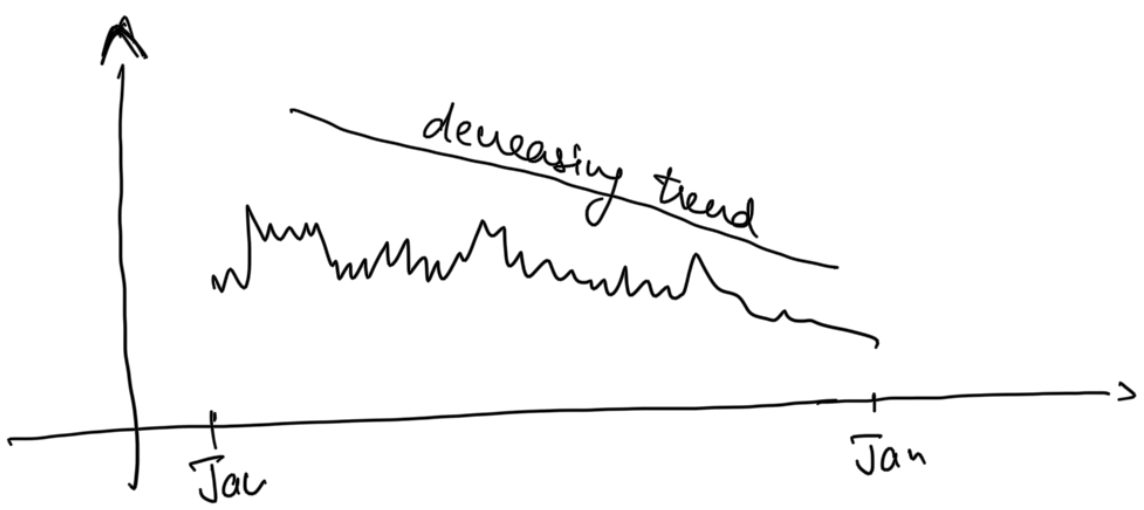
modelling of TS using ML models, training them on historical data and predicting.

Dates	Values	
01/01/2021	60	TS Analysis
01/02/2021	42	
01/03/2021	58	
01/04/2021	45	
01/05/2021	?	TS forecasting.
01/06/2021	?	

Components :-

1. Long term movement / trend.





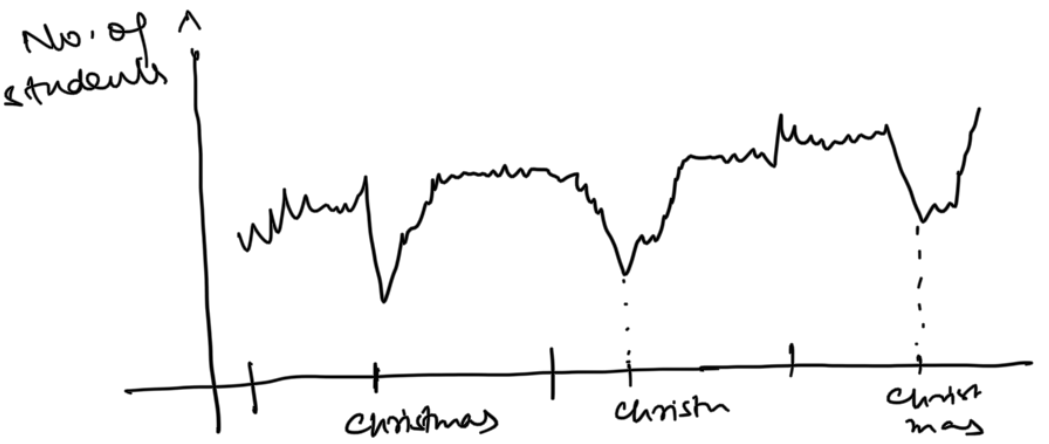
(2) Short term movements

a. Seasonal variation

periodic fluctuations observed but they show the same variation and they usually occur over a period of < 1 year.

fixed and known period.

eg holidays and festivals.



eg sale of umbrellas and raincoats

eg sale of Ac's in summers.

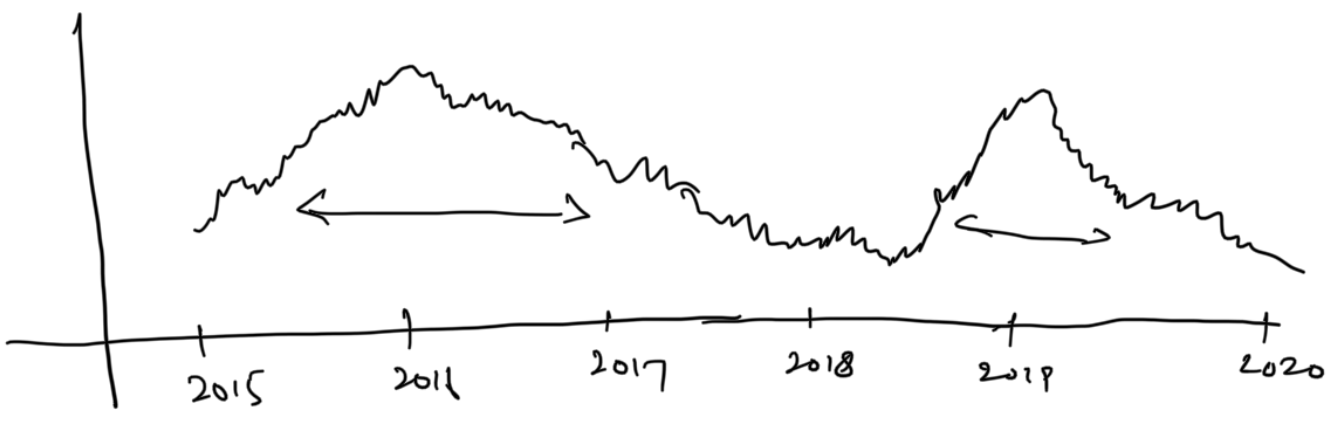
b. Cyclic variation.

recurrent patterns, not of a fixed period

3. Random Noise

Irregular fluctuations.

eg:- earthquakes, wars, flood etc.



signals + noise

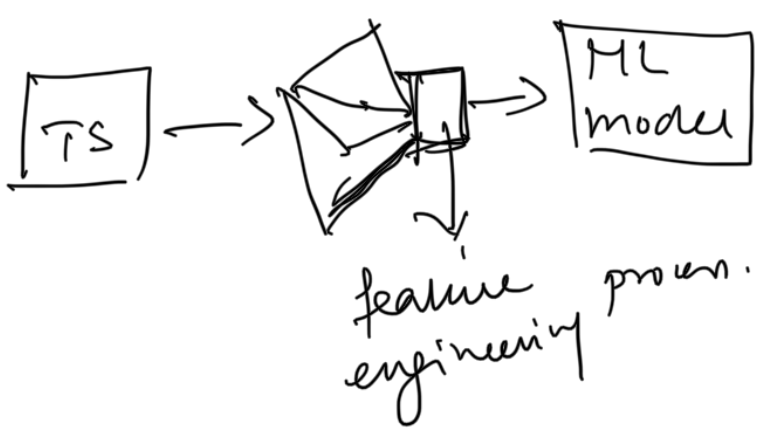
movements random

long term ...
+
short term movements
+
cyclic

error.

Decomposition process :—

practice labs



Test for stationarity

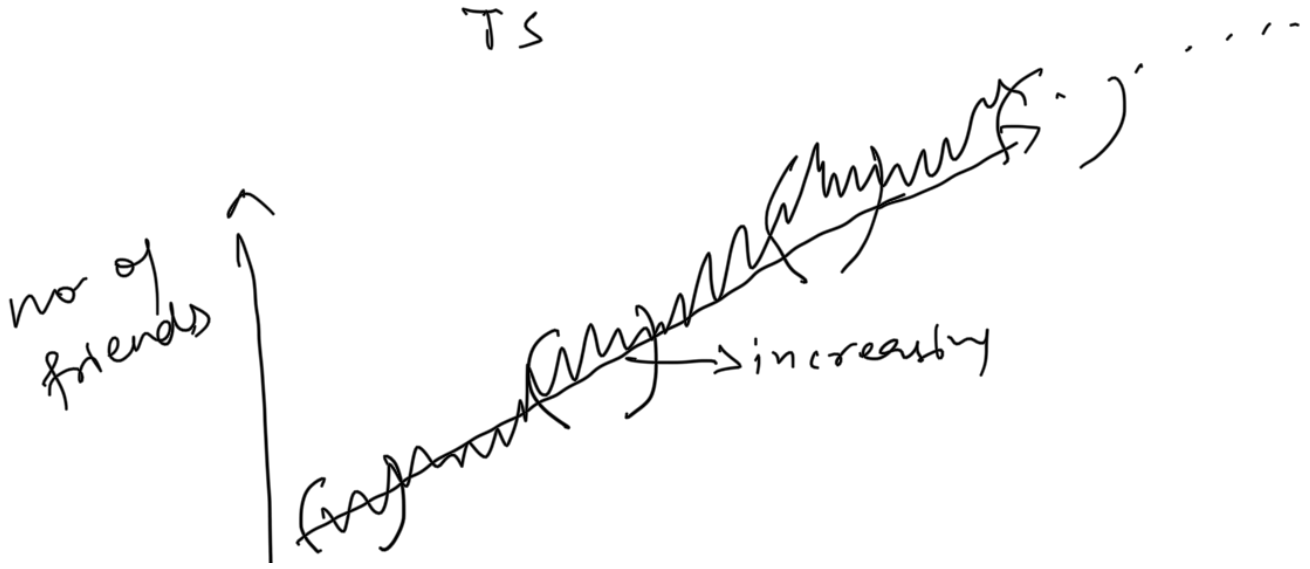
↳

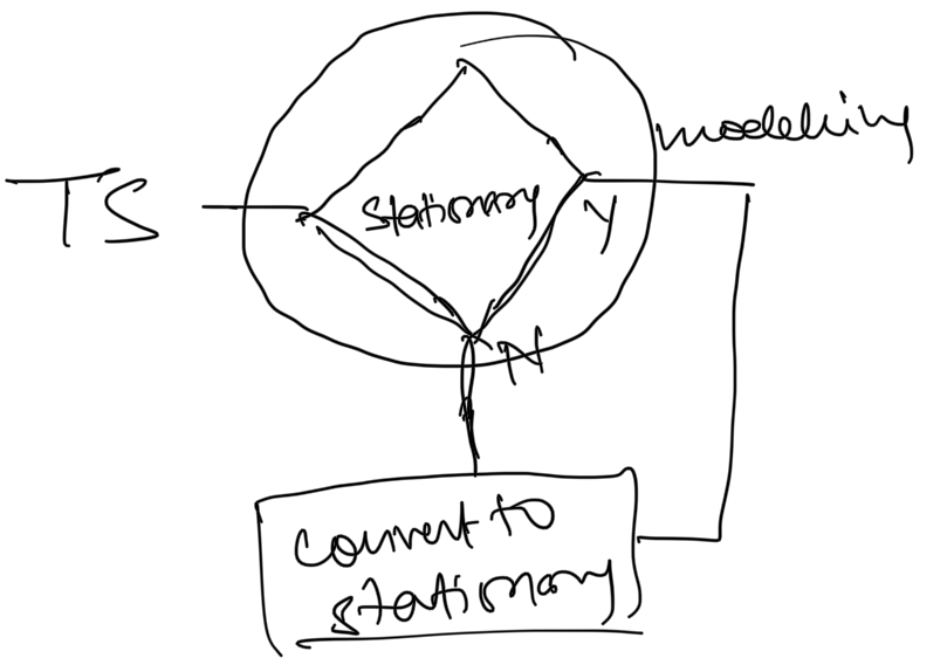
means that the statistical parameters of a TS don't change

1. Mean ✗
2. variance ✗

TS → stationary.

TS





Adfuller test —

How??

a. Transformation

Log transformation

sqrt "

cubert. "

b. Differencing / Detrending

→ $Y_t - Y_{t-1}$ or

$Y_t - A(Y_{t-1}, Y_{t-2})$

→ $Y_t - A(Y_{t-1}, Y_{t-2}, Y_{t-3})$

$\vdots$

$Y_t - A(Y_n)$

c. Decomposition.

TS - check - treat - Ready TS - model

Time Series Models

TS: 1 2 3 4 5 ??

a. Next value = Prvs value

$$Y_t = Y_{t-1}$$

$$\boxed{Y_t = 5}$$

b. Next val = Avg of past 2 values.

$$Y_t = \frac{Y_{t-1} + Y_{t-2}}{2}$$

$$= \frac{5+4}{2} = 4.5$$

$$Y_t = \frac{Y_{t-1} + Y_{t-2} + Y_{t-3}}{3}$$

⋮

c. Weighted average.

$$Y_t = \frac{A\, Y_{t-1} + B\, Y_{t-2}}{2}$$

$$Y_t = \frac{A}{2} Y_{t-1} + \frac{B}{2} Y_{t-2}$$

$$Y_t = \beta_1 y_{t-1} + \beta_2 y_{t-2} + \beta_3 y_{t-3} + \dots \beta_n y_{t-n} + \beta_0$$

$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots$

↳ Regression over its own past values.

d. ** **Autoregression**

How many ??

$\beta_1 \ \beta_2 \ \beta_3 \ \cdots\cdots\cdots ??$

$Y_t = Y_{t-1} \quad Y_{t-2} \quad Y_{t-3} \quad \cdots\cdots \quad Y_{t-n}$

Correlation of value with its own past

Auto correlation

partial auto correlation

ReadyTS ⟶ AR (p) ⟶ prediction.

↑

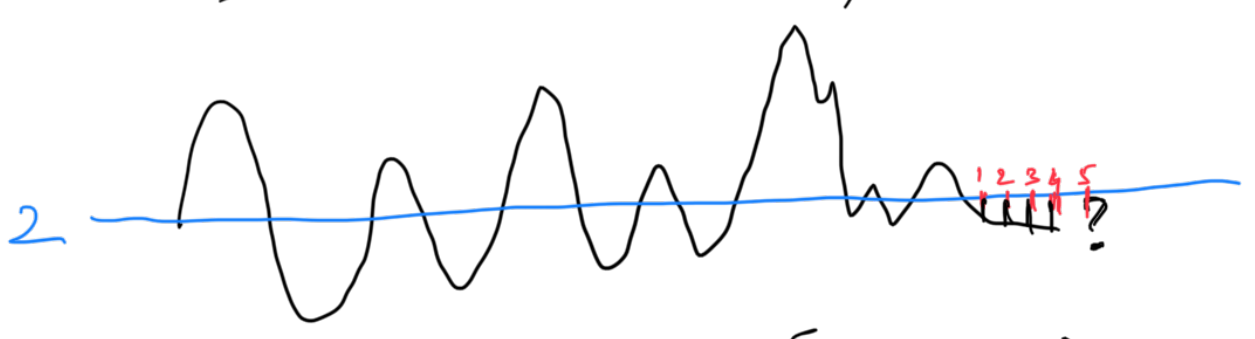
pacf

e. Moving average

1 2 3 4 5 $\frac{6}{4}\Big]_2$ mean + MA(errors)

⟶ mean + moving avg of prev error terms.

how many ??



$Y_{t5} = 2 + \text{Avg}\left[\left(\frac{\text{error at-}}{1}\right) + err_3 + \left(\frac{\text{error at-}}{2}\right) + err_4\right]$

$$= 2 + \text{Avg}\left(\frac{-1 - 1.2 - 1.4 - 1.45}{4}\right)$$

$$2 - 1.2$$

$$= 0.8 //$$

Ready TS → MA (q) → prediction

↑

acf

AR	MA
p	q
pacf	acf

g. ARMA (p, q)

g. ARIMA (p, d, q)

↓

order of differencing.

value that how many times to difference a TS to make it stationary.

PACF & ACF

How ??