TS-02

Monday, 11 December 2023 8:49 PM

Agenda :

→ DES / TES

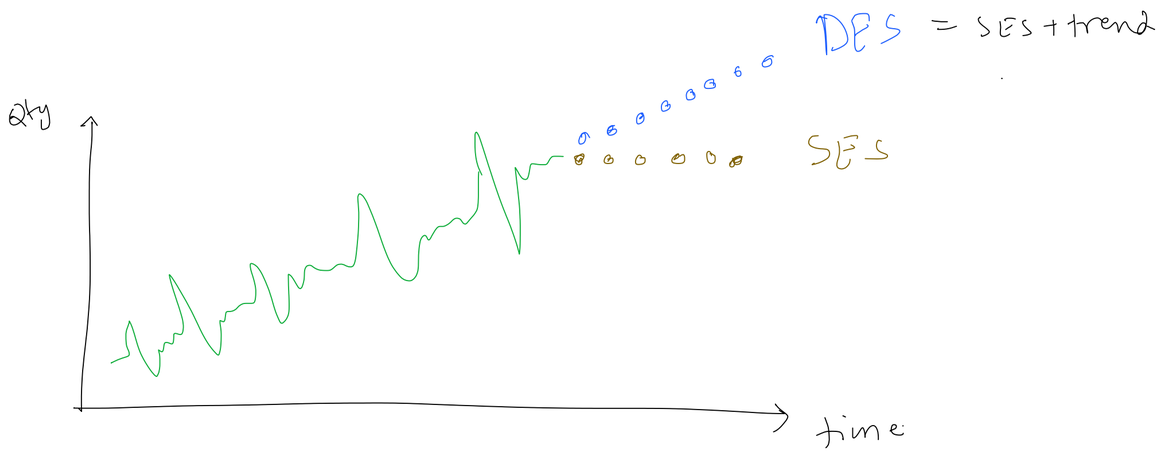
→ TS Concept : Stationarity

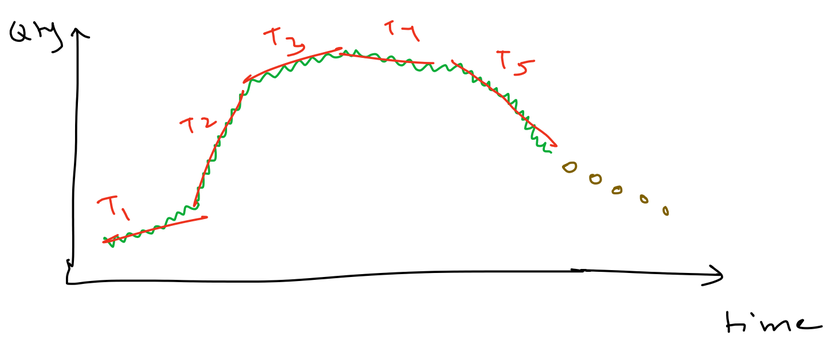
→ Acf | PAcf

Double Expo. Smoothing (DES)

DES = SES + Drift method (trend)

Naive + mean

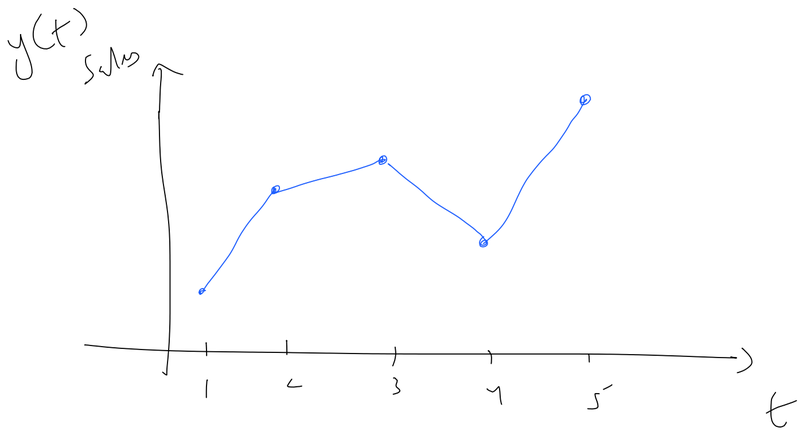


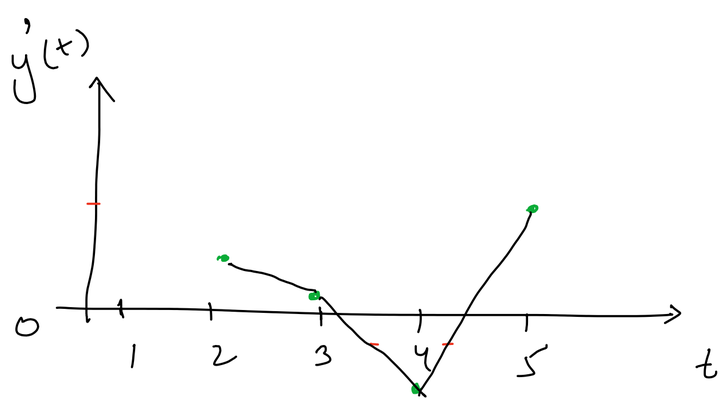


Trend.

↳ growth

Slope (rate of change) $y_2 - y_1 \Rightarrow \Delta y$

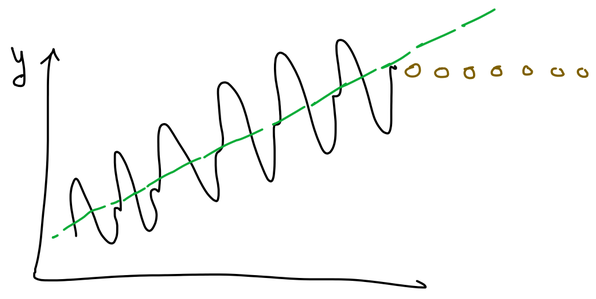




$y'(t) = \text{slope}(t)$

$\frac{\Delta y}{\Delta t} = \frac{y_2 - y_2}{1}$

y.diff()



① SES → reasonable level of y

② Reasonable estimate of trend ?

(a) take avg. trend so far.

(b) take latest trend (instantaneous trend)

"Combination of both"

Exponential smoothing ⇒ "trend" as well.

T.S → SES

take Δy T.S. → DES

→ simultaneously

DES

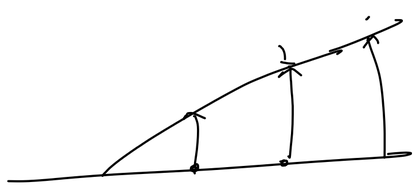
trend — Curr level — Curr trend

$$\hat{y}_{t+n} = l_t + h \cdot b_t$$

DES = SES + trend

$$\hat{y}_{t+1} = l_t + b_t$$

$$\hat{y}_{t+2} = l_t + 2 \cdot b_t$$



$$l_t = \alpha \cdot y_t + (1-\alpha) \cdot [\underbrace{l_{t-1} + b_{t-1}}_{\hat{y}_t}]$$

$$b_t = \beta [l_t - l_{t-1}] + (1-\beta) b_{t-1}$$

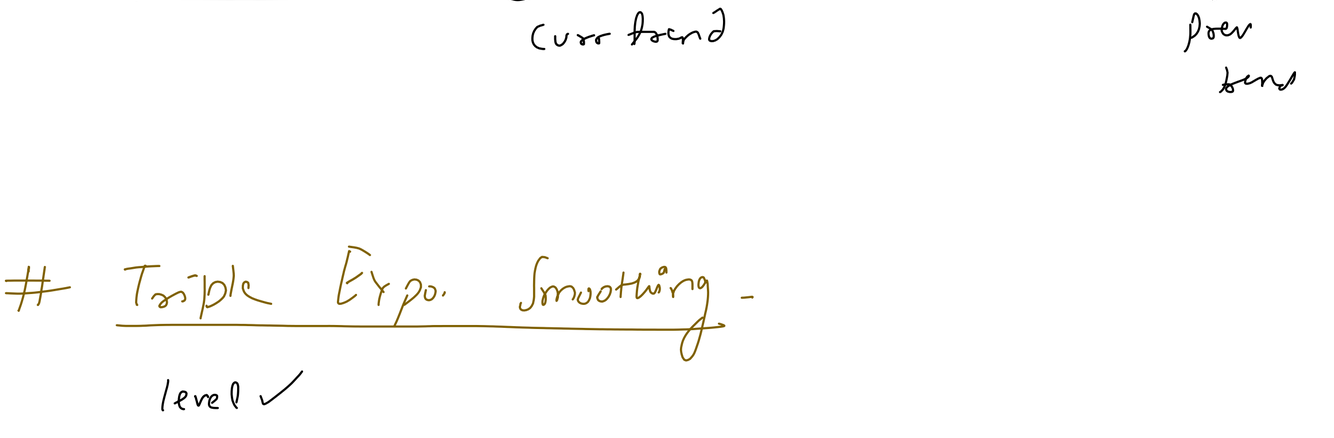
Curr trend — Prev trend

Triple Expo. Smoothing -

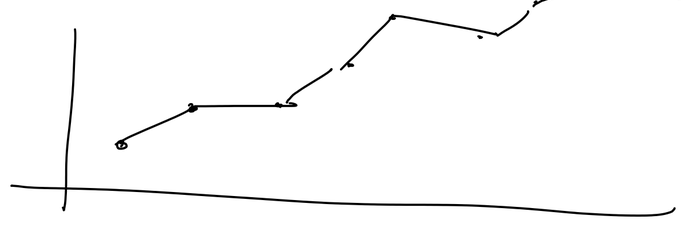
level ✓

trend ✓

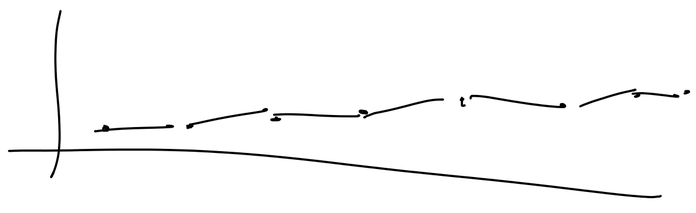
Seasonality



Take all Dec



Take all Jan



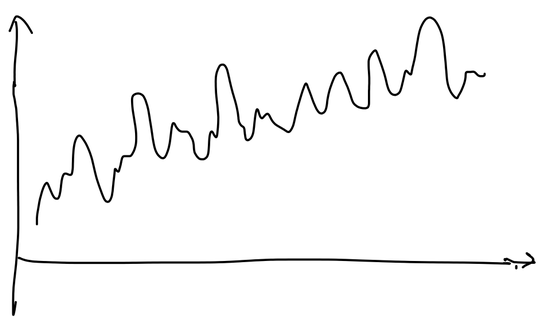
$$Jan(2024) = DES + \gamma(Jan2023) + \gamma(1-\gamma)(Jan2022) + \gamma(1-\gamma)^2(Jan2021) + \gamma\cdot(1-\gamma)^3(Jan2020) + \text{---}$$

$$\hat{y}_{t+h} = l_t + h.b_t + S_{t+h-m}$$

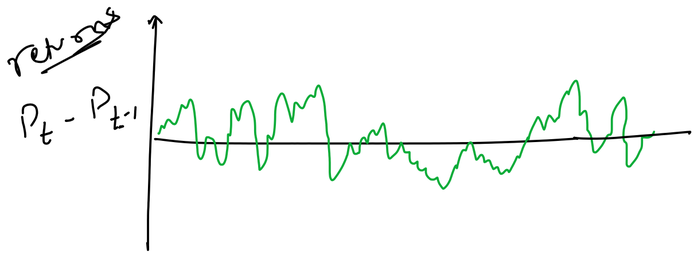
$m = 12$ → seasonality

$h = 1$

$$y_{t+1} = l_t + b_t + S_{t+1-12}$$



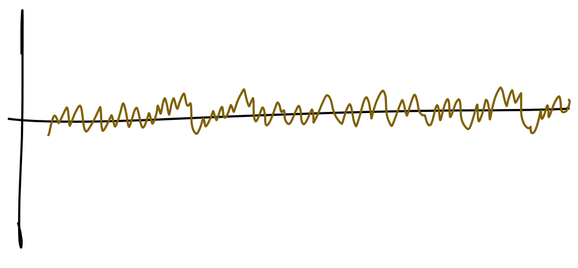
Predict movement of share Price



Predict Δy series.

↓

ARIMA [family]



No trend

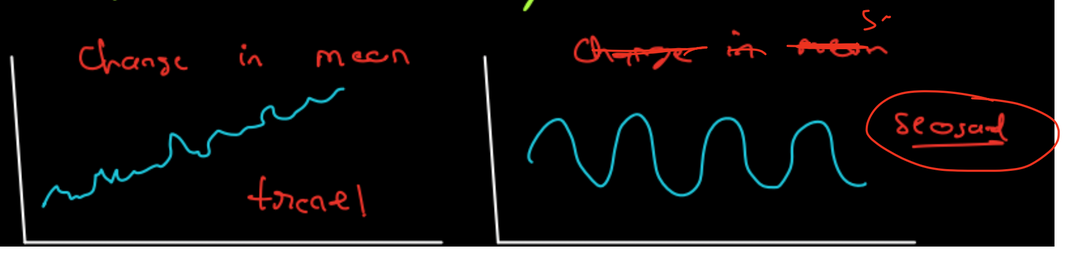
No Seasonality.

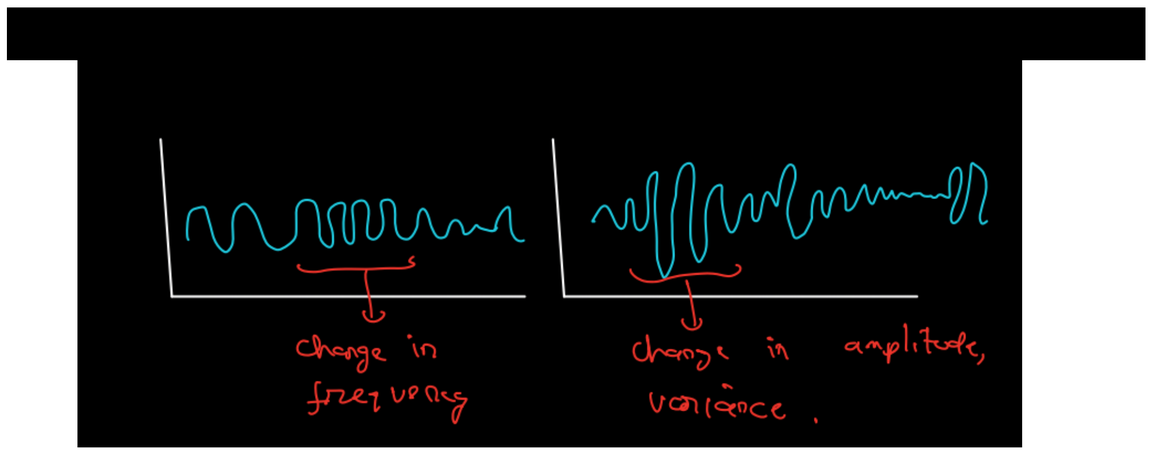
$$y(t) = b(t) + S(t) + \underbrace{e(t)}_{\text{no trend, no seasonality.}}$$

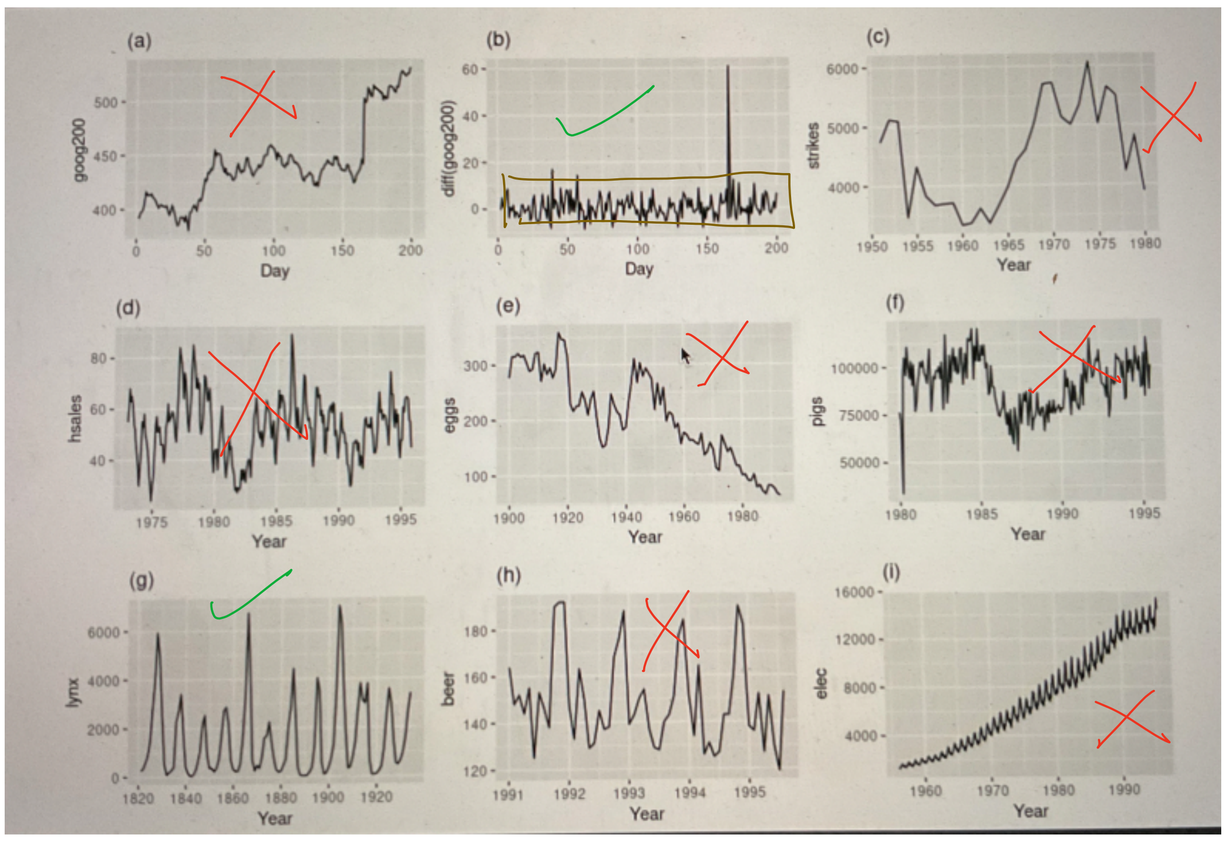
Stationarity

→ A signal is said to be stationary if its parameters such as mean, variance, amplitude, frequency do not change with time.

Eg: of non-stationary







[Dickey fuller Test]

H_0 = T.S is Not Stationary

H_a = TS is stationary

if p-value < sig. level (0.05):

→ TS is Stationary

Making a T.S → Stationary.

(1) Decomposition.

$y(t) = b(t) + s(t) + e(t)$

$e(t) = y(t) - [b(t) + s(t)]$ → $\hat{y}(t)$

e(t) → No trend / seasonality

(2) Differencing [De-trend] Δy

$y_2 - y_1$ $y_3 - y_2$

$y(t) = b(t) + s(t) + e(t)$

$b(t)$ → st. line → $mt + c$

y.diff(1)

$y'(t) = m + s'(t) + e'_2(t)$

m → not a trend anymore.

$e'_2(t)$ → new error

③ m - differencing [de - seasonality]

$m = 12$

$S(t) - S(t-m)$ → 12

Jan'23 − Jan'22
Mar'23 − Mar'22

ACF / PACF

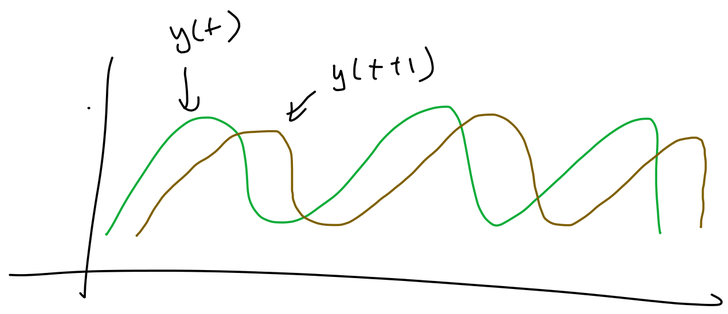
↓ Autocorrelation fn

→ Partial Autocorrelation fn

"m" → "Seasonal"

$y(t)$

$lag(1)$



$y(t)$ & $lag(1)$ $y(t)$

↓

Auto correlation

$i = 1$

$i = 2$

$i = 3$

$i = 4$

⋮

$i = m$ (30)

	lag	Correlation
i =	1	0.7
i =	2	0.6
	3	0.55
	4	⋮
	⋮	
	6	
	⋮	
⇒	12	Highest
	⋮	
	30