TS-01

Friday, 8 December 2023 9:04 PM

Agenda:

1. Decomposition from scratch
2. Simple Methods forecasting
3. MA ——— forecasting
4. Smoothing Method.

T.S.. → Trend
→ Seasonality

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

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

Scratch

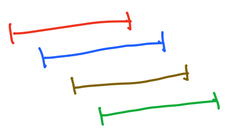
Trend → MA

" 1 time period

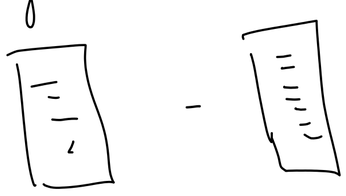
1 week, 1 month, 1 year

$m = 12$

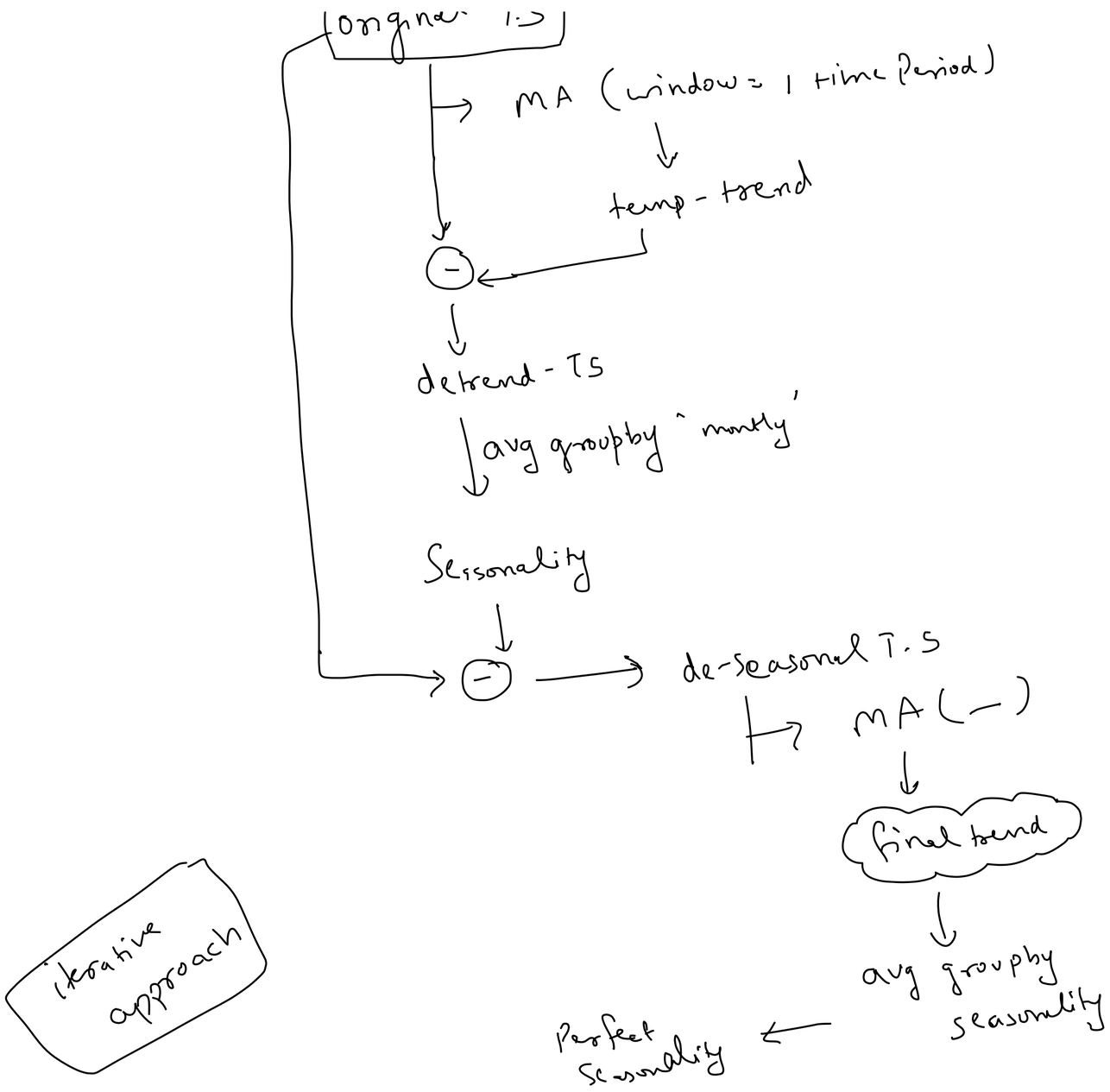
rolling window



detrend T.S = Original T.S. − trend.



Avg. Sales of Sat. = Seasonality of Sat.
Sun = Seasonality of Sun.
⋮
Mon = Seasonality of Mon.



MAPE

$$MAPE = \frac{1}{n}\sum_{i=1}^{n}\frac{|y^{(i)} - \hat{y}^{(i)}|}{y^{(i)}}$$

Sales → 350, Predict 315

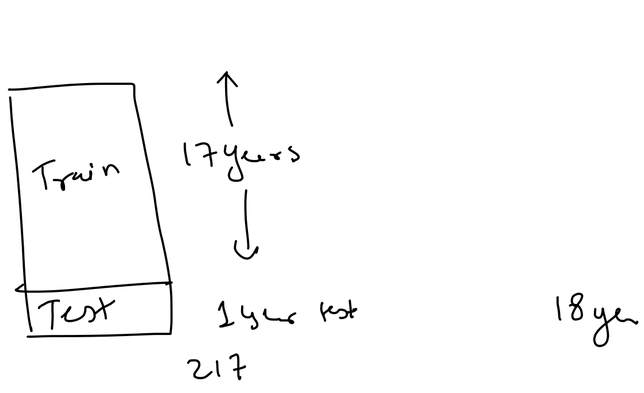
$$\frac{|350-315|}{350} \Rightarrow \frac{35}{350} = 10\%$$

Predicted 385

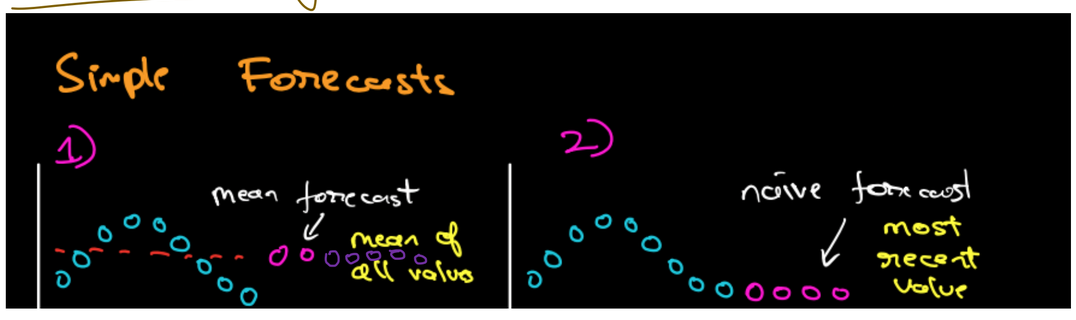
$$\frac{|350-385|}{350} = \frac{35}{350} = 10\%$$

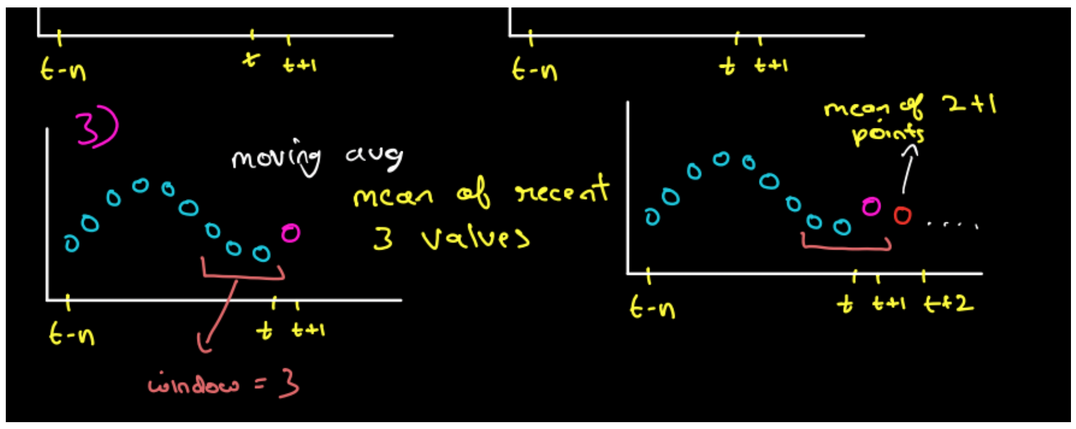
333 ← 350 → 367

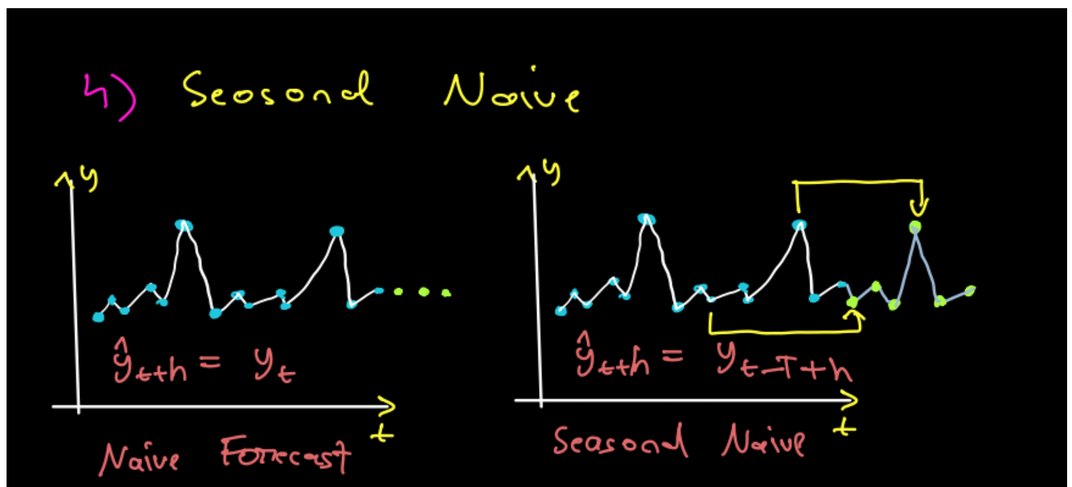
5%.

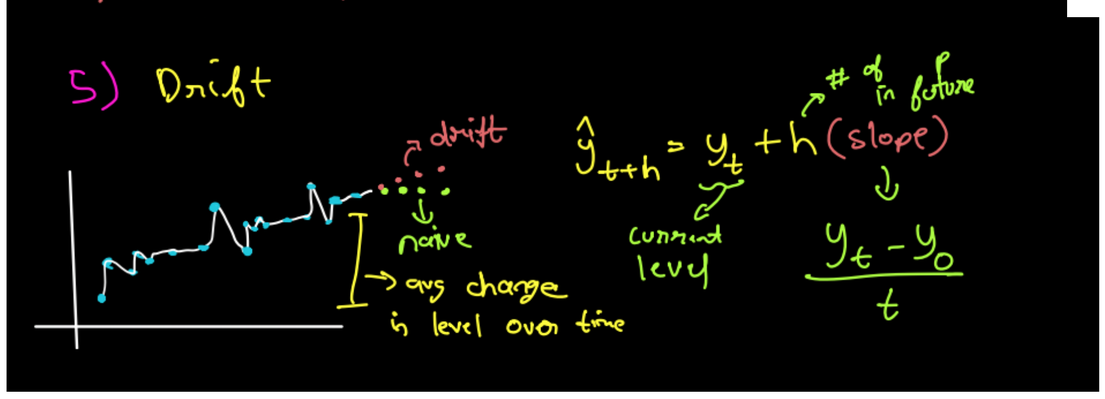


Simple forecasting





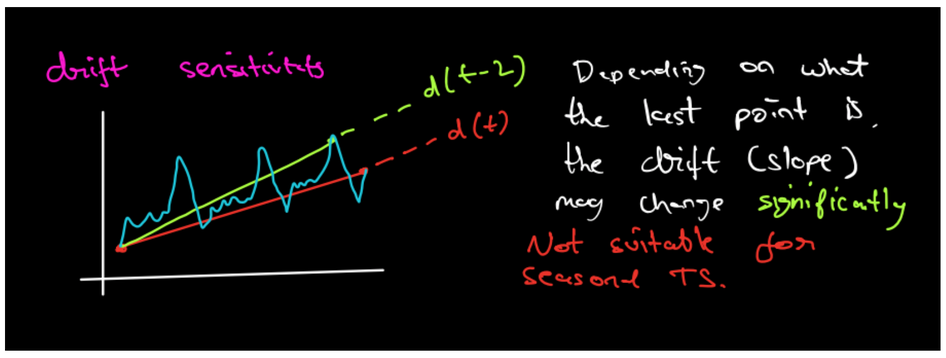




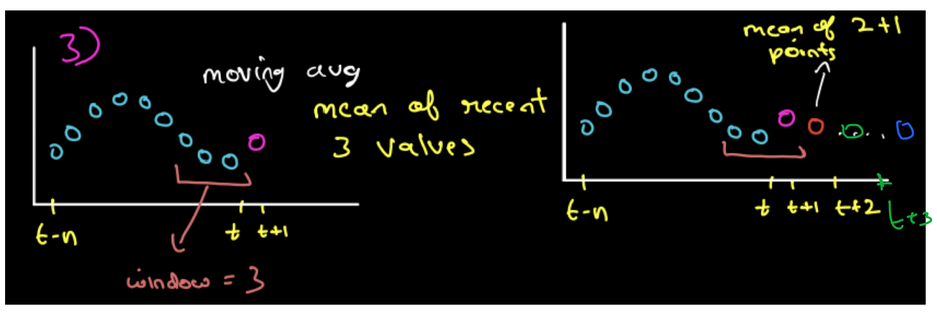
$$y_{t+1} = y_t + 1 \cdot \text{slope}$$

$$y_{t+2} = y_t + 2 \cdot \text{slope}$$

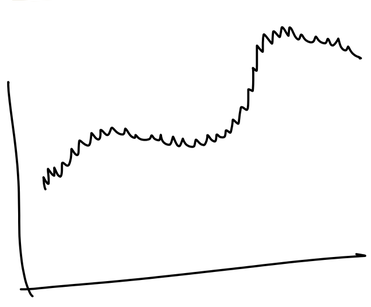
$$y_{t+h} = y_t + h \cdot \text{slope}$$



Moving Average -



Simple Exponential Smoothing [SES]



Combines

[Naive + Mean + window]

weighted avg !!

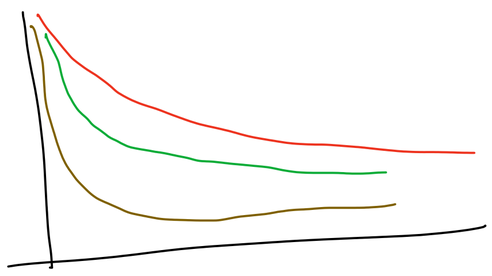
$$\hat{y}_{t+1} = \left(\frac{1}{t}\right) y_t + \left(\frac{1}{t}\right) y_{t-1} \; t - - \left(\frac{1}{\epsilon}\right) y_0$$

More weight

least weight

Not linear smoothing

"exponential smoothing"



Recursive formation:

$$\hat{y}_{t+1} = \alpha \cdot y_t + (1-\alpha)\hat{y}_t$$

$\alpha \rightarrow$ H.P

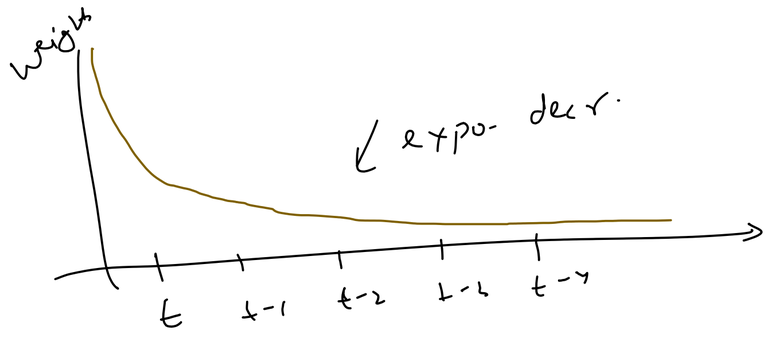
$\in (0,1)$

$$\hat{y}_{t+1} = \alpha \cdot y_t + (1-\alpha)\left[\alpha \cdot y_{t-1} + (1-\alpha)\hat{y}_{t-1}\right]$$

$$\hat{y}_{t+1} = \alpha \cdot y_t + (1-\alpha)\left[\alpha \cdot y_{t-1} + (1-\alpha)\left[\alpha \cdot y_{t-2} + (1-\alpha)\hat{y}_{t-2}\right]\right]$$

$$\hat{y}_{t+1} = \alpha y_t + \alpha(1-\alpha) y_{t-1} + \alpha(1-\alpha)^2 y_{t-2} + \alpha(1-\alpha)^3 y_{t-3} + \cdots$$

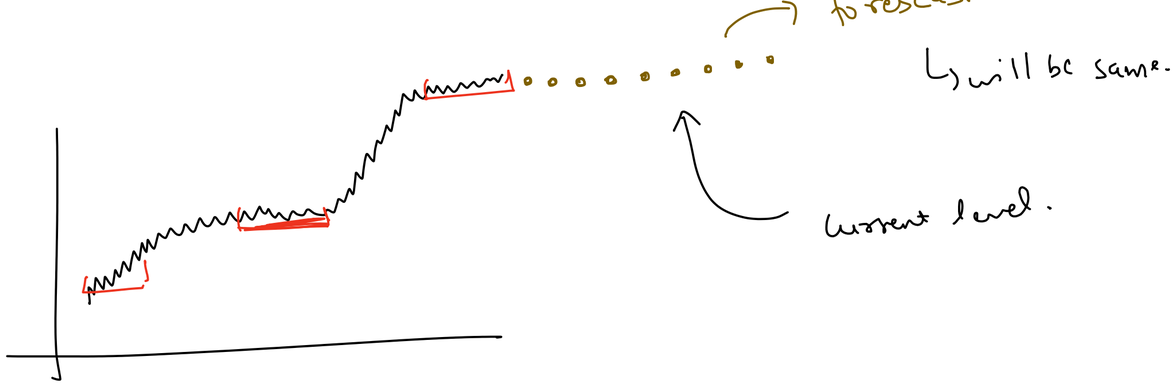
α: most recent; y_{t-1}: second then; y_{t-2}: older; y_{t-3}: more old



$\alpha = 0.8$ 0.1

$$\hat{y}_{t+1} = 0.8\, y_t + 0.16\, y_{t-1} + 0.032\, y_{t-2} + 0.0064\, y_{t-3}$$

"forecast"



SES → curr level.

$\alpha \downarrow\downarrow$ (low) ⇒ global mean / Avg model

$\alpha \uparrow\uparrow\uparrow\uparrow$ (v. larg) ⇒ Naive value

$\hat{y}_{t+1}$ ⇒ $h=1$

$\hat{y}_{t+h}$ $\hat{y}_{t+2}$ = $h=2$

$\hat{y}_{t+3}$ = $h=3$

$$\hat{y}_{t+h} = \alpha \cdot y_t + (1-\alpha)\,\hat{y}_t$$