Topics Covered

1. Decomposition From Scratch
2. Simple Forecasting Methods
3. Accuracy/Performance Measurement
4. Simple Forecasting Methods
5. Single Exponential Smoothing Method (Will again cover in next Class)

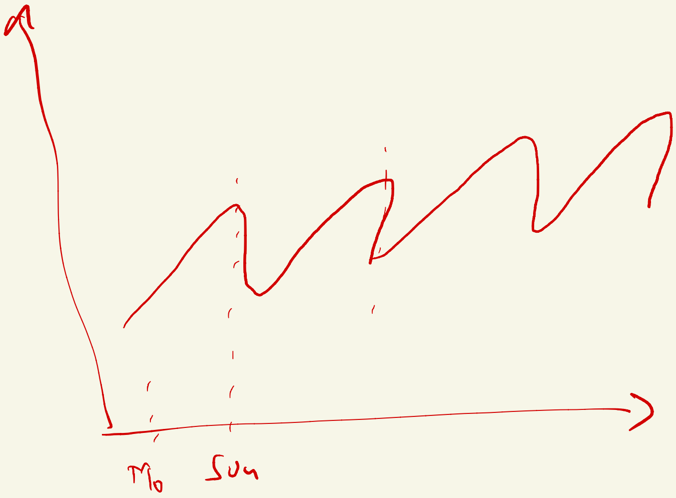
⇒ ① Decomposition from Scratch →
② Simple method of forecasting
③ Smoothing method

Start at 9:05

Recap → What is TS data
↳ ① forward moving data
② No repeatition Jan 2017 ← Jan 2016
③ Imputation → · Linear Interpolation
· MA
④ Anomaly / outlies → Quantile

↳ Trend, Seasonality & Error

Q Shoe



Trend → MA
↳ Ideal value

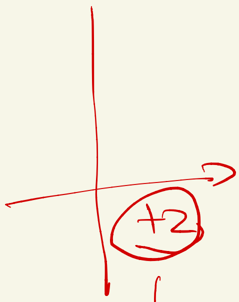
for m = 1 Seasonality Period.

$\Rightarrow y(t) = b(t) + \underline{s(t)} + \underline{e(t)}$

ignore

Monday → −20 from Sunday. ⟶ Seasonality

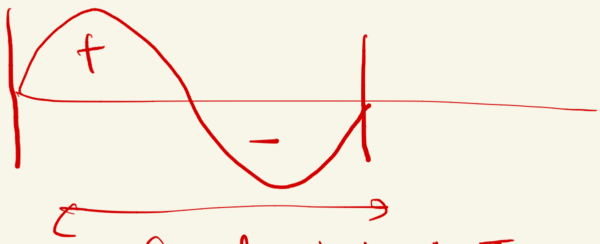
Mond	10		12
⋮	12		⋮
⋮	15		⋮
Sun	30		32
	Week 1		Week 2



trend

$\boxed{y(t) - s(t) = b(t)}$

Seasonality



Cancel out in 1 Time period → MA at this Time frame

effect of seasonality NO

Thus → $\boxed{\text{Trend}}$ is left.

⇒ If you use MA for approx seasonality Timeframe

↓

Approx Trend → $b^*(t)$

$\Rightarrow$ If I remove $\rightarrow y(t) - b^*(t)$

$\Rightarrow$ TS $\rightarrow$ Trend $\rightarrow$ / Seasonal $\rightarrow$ / Error $\rightarrow$

Independent of each other

Approx Trend $\leftarrow b^*(t)$

Approx Trend $\rightarrow$ MA of 12 months $\rightarrow$ ($y(t) \rightarrow$ Seasonality component)

$\downarrow$

$y(t) - b^*(t) \rightarrow$ detrend $s^*(t)$

$\downarrow$

Corresponding mean $\rightarrow S(t)$

To get a better trend -

$y(t) - S(t) \Rightarrow$ Better Trend

$\Rightarrow y(t) \rightarrow$ MA $\rightarrow b^*(t)$

$y(t) - b^*(t) \rightarrow$ detrende

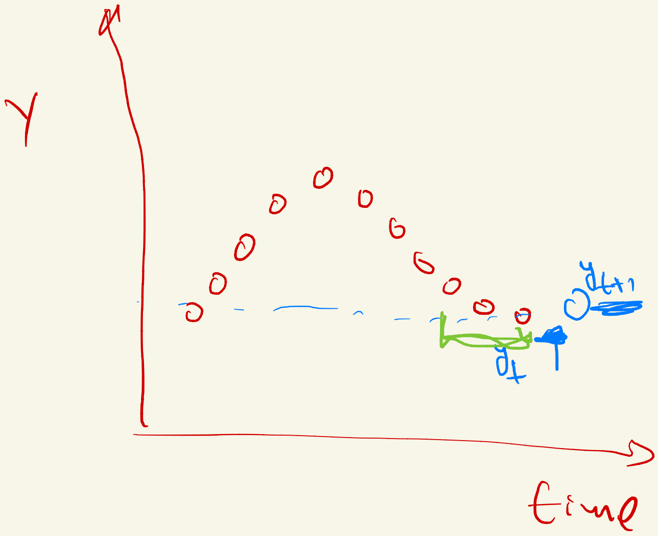
$\hookrightarrow$ Avg $\rightarrow S(t)$

$y(t) - s(t) \rightarrow b(t) \longrightarrow$ MA

→ Forecasting →

→ Analysis

→ Forecast / Error



→ Simple Forecasting →

① Naive Approach →

$$\hat{y}_{t+1} = y_t$$

Trend ✗
Season ✗

② Mean Approach →

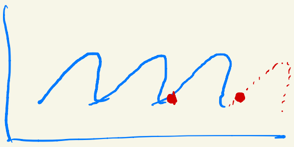
$$\hat{y}_{t+1} = \frac{y_1 + \dots + y_t}{t}$$

T ✗
S ✗

③ Seasonal Naive Approach

$$\hat{y}_{t+1} = y_t \quad \times\times\times$$

Trend ✗
Season ✓



↳ last corresponding seasonal value.

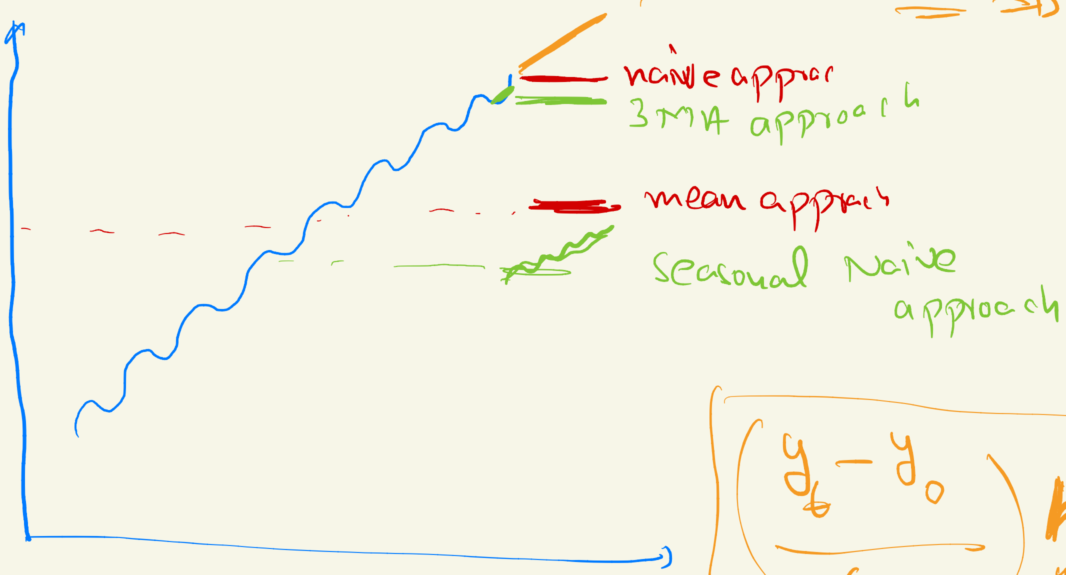
④ Moving average →

→ $$\hat{y}_{t+1} = \frac{y_t + y_{t-1} + \dots y_{t-m}}{m}$$

Trend ✗
Season ✗

→ $$\hat{y}_{t+2} = \frac{\hat{y}_{t+1} + y_t + \dots y_{t-m+1}}{m}$$

(5) Drift Method



Drift method → Extend the trend

$$\left(\frac{y_t - y_0}{t}\right) h + y_t = \hat{y}_{t+h}$$

$$\boxed{y_{t+h} = y_t + h * \text{Slope}}$$

→ avg slope of curve

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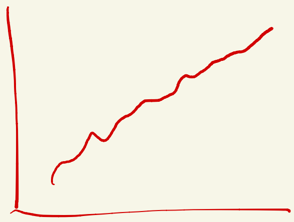
① Increasing trend →



Drift Approach

② Seasonal data

$\boxed{\text{Seasonal naive}}$

(3)

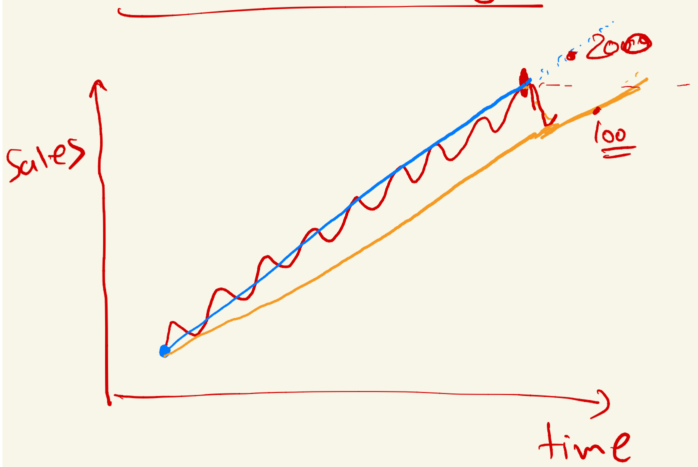
→ Mean Approach

(4)

→ Naive Approach

⇒ Drift Sensitivity →

→



→ Predict next Quarter values

$$\frac{y_t - y_0}{t} = \underline{\underline{Slope}}$$

Based on the time prediction all future values can change significantly.

⇒ Train-Test Split →

⇒ Accuracy

MAE ⇒ $\frac{\sum_{t=1}^{n} |\hat{y}_t - y_t|}{n}$

RMSE ⇒ $\sqrt{\frac{\sum_{1}^{n} (\hat{y}_t - y_t)^2}{n}}$

MAPE → Mean Absolot Percentage Error

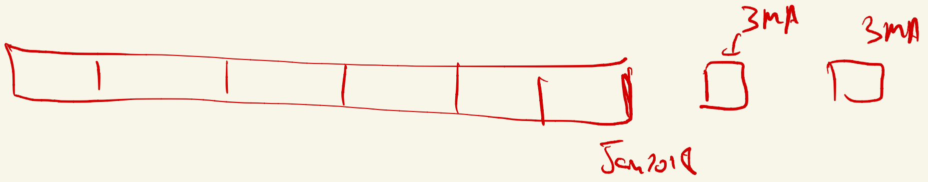
$$\Rightarrow \frac{\sum_{t=1}^{n} |\hat{y}_t - y_t|}{n} \times \frac{1}{y_t} \times 100$$

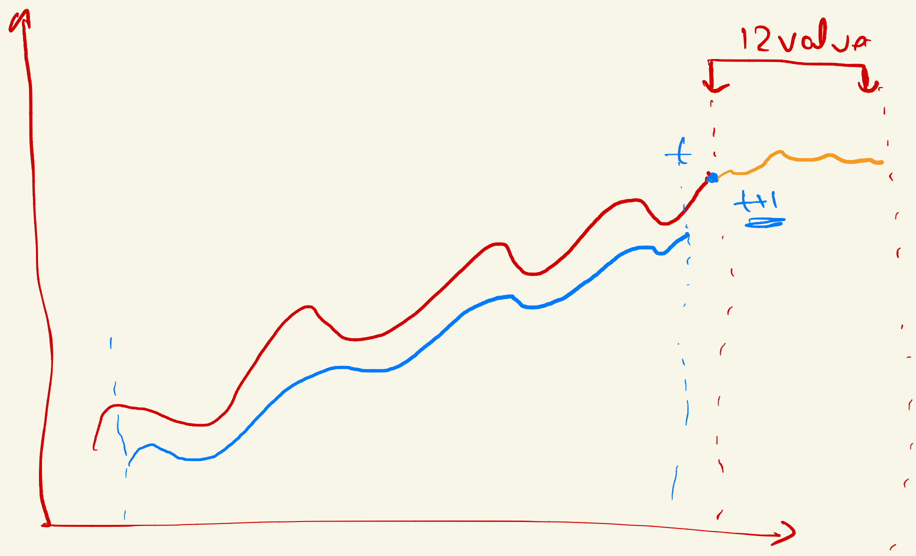
⇒ Splitted
- → Train → Jan 2001 → Jan 2018
- → Test → Feb 2018 → Jan 2019

→ How to get last 3 day MA for Feb 2018

Nov 17 Dec 17 Jan 2018

New Data Point



⇒ 

directly rolling avg

$$\left(\frac{P_t + P_{t-1} + P_{t-2}}{3}\right)$$

Last 12 value

⇓

Push them as y_{pred}

⇒ Smoothing ↳

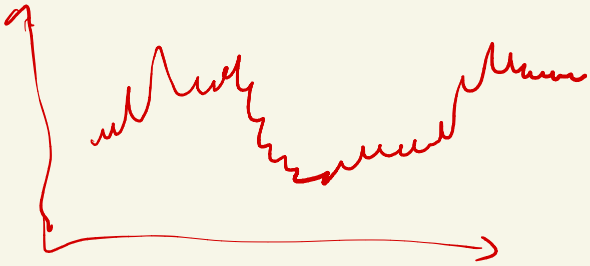
① SES → Single Exponential Smoothing

→ naive approach = give weightage to last value

→ mean approach = give weightage to all historical value

⇒ Give higher weightage to the recent value but give at least some weight to other value

⇒ only work on non-seasonal data



$$\hat{y}_{t+1} = y_t$$

$$\hat{y}_{t+1} = \frac{y_t + y_{t-1} + \dots y_0}{t}$$

SES $$\hat{y}_{t+1} = \alpha_t y_t + \alpha_{t-1} y_{t-1} + \dots + \alpha_1 t_1$$

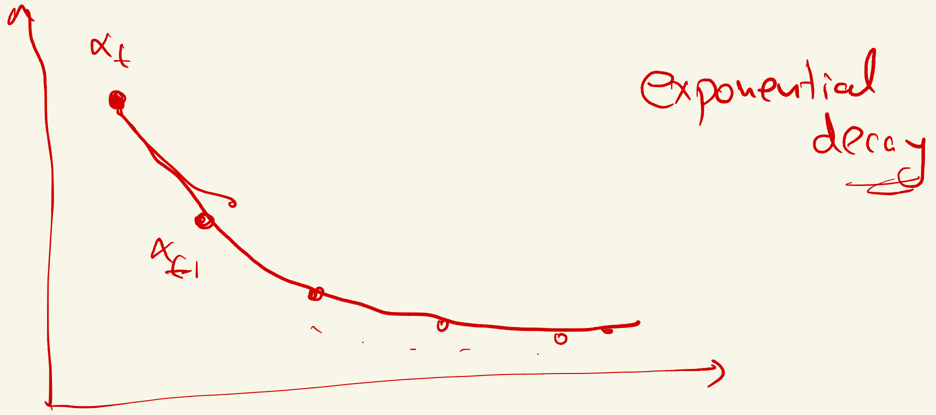
⇒ α_t → should be high ↓

α_1 → should be low

S values

	t	$t-1$	...		
↳	0.3	0.2	0.1		$= [1]$
↳	1	0	0	0 0	⇒ naive approach
↳	0.1	0.1	0.1 ...		⇒ mean approach

⇒ Exponential decay



$$\Rightarrow \hat{y}_{t+1} = \underbrace{\alpha}\, y_t + \underbrace{\alpha(1-\alpha)}\, y_{t-1} + \underbrace{\alpha(1-\alpha)^2}\, y_{t-2} + \dots$$

G.P $\quad \alpha, \ \alpha(1-\alpha), \ \alpha(1-\alpha)^2, \dots$

exponential decay