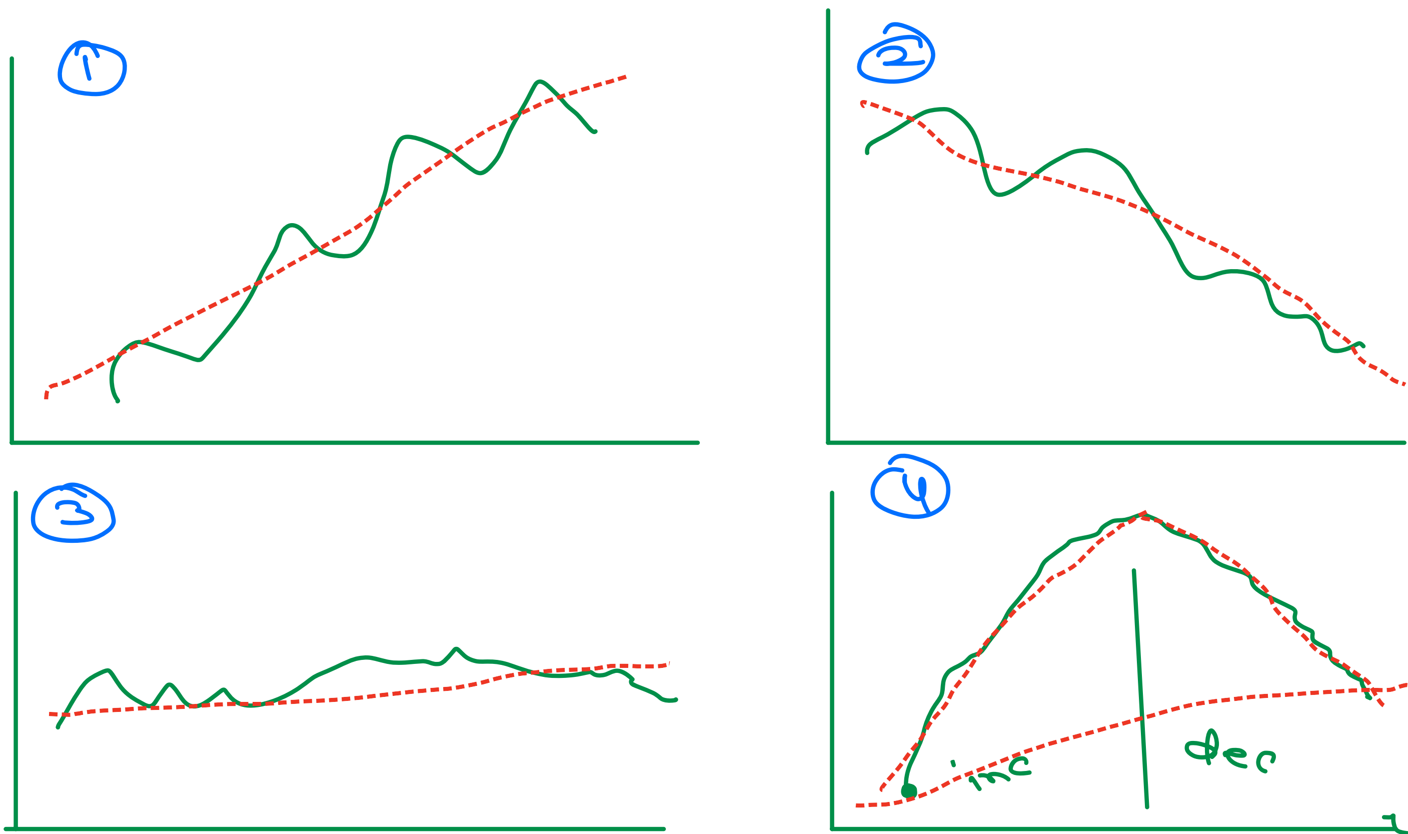
AGENDA:

* Revision
* Trend and Seasonality
* Seperating Trend and Seasonality
* Moving Average
* Implementing Decomposition with Stats Model
* MAPE
* Generating ForeCast with TS Models

Trend

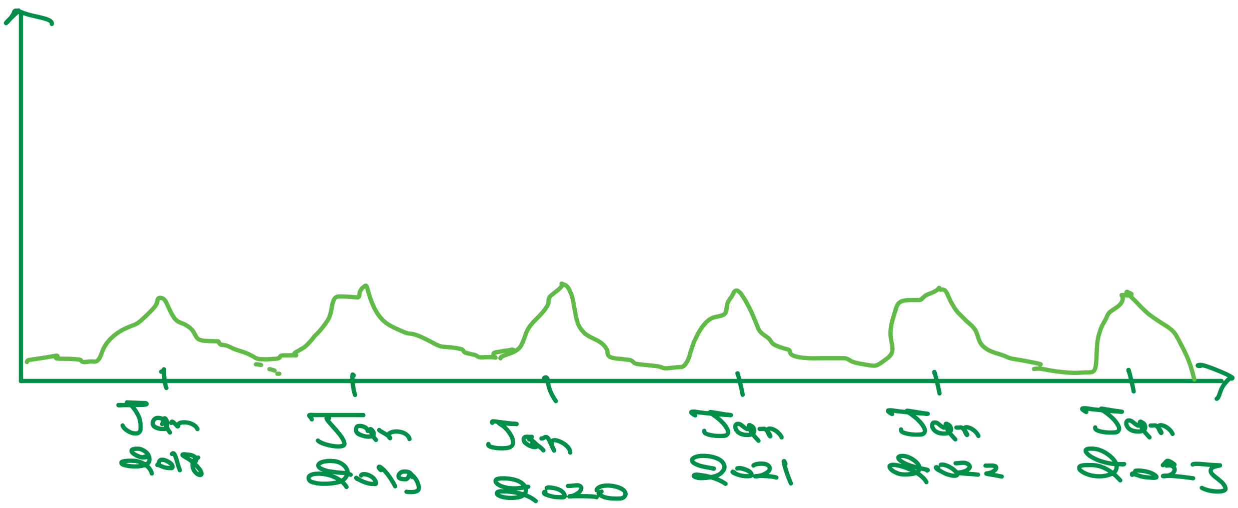
1) Trend can be thought of as the increasing or Decreasing behaviour of Time-Series over long period



Trend doesn't Need to be Straight line

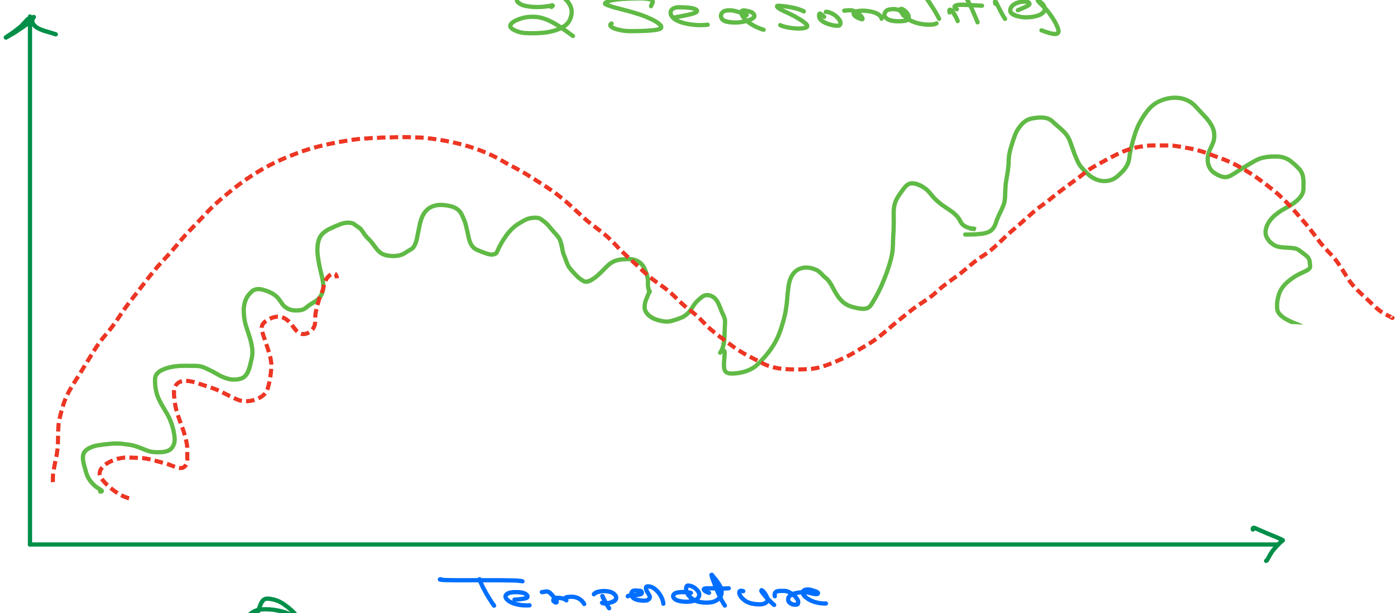
Seasonality

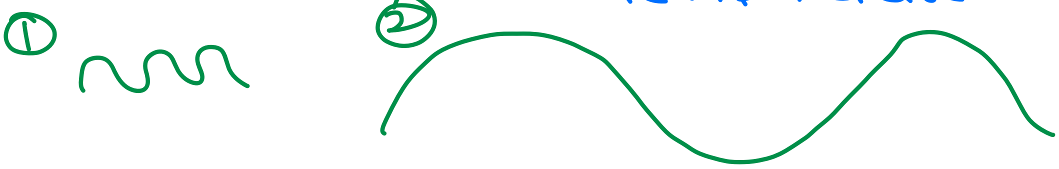
→ Seasonality refers to a **Repeating Pattern** that occurs at Regular Intervals



Sales of Sweater

2 Seasonalities





How Can we Seperate Trend and Seasonality From Time-Series

Time Series Decomposition (ETS Decomposition)

Additive

Multiplicative

$y_t = f(\text{trend}, \text{seasonality}, \text{Error/residual})$

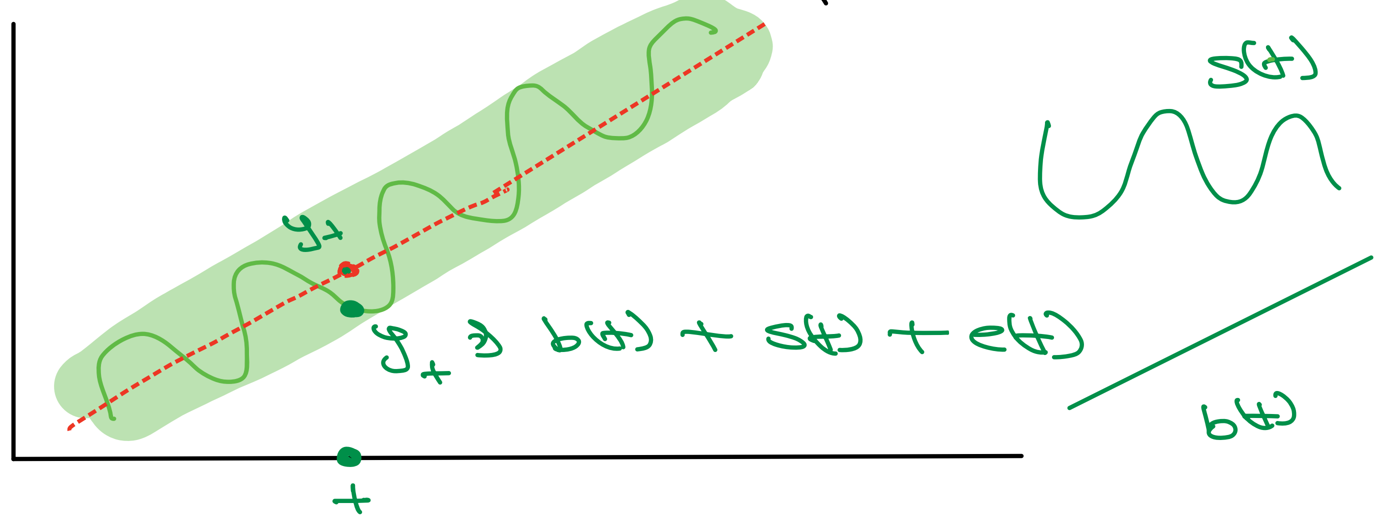
* Additive

$$y_t = \underbrace{b(t)}_{\text{trend}} + \underbrace{s(t)}_{\text{seasonality}} + \underbrace{e(t)}_{\text{residual}}$$

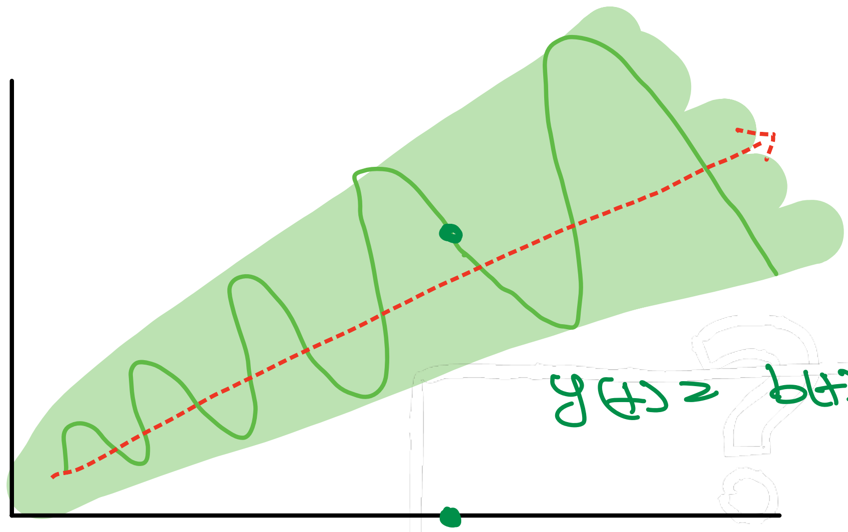
$e(t) = y_t - b(t) - s(t)$ 98

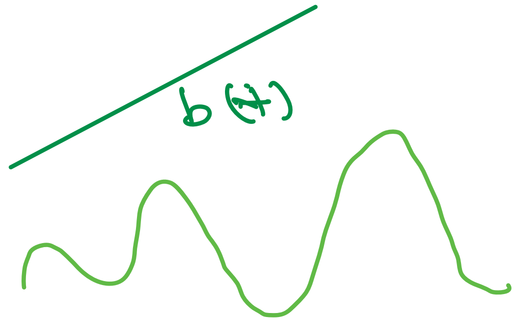
Ex 1:

ETS Decomposition



Ex2: Multiplicative SD





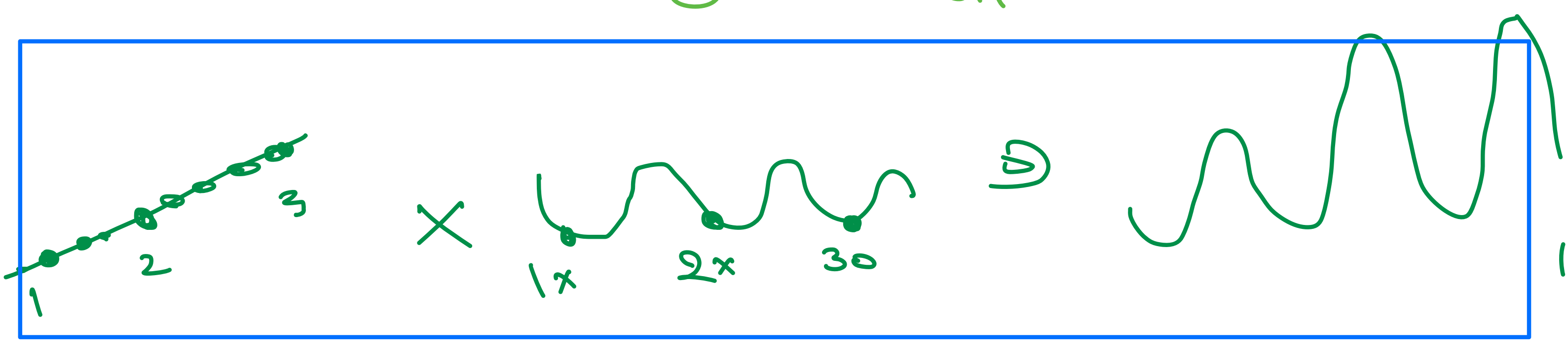
$y(t) = b(t) * s(t) * e(t)$

$e(t)$

add → $y(t) \rightarrow b(t) + s(t) + e(t)$

$e(t) \rightarrow y(t) - \underbrace{(b(t) + s(t))}_{\hat{y}_t}$

$e(t) \rightarrow y(t) - \hat{y}_t$



if e(t) has still som pattern we can again try model

$e(t) \rightarrow b'(t) + s'(t) + e'$

So How can we get trend from any given Time Series?

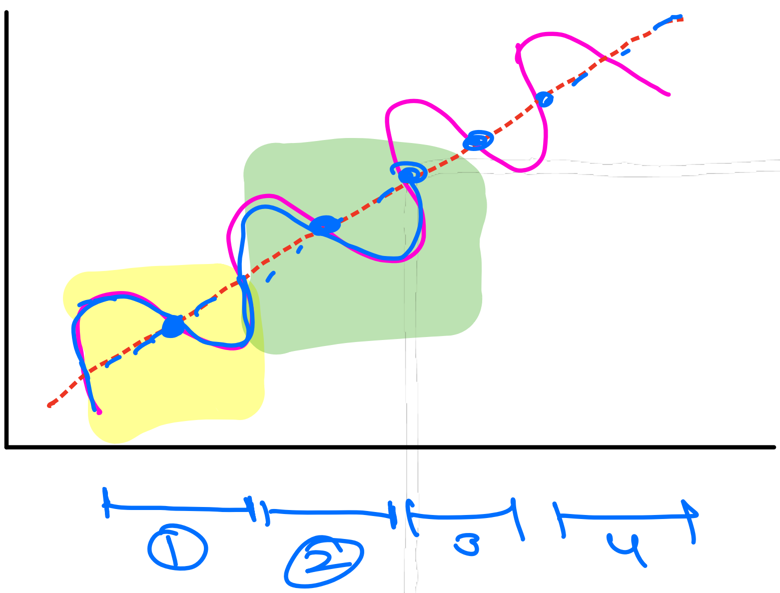
if we have $b(t)$ and $s(t)$

$$\hat{y}_t \Rightarrow s(t) + b(t)$$

or

$$\hat{y}_t \Rightarrow s(t) \times b(t)$$

Calculating Trend



Seasonality yearly

Can we take Average a full season

Decide a window size (Typically a full season) and calculate moving Average

$w \Rightarrow 3$

T	Sale
t_1	5
t_2	8
t_3	10
t_4	13
t_5	12

$\frac{5+8+3}{3}$ $\quad t_3 \quad 7.7$

$\frac{8+10+13}{3}$ $\quad t_4 \quad 10.3$

$\frac{10+13+12}{3}$ $\quad t_5 \quad 11.6$

? X

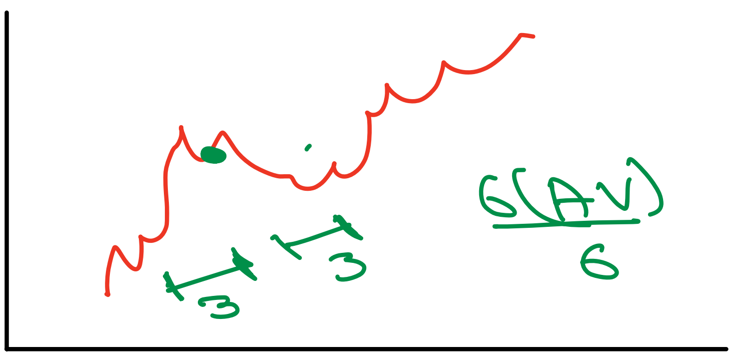
$w = m$

$$mA_{(t)} = \frac{y_{t-1} + y_{t-2} + y_{t-3} \cdots y_{t-m}}{m}$$

SMA $\boxed{mA_t = \frac{1}{m} \sum_{i=t-m}^{t} y_i}$

$\boxed{\text{CMA}}$

$w \Rightarrow 3$

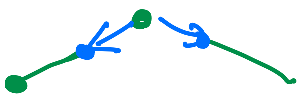


$\frac{6(AV)}{6}$

$$cma_t = \frac{1}{2m+1} \sum_{i=t-m}^{t+m} y_i$$

Q Linear Interpolation is a Variation of CMA?

LAD CMA $w=1$



$y(b(t)) \Rightarrow 100 \quad 100$
$\downarrow$
t

$E(t)$

$E_{additive} \Rightarrow y_t - (b(t) + s(t))$

$E_{multiplicative} \Rightarrow \frac{b(t) * s(t)}{y(t)}$ $\quad \frac{y(t)}{\frac{1}{s(t)} \times \frac{1}{b(t)}} \Rightarrow \hat{y}(t)$

$y(t) \Rightarrow b(t) \times s(t) \times e_t$

$\Rightarrow \frac{\hat{y}}{y_t}$

If your Error has some pattern

ex:- $y_t \Rightarrow b_t + s_t + e_t$

$\Rightarrow b_t + s(t) + (b'_t + s'_t + e'_t)$

Nested Decomposition

Q) Is there pattern in Error?

If Errors are distributed Normally and mean of Error is close to 0 we can say that we are Neither Underforecastin Nor Overforecasting

* Agenda : Point Forecast Mape ≤ 5%

$$\boxed{\begin{array}{c}\text{MAPE} \\ \text{(mean absolute percentage Error)}\end{array}}$$

$$\text{MAPE} \quad \frac{1}{N}\sum_{i=1}^{N}\frac{|y_i - \hat{y}_i|}{y_i}$$

$\hat{y} \Rightarrow 98$

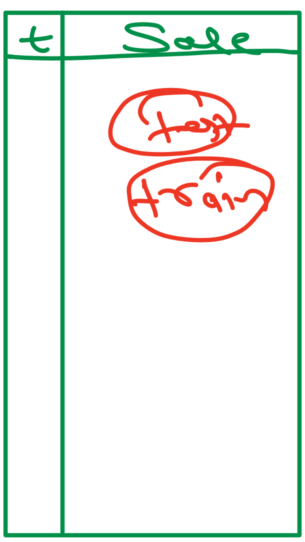
$y \Rightarrow 100$

$$\frac{y_i - \hat{y}}{y_i} \Rightarrow 0.02$$

PE

* We don't need other models to compare
* Relative Error % wrt actual values

Can we use standard train-test split?

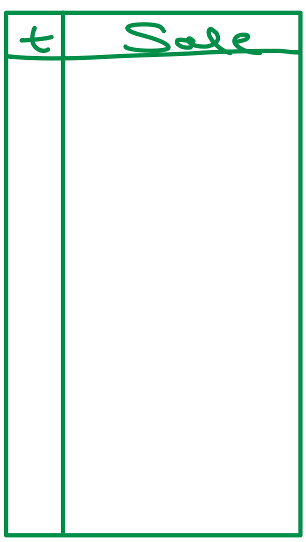


Shuffle

60% train
20% test
20% Validation

rand

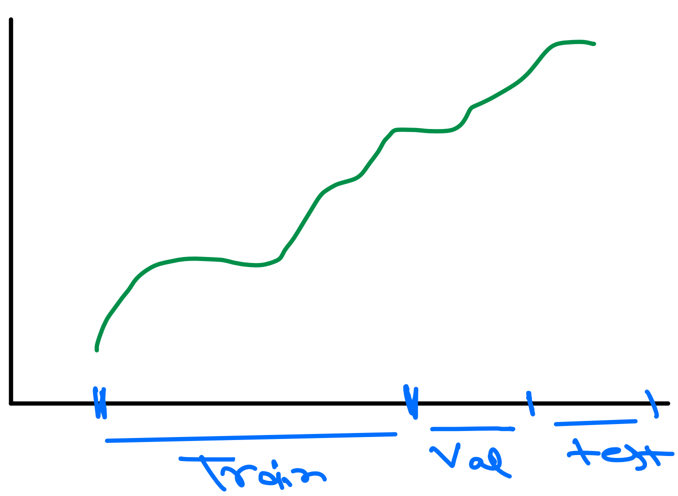
X



Train

Val

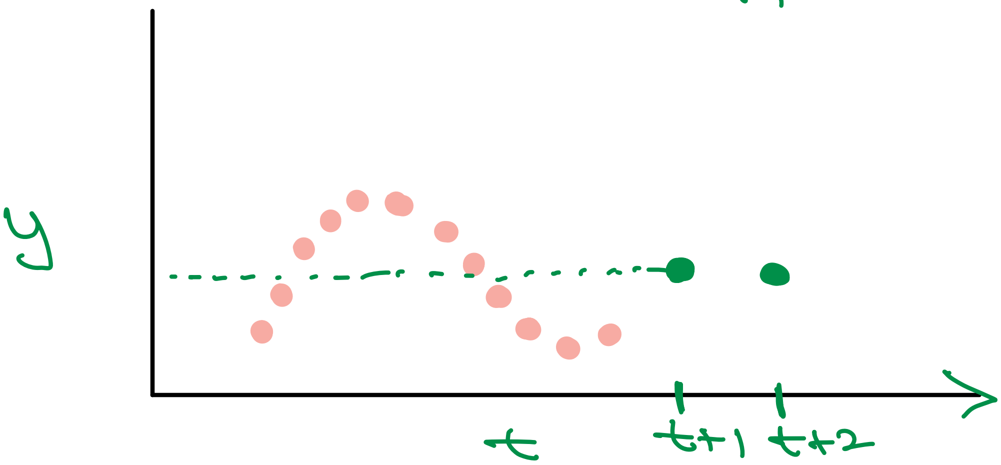
test



Simple Forecast Model

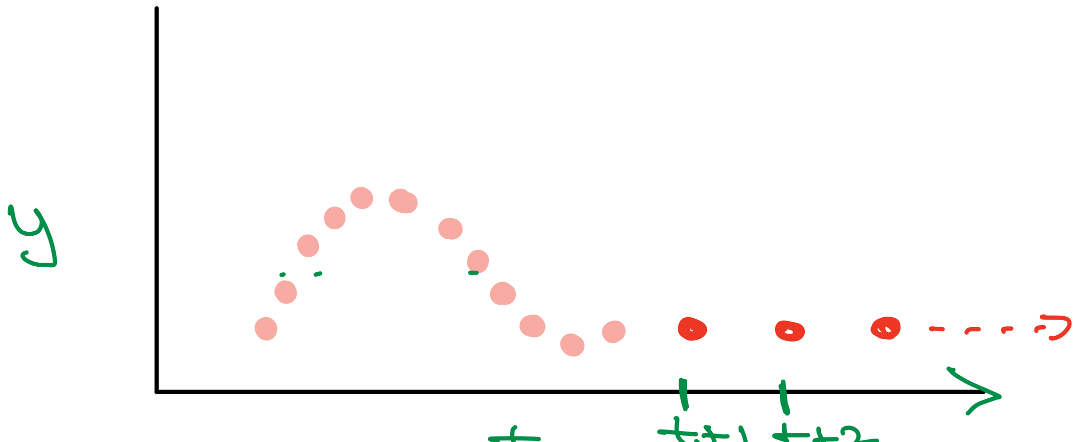
* mean or median

$$\bar{y} \Rightarrow \frac{y_1 + y_2 \cdots\cdots y_n}{n}$$



Conclusion : Mean and median are bad

Naive Approach

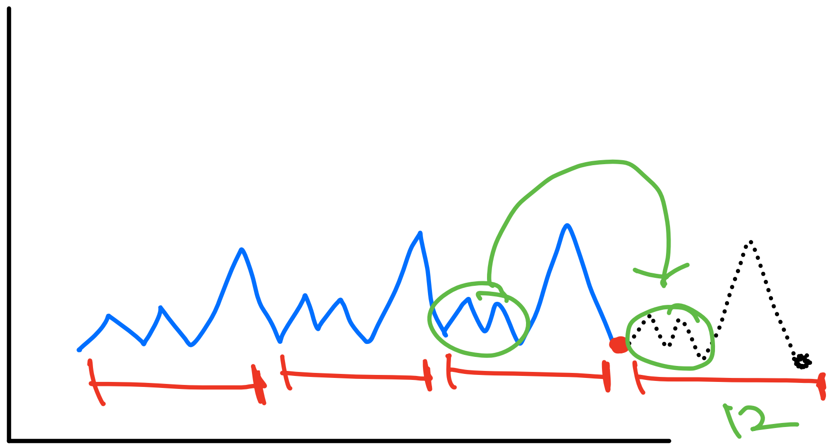


Feb ⇒ 105

March, 105

Apr ⇒ 105

Seasonal Naive Forecast



$$\hat{y}_{t+h} = y_{t-T+h}$$

T → season length