

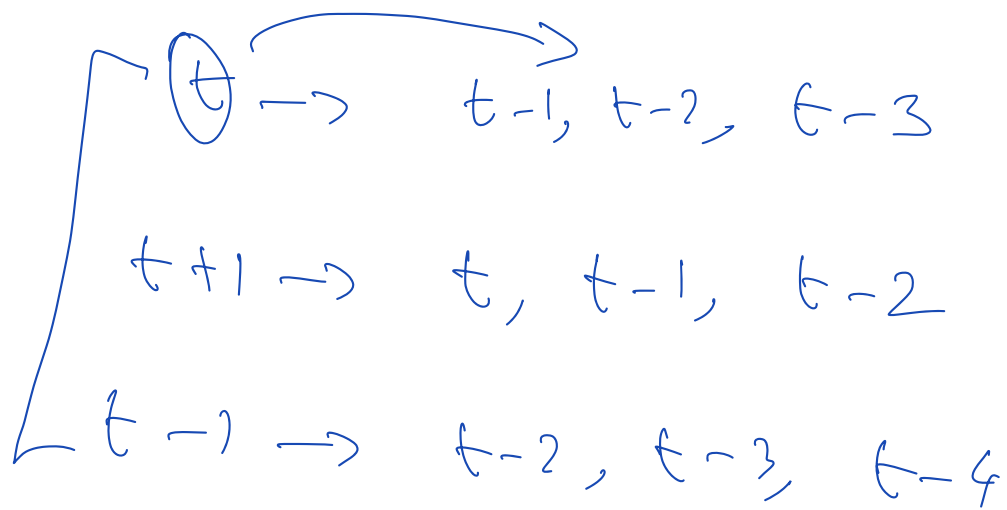
## Last class

- 1) How time series data looks like?
- 2) Handling missing values
- 3) Anomalies handling
- ~~4) Breaking down a time series~~
- ~~5) Moving Averages~~
- ~~6) Trend~~
- ~~7) Seasonality~~
- ~~8) Intro to time series decomposition~~

## Today's class

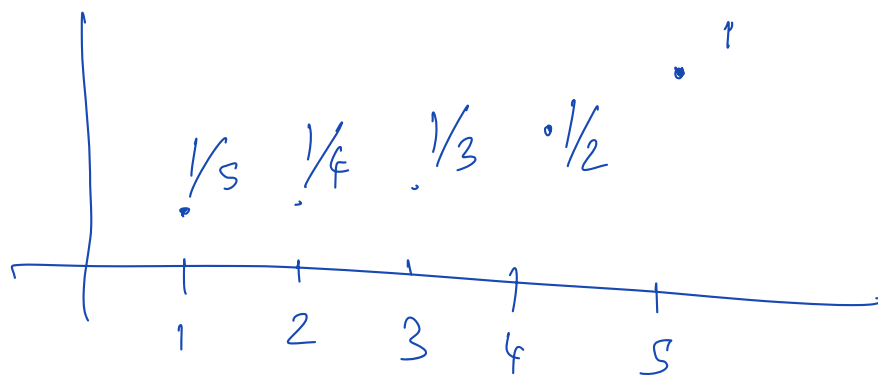
- 1) Breaking down a time series
- 2) Moving averages
- 3) Trend
- 4) Seasonality
- 5) Time Series decomposition
  - ↳ Decomposition from scratch

$n=3$



WMA: more weights  $\rightarrow$   $t-1$  value

len weights  $\rightarrow$   $t-m$  value

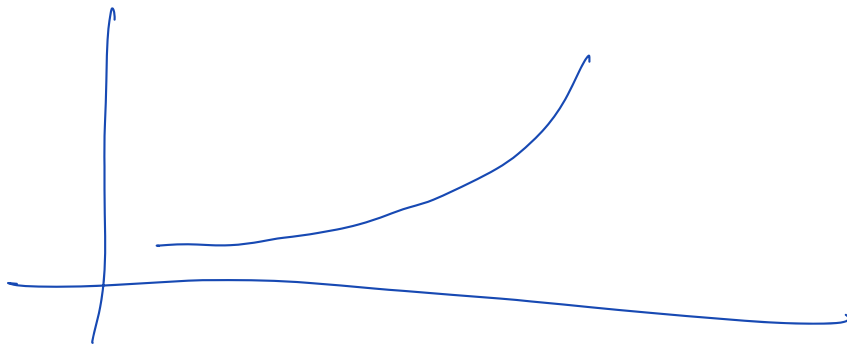


$$\begin{aligned}
 m A &= 1 \cdot y_{t-1} + 1 \cdot y_{t-2} + \\
 &1 \cdot y_{t-3} + 1 \cdot y_{t-4} \\
 &+ 1 \cdot y_{t-5} \\
 &\hline
 (1+1+1+1+1)
 \end{aligned}$$

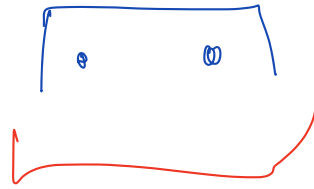
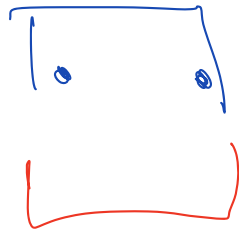
$$\begin{aligned}
 wMA(\hat{y}_t) &= \left( 1 \cdot y_{t-1} + \frac{1}{2} y_{t-2} + \frac{1}{3} y_{t-3} \right. \\
 &\quad \left. + \frac{1}{4} y_{t-4} + \frac{1}{5} y_{t-5} \right) \\
 &\quad \hline
 \left( 1 + \frac{1}{2} + \frac{1}{3} + \frac{1}{4} + \frac{1}{5} \right)
 \end{aligned}$$

$a_1, a_2, a_3, \dots$

$$den = \sum_{i=1}^m a_i$$



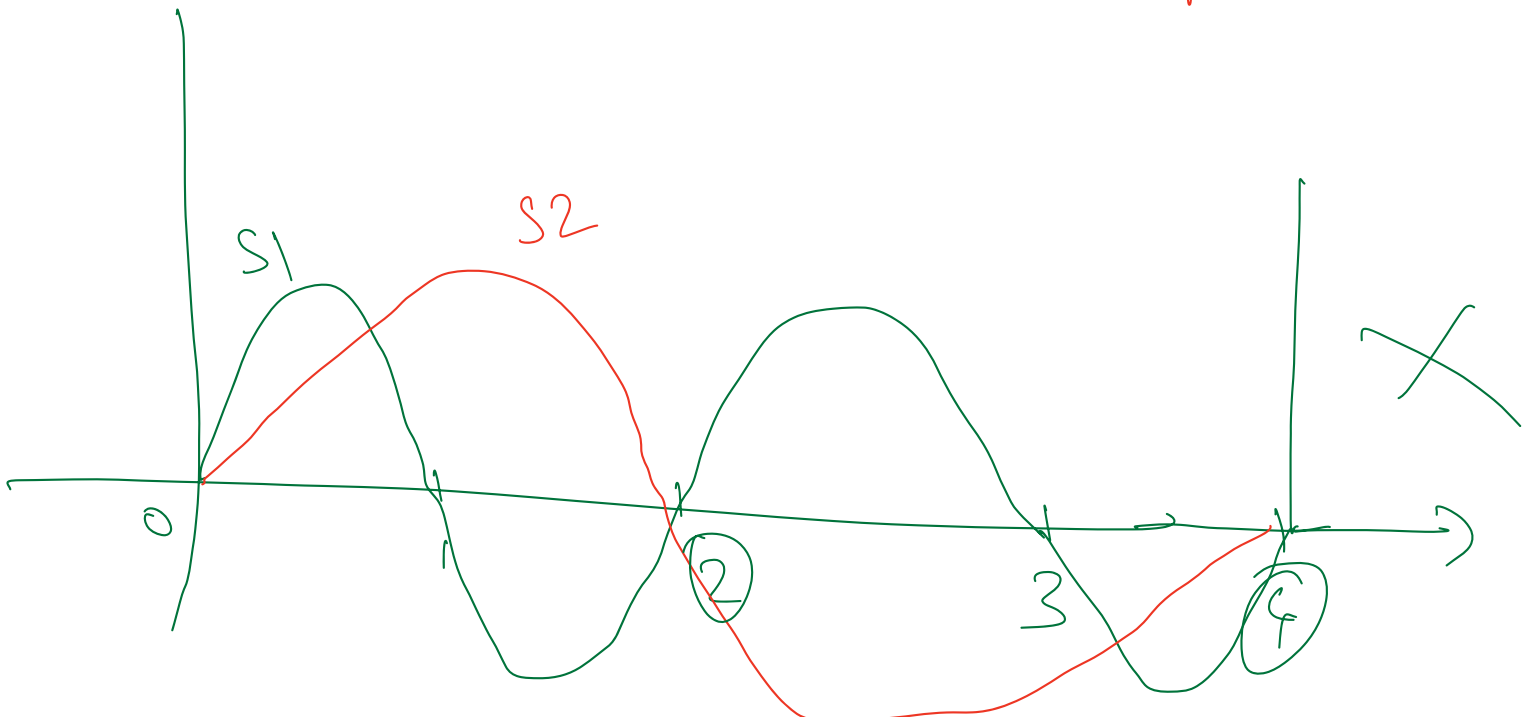
$$WS = 5$$



$$WS = 4$$

$$y = \underbrace{a \sin(kt)}_{\text{repeating pattern}} + \underbrace{bt^2 + ct + d}_{\text{non-repeating pattern}}$$

repeating pattern



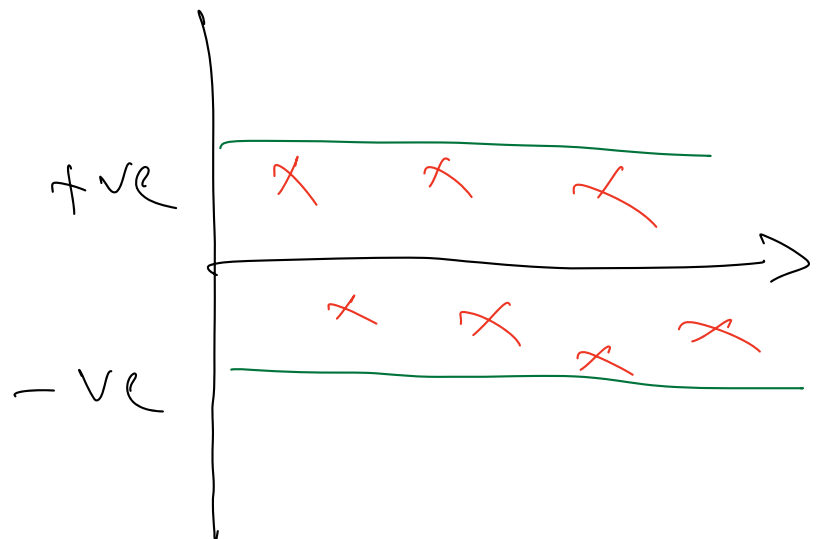
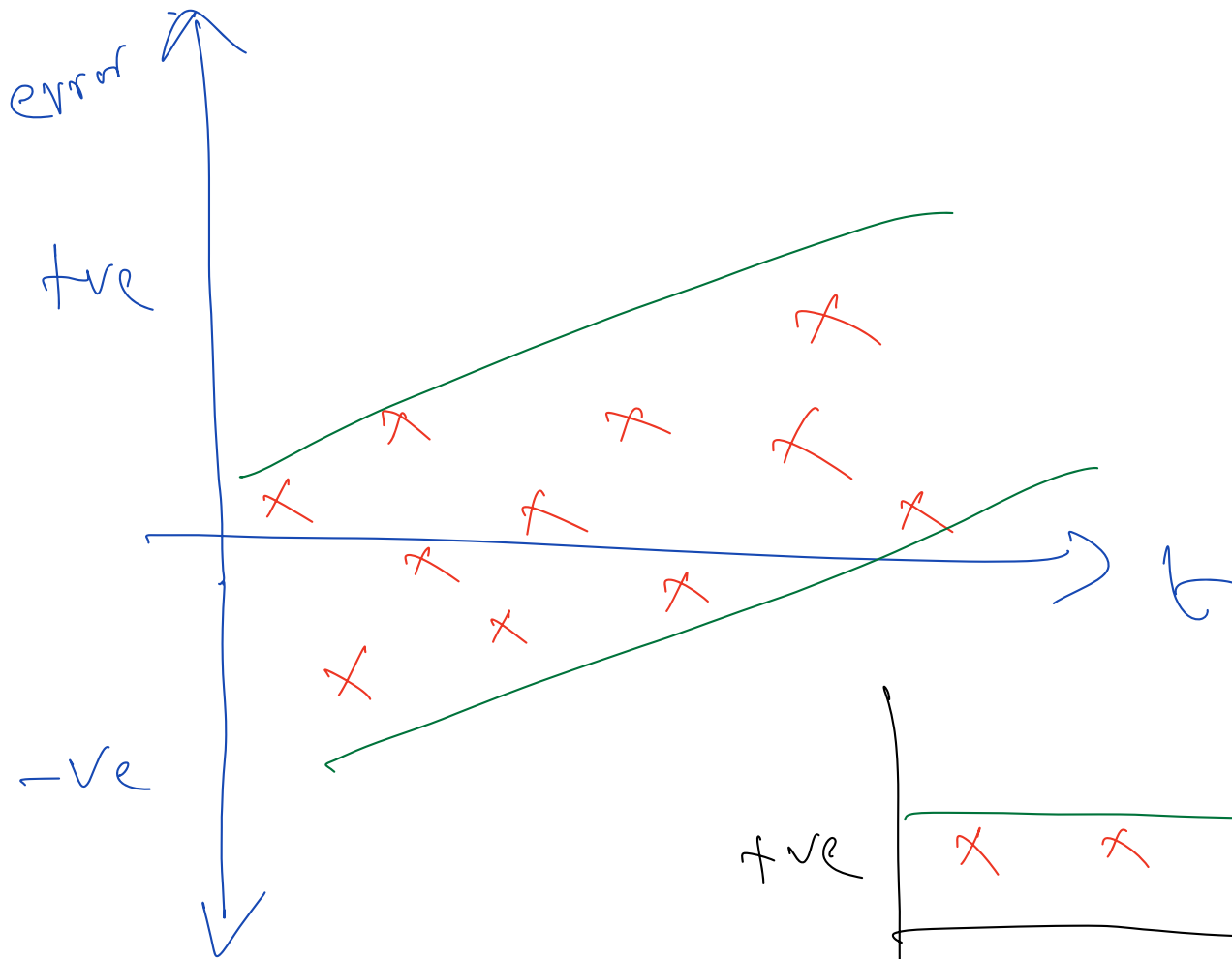
$$b(t) = \underline{at^3 + bt^2 + ct + d}$$

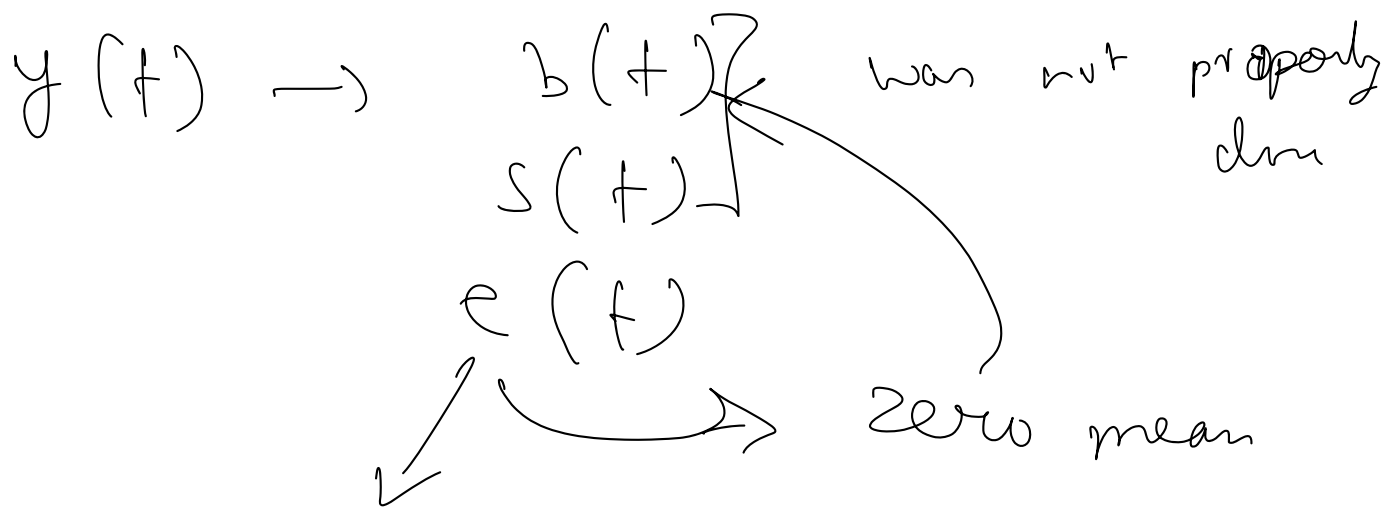
$$s(t) = A \sin(k_1 t) + B \cos(k_2 t) \quad \downarrow \text{trend (comp.)}$$

Seasonal  
(comp)

$$+ C \sin(k_3 t)$$

$$+ D \sin(k_4 t) + \dots$$





$$b_1(t), \quad s_1(t), \quad e_1(t)$$

trend:  $b(t) + b_1(t)$

season:  $s(t) + s_1(t)$

error/res:  $e_1(t)$