

Forecasting Models

LSTM.

→ Forecasting.

1. Naive Models

→ No Trend,
No Seasonality

2. Moving Averages

3. Smoothing Techniques.

4. Autoregression Models.

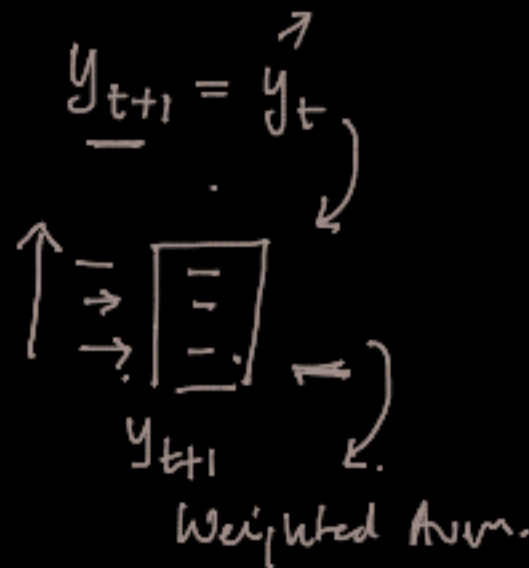
Single Exp. Smoothing (SES)

Double Exp. Smoothing (Holt)
Trend, No Seasonality

Triple Exponential Smoothing
(Holt-Winter)

- AR →
- MA →
- ARMA →
- ARIMA →

Stationary Trend + Seasonality
— No trend, No Seasonality —



→ Can handle Trend

SARIMA

→ Seasonal Arima

$$\alpha = 0.4$$

$$y_t = \alpha y_{t-1} + (1-\alpha) y_{t-2} + (1-\alpha)^2 y_{t-3} \dots$$

| Time (t) | y |
|-------------|-----------|
| 1 | |
| 2 | |
| 3 | y_{t-2} |
| ⋮ | y_{t-1} |
| 4 | y_t |

↑ Past
(x).

↓ Forecast
future
(y).

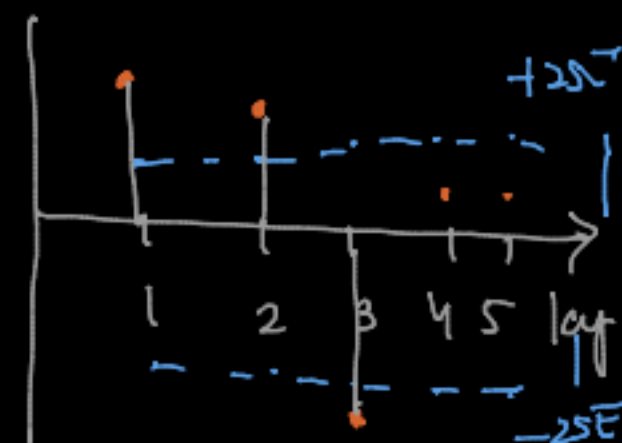
AR-Model.

→ How many terms to include-?

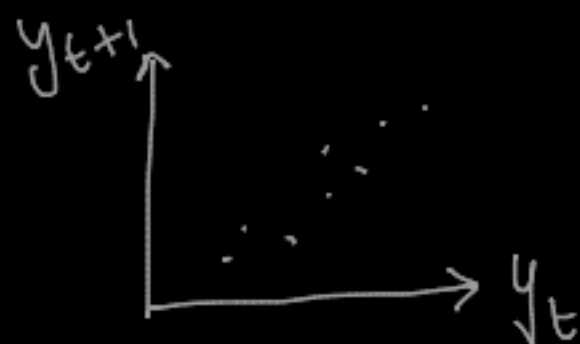
→ Order of the model

→ PACF

PACF.

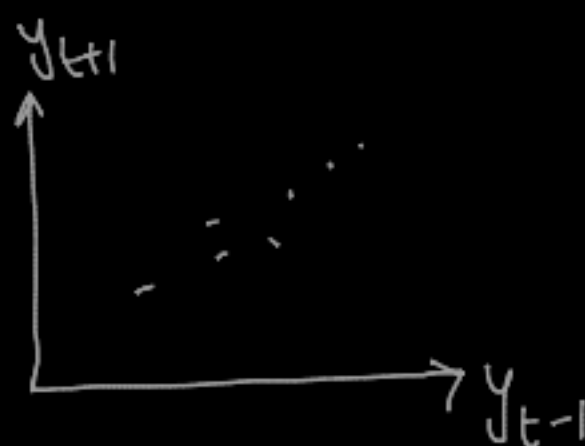


Step 1! Try lag plot -



lag 1.

PACF = lag 1



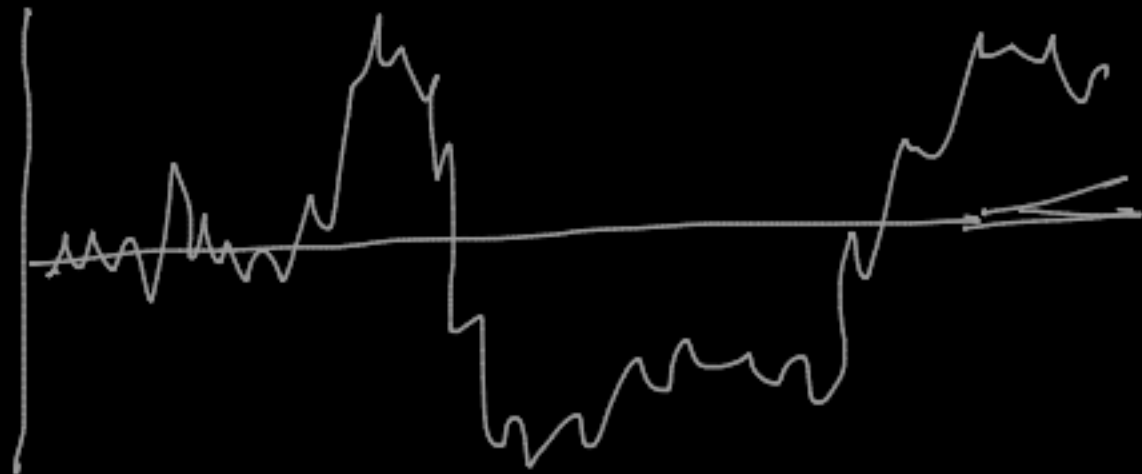
lag 2

PACF = lag 2

Order - 3 AR(3).

$$y_{t+1} = \beta_0 + \beta_1 y_t + \beta_2 y_{t-1} + \beta_3 y_{t-2}$$

→ AR Eqn.



MA \rightarrow Standalone

$$y_t = \phi_0 + \phi_1 \varepsilon_{t-1} + \phi_2 \varepsilon_{t-2} + \dots$$

\rightarrow Constant

$\phi_0 = 10 \rightarrow$ Every week

$$y_t = \phi_0 + \phi_1 \varepsilon_{t-1}$$

10 0.5 \rightarrow unimodal

$$10 + 0.5(-2)$$

$$10 - 1 = 9$$

| | y | \hat{y} | $y - \hat{y}$ |
|-------------------|-----|-----------|---------------|
| W_1 | 8 | 10 | -2 |
| $\rightarrow W_2$ | 11 | 9 | +2 ✓ |
| W_3 | 11 | 11 | 0 ✓ |

$$= 10 + 0.5(2)$$

$$= 10 + 1$$

$$= 11$$

10 10 0

10 \downarrow

ARMA -

$$y = \beta_0 + \beta_1 y_{t-1} + \beta_2 y_{t-2} + \dots + \phi_0 + \phi_1 \varepsilon_{t-1} + \phi_2 \varepsilon_{t-2}$$

← AR →

PACF.

← MA →

ACF → order.

MAC(1) → MAC(2) → ✓

MAC(2) → MAC(3) → ✓

ARMA(0,1).

→ MA(1).

MAC(4) →

MAC(5) — ✗.

→ ✓

AR(p)MA(q).

order
of AR

→ order
of MA.

← ARIMA →

↓
AR(p) I(d) MA(q)

↳ Integration
→ done first.

First order differencing

Differencing → d - order of difference.

| Time (t) | y | Δy | Δy |
|----------|-----------|------------------|------------------|
| ... | ... | ... | ... |
| n-3 | y_{t-3} | | |
| n-2 | y_{t-2} | Δy_{t-2} | |
| n-1 | y_{t-1} | Δy_{t-1} | Δy_{t-1} |
| n | y_t | Δy_t | Δy_t |

$\Delta y \rightarrow$
 Δy_t

