

# ACF, PACF and Autoregression

ACF  $\rightarrow$  Auto correlation function

PACF  $\rightarrow$  Partial Auto correlation function.

ACF  $\rightarrow$  Auto + Correlation  
 $\downarrow$   $\downarrow$   
 Correlation Relationship b/w two feature.  
 itself in the feature.

\* ACF measures the correlation between time series & its lag value

Date	y
Jan	10
Feb	20
Mar	30
Apr	40

$\downarrow$   
time series data

Month	$y_t$	1st lag	2nd lag	3rd lag
Jan	10	NA	NA	NA
Feb	25	10 (Jan)	NA	NA
Mar	35	25 (Feb)	10 (Jan)	NA
Apr	42	35 (Mar)	25 (Feb)	10 (Jan)
May	50	42	35 (Mar)	25 (Feb)
June	55	50	42	35
July	62	55	50	42

$y_t$

$y_{t-1}$

$y_{t-2}$

$y_{t-3}$

Auto correlation

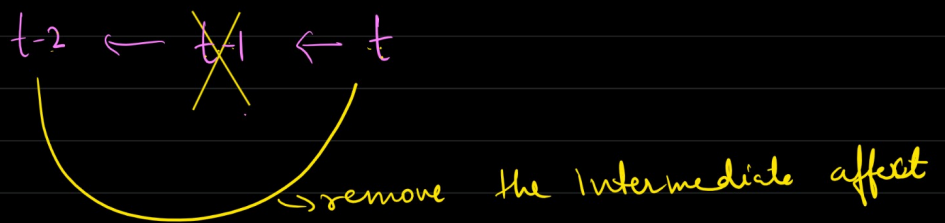
{ Pearson,  
Spearman  
rank,  
Kendall }

Corr ( $y_t, y_{t-1}$ )

Cor ( $y_t, y_{t-2}$ )

Corr ( $y_t, y_{t-3}$ )

# Partial Autocorrelation Function (PACF)



Month	$y_t$	$y_t - y_{t-2}$
$t-6$ Jan	10	
$t-5$ Feb	18 X	
$t-4$ Mar	25	15
$t-3$ April	29 X	
$t-2$ May	35	10
$t-1$ June	45 X	
$t$ July	50	15

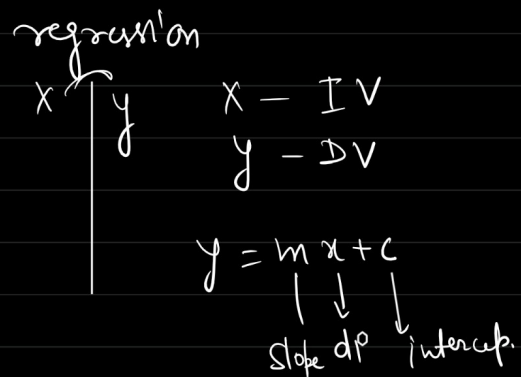
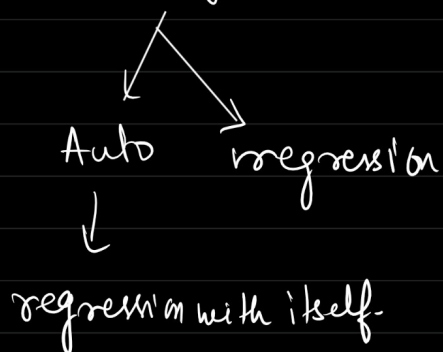
25	15
35	10
50	15

PACF

$$y_t - y_{t-3}$$

$$y_t - y_{t-4}$$

## \* Auto regression



$$y_t = \psi y_{t-1} + c$$

$$MLR \geq y = \theta_0 + \theta_1 x_1 + \theta_2 x_2 + \theta_3 x_3 + \dots + \theta_n x_n$$

$$y_t = \psi_1 y_{t-1} + \psi_2 y_{t-2} + c$$

$y_t$  - value at current timestamp  
 $\psi$  - Coeff

$$\theta_0, \theta_1, \theta_2, \dots = \text{Coeff.}$$

$$y_t = \psi_1 y_{t-1} + \psi_2 y_{t-2} + \psi_3 y_{t-3} + c$$

$c$  - Constant.  
 $\epsilon \rightarrow$  Error.

$$y_t = \varphi_1 y_{t-1} + \varphi_2 y_{t-2} + \varphi_3 y_{t-3} + \dots + \varphi_n y_{t-n} + \epsilon$$

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How to decide if you have to go till  
 $t-1$ , or  $t-2$  or  $t-3$ ??



ACF / PACF

ARIMA