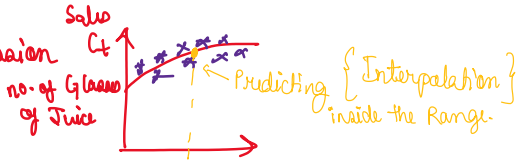
Time Series

Saturday, 11 May 2024 2:23 PM

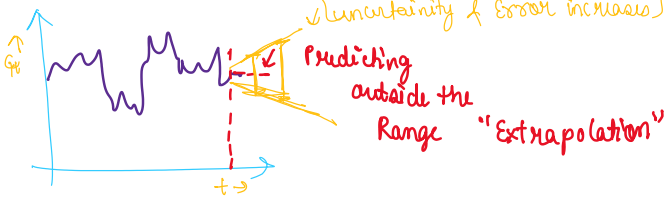
why time series?

Regression



{Uncertainity & Error increases}

Time series



Time series

Sequentially ordered data over time

Observations are typically collected at regular intervals

- Every second | minute | hourly
- Daily
- Monthly
- Quarterly / Yearly

The time series analysis is also known as trend analysis helps identify trends or patterns in data to time

Analysis Methods in time series

- Descriptive analysis: Using graphical methods to understand and determine the trends or pattern in time series

Spectral Analysis: The idea is to decompose a stationary time series into combination of sinusoids. This kind of analysis helps separate the periodic and cyclic components in time series data.

forecasting: It is the predictive analysis method based on historical trends in data

Intervention analysis: Intervention analysis is used to understand the effect of an intervention on time series, that is if a particular event has triggered a change of pattern in time series.

Explanative analysis: Studies the cross-correlation or relationship between two time series and the dependance of one another.

The two main types of pattern that are found in time series are

* Seasonal patterns or periodic patterns
* Cyclic patterns.

Seasonal patterns: A time series is known as seasonal or periodic time series if the same behaviour is repeats over some time, and the periodic interval is fixed / known.

Cyclic Patterns: Cyclic patterns are mostly patterns that do not have fixed period.

Moving Average Model

t	$\hat{f}_t$	ε_t	f_t
1	10	-2	8
2		1	
3		0	
4		1	
5		2	

normal distribution

$N(\mu_\varepsilon, \sigma_\varepsilon)$

μ_ε → 0 → mean

σ_ε → 1 → Standard deviation

ε_t is number of cupcake which are extra or less

$\mu \Rightarrow$ mean $\Rightarrow$ 10

The function to calculate moving average is as follows.

$$\hat{f}_t = \mu + \phi_1 \varepsilon_{t-1}$$

μ ← mean

ϕ_1 ← Standard Co-efficient

ε_{t-1} ← Previous Error

← how wrong you were in previous month to make correct Estimation in month.

Day 1 ←

t	$\hat{f}_t$	ε_t	f_t
1	10	-2	8
2	9	1	10
3	10.5	0	10.5
4	10	2	12
5	11	1	12

$10 + [0.5 * (-2)]$

μ ϕ_1 ε_{t-1} ← Error from previous month

(2) → $10 + [0.5 * 1]$

(3) → $10 + [0.5 * 0]$

(4) → $10 + [0.5 * 1]$

(5) → $10 + (0.5 * 2)$

Auto Regressive Integrated Moving Average (ARIMA)

Autoregressive : A model that uses the relationship between an observation and some observation that happened before time.

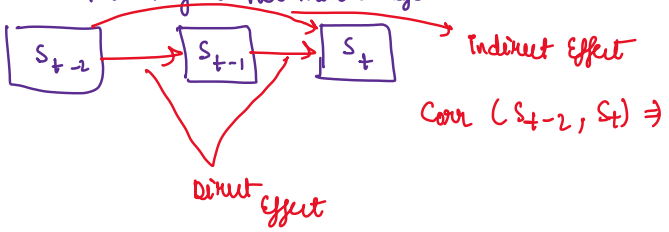
ACF [Auto Correlation function]

predict the average monthly price of Gold

S_t = Avg ₹ this month

S_{t-1} = Avg ₹ last month

S_{t-2} = Avg ₹ two months ago



Corr $(S_{t-2}, S_t) \Rightarrow$

$$r_{xy} = \frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^{n}(x_i - \bar{x})^2}\sqrt{\sum_{i=1}^{n}(y_i - \bar{y})^2}}$$

n : no. of samples

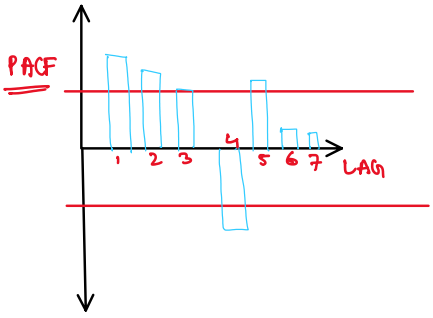
x_i, y_i are the individual sample points indexed with i

$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i$ (sample mean)

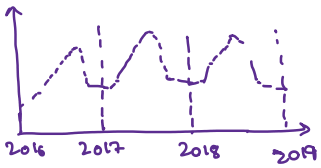
For PACF {Partial Autocorrelation}, just $S_{t-2} \rightarrow S_t$

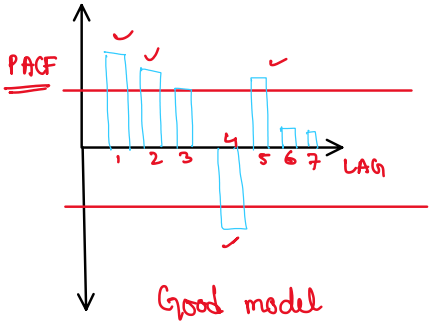
$$S_t = \phi_{21} S_{t-1} + \phi_{22} S_{t-2} + \varepsilon_t$$

PACF $k = 2$



Auto Regressive

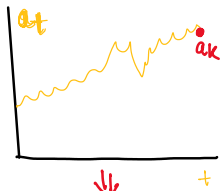




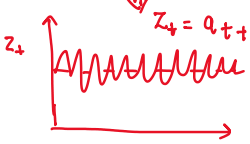
Good model

$$m_t = B_0 + B_1 m_{t-1} + B_2 m_{t-2} + B_4 m_{t-4} + B_5 m_{t-5} + \varepsilon_t$$

Integrated: The methodology of subtracting the observation values to result in a series that is more stationary and uniform.



$$Z_t = a_{t+1} - a_t \quad \text{---} \quad (Eq1)$$



ARIMA (1, 1, 1)
P Q d

$$Z_t = \phi_1 Z_{t-1} + \theta_1 \varepsilon_{t-1} + \varepsilon_t$$

P = lag order
number of lag observations included in model

d = Difference of degree
The number of times that raw observations are differenced

q: order of moving average
The size of moving average window

Recover a_K ?
suppose Have $a_0, a_1, \text{---}, a_L$

from Eq①

$$a_K = Z_{K-1} + a_{K-1} = Z_{K-1} + Z_{K-2} + a_{K-2} = \text{---}$$

$$\sum_{i=1}^{k} Z_{K-i} + a_L$$