

Reveals temporal behaviour of underlying mechanism that produce data.

Time Series databases

↓
consists of sequences
of values or events
that change over time.
+
recorded at regular
intervals.

- **Applications** → Financial (Stock market, Sales)
Industry (Power consumption, quality control)
Meteorological (temperature, wind, earthquakes)
- **Goals** → Modeling time series (kisi factor ka data ke behaviour or kya kya hai)
Forecasting time series (future values ko predict kr skain)
- **Methods** →
 - Trend analysis
 - Similarity Search.

Trend Analysis (Application of statistical techniques)

- e.g. → Regression analysis
- **Goal** → construct a model that explains behaviour of data (without needing to understand underlying physics or other factors behind data generation)
- **Regression analysis (RA)** →
 - modeling time series
 - finding trends / finding outliers.
 - Numerical data analysis in which one dependent variable (known as response variable) (or) one or more independent variables values is there.
 - Dependent variable is used as function of the independent variables & their parameters + error term.

shows how strongly X & Y move together.



- Correlation (measured using Pearson Correlation coefficient (PCC))

1 (perfect as $X \uparrow, Y \uparrow$)

-1 (opposite $X \downarrow, Y \uparrow$)

0 (no relationship X & Y are not related)

• Regression trend channels (RTC)



Based on std of linear regression.

- Consists of 3 parallel lines.

a) Center line is linear regression line

b) Upper & lower lines are at ± 1 std from center line.

- Linear Regression is simplest type of regression.
- Non-linear regression
- Bayesian method (use probability to improve predictions)
- Regression analysis can not capture all trend movements in real-world data. / solution is to break down time-series data into basic movements

• Time Series movements (components)

Trend (T) - show long-term direction of data.

Seasonal (S) - fix pattern follow K times by every year.

Cycle (C) - economy key moving up & down by.

Irregular (I) - Random changes.

1- Time Series decomposition

- Additive model $T + C + S + I$
(used when seasonal changes remain constant over time)

MA

- Multiplicative model $T \times C \times S \times I$
(used when seasonal changes increase or decrease)

VNAP

2- Trend analysis methods

a) Freehand method (Aankhon se graph dekh kr draw)
- not good for big data mng. krna

b) Least-Square method.
- Mathematical method.
- Minimizes trend line errors
- accurate way

c) Moving Average Method.

- Eliminates C, S, I
- lost of end data
- sensitive for outliers.

$$\frac{y_1 + y_2 + \dots + y_n}{n} + \frac{y_2 + y_3 + \dots + y_{n+1}}{n} + \frac{y_3 + y_4 + \dots + y_{n+2}}{n}$$

■ If extreme values zaidi hoo tou we use **WMA**.

- **WMA(3)** with weights $(1, 4, 1)$ more weight.

- Cumulative moving average (**CMA**) / long running average.
• includes past data and updates with new data.

- Exponential weighted moving average (**EWMA**)

• gives more importance to recent data.
• helps track recent trends.

- When we break a time-series in T, C, S, I parts
↓ then

We can use it to make accurate short-term or long-term prediction ^{this known as} time-series forecasting.

== Estimation of seasonal variation (S)

• Seasonal index → set of numbers for each month
ki value dikhati hy as compared to full year.

• De-seasonalized data → when seasonal effects are removed from data.

• Divide $\frac{\text{Original monthly data}}{\text{seasonal index of that month.}}$

== Estimation of cyclic variation (C)

• long-term up & downs in data (economic cycles)
• If cycles repeat regularly we can create cyclic index.

• Helps identify periods of growth or decline over years, not months.

== Estimation of irregular estimation (vandum)

• 9/11 occurs, markets down.

applied where data show evidence of non-

== Time Series forecasting e.s., ARIMA. Stationary

• Predict future values by finding a mathematical formula

1- Similarity Search

- We search for items that are not exactly the same but very close pattern or behaviour.