An ordered set of observations with respect to time periods is a time series. In simple words, a sequential organization of data accordingly to their **time of occurrence is termed as time series.**

Introduction:

We know that planning about future is very necessary for the every business firm, every govt. institute, every individual and for every country. Every family is also doing planning for his income expenditure. As like every business is doing planning for possibilities of its financial resources & sales and for maximization its profit.

Definition:

"A time series is a set of observation taken at specified times, usually at equal intervals".

"A time series may be defined as a collection of reading belonging to different time periods of some economic or composite variables".

By –Ya-Lun-Chau

- Time series establish relation between **"cause" & "Effects".**
- One variable is "Time" which is independent variable & and the second is "Data" which is the dependent variable.

We explain it from the following example:

Day	No. of Packets of milk sold
Monday	90
Tuesday	88
Wednesday	85
Thursday	75
Friday	72
Saturday	90
Sunday	102

Year	Population (in Million)
1921	251
1931	279
1941	319
1951	361
1961	439
1971	548
1981	685

- From example 1 it is clear that the sale of milk packets is decrease from Monday to Friday then again its start to increase.
- Same thing in example 2 the population is continuously increase.

Importance of Time Series Analysis:-

As the basis of Time series Analysis businessman can predict about the changes in economy. There are following points which clear about the its importance:

1. Profit of experience.
2. Safety from future
3. Utility Studies
4. Sales Forecasting
5. Budgetary Analysis
6. Stock Market Analysis
7. Yield Projections
8. Process and Quality Control
9. Inventory Studies
10. Economic Forecasting
11. Risk Analysis & Evaluation of changes.
12. Census Analysis

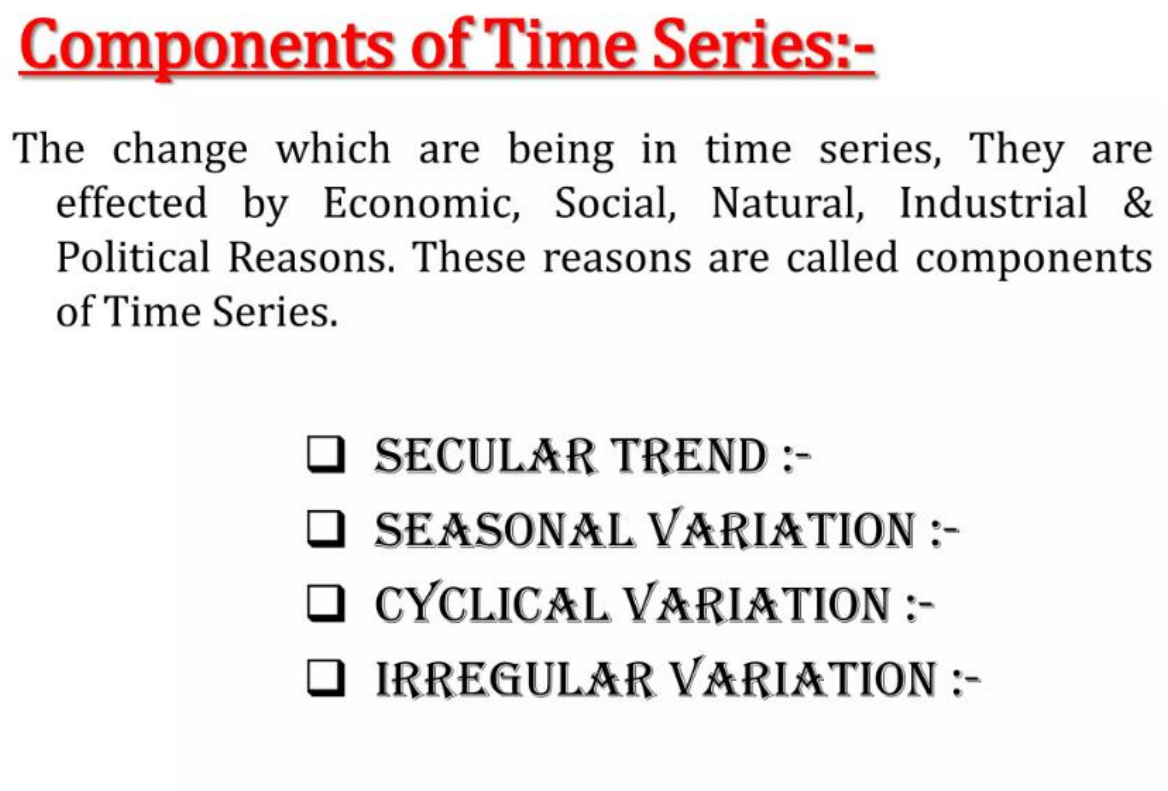
The time series data is of three types:

- **Time series data:** A set of observations contains values, taken by variable at different times.
- **Cross-sectional data:** Data values of one or more variables, gathered at the same time-point.
- **Pooled data:** A combination of time series data and cross-sectional data.

How to analyze Time Series?

Quick steps here for your reference, anyway. Will see this in detail in this article later.

- Collecting the data and cleaning it
- Preparing Visualization with respect to time vs key feature
- Observing the stationarity of the series
- Developing charts to understand its nature.
- Model building – AR, MA, ARMA and ARIMA
- Extracting insights from prediction



❑Secular trend:

The increase or decrease in the movements of a time series is called Secular trend.

A time series data may show upward trend or downward trend for a period of years and this may be due to factors like:

- ❑ increase in population,
- ❑change in technological progress ,
- ❑large scale shift in consumers demands,

For example,

- population increases over a period of time,price increases over a period of years,production of goods on the capital market of the country increases over a period of years.These are the examples of upward trend.
- The sales of a commodity may decrease over a period of time because of better products coming to the market.This is an example of declining trend or downward.

The trend would be Negative or Positive or Null Trend.

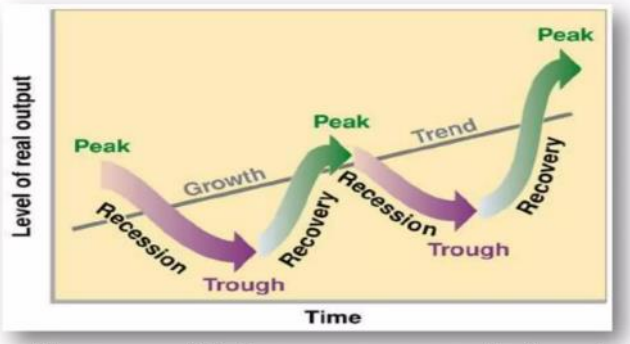
• Seasonal variation:

- Seasonal variation are short-term fluctuation in a time series which occur periodically in a year. This continues to repeat year after year.
  - The major factors that are weather conditions and customs of people.
  - More woolen clothes are sold in winter than in the season of summer .
  - each year more ice creams are sold in summer and very little in Winter season.
  - The sales in the departmental stores are more during festive seasons that in the normal days.

Would be bell curve or saw tooth.

❑Cyclical Variations:

Cyclical variations are recurrent upward or downward movements in a time series but the period of cycle is greater than a year. Also these variations are not regular as seasonal variation.

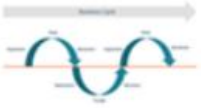


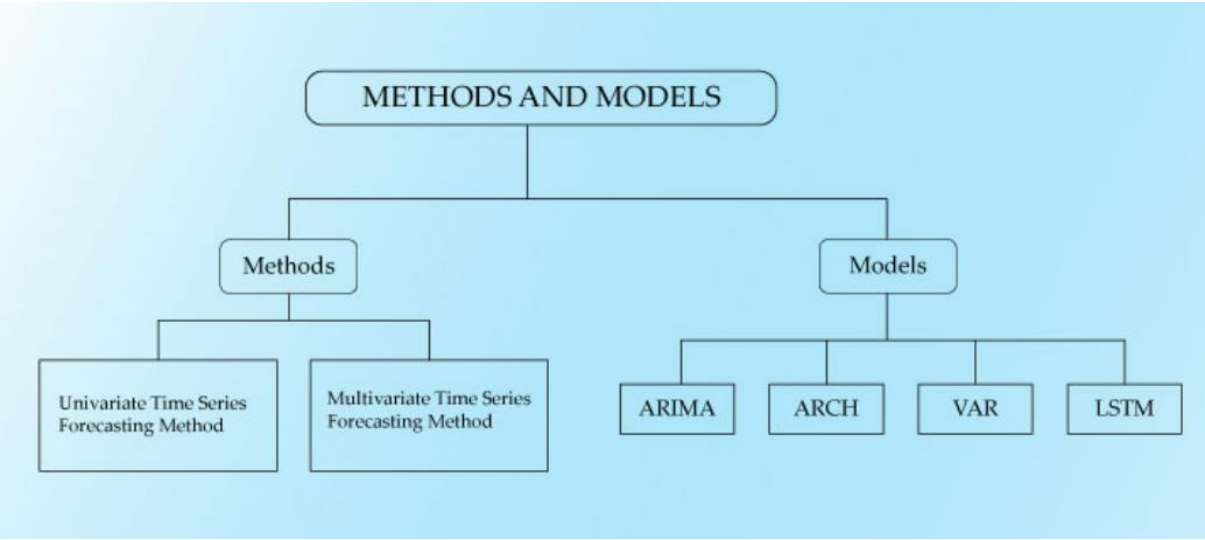
A business cycle showing these oscillatory movements has to pass through four phases-prosperity, recession, depression and recovery. In a business, these four phases are completed by passing one to another in this order.

• Irregular variation:

Irregular variations are fluctuations in time series that are short in duration, erratic in nature and follow no regularity in the occurrence pattern. These variations are also referred to as residual variations since by definition they represent what is left out in a time series after trend ,cyclical and seasonal variations. Irregular fluctuations results due to the occurrence of unforeseen events like :

- FLOODS,
- EARTHQUAKES,
- WARS,
- FAMINES

	Trend	Seasonality	Cyclical	Irregularity
Time	Fixed Time Interval	Fixed Time Interval	Not Fixed Time Interval	Not Fixed Time Interval
Duration	Long and Short Term	Short Term	Long and Short Term	Regular/Irregular
Visualization				
Nature - I	Gradual	Swings between Up or Down	Repeating Up and Down	Errored or High Fluctuation
Nature – II	Upward/Down Trend	Pattern repeatable	No fixed period	Short and Not repeatable
Prediction Capability	Predictable	Predictable	Challenging	Challenging
Market Model				Highly random/Unforeseen Events – along with white noise.



ML Methods For Time-Series Forecasting

1. In the ***Univariate Time-series Forecasting method***, forecasting problems contain only two variables in which one is time and the other is the field we are looking to forecast.

    - For example, if you want to predict the mean temperature of a city for the coming week, now one parameter is time(week) and the other is a city.

- Another example could be when measuring a person's heart rate per minute through using past observations of heart rate only. Now one parameter is time(minute) and the other is a heart rate.

2. On the other hand, in the ***Multivariate Time-series Forecasting method***, forecasting problems contain multiple variables keeping one variable as time fixed and others will be multiple in parameters.

Consider the same example, predicting the temperature of a city for the coming week, the only difference would come here now temperature will consider impacting factors such as

- *Rainfall and time duration of raining,*
- *Humidity,*
- *Wind speed,*
- *Precipitation,*
- *Atmospheric pressure, etc,*

And then the temperature of the city will be predicted accordingly. All these factors are related to temperature and impact it vigorously.