# Assignment-1-Aparna Bharathi Suresh

## 1.What are autoregressive models? Provide real-world examples.

Ans:

- Autoregressive models are a type of statistical model used for time series analysis and forecasting, where future values are predicted based on past values. The current value of the variable is the linear combination of its previous values, plus some random noise.
- Autoregressive model belongs to the family of time series models, where data points are collected sequentially over time.
- Autoregressive models are used in areas where data changes over time, like nature, finance, etc.
- Mathematical Representation of AR model:

$$X_t = c + \phi_1 X_{t-1} + \phi_2 X_{t-2} + \ldots + \phi_p X_{t-p} + \varepsilon_t$$

- Explanation of the above representation from left to right: Xt: The value at time t, C is a constant, Phi1 phi2...: are model parameters, p: The order of the AR model, indicating how many previous time steps (t−1,t−2,...,t−p) are considered, Epsilon represents the error or noise at time t.
- Autocorrelation in AR model: Measures the correlation between a time series and its lagged values. High autocorrelation indicates a strong relationship between the current and past values. Low autocorrelation means weak relationships.
- Partial Autocorrelation in AR model: Conditional correlation. Measures the correlation between a time series and its lagged values, after removing the influence of intermediate lags.

$$\frac{\text{Covariance}(x_t, x_{t-3} | x_{t-1}, x_{t-2})}{\sqrt{\text{Variance}(x_t | x_{t-1}, x_{t-2}) \text{Variance}(x_{t-3} | x_{t-1}, x_{t-2})}}$$

**Real world Examples:**

- **Stock price prediction**:
  AR models are used to predict stock prices based on past closing prices.
- **Weather Forecasting**:
  Predicting tomorrow's temperature based on past temperature trends.

- **Sales Forecasting**:
  Retailers use AR models to predict future sales based on historical sales data.
- **Traffic flow prediction**:
  AR models can forecast traffic volume on highways or city roads using past traffic data.
- **Economic Forecasting**:
  AR models are used to forecast economic indicators like Inflation rate, GDP growth, unemployment rates based on past trends.
- **Energy demand Forecasting**:
  AR models can predict electricity or gas demand based on the consumption patterns in the past.