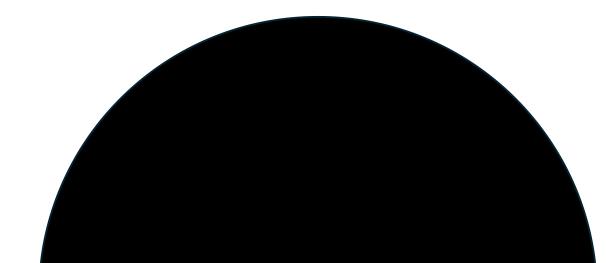Session #03

# Time Series Regression Models

# What is a Time-Series Model?

- Regression applied to data indexed by time

- Captures: trends, seasonality, autocorrelation, external predictors

- Useful for understanding drivers & forecasting future values

# Key Components

- Trend – Long-term direction

- Seasonality – Repeating patterns (monthly, yearly)

- Autocorrelation – Dependence on past values

- Exogenous Variables – Independent predictors (weather, ads, etc.)

# Types of Time-series models

- Linear Regression with Time

- Autoregressive (AR) models

- Distributed Lag Models

- ARIMAX (ARIMA + Exogenous variables)

- Machine Learning Regression (RF, XGBoost, LSTM)

# Building a Model (Steps)

- Explore Data – Plot, check ACF/PACF

- Feature Engineering – Add lags, seasonal dummies

- Model Training – Linear, ARIMAX, ML

- Diagnostics – Residual checks, error metrics

- Forecasting – Predict future values

# Real-World examples

- **Retail**: daily sales using yesterday's sales, day-of-week, holidays, price, and promos.

- **Energy**: hourly demand using recent demand, hour of day, and temperature forecasts.

- **Healthcare**: ER visits using last week's counts, weekday patterns, and flu indicators.

- **Finance Ops**: call-center volume using month-end effects and product launch dates.
  Same recipe, different domain."

# Key Takeaways

Time-series regression = regression that's time-aware.

It captures trend, seasonality, memory, and outside forces

Airline Passengers with 12-Month Rolling Mean