



Time-series Forecasting (TSF)

Artificial Intelligence Applications
(Case-studies)



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Full Course Outline:

- **TSF Basics**
 - What? & Why?
- **TSF Applications (Examples)**
- **TSF Approaches**
 - Statistical Models
 - ARIMA Model
 - Machine Learning
 - Deep Learning
- **TSF Toolkit (Frameworks)**

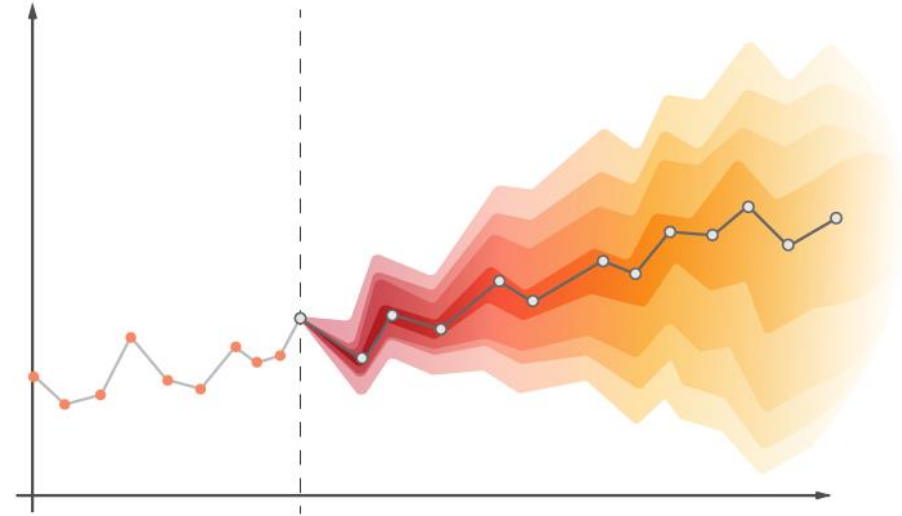


Time-series Forecasting (TSF)

"Time is money." ~ Benjamin Franklin.

Time-series Forecasting Basics

- **Time-series Forecasting (TSF)** occurs when you make scientific predictions based on historical time stamped data.
- A **time-series** is a **sequence** where a metric is recorded over regular time intervals.
 - Hourly, daily, weekly, monthly, quarterly and annual.
- **Why?**
 - Time series analysis **shows how data changes over time**, and good forecasting can identify the **direction** in which the data is changing.



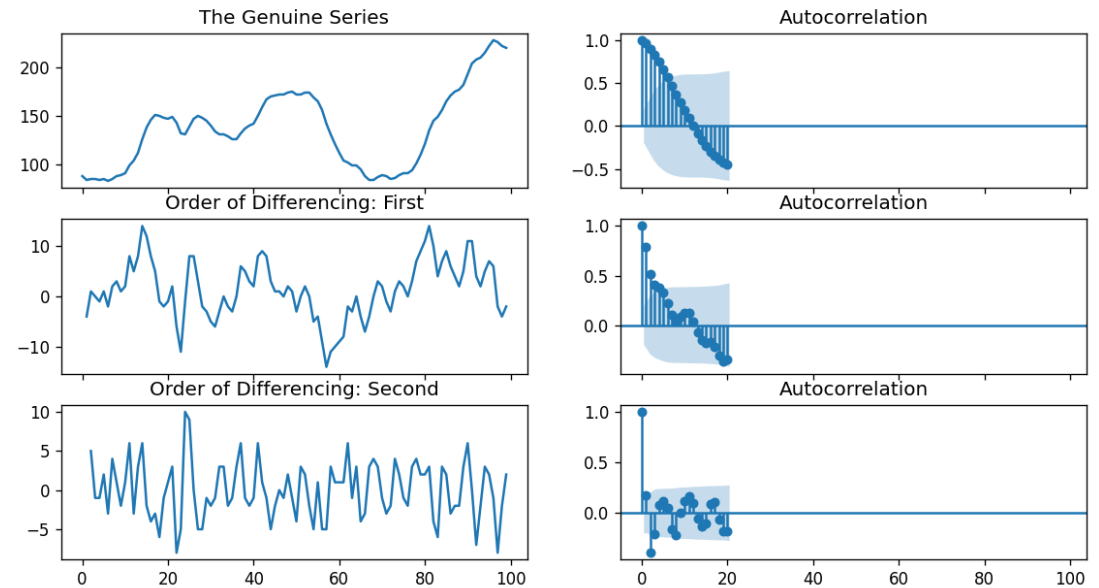
TSF Applications (Examples)

- A retailer may be interested in **predicting future sales** at an SKU (stock keeping unit) level for planning and budgeting.
- A small merchant may be interested in **forecasting sales by store**, so it can schedule the right resources (more people during busy periods and vice versa).
- A software giant like Google may be interested in **knowing the busiest hour of the day** or busiest day of the week so that they can schedule server resources accordingly.
- The health department may be interested in **predicting the cumulative COVID vaccinations** administered so that they can further predict when herd immunity is expected to kick in.
- **Predicting the TESLA stock price** using time-series forecasting techniques.



TSF Approaches

- **Classical / Statistical Models** — Moving Averages, Exponential Smoothing, ARIMA, SARIMA, TBATS (**StatsModels**)
 - **ARIMA** (Auto Regressive Integrated Moving Average) Model
- **Machine Learning** — Linear Regression, XGBoost, Random Forest, or any ML model with reduction methods (**Facebook Prophet**)
- **Deep Learning** — RNN, LSTM (**Neural Prophet**)



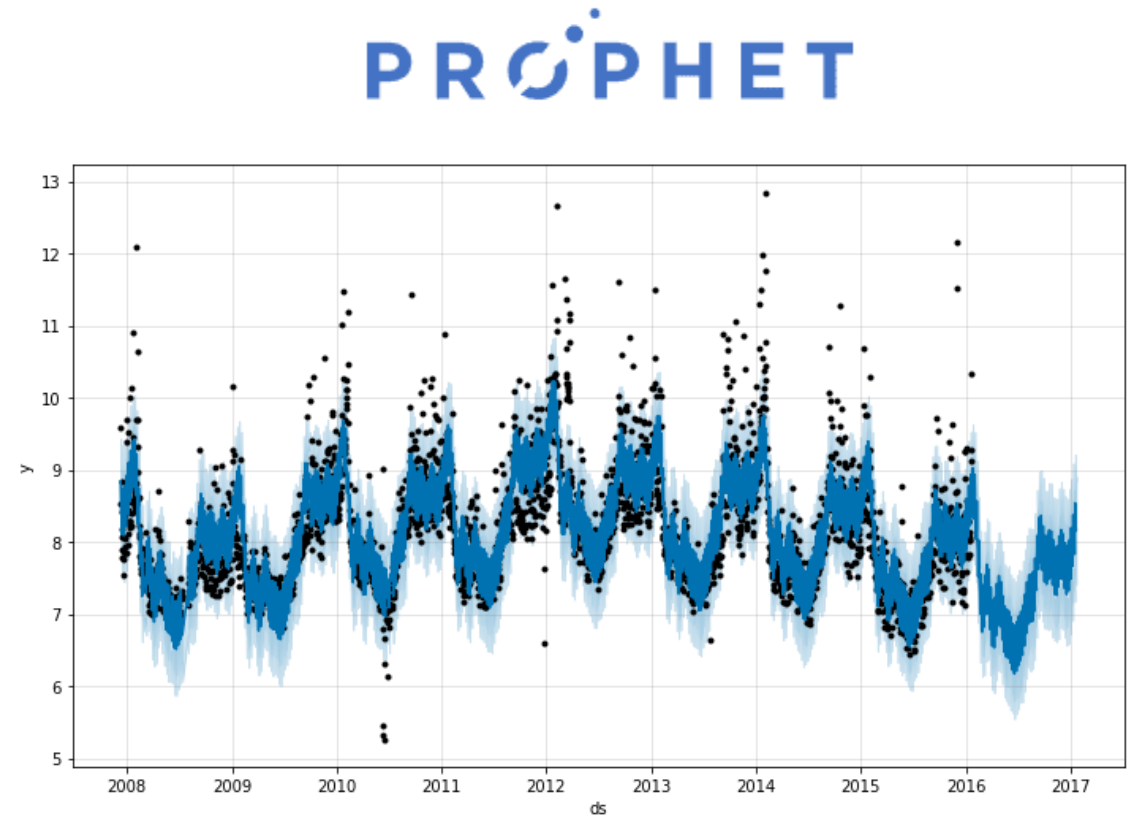
$$Y_t = \beta_1 Y_{t-1} + \beta_2 Y_{t-2} + \dots + \beta_0 Y_0 + \epsilon_t$$

$$Y_{t-1} = \beta_1 Y_{t-2} + \beta_2 Y_{t-3} + \dots + \beta_0 Y_0 + \epsilon_{t-1}$$



TSF Toolkit (Python Frameworks)

- Statsmodels
- Facebook Prophet
- Sktime
- PMDARIMA
- Kats
- TensorFlow
- PyTorch
- PyCaret



THANKS

Keep Moving Forward! 😊



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