**Data Visualization using Matplotlib**

**Duration**: 4 Hours  
**Prerequisites**: Basic Python, NumPy, Pandas fundamentals

**Outcomes:**

By the end of this course, learners will be able to:

* Understand Matplotlib’s core concepts and plotting workflow
* Create a variety of static visualizations for data analysis
* Customize plots with titles, labels, legends, and styles
* Combine multiple plots and subplots effectively
* Save and export visualizations

**Hour 1: Introduction to Matplotlib and Basic Plots**

**Goal**: Understand plotting basics and create simple visualizations

**Topics**:

* What is Matplotlib? Overview and importance
* Anatomy of a Matplotlib figure and axes
* The Pyplot interface: import matplotlib.pyplot as plt
* Plotting basic charts:
  + Line plots (plt.plot())
  + Scatter plots (plt.scatter())
  + Bar charts (plt.bar())
* Adding titles, axis labels, legends

**Exercise**:

* Plot a line chart and scatter plot from simple data arrays
* Customize labels and add legends

**Hour 2: Customizing Plots and Advanced Plot Types**

**Goal**: Learn how to customize plots and explore additional chart types

**Topics**:

* Colors, markers, line styles, transparency (alpha)
* Plot annotations: text, arrows, grid
* Histograms (plt.hist())
* Box plots (plt.boxplot())
* Pie charts (plt.pie())
* Plot styles and themes (e.g., plt.style.use('ggplot'))

**Exercise**:

* Create histogram and box plot from dataset columns
* Customize plot appearance with colors and styles

**Hour 3: Multiple Plots and Layouts**

**Goal**: Manage complex figures with multiple subplots and shared axes

**Topics**:

* Creating multiple plots: plt.subplot() and plt.subplots()
* Sharing axes (sharex, sharey)
* Adjusting spacing between subplots (plt.tight\_layout())
* Legends and annotations on multi-plot figures
* Combining different plot types in one figure

**Exercise**:

* Create a figure with 2x2 grid of plots showing different visualizations
* Customize each subplot with titles and axis labels

**Hour 4: Working with Real Data & Exporting Plots**

**Goal**: Apply Matplotlib skills on real data and export visuals

**Topics**:

* Plotting data directly from Pandas DataFrames
* Time series plotting basics
* Saving figures to files (plt.savefig()) — PNG, PDF, SVG
* Adjusting figure size and resolution
* Best practices for clear and informative visuals

**Mini Project**:

* Load a dataset (e.g., COVID-19, stock prices, or sales data)
* Create multiple plot types to analyze key trends
* Customize plots for presentation
* Save and export the final figures