# TASK 3

## Exploratory Data Analysis (EDA)

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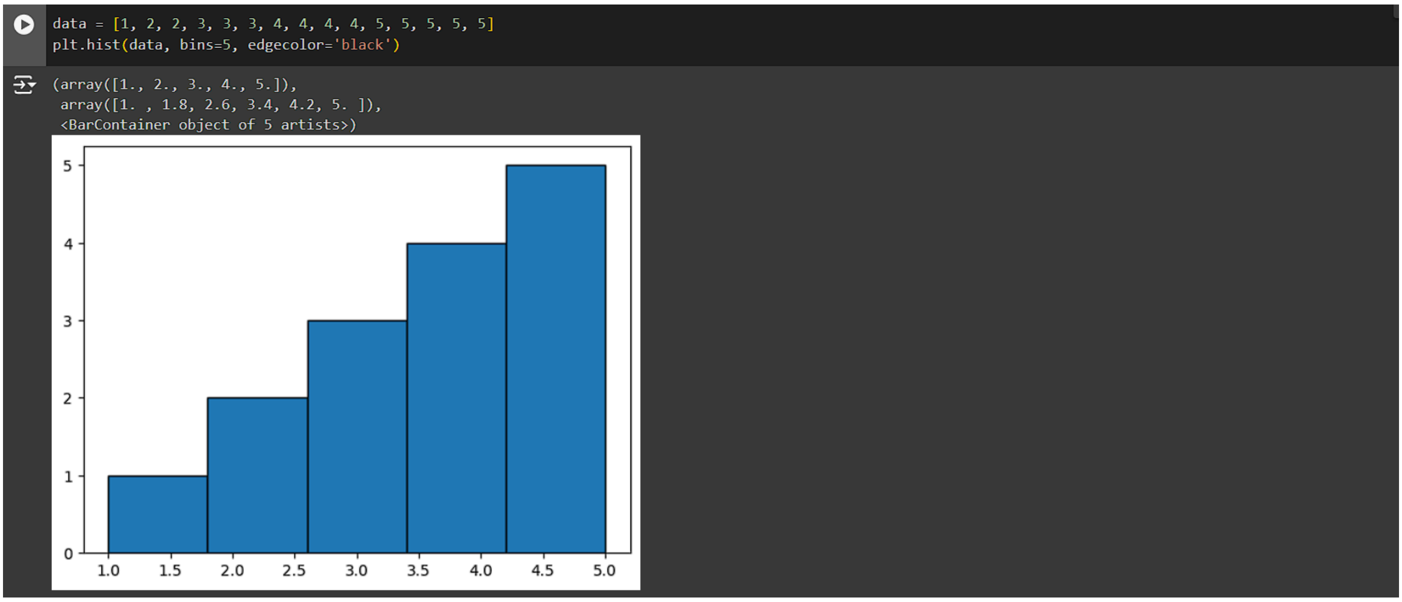
EDA is the process of analyzing datasets to summarize their main characteristics, often using visual methods. It helps in understanding the data, identifying patterns, and detecting anomalies. Key steps include:

### 1. Data Visualization:

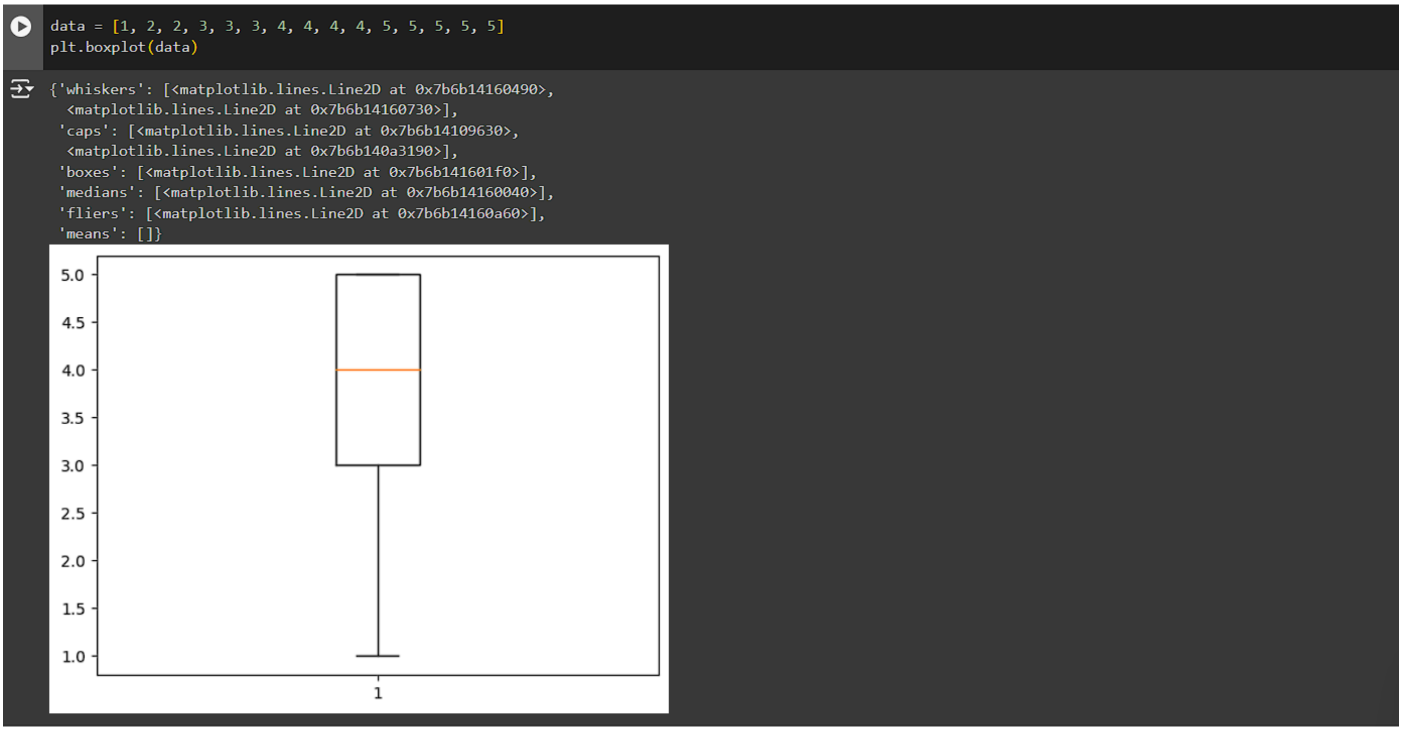
- **Histograms:** For understanding the distribution of a single variable.



```
data = [1, 2, 2, 3, 3, 3, 4, 4, 4, 4, 5, 5, 5, 5, 5]
plt.hist(data, bins=5, edgecolor='black')
```

```
(array([1., 2., 3., 4., 5.]),
 array([1. , 1.8, 2.6, 3.4, 4.2, 5. ]),
 <BarContainer object of 5 artists>)
```

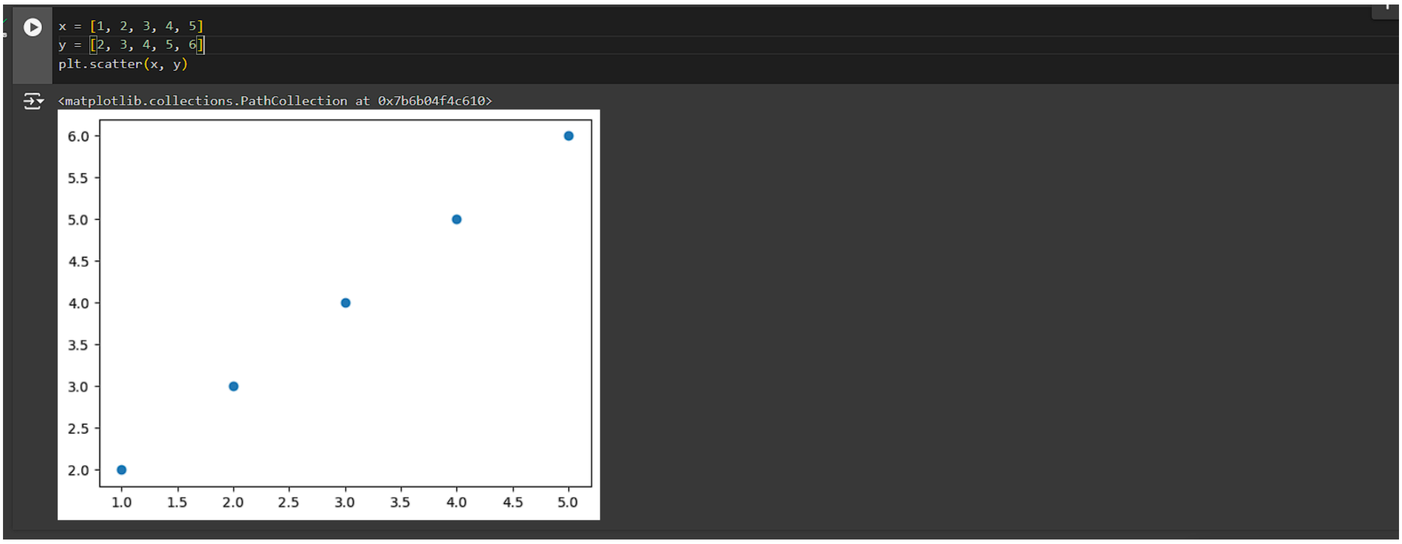
- **Box Plots:** To identify outliers and understand data spread.



```
data = [1, 2, 2, 3, 3, 3, 4, 4, 4, 4, 5, 5, 5, 5, 5]
plt.boxplot(data)
```

```
{'whiskers': [<matplotlib.lines.Line2D at 0x7b6b14160490>,
  <matplotlib.lines.Line2D at 0x7b6b14160730>],
 'caps': [<matplotlib.lines.Line2D at 0x7b6b14109630>,
  <matplotlib.lines.Line2D at 0x7b6b140a3190>],
 'boxes': [<matplotlib.lines.Line2D at 0x7b6b141601f0>],
 'medians': [<matplotlib.lines.Line2D at 0x7b6b14160040>],
 'fliers': [<matplotlib.lines.Line2D at 0x7b6b14160a60>],
 'means': []}
```

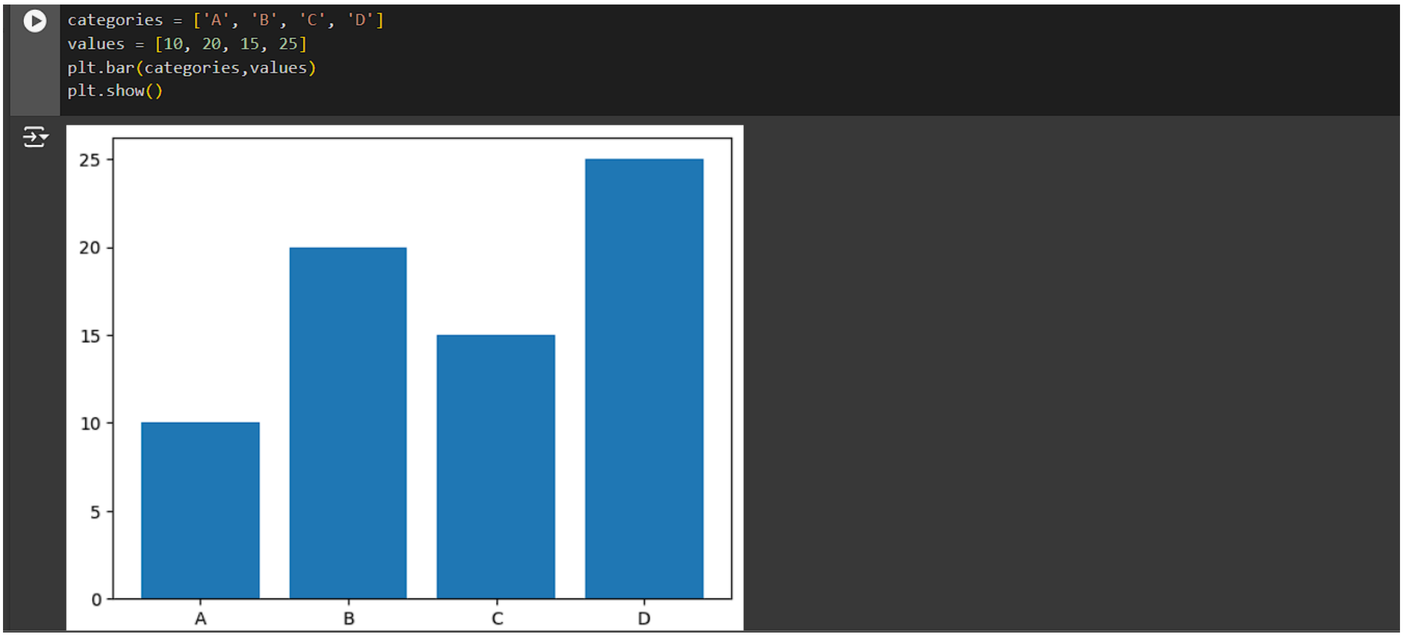
- **Scatter Plots:** To analyze relationships between two numerical variables.



```
x = [1, 2, 3, 4, 5]
y = [2, 3, 4, 5, 6]
plt.scatter(x, y)
```

```
<matplotlib.collections.PathCollection at 0x7b6b04f4c610>
```

- **Bar Charts:** For categorical data frequency.



```
categories = ['A', 'B', 'C', 'D']
values = [10, 20, 15, 25]
plt.bar(categories,values)
plt.show()
```

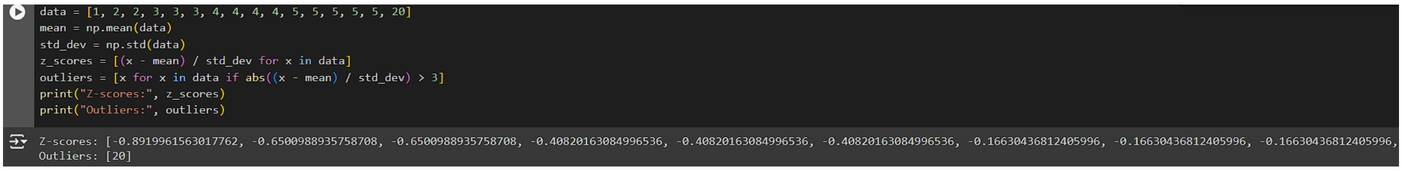
## 2. Summary Statistics:

- Mean, median, mode (measures of central tendency).
- Variance, standard deviation (measures of dispersion).

## 3. Outlier Detection:

- Identifying data points that significantly deviate from the norm using IQR, Z-scores, etc.
- **Z-SCORE**
  1. Z-Score Method:

The Z-score indicates how many standard deviations a data point is from the mean. A Z-score greater than 3 or less than -3 is often considered an outlier.

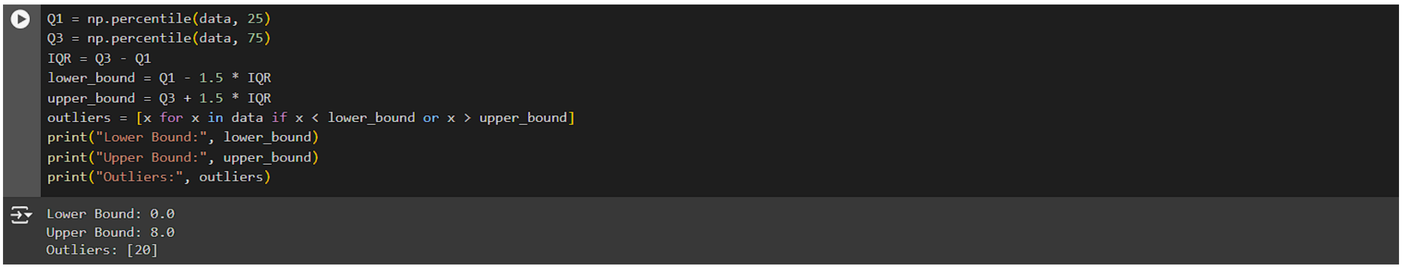


```
data = [1, 2, 2, 3, 3, 3, 4, 4, 4, 4, 5, 5, 5, 5, 5, 20]
mean = np.mean(data)
std_dev = np.std(data)
z_scores = [(x - mean) / std_dev for x in data]
outliers = [x for x in data if abs((x - mean) / std_dev) > 3]
print("Z-scores:", z_scores)
print("Outliers:", outliers)
```

```
Z-scores: [-0.8919961563017762, -0.6500988935758708, -0.6500988935758708, -0.40820163084996536, -0.40820163084996536, -0.40820163084996536, -0.16630436812405996, -0.16630436812405996, -0.16630436812405996,
Outliers: [20]
```

2. IQR Method:

   The Interquartile Range (IQR) measures the spread of the middle 50% of the data. Outliers are typically defined as points outside the range [Q1−1.5∗IQR,Q3+1.5∗IQR].

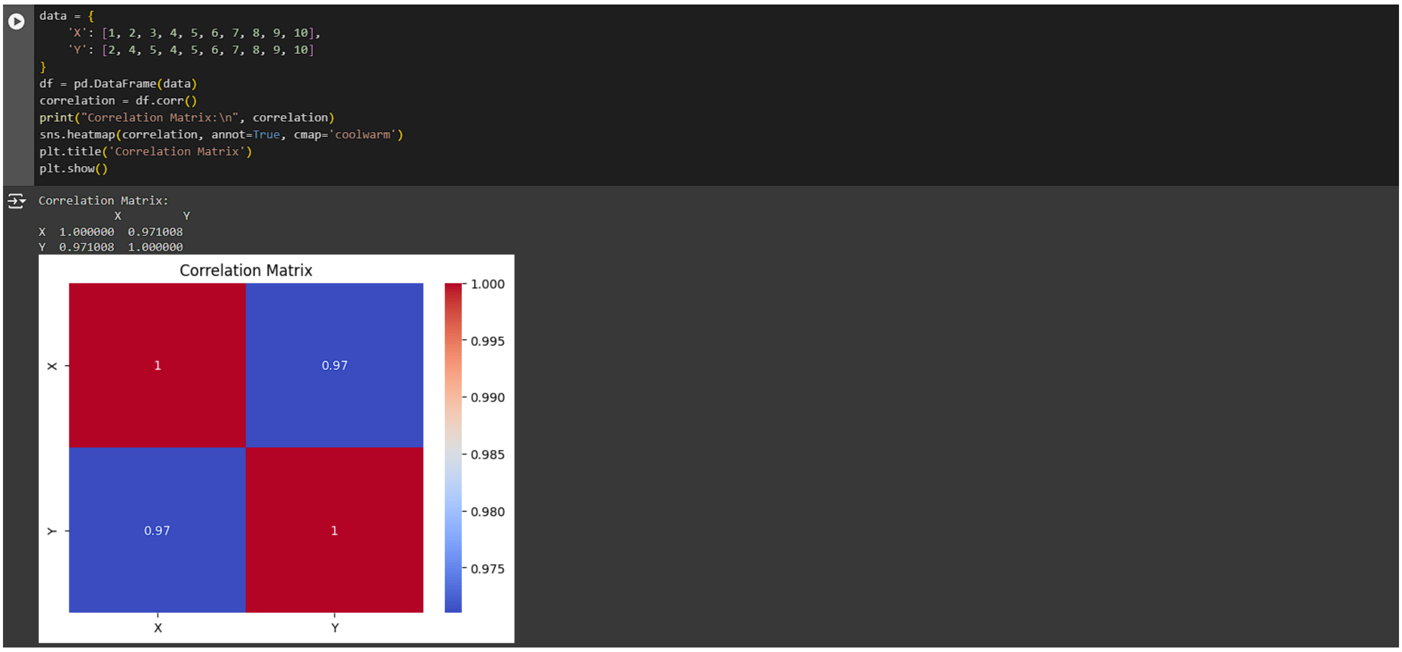


```
Q1 = np.percentile(data, 25)
Q3 = np.percentile(data, 75)
IQR = Q3 - Q1
lower_bound = Q1 - 1.5 * IQR
upper_bound = Q3 + 1.5 * IQR
outliers = [x for x in data if x < lower_bound or x > upper_bound]
print("Lower Bound:", lower_bound)
print("Upper Bound:", upper_bound)
print("Outliers:", outliers)
```

```
Lower Bound: 0.0
Upper Bound: 8.0
Outliers: [20]
```

## 4. Correlation Analysis:

- Using correlation matrices and coefficients to understand **relationships** between variables.



```
data = {
    'X': [1, 2, 3, 4, 5, 6, 7, 8, 9, 10],
    'Y': [2, 4, 5, 4, 5, 6, 7, 8, 9, 10]
}
df = pd.DataFrame(data)
correlation = df.corr()
print("Correlation Matrix:\n", correlation)
sns.heatmap(correlation, annot=True, cmap='coolwarm')
plt.title('Correlation Matrix')
plt.show()
```

```
Correlation Matrix:
           X         Y
X  1.000000  0.971008
Y  0.971008  1.000000
```

## Importance of Statistics in Data Science

Statistics is foundational in data science, providing tools to extract insights from data, make predictions, and inform decisions. Key areas include:

1. **Descriptive Statistics**:
   - Summarizing and describing data features.
   - Using graphical representations and summary statistics.

2. **Inferential Statistics**:
    - Making inferences about populations from samples.
    - Hypothesis testing, confidence intervals, and regression analysis.

## Applications of Statistics in Data Science

Statistics is applied across various domains to solve real-world problems:

1. **Business Analytics and Market Research**:
    - Identifying trends and consumer behavior.
    - Making informed business decisions using regression analysis and hypothesis testing.
2. **Healthcare and Medical Research**:
    - Analyzing clinical trial data and patient outcomes.
    - Conducting epidemiological studies and public health interventions.
3. **Finance and Risk Management**:
    - Evaluating financial risks using time series analysis and Monte Carlo simulations.
    - Optimizing investment strategies and managing portfolios.
4. **Social Sciences and Demographic Studies**:
    - Analyzing population trends and socioeconomic indicators.
    - Assessing the impact of policy decisions.
5. **Environmental Monitoring and Climate Science**:
    - Studying weather patterns and climate change impacts.
    - Assessing environmental policies.
6. **Sports Analytics and Performance Tracking**:
    - Evaluating player performance and team strategies.
    - Enhancing training programs and game tactics.
7. **Transportation and Logistics Optimization**:
    - Analyzing traffic patterns and optimizing supply chains.
    - Improving route planning and inventory management.
8. **Fraud Detection and Cybersecurity**:
    - Detecting fraudulent activities and security threats.
    - Using anomaly detection and clustering analysis.

## Tools for Performing EDA and Statistics

**Python Libraries**:

- Pandas: Data manipulation and analysis.
- Matplotlib and Seaborn: Data visualization.
- Plotly: Interactive visualizations.