

Data

Science

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OUTLIERS

- **Outliers** are values that are **very different** from the rest of the data.
- They may indicate variability, errors, or something important.

Ex: (1) In a dataset of ages [22, 24, 23, 25, 21, 100], the value 100 is an outlier.

(2) fraud detection, equipment failure



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Types of Outliers/Anomalies :

- (1) Point Anomalies (Global Outliers): A single data point that is very different from the rest of the data. (By Box Plot and Z-score).
- (2) Contextual Anomalies (Conditional Outliers) : A data point that is normal in some contexts but anomalous in others. (By Time Series)
- (3) Collective Anomalies (Group Outliers) : A group of data points that together show an anomaly, even if individual points seem normal.

Methods to Detect Outliers

- (1) IQR (Inter quartile range)
- (2) Z-score
- (3) Visualization Methods – Histogram, Scatter Plot
- (4) Isolation Forest (ML-Based)
- (5) DBSCAN (Clustering based)

(1) IQR (Inter-quartile Range) : Visualization Code 1.

```
import pandas as pd
```

```
import matplotlib.pyplot as plt
```

```
data = [3, 3, 7, 8, 8, 10, 11, 12, 15, 18, 40] # 40 is an outlier  
df = pd.DataFrame(data, columns=['Years'])
```

```
# Box Plot
```

```
plt.boxplot(df['Years'])
```

```
plt.title('Box Plot for Teaching Years')
```

```
plt.show()
```



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```
import numpy as np
```

```
data = [10, 12, 14, 15, 15, 16, 18, 19, 20, 29, 100]
```

```
data_sorted = sorted(data)
```

```
# Calculate Q1, Q3 and IQR
```

```
Q1 = np.percentile(data_sorted, 25)
```

```
Q3 = np.percentile(data_sorted, 75)
```

```
IQR = Q3 - Q1
```

```
lower_bound = Q1 - 1.5 * IQR
```

```
upper_bound = Q3 + 1.5 * IQR
```



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```
# Detect outliers
```

```
outliers_iqr = [x for x in data if x < lower_bound or x >  
upper_bound]
```

```
print("Q1 =", Q1)
print("Q3 =", Q3)
print("IQR =", IQR)
print("Lower Bound =", lower_bound)
print("Upper Bound =", upper_bound)
print("Outliers using IQR method:", outliers_iqr)
```



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Unitedworld Institute of Technology **(2) Z-Score**

The Z-score (or standard score) tells you how many standard deviations a data point is from the mean.

Formula:

deviation

Where:

x = data point

μ = mean of the

data σ = standard

$$\begin{matrix} \diamond \text{?} & \diamond \text{?} \\ \diamond \text{?} & \diamond \text{?} \end{matrix} = \begin{matrix} \diamond \text{?} & \diamond \text{?} \\ \diamond \text{?} & \diamond \text{?} \end{matrix} - \begin{matrix} \diamond \text{?} & \diamond \text{?} \\ \diamond \text{?} & \diamond \text{?} \end{matrix}$$



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Unitedworld Institute of Technology **Z-Score Outlier Rule:**

- If $|Z| > 3$, the point is considered an outlier.
- That means the value is more than 3 standard deviations away from the mean.



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