KARNAVATI UNIVERSITY

Data Science

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Descriptive Statistics

Part A:

Descriptive Statistics & Data Preparation

- Descriptive Statistics
- Measures of Central Tendency: Mean, Median, Mode
- Measures of Spread: Range, Variance, Standard Deviation, IQR
- Skewness & Kurtosis (Measuring Asymmetry)
- Python with pandas.describe(), scipy.stats, numpy

1. Measures of Central Tendency

- These describe the "center" of the data.

(A) Mean (Average):

$$Mean = \frac{Sum\ of\ all\ values}{Number\ of\ values}$$

(B) Median: Middle value when data is sorted. If even number of observations, median = average of two middle values.

(C) Mode: Most frequent value(s).

2. Measures of Dispersion (Spread)

These describe how spread out the data is.

(A) Range: Max – Min.

(B) Variance (σ^2): Average squared deviation from mean.

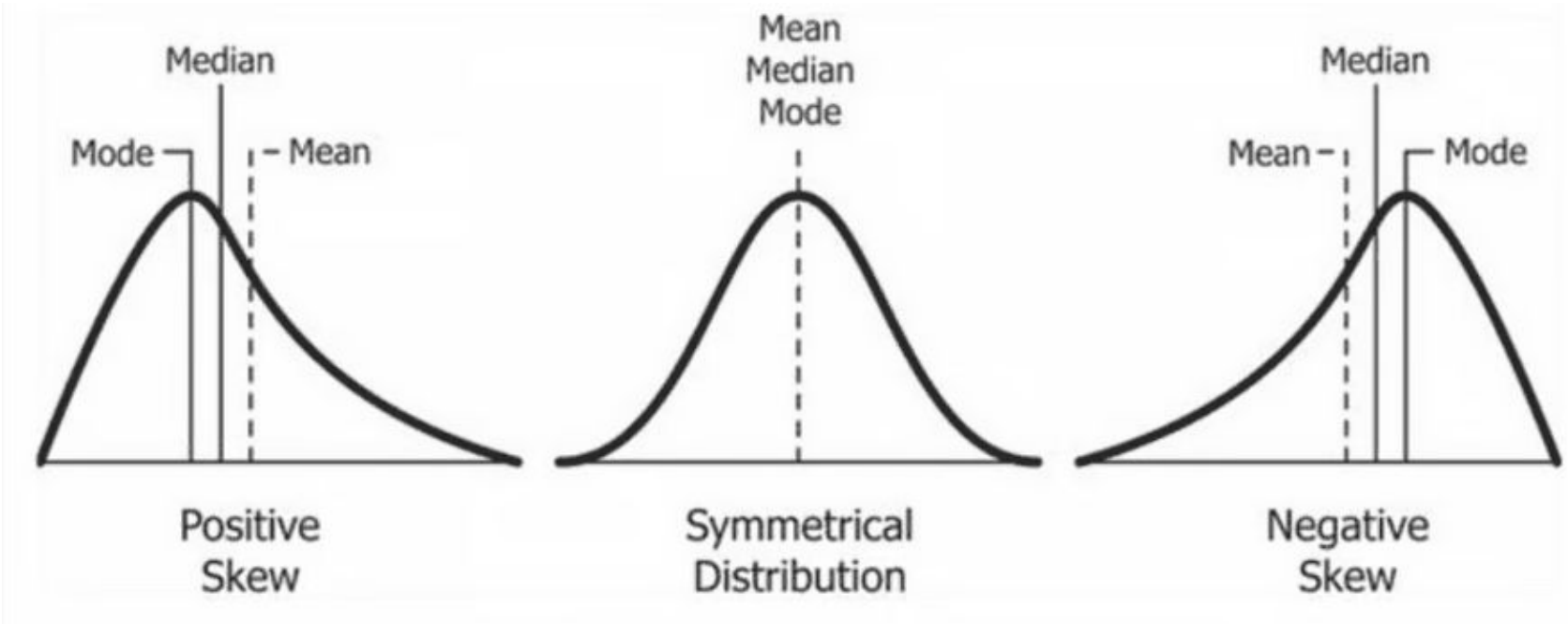
$$\sigma^2 = \frac{\sum(xi - \mu)^2}{\sigma^2}$$

(C) Standard Deviation (σ): Square root of variance.

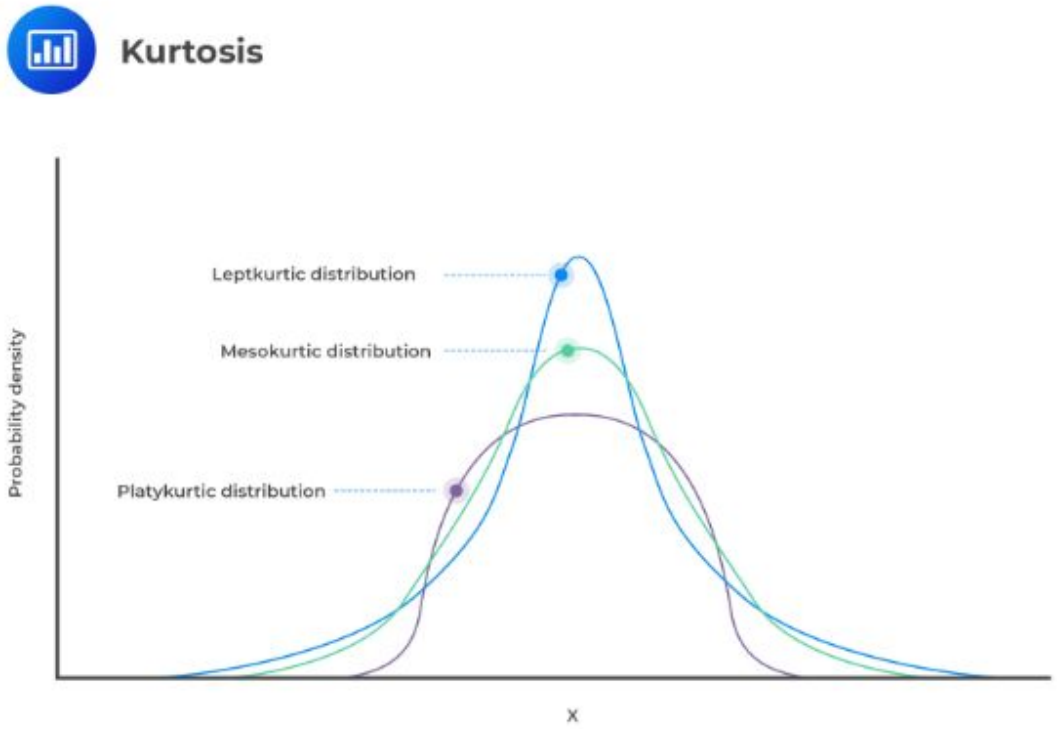
(D) IQR (Interquartile Range): Q3 – Q1 (middle 50% of data).

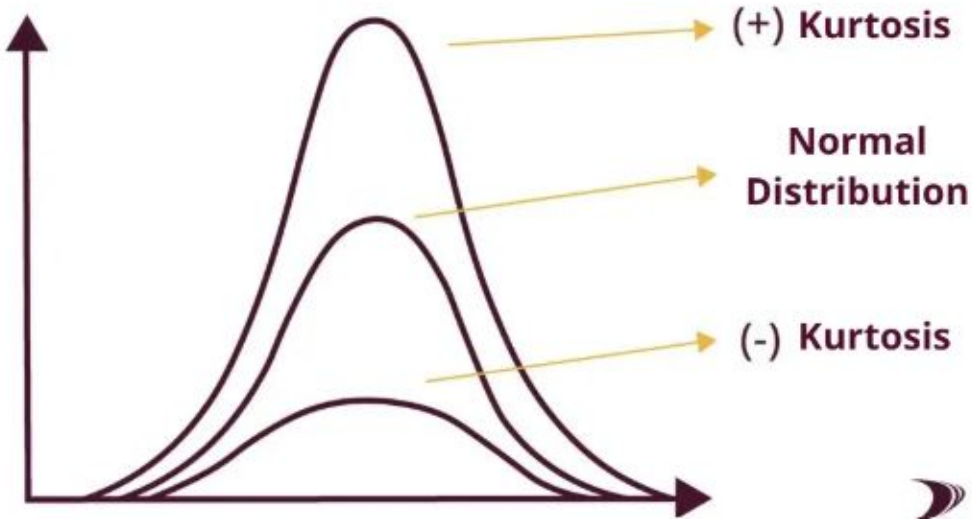
3. Measuring Asymmetry

- **Skewness:** Tells if data is symmetric or skewed.
  - Positive skew → long right tail
  - Negative skew → long left tail
- **Kurtosis:** Tells if data is flat or peaked compared to normal distribution.
  - High kurtosis → heavy tails
  - Low kurtosis → light tails


Median
Mode
Mean
Positive Skew
Mean
Median
Mode
Symmetrical Distribution
Median
Mean
Mode
Negative Skew

Kurtosis


Kurtosis
Leptkurtic distribution
Mesokurtic distribution
Platykurtic distribution
Probability density
X


(+) Kurtosis
Normal Distribution
(-) Kurtosis

Code 1: Mean, Median, Mode, Skweness, Kurtosis

```
import numpy as np
import pandas as pd
from scipy import stats

# Sample dataset
data = [45, 50, 55, 60, 65, 70, 70, 80, 85, 90]

# Convert to pandas Series
s = pd.Series(data)

# Measures of Central Tendency
mean = s.mean()
median = s.median()
mode = s.mode().tolist()
```

```
# Measures of Spread
variance = s.var()
std_dev = s.std()
iqr = s.quantile(0.75) - s.quantile(0.25)

# Skewness & Kurtosis
skewness = s.skew()
kurtosis = s.kurt()
```

```
print("Mean:", mean)
print("Median:", median)
print("Mode:", mode)
print("Variance:", variance)
print("Standard Deviation:", std_dev)
print("Interquartile Range (IQR):", iqr)
print("Skewness:", skewness)
print("Kurtosis:", kurtosis)
```

OUTPUT:

Mean: 67.0
Median: 67.5
Mode: [70]
Variance: 206.67
Standard Deviation: 14.38
Interquartile Range (IQR): 25.0
Skewness: -0.07 # almost symmetric
Kurtosis: -1.34 # flatter than normal

Skewness and Kurtosis Visualization

CODE:

```
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
from scipy.stats import skew, kurtosis

# Sample dataset
data = [45, 50, 55, 60, 65, 70, 70, 80, 85, 90]
s = pd.Series(data)
```

```
# Calculate skewness and kurtosis
skewness = skew(s)
kurt = kurtosis(s)
print("Skewness:", skewness)
print("Kurtosis:", kurt)

# Plot histogram with KDE
plt.figure(figsize=(8,5))
sns.histplot(s, bins=8, kde=True, color="skyblue",
edgecolor="black")
plt.title(f"Distribution of Data\nSkewness = {skewness:.2f},
Kurtosis = {kurt:.2f}", fontsize = 14)
```

```
plt.xlabel("Values")
plt.ylabel("Frequency")
plt.show()
```

NOTE:

- Both list and Series can be plotted.
- But **Pandas Series is more powerful** because it has built-in **statistics functions**.


Thanks!