Assignment 2

Q). Take one Domain and draw the graph (Normal distribution) (Empirical rule)

Domain: Annual Rainfall in a Region

1.Introduction

Rainfall is one of the most important climatic factors affecting agriculture, water resources, and environmental balance. When rainfall data is collected for many years in a particular region, the values tend to cluster around an average amount. Extremely low rainfall (drought years) and extremely high rainfall (flood years) occur rarely.

Because of this natural pattern, annual rainfall often follows a Normal Distribution, which is a continuous probability distribution that forms a symmetric bell-shaped curve.

2.About Normal Distribution

A Normal Distribution is defined by two parameters:

a). Mean (μ) → Average value

b).Standard Deviation (σ) → Measure of spread or variation

The mathematical formula of normal distribution is:

$$f(x) = \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$

Where:

μ = Mean

σ = Standard Deviation

$\pi \approx 3.1416$

$e \approx 2.718$

This formula produces the bell-shaped curve.

3.Assumed Data for This Project

For demonstration, we assumed:

Mean rainfall (μ) = 1200 mm

Standard deviation (σ) = 200 mm

These values represent a moderately high rainfall region.

4. Explanation of the Graph

a).X-Axis (Horizontal Axis)

- Represents Annual Rainfall in millimeters (mm)
- The range shown is from approximately 400 mm to 2000 mm.

b). Y-Axis (Vertical Axis)

Represents Probability Density, which shows how likely a rainfall value is.

c). Shape of the Curve

- Bell-shaped
- Symmetrical
- Highest point at the mean (1200 mm)
- This means most rainfall values are close to 1200 mm.

5. Empirical Rule (68–95–99.7 Rule)

Normal distribution follows a special rule:

a). 68% Rule

About 68% of rainfall values lie between: 1200 ± 200

→ 1000 mm to 1400 mm

b). 95% Rule

About 95% of rainfall values lie between: 1200 ± 400

→ 800 mm to 1600 mm

c). 99.7% Rule

About 99.7% of rainfall values lie between: 1200 ± 600

→ 600 mm to 1800 mm

This shows extreme rainfall events are very rare.

6. Why Rainfall Can Be Modeled as Normal Distribution

Rainfall depends on many small independent natural factors:

- Temperature variations
- Atmospheric pressure
- Humidity levels
- Ocean currents
- Wind systems
- Seasonal climate cycles

When many independent natural factors combine, the result tends to follow a normal distribution (according to the Central Limit Theorem).

7. Importance of Modeling Rainfall Using Normal Distribution

Using normal distribution helps in:

a). Agriculture

- Crop planning
- Irrigation scheduling

b).Flood Management

- Estimating probability of heavy rainfall
- Planning drainage systems

c). Drought Prediction

- Identifying below-average rainfall years

d). Water Resource Planning

- Reservoir capacity planning
- Groundwater recharge estimation

e). Climate Research

- Studying long-term climate patterns
- Detecting climate change trends

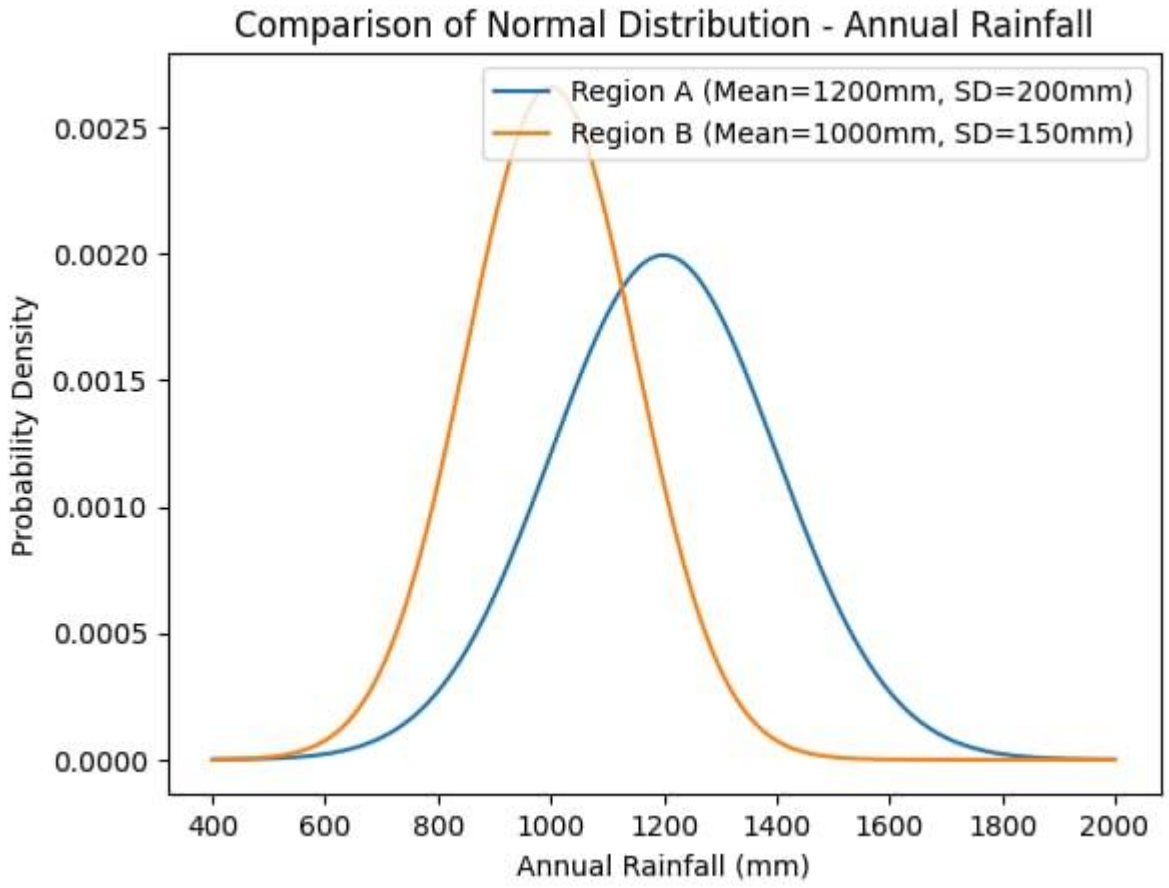
8. Advantages of Using Normal Distribution

- Easy to understand and interpret
- Useful for prediction
- Helps calculate probabilities
- Widely used in statistics and machine learning

9.Limitations

- Real rainfall data may sometimes be slightly skewed.
- Extreme climate change can disturb the normal pattern.
- Short-term data may not perfectly follow normal distribution.

10.NORMAL DISTRIBUTION GRAPH



- The graph shows two normal distribution curves.
- Each curve represents annual rainfall of one region.
- The peak of the curve shows the average rainfall.
- Region A has higher average rainfall than Region B.
- Region A curve is wider, so rainfall varies more.
- Region B curve is narrower, so rainfall is more consistent.
- Both curves are bell-shaped and symmetric.
- Very low and very high rainfall years are rare.