ASSIGNMENT -2

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

Normal Distribution and Empirical Rule (68–95–99.7 Rule)

Domain: Student Examination Scores

1. Introduction

Statistics plays a vital role in analysing numerical data and drawing meaningful conclusions. In educational institutions, statistics is used to evaluate student performance, compare academic progress, and design grading systems. One of the most important statistical distributions used for this purpose is the Normal Distribution.

This report explains the concept of Normal Distribution and the Empirical Rule using the domain of Student Examination Scores. The explanation is given step-by-step with clarity, including theoretical background, graphical interpretation, mathematical explanation, and real-life applications.

2. Objective of the Report

The objectives of this report are:

- To understand the concept of Normal Distribution
- To explain Mean and Standard Deviation
- To draw and interpret the Normal Distribution graph
- To apply the Empirical Rule (68–95–99.7 Rule)
- To analyse student examination scores using statistical methods

3. Selection of Domain

Domain Chosen: Student Examination Scores

This domain is selected because examination marks usually follow a pattern where:

- Most students score near the average
- Few students score extremely high
- Few students score extremely low

This natural pattern forms a bell-shaped curve, making it suitable for Normal Distribution analysis.

4. Historical Background

The Normal Distribution was introduced by Carl Friedrich Gauss.

Initially, it was used to study errors in astronomical measurements. Later, it became one of the most important probability distributions in statistics, research, and data analysis.

Because of Gauss's contribution, it is also called the Gaussian Distribution.

5. Definition of Normal Distribution

A Normal Distribution is a continuous probability distribution that:

- Is symmetric around the mean
- Forms a bell-shaped curve
- Has Mean = Median = Mode
- Has total area under the curve equal to 1

The highest point of the curve represents the mean.

6. Important Parameters

Normal Distribution depends on two parameters:

6.1 Mean (μ)

- Represents the average value
- Central point of the distribution

Formula for mean: $\mu = \frac{\sum X}{N}$

Where:
X = individual values
N = total number of observations

6.2 Standard Deviation (σ)

- Measures how spread out the data is
- Indicates variability

Formula: $\sigma = \sqrt{\frac{\sum(X-\mu)^2}{N}}$

If σ is small → data is tightly packed
If σ is large → data is widely spread

7. Domain Example: Student Examination Scores

Assume:

- Mean (μ) = 70 marks
- Standard Deviation (σ) = 10 marks

Interpretation:

- Average student score is 70
- Most students score between 60 and 80
- Few students score below 40 or above 100

8. Steps to Draw the Normal Distribution Graph

Step 1: Draw X-axis

Label it as "Student Scores"

Step 2: Mark Mean (70)

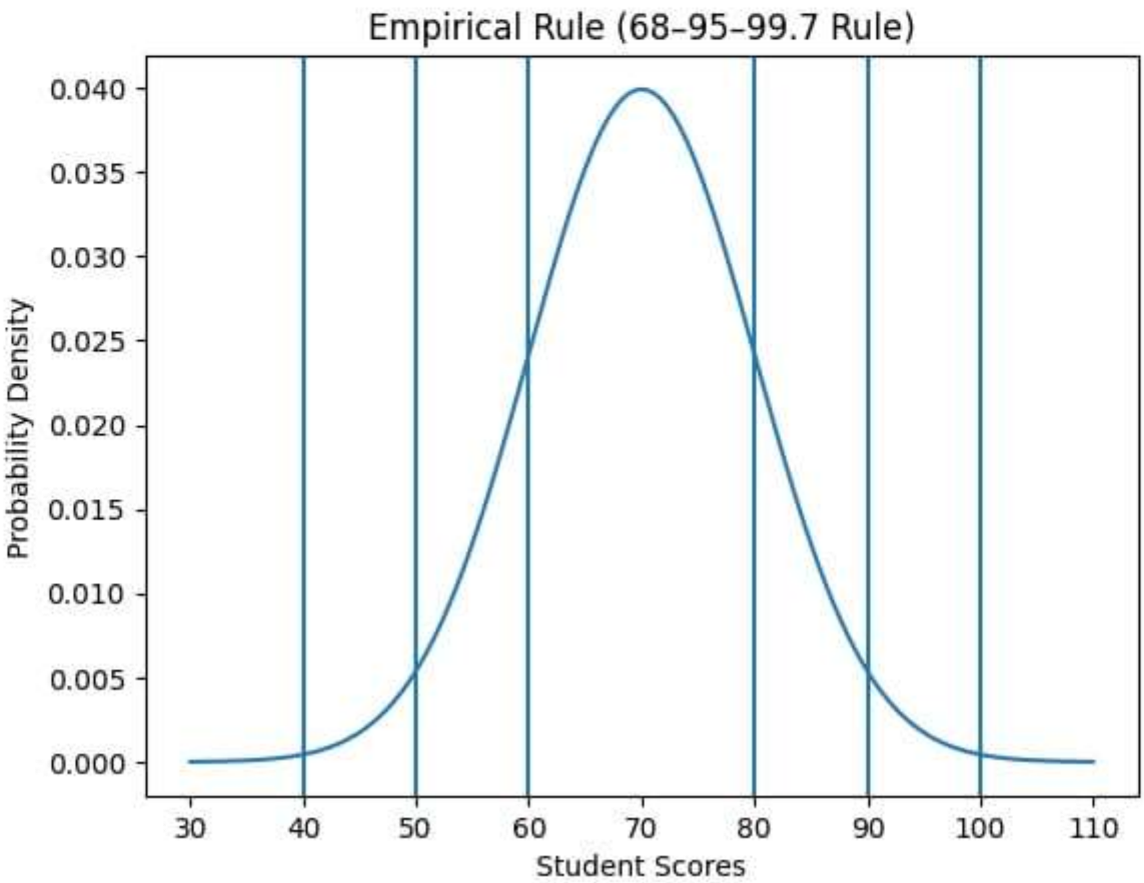
Step 3: Calculate Standard Deviations

- $\mu - 1\sigma = 60$
- $\mu + 1\sigma = 80$
- $\mu - 2\sigma = 50$
- $\mu + 2\sigma = 90$
- $\mu - 3\sigma = 40$
- $\mu + 3\sigma = 100$

Step 4: Draw Bell-Shaped Curve

- Highest at 70
- Symmetrical
- Smooth curve

9. Normal Distribution Graph



10. Empirical Rule (68–95–99.7 Rule)

The Empirical Rule applies only to Normal Distribution.

10.1 68% Rule

68% of data lies within $\pm 1\sigma$

60 – 80 marks

10.2 95% Rule

95% of data lies within $\pm 2\sigma$

50 – 90 marks

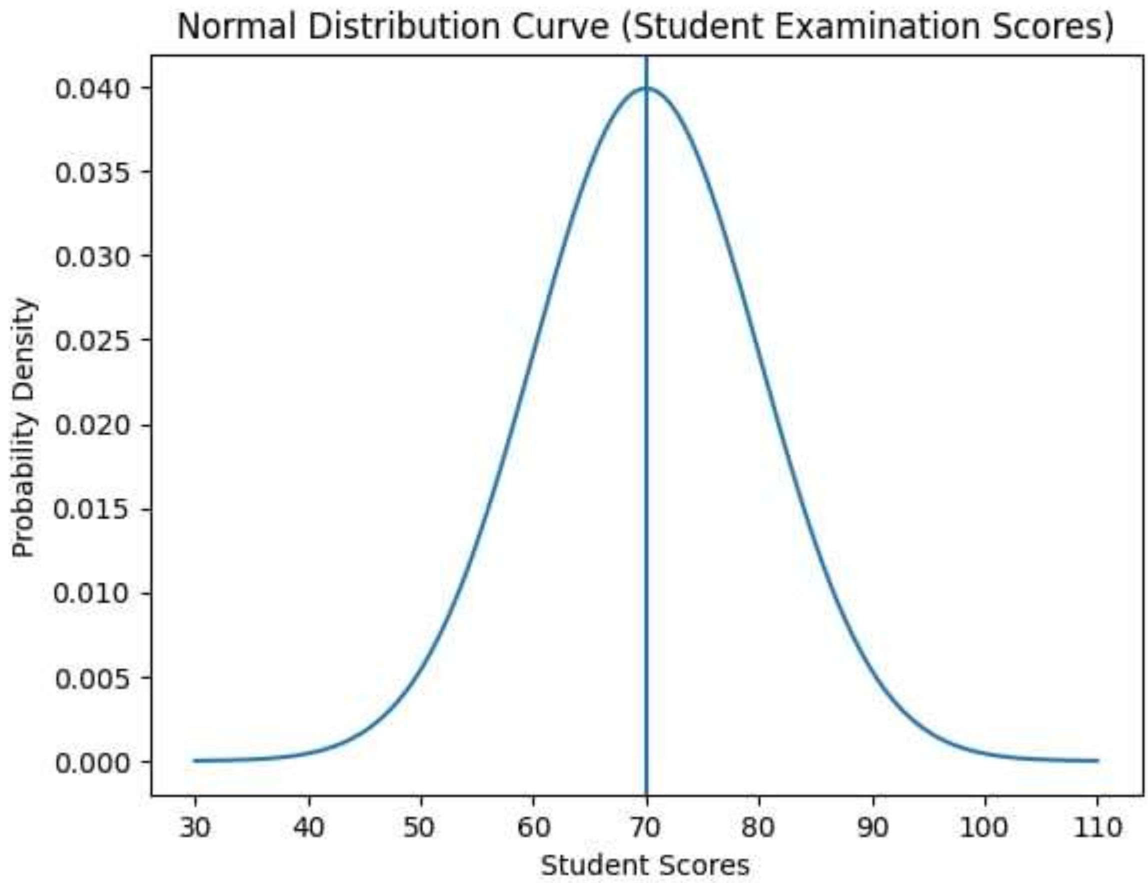
10.3 99.7% Rule

99.7% of data lies within $\pm 3\sigma$

40 – 100 marks

This means extreme scores are very rare.

11. Empirical Rule Graph



12. Mathematical Formula of Normal Distribution

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

Where:

- μ = Mean
- σ = Standard Deviation
- π = 3.14159
- e = 2.718

This formula calculates probability density.

13. Standard Normal Distribution (Z-Score)

To standardize values, we use: $Z = \frac{X-\mu}{\sigma}$

Z-score tells how many standard deviations a value is from the mean.

Example:

If a student scores 85:

$$Z = \frac{85 - 70}{10} = 1.5$$

This means the score is 1.5 standard deviations above the mean.

14. Applications in Education

Normal Distribution is used for:

- Designing grading systems
- Comparing performance
- Setting cut-off marks
- Scholarship selection
- Identifying outliers
- Academic research

15. Advantages

1. Easy Data Understanding

- Helps quickly understand how data is distributed around the mean.

2. Predicts Data Behaviour

- We can estimate how many students will fall in a certain score range.

3. Identifies Outliers

- Scores beyond **±3σ** are very rare and may indicate errors or exceptional performance.

16. Limitations

- Not all data is normal
- Sensitive to outliers
- Cannot model skewed data

17. Real-Life Importance

Beyond education, Normal Distribution is used in:

- Height and weight measurement
-

18. Conclusion

In the domain of Student Examination Scores, the Normal Distribution clearly explains how marks are distributed.

With:

- Mean = 70
- Standard Deviation = 10

We conclude:

- 68% students score 60–80
- 95% score 50–90
- 99.7% score 40–100

Thus, Normal Distribution and the Empirical Rule provide a powerful statistical framework to analyse academic performance.