



# The Bell Curve in Everyday Life: Understanding Normal Distribution through exam scores

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## Abstract—

The bell curve, or normal distribution, is a fundamental concept in statistics that describes how many natural and social phenomena are distributed around a central value. This paper explores the relevance of the bell curve in everyday life, focusing on accessible example of exam scores. Exam performance often clusters around an average, with most students achieving moderate results while fewer attain exceptionally high or low scores. By analysing this case, the paper illustrates how the normal distribution provides insights into patterns of variation, fairness in evaluation. Understanding the bell curve helps in interpreting data more effectively, avoiding misjudgments about outliers, and appreciating the balance between commonality and rareness in populations. Beyond academics, the normal distribution underpins decision-making in education, biology, healthcare, and social sciences, making it a vital tool for recognizing order within apparent randomness. This study emphasizes that the bell curve is not merely a mathematical abstraction but a lens through which everyday phenomena can be understood, predicted, and contextualized.

**Keywords—** Normal Distribution; Bell Curve; Symmetry; Skewness; Kurtosis



## I. INTRODUCTION

The bell curve, known as the normal distribution, is one of the most significant concepts in statistics and probability. It provides a framework for understanding how data points are distributed around a central value, with frequencies gradually decreasing as values move further from the mean. This distribution is characterized by its symmetrical, bell-shaped curve, which reflects balance and regularity in many natural and social phenomena. Far beyond being a theoretical construct, the normal distribution is deeply embedded in everyday life, shaping the way we interpret patterns in education, health, economics, and human behavior.

The common example that illustrates the presence of the bell curve in real-world contexts is academic exam scores. In educational settings, student performance often clusters around an average score, with relatively few students achieving extremely high or extremely low marks. This pattern mirrors the properties of the normal distribution, where most observations lie close to the mean and only a small proportion deviate significantly. This example highlights how the bell curve serves as a natural model for understanding variation in human attributes and achievements.

Analysing such datasets through statistical measures—including mean, median, mode, variance, and standard deviation—provides insight into their central tendency and dispersion. Furthermore, the calculation of skewness helps determine whether the data is symmetric or exhibits deviation from normality. Graphical representations, such as probability density curves, complement these numerical measures by offering a visual understanding of distributional patterns. The bell curve, with its mesokurtic shape and symmetry about the mean, thus becomes a powerful tool for bridging theoretical statistics with practical interpretation.

This paper explores the role of the bell curve in everyday life by examining exam scores as representative dataset. Through both numerical and graphical analysis, the study demonstrates how normal distribution not only explains the behavior of data but also provides a foundation for meaningful interpretation in diverse fields. By connecting statistical theory with observable realities, the research underscores the enduring

relevance of the bell curve as a lens through which everyday phenomena can be understood.

## II. LITERATURE REVIEW

Summarize previous work relevant to your study. Present key contributions, methodologies, and findings from earlier research. Discuss limitations or gaps in existing studies that your work aims to fill. Group similar studies together for clarity, and cite appropriately. Highlight how your research builds upon or differs from prior work in the field. Explain the rationale behind your chosen approach and how it addresses identified gaps or limitations. Clearly state the unique contributions and potential impact of your study within the broader research context.

## III. METHODOLOGY

This study adopts a **descriptive research methodology**, focusing on the systematic collection, organization, and interpretation of exam score data to evaluate its conformity to the **normal distribution**. The descriptive approach emphasizes summarizing and characterizing the dataset rather than manipulating variables, thereby providing a clear picture of how exam scores behave in relation to the bell curve.

### Data Collection

**Exam Scores:** Mathematics examination scores were collected from 70 students, each graded out of a maximum of 30 marks.

**Sampling Method:** A simple random sampling technique was employed to ensure unbiased representation of student performance.

**Data Integrity:** Scores were anonymized to maintain confidentiality and entered into spreadsheets for computational analysis.

### Statistical Measures

The descriptive methodology relies on **measures of central tendency and dispersion** to summarize the dataset. Basic measures of central tendency and dispersion were calculated to provide an overview of the data. Comparing the mean and median helped identify potential asymmetry, while the standard deviation quantified variability.

### Shape and Symmetry Analysis:

Skewness was used to measure the degree of asymmetry in the distribution, whereas kurtosis assessed the "tailedness" or peakedness. Values close to zero for skewness and near three for kurtosis typically indicate normality. Karl



Pearson's coefficient was calculated to measure asymmetry. A value near zero indicates symmetry, while positive or negative values suggest deviation. Assessed the peakedness and tail behavior of the distribution, with mesokurtic values approximating normality.

#### Graphical representation:

Visual inspection was performed using histograms overlaid with KDE curves. This allowed for a graphical comparison between the empirical distribution and the expected bell-shaped curve of a normal distribution. Q-Q plots were generated to compare sample quantiles against theoretical quantiles of a normal distribution. Data points aligning closely with the reference line suggested conformity to normality.

#### Normality Testing

To formally assess distributional conformity:

**Shapiro–Wilk Test:** A formal statistical test was conducted to evaluate the null hypothesis that the data were normally distributed. The Shapiro–Wilk test is particularly sensitive for small to medium sample sizes.

**Kolmogorov–Smirnov Test:** This non-parametric test compared the empirical distribution function of the sample with the cumulative distribution function of a normal distribution, providing an additional statistical check for normality.

#### IV. RESULTS

The following approaches were applied to evaluate distribution characteristics:

- 1) Descriptive statistical analysis (Mean, Median, Standard Deviation)
- 2) Skewness and Kurtosis measurement
- 3) Histogram with Kernel Density Estimation (KDE)
- 4) Quantile–Quantile (Q-Q) Plot analysis
- 5) Shapiro–Wilk Normality Test
- 6) Kolmogorov–Smirnov Goodness-of-Fit Test

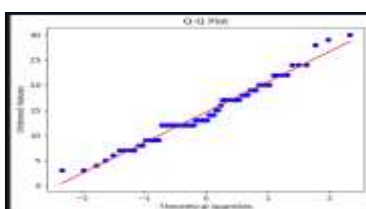
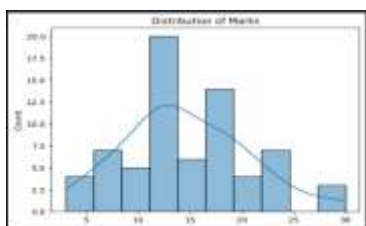


Table I: Numerical Results

Metric	Value
Mean	14.54
Median	13.00
Standard Deviation	5.97
Skewness	0.36
Kurtosis	-0.099
Shapiro-Wilk p-value	0.157
KS Test p-value	0.279

#### V. CONCLUSION

The **mean and median** are closely aligned, suggesting near symmetry.

**Skewness (0.36)** lies within acceptable limits ( $-1$  to  $+1$ ), indicating mild positive skew.

**Kurtosis (-0.099)** approximates zero, reflecting normal tail behavior.

**Histogram and KDE curves** show an approximately bell-shaped distribution.

**Q-Q plots** align closely with theoretical quantiles. Both **Shapiro–Wilk** and **KS tests** yielded p-values  $> 0.05$ , confirming no significant deviation from normality.

Thus, the dataset can be considered **approximately normally distributed**.

Based on graphical analysis and statistical goodness-of-fit testing, the marks dataset does not significantly deviate from a Normal Distribution. Therefore, the data can be considered approximately normally distributed and suitable for further parametric statistical analysis.

#### APPLICATIONS OF NORMAL DISTRIBUTION

The results demonstrate that exam scores follow the **normal distribution**, validating the bell curve as a model for educational performance. This has broader implications:

In **education**, it supports fair grading systems and helps identify outliers.

In **healthcare**, normal distribution models biological measures such as blood pressure or height.

In **economics**, it explains income distribution patterns when adjusted for skewness.

In **social sciences**, it aids in understanding human behavior and psychological traits.

The bell curve thus serves as a **unifying statistical framework** across disciplines, bridging theoretical probability with real-world phenomena.



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