



OVERVIEW

To truly understand your data, you need to know more than just averages. This module breaks down how data is shaped, how much it varies, and how far it spreads from the average. Learn how tools like distribution, variance, and standard deviation reveal hidden patterns and outliers that can shape your decisions.

Distribution

- **Definition:** Describes how data values are spread and their frequency.

Type	Description	Example
Left-skewed	Most values high; long left tail	Seniors' bedtimes
Normal (Unimodal)	Values cluster around the mean	Human height
Right-skewed	Most values low; long right tail	Number of pets per household

Variance and Standard Deviation

- **Variance:** Measures average spread of data points.
 - **Low: Data clustered (e.g., preschoolers' heights).**
 - **High: Data spread out (e.g., heights at a basketball game).**
- **Standard Deviation:** Average distance from the mean.

Formulas

$$\text{Sample Variance: } s^2 = \frac{\sum (x - \bar{x})^2}{n-1}$$

$$\text{Sample Standard Deviation: } s = \sqrt{\frac{\sum (x - \bar{x})^2}{n-1}}$$

Averages

- **Mean:** Sum of values divided by count. Best for normal data.
 - **Example:** Average commute time (if no outliers).
- **Median:** Middle value in ordered data. Best for skewed data.
 - **Example:** Household income (with extreme values).
- **Mode:** Most frequent value. Best for categorical data.
 - **Example:** Most common demographic at a fair (adults).

High Variability

- Use larger samples.
- Clean or transform skewed data.
- Compare datasets cautiously.

Real-World Applications

- **Equity Assessment:** Distribution of healthcare access across neighborhoods.
- **Policy Planning:** Analyzing food assistance uptake by ZIP code.
- **Business:** Identifying customer spending patterns.

Key Takeaways

- Distribution reveals data shape (e.g., gaps in services).
- Standard deviation quantifies spread; variance highlights variability.
- **Mean ≠ Median ≠ Mode:** Choose based on data type and skew.
- Outliers distort means but not medians.