Measure of Dispersion

1. What is the range of the following data set: [3, 5, 7, 9, 11]?

The range is the maximum minus the minimum.

Max = 11
Min = 3
Range = 11 − 3 = 8

Answer: 8

2. Find the variance of the data set: [2, 4, 6, 8,].

Mean = (2 + 4 + 6 + 8) / 4 = 5
Squared deviations sum = $(-3)^2 + (-1)^2 + 1^2 + 3^2 = 9 + 1 + 1 + 9 = 20$

Population variance (σ^2) = 20 / 4 = 5
Sample variance (s^2) = 20 / (4 − 1) = 20 / 3 = 6.6667

Answer: population variance = 5; sample variance = 20/3 ($\approx$ 6.6667)

3. Calculate the standard deviation of the values: [1, 2, 3, 4, 5].

We'll calculate step by step for the dataset [1, 2, 3, 4, 5].

Step 1: Mean

Mean=[1+2+3+4+5] /5=3

Step 2: Squared deviations from mean

- $(1 - 3)^2 = (-2)^2 = 4$
- $(2 - 3)^2 = (-1)^2 = 1$
- $(3 - 3)^2 = 0^2 = 0$
- $(4 - 3)^2 = 1^2 = 1$
- $(5 - 3)^2 = 2^2 = 4$

Sum = 4 + 1 + 0 + 1 + 4 = 10

Step 3: Variance

- Population variance = 10 / 5 = 2
- Sample variance = 10 / (5 − 1) = 10 / 4 = 2.5

Step 4: Standard Deviation

- Population SD = $\sqrt{2} \approx$ **1.414**
- Sample SD = $\sqrt{2.5} \approx$ **1.581**

✓ **Answer:** Population SD = 1.414, Sample SD = 1.581

4. Define range in your own words.

Range is the difference between the highest value and the lowest value in a dataset.

5. What does a high standard deviation indicate about a data set?

A high standard deviation means the values in the dataset are spread out widely from the mean (average).

6. If all numbers in a data set are the same, what is the standard deviation?

If all numbers in a dataset are the same, then:

- Every value = Mean
- So, each deviation from the mean = 0
- Variance = 0
- Standard deviation = $\sqrt{0}$ = **0** ✅

 Answer: The standard deviation is 0.

7. Find the range of the values: [15, 18, 12, 20, 10].

Let's calculate step by step:

- Maximum = 20
- Minimum = 10
- Range = 20 − 10 = **10** ✅

Answer: 10

8. What is the formula to calculate variance in a population?

The formula for **population variance** (σ^2) is:

$$\sigma^2 = \frac{\sum_{i=1}^{N}(x_i - \mu)^2}{N}$$

Where:

- N = total number of values in the population
- x_i = each individual value
- μ = population mean

 In words: **Variance is the average of the squared differences from the mean.**

9. Explain the difference between sample variance and population variance.

Population variance is used when you have data for the **entire group** you are studying. It measures how spread out all the values are in the whole population.

Sample variance is used when you only have data from a **subset (sample)** of the population. Since a sample doesn't represent the whole perfectly, we make a small adjustment (by dividing a little differently) to avoid underestimating the spread.

10. **Compute the standard deviation for this data set: [4, 4, 4, 4, 4].**

Let's check step by step for the dataset [4, 4, 4, 4, 4]:

Step 1: Mean

Mean = [4+4+4+4+4]/5 = 4

Step 2: Deviations from mean
Each value − Mean = 4 − 4 = 0

Step 3: Squared deviations
All are $0^2 = 0$

Step 4: Variance
Average of squared deviations = 0

Step 5: Standard Deviation

$\sqrt{0} = 0$

Answer: The standard deviation is 0

11. **A data set has a variance of 0. What can you say about its values.**

If a dataset has a **variance of 0**, it means **there is no spread at all** in the data.

In simple words: **all the values in the dataset are exactly the same.**

For example: [7, 7, 7, 7] → variance = 0.

12. **What is the square root of variance called?**

The **square root of variance** is called the **standard deviation** ✓

13. **Why do we square the differences from the mean when calculating variance?**

We square the differences to **remove negatives**, **prevent cancellation**, and **emphasize larger deviations**.

14. **Which measure of dispersion is affected most by outliers?**

The measure of dispersion most affected by **outliers** is the **range** ✓

15. **True or False: Range is a measure of central tendency.**

False