Assignment 3:

If $\mu = 55$, $\sigma_{4a} = 4$, $\sigma_{4\beta} = 10$, $\sigma_4 = c\ 15$, In this which is better

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1. Introduction

In statistics, the Normal Distribution is defined by two main parameters:

- **Mean (μ)** – the central value of the distribution
- **Standard Deviation (σ)** – the measure of spread or variability

When the mean remains constant and only the standard deviation changes, the center of the distribution does not move, but the spread of the data changes significantly.

In this report, we analyze three normal distributions with:

- **$\mu = 55$**
- **$\sigma_a = 4$**
- **$\sigma_\beta = 10$**
- **$\sigma c = 15$**

The goal is to determine which distribution is "better" and under what context.

2. Understanding the Parameters

2.1 Mean (μ = 55)

The mean represents the central value of the distribution. All three distributions have the same mean (55), meaning:

- The peak of all three curves is centered at 55.
- The average performance is the same in all cases.

Thus, the only difference lies in how spread out the data is.

2.2 Standard Deviation (σ)

Standard deviation measures how far data points are from the mean.

- Small σ → Data tightly clustered around the mean.
- Large σ → Data widely spread out.

3. Case Analysis

Case 1: $\sigma_a = 4$

This is a **small standard deviation**.

Characteristics:

- Data is highly concentrated near 55.
- Most values fall within a narrow range.
- Curve is tall and narrow.

Using the Empirical Rule:

- 68% of values lie between:

$55 \pm 4 = (51,59)$

- 95% lie between:

$55 \pm 8 = (47,63)$

This shows very little variation.

Interpretation:

If this represents exam scores, most students score very close to 55. There is consistency and low variability.

Case 2: $\sigma_\beta = 10$

This is a **moderate standard deviation**.

Characteristics:

- Data moderately spread.
- Curve is wider than σ_a.
- Balanced variability.

Using the Empirical Rule:

- 68% between:

$55 \pm 10 = (45,65)$

- 95% between:

$55 \pm 20 = (35,75)$

This indicates reasonable variation.

Interpretation:

If this represents exam scores, students show diversity in performance but still remain around the average.

Case 3: $\sigma c = 15$

This is a **large standard deviation**.

Characteristics*:*

- Data widely spread.
- Curve is flatter and broader.
- High variability.

Using the Empirical Rule:

- 68% between:

$55 \pm 15 = (40,70)$

- 95% between:

$55 \pm 30 = (25,85)$

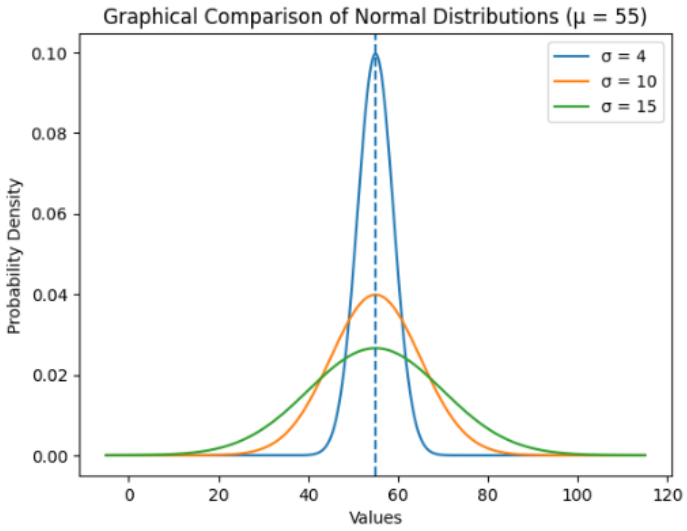
This shows large dispersion.

Interpretation:

Scores vary greatly. Some students perform very poorly, while others perform very well.

4. Graphical Comparison (Conceptual)

If drawn on the same graph:



- $\sigma_a = 4 \rightarrow$ Tall and narrow curve
- $\sigma_\beta = 10 \rightarrow$ Moderate width curve
- $\sigma c = 15 \rightarrow$ Wide and flat curve

All three peak at 55, but their spreads differ significantly.

5. Which is Better?

The answer depends on the context.

If we want consistency and stability

Example: Manufacturing quality control, exam grading fairness

σ = 4 is better
Because:

- Less variation
- More predictable outcomes
- Higher reliability

If we want moderate diversity

Example: Educational performance measurement

σ = 10 is better
Because:

- Shows natural variation
- Avoids extreme clustering
- Balanced spread

If we want high diversity or wide performance range

Example: Talent identification, competitive selection

σ = 15 may be useful Because:

- Highlights extreme performers
- Shows large differences in ability

However, too much variation may indicate instability or inequality.

6. Statistical Perspective

From a statistical efficiency standpoint:

- Smaller standard deviation means lower variance.
- Lower variance generally indicates better precision.
- In most controlled systems, smaller σ is preferred.

Thus:

σ=4is statistically more stable and precise.

7. Conclusion

All three distributions share the same mean (55), but differ in spread.

Standard Deviation	Spread	Stability	Variability
σ = 4	Narrow	High	Low
σ = 10	Moderate	Medium	Medium
σ = 15	Wide	Low	High

Final Answer:

If the question asks generally, without specific context:

$\sigma = 4$ is better because it shows lower variability, greater stability, and more consistent outcomes.

However, in real-world scenarios, the "best" standard deviation depends on the purpose of analysis.