**Why We Use n−1n - 1n−1 When Calculating Sample Variance**

When we estimate the **population variance** using a **sample**, we calculate the sample variance using the formula:

**✅ Key Points to Remember:**

1. **Sample Mean Is an Estimate**:
   * The sample mean xˉ\bar{x}xˉ is calculated from the same data you're using to measure variability.
   * This "pulls" the deviations closer together, leading to an **underestimate** of the true variance if we divide by nnn.
2. **Degrees of Freedom (DoF)**:
   * Out of the nnn sample values, once the mean is fixed, **only n−1n - 1n−1** values are free to vary.
   * The last value is **constrained** to ensure the mean remains the same.
   * This loss of one "free" value is why we adjust the denominator.
3. **Bessel’s Correction**:
   * Dividing by n−1n - 1n−1 instead of nnn is called **Bessel’s correction**.
   * It makes the sample variance an **unbiased estimator** of the population variance.

**🧠 Intuition:**

Since the sample mean is fitted to the data, deviations from it are **always slightly smaller** than deviations from the true population mean. To compensate for this bias, we divide by n−1n - 1n−1, not nnn.