Variance Estimation Video

Start of transcript. Skip to the end.

- Hello and welcome back.

Last time we saw how to estimate the mean of a distribution.

And now we're going to talk about the next

most natural parameter, which is the variance

and see how to estimate that.

And we're going follow one of the early data scientists,

7:07 / 0:00 1.0x

POLL

As an estimator for distribution variance, the "raw" sample variance is

RESULTS

biased	**74%**
unbiased	**26%**

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Results gathered from 134 respondents.

FEEDBACK
It's biased.

11.3_Variance_Estimation

1

2.0/2.0 points (graded)
Let $\overline{X}_n$ and S_n^2 be the sample mean and the sample variance of $\{X_1, \dots, X_n\}$. Let $\overline{X}_{n+1}$ and S_{n+1}^2 be the sample mean and the sample variance of $\{X_1, \dots, X_n, \overline{X}_n\}$. Which of the following hold

- for sample means,

- $\overline{X}_n > \overline{X}_{n+1}$
- $\overline{X}_n < \overline{X}_{n+1}$
- $\overline{X}_n = \overline{X}_{n+1}$ ✔

Explanation
$\overline{X}_{n+1} = \frac{\sum_{i=1}^n X_i + \overline{X}_n}{n+1} = \frac{n \cdot \overline{X}_n + \overline{X}_n}{n+1} = \overline{X}_n$.

- for sample variances?

- $S_n^2 > S_{n+1}^2$ ✔
- $S_n^2 < S_{n+1}^2$
- $S_n^2 = S_{n+1}^2$

Explanation

$S^2_{n+1} = \frac{\sum_{i=1}^{n}(X_i - \overline{X}_{n+1})^2 + (\overline{X}_n - \overline{X}_{n+1})^2}{n} = \frac{\sum_{i=1}^{n}(X_i - \overline{X}_n)^2 + (\overline{X}_n - \overline{X}_n)^2}{n} < \frac{\sum_{i=1}^{n}(X_i - \overline{X}_n)^2}{n-1} = S^2_n.$

Submit You have used 1 of 4 attempts

Answers are displayed within the problem

2

2.0/2.0 points (graded)

Consider the following array of $m \times n$ random variables $X_{11}, X_{12}, \cdots, X_{1n}, \cdots, X_{i1}, X_{i2}, \cdots, X_{in}, \cdots, X_{m1}, X_{m2}, \cdots, X_{mn}$For $i = 1, \cdots, m$, let $\overline{X}_i$ be the sample mean of $\{X_{i1}, X_{i2}, \cdots, X_{in}\}$, and $\overline{S}^2$ be the "raw" sample variance of $\{\overline{X}_1, \overline{X}_2, \cdots, \overline{X}_m\}$. If $\forall i, j, V(X_{ij}) = \sigma^2$, what is $E(\overline{S}^2)$?

- $\frac{n-1}{n}\sigma^2$
- $\frac{m-1}{m}\sigma^2$
- $\frac{1}{n}\sigma^2$
- $\frac{1}{m}\sigma^2$
- $\frac{n-1}{mn}\sigma^2$
- $\frac{m-1}{mn}\sigma^2$ ✔

Explanation

According to wlln, $V(\overline{X}_i) = \frac{\sigma^2}{n}$.

$E(\overline{S}^2) = \frac{m-1}{m} V(\overline{X}_i) = \frac{m-1}{mn}\sigma^2.$

Submit You have used 2 of 2 attempts

Answers are displayed within the problem

3

0 points possible (ungraded)

If all the observations in a sample increase by 5

- [ ] the sample mean increases by 5, ✔
- [x] the sample mean stays the same,
- [ ] the sample variance increases by 5,
- [x] the sample variance stays the same. ✔

✖

Explanation

Let $y_i = x_i + 5$

- True. $\bar{y} = \frac{1}{n}\sum_{i=1}^{n} y_i = \frac{1}{n}\sum_{i=1}^{n}(x_i+5) = \frac{1}{n}\sum_{i=1}^{n} x_i + 5 = \bar{x} + 5$
- False.
- False.
- True.

$s_y^2 = \frac{1}{n}\sum_{i=1}^{n}(y_i - \bar{y})^2 = \frac{1}{n}\sum_{i=1}^{n}(x_i + 5 - (\bar{x}+5))^2 = \frac{1}{n}\sum_{i=1}^{n}(x_i - \bar{x})^2 = s_x^2$

Submit You have used 2 of 2 attempts

Answers are displayed within the problem

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