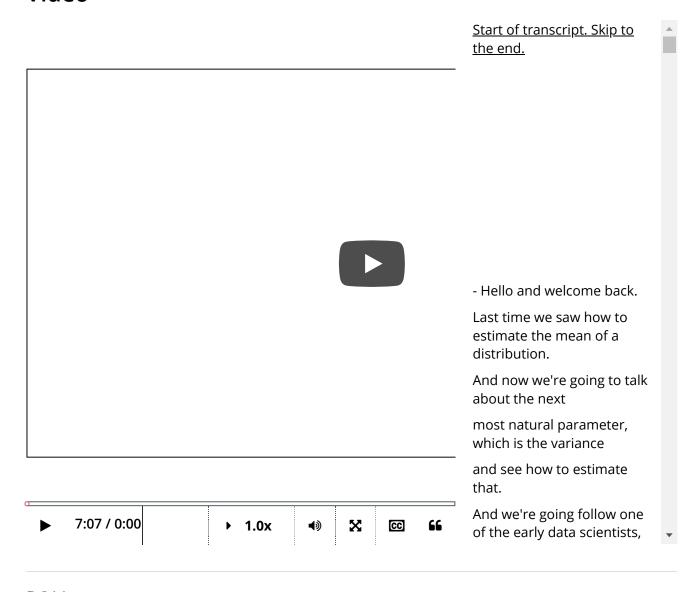


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Variance Estimation Video



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 $\{X_1,\ldots,X_n\}$. Let \overline{X}_{n+1} and S^2_{n+1} 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,
- $igcup \overline{X}_n > \overline{X}_{n+1}$
- ullet $\overline{X}_n < \overline{X}_{n+1}$
- $lackbox{0} \ \overline{X}_n = \overline{X}_{n+1}$

Explanation

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

- for sample variances?
- $ullet S_n^2 > S_{n+1}^2 \, ullet$
- \circ $S_n^2 < S_{n+1}^2$
- \circ $S_n^2=S_{n+1}^2$

Explanation

$$S_{n+1}^2 = rac{\sum_{i=1}^n \left(X_i - \overline{X}_{n+1}
ight)^2 + \left(\overline{X}_n - \overline{X}_{n+1}
ight)^2}{n} = rac{\sum_{i=1}^n \left(X_i - \overline{X}_n
ight)^2 + \left(\overline{X}_n - \overline{X}_n
ight)^2}{n} < rac{\sum_{i=1}^n \left(X_i - \overline{X}_n
ight)^2}{n-1} = S_n^2.$$

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You have used 1 of 4 attempts

1 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 $E(\overline{S}^2)$?

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

Explanation

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

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

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You have used 2 of 2 attempts

1 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,
- the sample mean stays the same,
- the sample variance increases by 5,
- the sample variance stays the same.



Explanation

Let $y_i = x_i + 5$

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

- False.
- False.
- True.

$$s_y^2 = rac{1}{n} \sum_{i=1}^n \left(y_i - ar{y}
ight)^2 = rac{1}{n} \sum_{i=1}^n \left(x_i + 5 - (ar{x} + 5)
ight)^2 = rac{1}{n} \sum_{i=1}^n \left(x_i - ar{x}
ight)^2 = s_x^2$$

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You have used 2 of 2 attempts

Answers are displayed within the problem

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