2. Biased and unbiased estimation for variance of Bernoulli variables

(a)

2/2 points (graded)

Let $X_1, \ldots, X_n$ be i.i.d. Bernoulli random variables, with unknown parameter $p \in (0,1)$. The aim of this exercise is to estimate the common variance of the X_i.

First, recall what $\mathrm{Var}(X_i)$ is for Bernoulli random variables.

$\mathrm{Var}(X_i)$ = p*(1-p) ✔

$p \cdot (1-p)$

Let $\overline{X}_n$ be the sample average of the X_i,

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

We are interested in finding an estimator for $\mathsf{Var}(X_i)$, and propose to use

$$\hat{V} = \overline{X}_n\left(1-\overline{X}_n\right).$$

Check the correct statement that applies to $\hat{V}$:

- $\hat{V}$ is not consistent because $\mathsf{Var}(X_i)$ is not linear in p
- **$\hat{V}$ is consistent because of the Law of Large Numbers** ✔
- $\hat{V}$ is consistent because of the Central Limit Theorem

✔

STANDARD NOTATION

Submit You have used 1 of 2 attempts

✔ Correct (2/2 points)

(b)

2/2 points (graded)

Now, we are interested in the bias of $\hat{V}$. Compute:

$\mathbb{E}[\hat{V}] - \mathrm{Var}(X_i) =$ (p^2-p)/n ✔

$\frac{p^2-p}{n}$

Using this, find an unbiased estimator $\hat{V'}$ for $p(1-p)$ if $n \geq 2$.

Write barX_n for $\overline{X}_n$.

$\hat{V'} =$ n/(n-1)*(barX_n*(1-barX_ ✔

STANDARD NOTATION

Submit You have used 3 of 3 attempts

✔ Correct (2/2 points)

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- Can't eliminate p in the second exercise — 3
  I already checked other question posted here but I'm still unable to eliminate P from my exercise although the exercise seems to be straight forward I first calculated E[V], rep...
- Any hints for b) please? — 4
  Particularly how to find E[V]?
- Hint for part (b) — 3

STAFF - Add "Show Answer" button after correct submission or no more attempts left

I just could not figure out the answer to part b. I got the unbiased estimator right after a long time of researching the internet, but unfortunately I could not figure out the sol...

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