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2. Biased and unbiased estimation

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> for variance of Bernoulli variables

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## 2. Biased and unbiased estimation for variance of Bernoulli variables

(a)

2/2 points (graded)

Let  $X_1, \dots, X_n$  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  $\text{Var}(X_i)$  is for Bernoulli random variables.

$\text{Var}(X_i) =$   ✓

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

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

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

$$\hat{V} = \bar{X}_n (1 - \bar{X}_n).$$

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

☐  $\hat{V}$  is not consistent because  $\text{Var}(X_i)$  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:

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

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

Write  $\bar{X}_n$  for  $\bar{X}_n$ .

$$\hat{V}' = \frac{n}{n-1} (\bar{X}_n (1 - \bar{X}_n))$$

STANDARD NOTATION

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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

4

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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