MITx: 14.310x Data Analysis for Social Scientists

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Unbiased Estimators - Quiz

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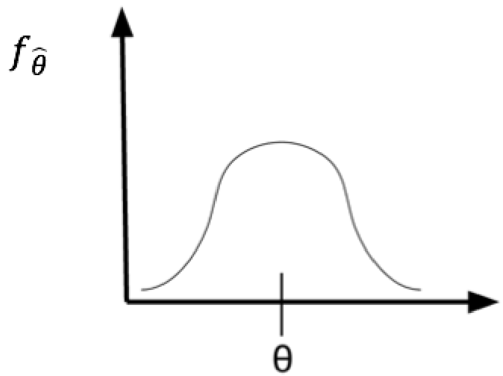
Question 1

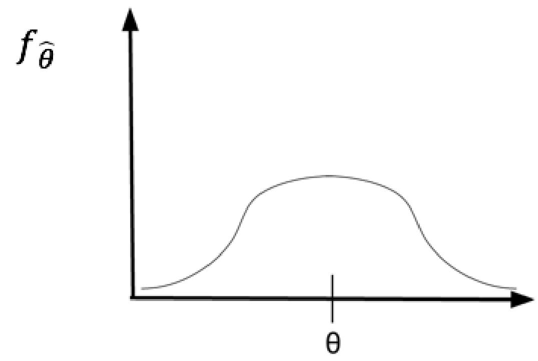
1.0/1.0 point (graded)

Which estimators $\hat{\theta}$ are unbiased? These graphs show PDFs of $\hat{\theta}$. (Select all that apply.)

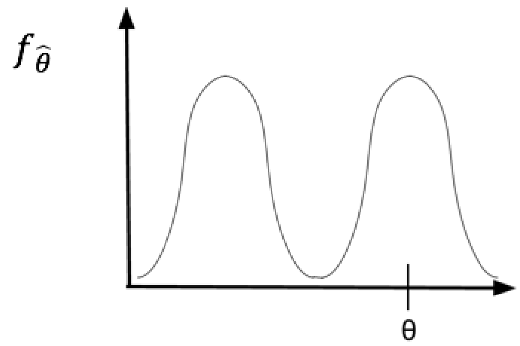
- [x] a.



- [x] b.



- [ ] c.



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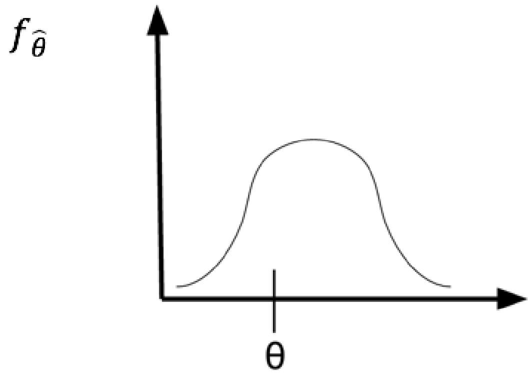
d. 

Explanation

Recall the definition of an unbiased estimator: an estimator $\hat{\theta}$ is unbiased if, in expectation, it is equal to the parameter it is trying to estimate. (In other words, an estimator is unbiased for θ if $E[\hat{\theta}] = \theta$ for all θ in Φ.) Therefore, the estimators in a. and b. are both unbiased, because the expectation of $\hat{\theta}$ is the center of the distribution.

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Question 2

1.0/1.0 point (graded)

Suppose we are trying to estimate the mean μ of a $N(\mu, \theta)$ distribution. Which of the following estimators would be unbiased? (Select all that apply)

- [x] a. $\hat{\mu} = \frac{1}{n}\sum_{i=1}^{n} X_i$
- [ ] b. $\hat{\mu} = \frac{1}{2}\max\{X_1, X_2, \ldots X_n\}$
- [ ] c. $\hat{\mu} = n\min\{X_1, X_2, \ldots, X_n\}$
- [ ] d. $\hat{\mu} = \frac{2}{n}\sum_{i=1}^{n} X_i$

✔

Explanation

We can calculate the expectation of any of these estimators to determine whether they are biased. The estimator in (a) is unbiased: $E\left[\frac{1}{n}\sum_{i=1}^{n} X_i\right] = \frac{1}{n}\sum_{i=1}^{n} E[X_i] = \frac{1}{n}\sum_{i=1}^{n}\mu = \frac{n\mu}{n} = \mu$. The estimator in (b) is biased because, as we saw in lecture, the n^{th} order statistic is a biased estimator for μ. Intuitively, the estimator will always be less than or equal to θ, and equal θ with 0 probability. The estimator in (c) can be shown to be a biased estimator for μ, in the same way the n^{th} order statistic is a biased estimator. The estimator in (d) would estimate θ, not μ.

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Discussion

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