



MITx: 6.041x Introduction to Probability - The Science of Uncertainty



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Exercise: Bias and MSE

(2/2 points)

We estimate the unknown mean θ of a random variable X with unit variance by forming the sample mean $M_n = (X_1 + \cdots + X_n)/n$ of n i.i.d. samples X_i and then forming the estimator

$$\hat{\Theta}_n = \frac{1}{3} \cdot M_n.$$

Your answers below can be functions of θ and n . Follow standard notation and use 'theta' to indicate θ .


The bias $\mathbf{E}[\hat{\Theta}_n] - \theta$ of this estimator is:

**Answer:** -2*(theta)/3


- ▶ Unit 6: Further topics on random variables
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Unit overview


Lec. 18: Inequalities, convergence, and the Weak Law of Large Numbers

Exercises 18 due Apr 27, 2016
at 23:59 UTC 

Lec. 19: The Central Limit Theorem (CLT)

Exercises 19 due Apr 27, 2016
at 23:59 UTC 

Lec. 20: An introduction to classical statistics

Exercises 20 due Apr 27, 2016
at 23:59 UTC 

The mean squared error of this estimator is:

$$1/(9*n)+4*\theta^2/9$$



Answer: $1/(9*n)+4*(\theta)^2/9$


Answer:

Since $\mathbf{E}[M_n] = \theta$, we have $\mathbf{E}[\hat{\Theta}_n] = \theta/3$, and the bias is $-2\theta/3$.

The variance of $\hat{\Theta}_n$ is $1/9$ times the variance of M_n , which is $1/n$. The mean squared error is the sum of the variance and the square of the bias: $1/(9n) + (4\theta^2/9)$.

You have used 1 of 2 submissions

[Solved problems](#)[Additional theoretical material](#)[Problem Set 8](#)

Problem Set 8 due Apr 27, 2016
at 23:59 UTC 

[Unit summary](#)

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