8. Exercise: Conditional variance

Exercises due Feb 28, 2020 05:29 IST *Completed*

Exercise: Conditional variance

2/2 points (graded)

In the last example, we saw that the conditional distribution of X, which was a uniform over a smaller range (and in some sense, less uncertain), had a smaller variance, i.e., $\mathsf{Var}(X \mid A) \leq \mathsf{Var}(X)$. Here is an example where this is not true. Let Y be uniform on $\{0, 1, 2\}$ and let B be the event that Y belongs to $\{0, 2\}$.

a) What is the variance of Y?

$\mathsf{Var}(Y) =$ 2/3 ✔ **Answer:** 0.66667

b) What is the conditional variance $\mathsf{Var}(Y \mid B)$?

$\mathsf{Var}(Y \mid B) =$ 1 ✔ **Answer:** 1

Solution:

a) The calculation of the variance of Y is exactly the same as the calculation of $\mathsf{Var}(X \mid A)$ in the preceding example, yielding 2/3.

b) In the conditional model, the conditional mean is $\mathbf{E}[Y \mid B] = 1$. Since Y is either 0 or 2 in the conditional model, the difference between Y and the conditional mean is either 1 or -1, so that $(Y - \mathbf{E}[Y \mid B])^2$ is always equal to 1. It follows that the conditional variance is equal to 1.

Note that in this example, $\mathsf{Var}(Y \mid B) > \mathsf{Var}(Y)$.

You have used 3 of 3 attempts

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Answers are displayed within the problem

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