5. Exercise: The expected value rule with conditioning

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

Exercise: The expected value rule with conditioning

6/6 points (graded)

For each of the formulas below, state whether it is true or false.

1) $\mathbf{E}\left[g\left(X,Y\right) \mid Y=2\right] = \sum_{x} g\left(x,y\right) p_{X,Y}\left(x,y\right)$

False ✔ **Answer:** False

2) $\mathbf{E}\left[g\left(X,Y\right) \mid Y=2\right] = \sum_{x} g\left(x,y\right) p_{X,Y}\left(x,2\right)$

False ✔ **Answer:** False

3) $\mathbf{E}\left[g\left(X,Y\right) \mid Y=2\right] = \sum_{x} g\left(x,2\right) p_{X,Y}\left(x,2\right)$

False ✔ **Answer:** False

4) $\mathbf{E}\left[g\left(X,Y\right) \mid Y=2\right] = \sum_{x} g\left(x,2\right) p_{X|Y}\left(x \mid 2\right)$

True ✔ **Answer:** True

5) $\mathbf{E}\left[g\left(X,Y\right) \mid Y=2\right] = \sum_{x} g\left(x,2\right) \frac{p_{X,Y}\left(x,2\right)}{p_{Y}\left(2\right)}$

True ✔ **Answer:** True

6) $\mathbf{E}\left[g\left(X,Y\right) \mid Y=2\right] = \sum_{x}\sum_{y} g\left(x,y\right) p_{X,Y|Y}\left(x,y \mid 2\right)$

True ✔ **Answer:** True

Solution:

1-3) There is no reason for any of the first three formulas to be true.

4) True. This is just the usual expected value rule, in a model in which the event $\{Y=2\}$ is known to have occurred. Given the information that $Y=2$, the function $g\left(x,y\right)$ is replaced by $g\left(x,2\right)$, and we are dealing with a function $g\left(x,2\right)$ of a single variable x. We apply the expected value rule for a function of a single variable, but since we are within a conditional model, we need to use the conditional PMF of X.

5) True. This is the same as the fourth statement, except that we have substituted in the definition of $p_{X|Y}\left(x \mid 2\right)$.

6) True. This is just the expected value rule for a function of two variables, applied within a conditional universe where the event $\{Y=2\}$ is known to have occurred.

Notice that $p_{X,Y|Y}\left(x,y \mid 2\right)$ will be zero for any $y \neq 2$. And for $y=2$,

$$p_{X,Y|Y}\left(x,2 \mid 2\right) = \mathbf{P}\left(X=x, Y=2 \mid Y=2\right) = \mathbf{P}\left(X=x \mid Y=2\right) = p_{X|Y}\left(x \mid 2\right),$$

so that the sixth formula agrees with the fourth one.

Submit You have used 1 of 1 attempt

Answers are displayed within the problem

Discussion

Hide Discussion

Topic: Unit 4: Discrete random variables:Lec. 7: Conditioning on a random variable; Independence of r.v.'s / 5. Exercise: The expected value rule with conditioning

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? Summation
In (6), When the value for Y is fixed to 2, is the second summation over y ignored on the right hand side. 2

? In question 6 the conditioning is misleading
I was confused by |2 at the end of the formula, it should be |y=2, that caused me to choose the wrong an... 2

? Question on #6
For my understanding of Q6, would it be possible for me to know whether the same relationship holds ev... 5

Really dislike how some of the answers are just swept under the rug
Answers for the questions 1-3 teach bad habits to the students. You can't declare something to be false, si... 1

#6 Very confusing notation which requires more clarification 3

#5 Notation 2

Difference between #3 and #4?
I'm not sure why these two are different: isn't the probability that x and y are x and 2 the same as the con... 6

Clarity on Notations
Where can I read somewhere to get better clarity on these notations. For example 1. Σ $g(x,2)pX|Y(x|2)$ <<-- ... 6

6. Ugh, made a mistake. Here is a hint to avoid it (shouldn't violate the honor code) 3

Not much of an explanation...
...in the answer about why 3 is what it is. "Show answer" explanation is a bit glib. Seems a lot like 4 and 6. 1

? g(x,y) and psubXY(x,y)
In question 1 (though I have this question elsewhere), we are given that Y=2. We sum over all x: g(x,y) * ps... 2

Please update solution to this excellent problem
I received full marks for this qustion, but please update the solution in the place where "there is no reason... 3