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11. Exercise: Total probability theorem

Exercises due Feb 12, 2020 05:29 IST Completed

Exercise: Total probability theorem

2.0/2.0 points (graded)

We have an infinite collection of biased coins, indexed by the positive integers. Coin i has probability 2^{-i} of being selected. A flip of coin i results in Heads with probability 3^{-i} . We select a coin and flip it. What is the probability that the result is Heads? The geometric sum

formula may be useful here: $\sum_{i=1}^{\infty} \alpha^i = \frac{\alpha}{1 - \alpha}$, when $|\alpha| < 1$.

The probability that the result is Heads is:

✓ Answer: 0.2

Solution:

We think of the selection of coin i as scenario/event A_i . By the total probability theorem, for the case of infinitely many scenarios,

$$\mathbf{P}(\text{Heads}) = \sum_{i=1}^{\infty} \mathbf{P}(A_i) \mathbf{P}(\text{Heads}|A_i) = \sum_{i=1}^{\infty} 2^{-i} 3^{-i} = \sum_{i=1}^{\infty} (1/6)^i = \frac{1/6}{1 - (1/6)} = \frac{1}{5}.$$

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You have used 1 of 3 attempts

Answers are displayed within the problem

Discussion

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Fractions
4

I know this is a very basic math question and probably stupid, but I graduated back in 2000 ...where can ...

a Hint
7

Anyone can give some hints on the solution?
2 new_ 12

Appreciate if anyone could give some hints on the solution.

Struggling with the wording of the question?
5

I'm reading this very literally which is throwing me off. It asks us that if we select a coin out of an infinite ...

Checking your answer
1

One tip: I found I was able to check my answer using MS Excel by constructing the infinite sum using the ...

Rats, I threw out 2 off the cuff answers
4

without thinking too much. Stupid. Now I have only one real thoughtful response left.:(Just wanted to s...

Probability of the complements? or the other biased coins?
2

Hi. This makes me think we need to be able to consider what happens when coin i is not selected. Shoul...

Approach Feedback
7

OK. Here is the logic I am using. Would appreciate any feedback. The probability of selecting the biased c...

A Major Hint
2

Let us consider coin 3 for making things easier. $P(C_3) = 1/(2^3)$ $P(H|C_3) = 1/(3^3)$ so they are asking $P(H)$...

If coin count = 1, then its selection = 1/2 ?
3

I'm a little bothered by the idea of a universe where the selection of a coin from just one option is 50 / 50.

Use excel to understand the problem
4

I used excel to lay out the problem. My first column was an index, the second for the probability of selec...

What about the unbiased coin?
3

Hi, if the Chance of selecting a biased coin is 1/2 then the selection of an unbiased coin should be 1/2 as ...

interpretation
3

The probability of a flip of a coin (C i) resulting in Head(H),, does it mean $P(C_i \cap H)$ or $P(H|C_i)$.

P(Heads|A) vs P(Heads|B, A)

