## 20. Exercise: On countable additivity

Exercises due Feb 5, 2020 05:29 IST   *Completed*

Exercise: On countable additivity

2/2 points (graded)

Let the sample space be the two-dimensional plane. For any real number $x$, let $A_x$ be the subset of the plane that consists of all points of the vertical line through the point $(x, 0)$, i.e., $A_x = \{(x, y) : y \in \text{Re}\}$.

a) Do the axioms of probability theory imply that the probability of the union of the sets $A_x$ (which is the whole plane) is equal to the sum of the probabilities $\mathbf{P}(A_x)$?

No      ✔ **Answer: No**

b) Do the axioms of probability theory imply that

$$\mathbf{P}\left(A_1 \cup A_2 \cup \cdots\right) = \sum_{x=1}^{\infty} \mathbf{P}(A_x)?$$

(In other words, we consider only those lines for which the $x$ coordinate is a positive integer.)

Yes      ✔ **Answer: Yes**

**Solution:**

a) The collection of sets $A_x$ is not countable because the set of real numbers is not countable (i.e., cannot be arranged in a sequence), and so the additivity axiom does not apply.

b) The countable additivity axiom applies because we are dealing with a sequence (in particular, a countable collection) of disjoint events.

ℹ  Answers are displayed within the problem

# Discussion

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**Topic:** Unit 1: Probability models and axioms:Lec. 1: Probability models and axioms / 20. Exercise: On countable additivity

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☑  **Countable additivity axiom holds for uncountable sample space?**
I am not sure I understand the answer to b) because even choosing a countable subset, the sample spac...    **4**

❓  **In the first question, Why is 'y' descripted as Real number?**
If the sample space is just a plane, then shouldn't 'y' always be a 0? Since the plane is vertical, I am thinki...    **2**

☑  **use of wording in the statement**
Hi, In this statement "(x,0) , i.e., Ax={(x,y):y∈Re}" is it implicit that x belongs to the Real numbers? Or do w...    **2**

❓  **What does Re mean in y∈Re?**
The title pretty much says it all. I am unsure about the notation.    **2**

❓  **What's the difference between a) and b)?**
Yes, in b) we see the numbers at the A's, but how come they matter? One can reorder them, so effectivel...    **3**

❓  **Clarity on Additivity axion**
In question B, X varies from 1 to Infinity ie uncountable events...additivity holds for countable events onl...    **2**

❓  **Question B**
The Probability of Line is zero, How do the axioms imply? When we add all to gather, the probability of o...    **7**

💬  **Missing something important**
The class seems to cover the material in a very high level, however I am not able to solve the problems h...    **4**

💬  **The definition of x changes**
The key point seems to be that x in part a is a real number, and in part b it is an integer. Integers are cou...    1 new

💬  **Probability law is not mentioned, as it is irrelevant for the questions.**
They make no statements about what probability law the set follows, all they focus on is the set. It helps ...    **1**

❓  **Countable, but doesn't satisfy the "nice" area assumption?**
I'm second guessing myself. Clearly, they want to draw an distinction between uncountable and countab...    **11**

☑ **What is the difference between a and b?**
Aren't they talking about the same equation?

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