

# Re: Calculus XOR Probability

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- *From:* Matt Gutting <[tchrmatt@xxxxxxxxxx](mailto:tchrmatt@xxxxxxxxxx)>
  - *Date:* Mon, 22 May 2006 15:14:47 -0400
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Tony Orlow wrote:

cbrown@xxxxxxxxxxxxxxxxxxxx said:

What is missing is a statement of /exactly what you mean/ by "the length of (the limit of the staircases) is {whatever you propose}".

The limit of the staircases is the series  $\text{Sum}(n \rightarrow \infty: \{1/n, 0\}, \{0, 1/n\})$ . That's  $n$  repetitions of a step with length  $2/n$ , for a total length of 2.

You're assuming again that you can interchange the sum and the limit process. The length of the limit of staircases need not equal the limit of the length of staircases with the standard definition.

Do you mean to say that the limit of the staircases is a series? That's how your sentence is phrased, but it doesn't seem to make sense. You're apparently making a sequence of geometric figures (staircases), then stating that the limit is an infinite series, presumably evaluated in the same way that infinite series typically are – although you need to be clearer about the meaning of " $n \rightarrow \infty (1/n, 0), (0, 1/n)$ ". How does the limit of a sequence of geometric figures get to be a sequence of real numbers? Or is that what you meant?

In order for me to understand your answer, you must first state /exactly what you mean/ by "the limit of the staircases"; which you have not done in the above paragraphs. Is "the limit of the staircases" a function? Is it a real number? A set of line segments? A set of pairs of pairs in  $\mathbb{R}^2 \times \mathbb{R}^2$ ? A white elephant?

## Re: Calculus XOR Probability

I stated already it's a sequence of line segments. See above, "defined as a pair of reals which represent the x and y coordinate differences between subsequent points". Each of those pairs represents a line segment.

So, each staircase is a sequence of line segments. How do you decide that the limit is also a sequence of line segments?

The closest you get is this cryptic comment: "Because of the difference in vector direction, even at the infinitesimal scale, the staircase is longer than the diagonal." But this doesn't tell me what "the limit of the staircases" is; it simply mentions several (undefined) properties you propose it to have.

It's a staircase with  $\infty$  stairs, each  $2/\infty$  long, given riser and tread. What is your question?

\*My\* question is, since you haven't actually defined  $\infty$ , how can you tell whether  $\infty$  or  $2/\infty$  exist?

For example, presumably there is some point  $p = (a,b)$  in  $\mathbb{R}^2$  that is in the limit of the staircases. Does that point satisfy  $b = 1 - a$ , or does it not?

The tread of one step meets the riser of the next at a point on the diagonal. Where the riser meets its tread, that corner is NOT on the diagonal, even if it may be only an infinitesimal difference away, and consider coincident with the line according to standard finitist limits.

Given that point  $p$ , what is the "vector direction, at the infinitesimal scale" associated with it? Can we deduce it from the values of  $a$  and  $b$ ? For example, how do I determine the "vector direction, at the infinitesimal scale" at the point  $(1/2, 1/2)$  (which I presume is in the "limit of the staircases")?

The point  $(1/2, 1/2)$  is in every staircase for  $n > 1$ , for sure. The direction of the tread before it is horizontal, and the direction of the riser after that point is vertical. Remember, directions are not defined for points, but for segments. That point has not direction of its own, hence the need to look at the limit, not of the points, but of the segments.

## Re: Calculus XOR Probability

How do you know that the limit of the segments exists, and that it is a segment?

Given two points  $p$  and  $q$  in  $\mathbb{R}^2$  which are in the limit, how do I determine whether  $p$  and  $q$  have the same or different "vector directions, at the infinitesimal scale"?

Points do not have directions, ultimately. The segment  $\{1/2, 0\}$  is horizontal, and  $\{0, 1/2\}$  is vertical.

Okay, so how about the infinitesimal scale?

Once you have addressed these questions, we can suppose that your definition of "the limit of the staircases" is a mathematical object called "L". /Then/ I can evaluate a statement you might make of the form "the length of L is {whatever you propose}".

Are you sure you won't ask the already answered questions, again?

I still have questions about your answers to the questions.

Until then, you haven't defined what you mean by "the length of (the limit of the staircases)"; all you have defined is "the limit of (the length of the staircases)"; and at least in its result, we are all in agreement: the limit of the length of the staircases is 2, and the length of the diagonal is  $\sqrt{2}$ .

But you disagree that the limit of the staircases is anything other than the diagonal, whereas I have demonstrated a form of limit which shows clearly that there's a difference, and which accounts precisely for the error.

I don't see a clear definition of limit. Can you fill in the blanks here:

DEFINITION: The limit of a \_\_\_\_\_ (insert name of mathematical object) is a \_\_\_\_ (insert name of a mathematical object) satisfying the following

Re: Calculus XOR Probability

criteria: \_\_\_\_\_.

Both blanks have to be filled with terms which either are agreed upon generally, or are defined in turn according to the template provided.

Once you can fill in those blanks, then we have something we can talk about. Until then, your definition is not sufficiently well-formed to be able to discuss anything related to it.

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