6. Probabilty Review: Probability Density Functions

Let X be a **continuous** random variable with probability **density** function (pdf) $f_X(x)$.

Concept Check

3/4 points (graded)

1. Is the value of $f_X(x)$ always $\in [0,1]$?

   - yes
   - no ✔

2. For $a < b$, $\int_a^b f_X(x)\,dx \in [0,1]$ and represents the probability that the value of X falls between a and b.

- (●) yes
- ( ) no

✔

3. Is the value of $f_X\left(x\right)$ always non-negative?

- (●) yes
- ( ) no

✔

4. The value of integral $\int_{-\infty}^{\infty} f_X\left(x\right)\,dx$ of $f_X\left(x\right)$ from $-\infty$ to ∞ is a finite, undetermined value.

- (●) yes
- ( ) no ✔

✖

Solution:

1. While probabilities are always between 0 and 1, the probability density function (PDF) is not the actual probability of observing a particular outcome. This is an important distinction from probability mass functions, the analog for discrete random variables. So the PDF can be greater than 1, but its integral, which gives the probability must always be $\in [0, 1]$.

2. Yes, by definition.

3. Yes, by definition $f_X\left(x\right) \geq 0$.

4. The integral across a range (here, from $-\infty$ to ∞) is the total probability that X takes values in that range. Since this range contains all possible values any random variable can take, by definition, not only is the integral finite, but since the total probability must be 1, the integral is always 1, i.e. $\int_{-\infty}^{\infty} p_X(x)\,dx = 1$.

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Answers are displayed within the problem

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problem 1 Why the value of f_X(x) is not between [0,1]? Is the value of function or the value of the proba...	4
3. Undetermined value I am confused by the terminology. What is the “undetermined value” in 3. ? And is X and f(x) d...	6
undetermined value 1/ A pdf is always integrable and the value of the integral is always 1. So y don't understand t...	1
Ambiguity in definition This one is kind of annoying, to be honest. On the one hand, it seems fairly obvious what the ...	8
Concept Check Hello. I confuse, do you mean that [0,1] ∈ R? I mean [R,R]?	3

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