Exercise: Conditional probabilities in a continuous model

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2.0/2.0 points (graded)

Let the sample space be the unit square, $\Omega = [0,1]^2$, and let the probability of a set be the area of the set. Let A be the set of points $(x,y) \in [0,1]^2$ for which $y \leq x$. Let B be the set of points for which $x \leq 1/2$. Find $\mathbf{P}(A \mid B)$.

$\mathbf{P}(A \mid B) =$ 0.25 ✔ **Answer:** 0.25

Answer:
We observe that the area of the set B is $1/2$, so that $\mathbf{P}(B) = 1/2$. Furthermore, the set $A \cap B$ is the triangle with vertices at $(0,0)$, $(1/2,0)$, $(1/2,1/2)$. The area of that triangle is $1/8$, so that $\mathbf{P}(A \cap B) = 1/8$. Therefore,

$$\mathbf{P}(A \mid B) = \frac{\mathbf{P}(A \cap B)}{\mathbf{P}(B)} = \frac{1/8}{1/2} = \frac{1}{4}.$$

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