Topic: Independent and dependent events and conditional probability

Question: Events A and B are independent events. Find $P(B)$ if $P(A \text{ and } B) = 0.25$ and $P(A) = 0.5$.

Answer choices:

A $P(B) = 0.125$

B $P(B) = 0.45$

C $P(B) = 0.5$

D Not enough information

Solution: C

Since the events are independent, events we know that

$$P(A \text{ and } B) = P(A) \cdot P(B)$$

We can plug in $P(A \text{ and } B) = 0.25$ and $P(A) = 0.5$ and solve for $P(B)$.

$$0.25 = 0.5 \cdot P(B)$$

$$P(B) = \frac{0.25}{0.5}$$

$$P(B) = 0.5$$

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Question: Events A and B are dependent events. If $P(A \text{ and } B)=0.7$ and $P(B)=0.875$, what is $P(A)$?

Answer choices:

A $\quad P(A)=0.875$

B $\quad P(A)=0.8$

C $\quad P(A)=0.6125$

D $\quad$ Not enough information

Solution: D

These events are dependent events, so we can say

$$P(A \text{ and } B) = P(A) \cdot P(B|A)$$

We know that $P(A \text{ and } B) = 0.7$, but we would also need to know $P(B|A)$ in order to be able to solve for $P(A)$. Therefore, we don't have enough information to solve the problem.

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Question: Suppose that Katie rolls a six-sided die twice. Event A is that the first roll is a 6, so $P(A)$ is the probability that the first roll is a 6. Event B is that the second roll is a 6, so $P(B)$ is the probability that the second roll is a 6. Which statement is false?

Answer choices:

A The events are independent.

B The events are dependent.

C $P(A \text{ and } B) = P(A) \cdot P(B|A)$

D $P(A \text{ and } B) = P(A) \cdot P(B)$

Solution: B

Events can't be independent and dependent at the same time, so either answer choice A is false or answer choice B is false.

The rolls are independent if we can show that $P(A \text{ and } B) = P(A) \cdot P(B)$. If events are independent, it doesn't necessarily mean that $P(A \text{ and } B) = P(A) \cdot P(B|A)$ is a false statement. It just means that $P(B) = P(B|A)$.

$P(A)$ is the probability that the first die lands on 6, so $P(A) = 1/6$. $P(B)$ is the probability that the second die lands on 6, so $P(B) = 1/6$. $P(A \text{ and } B)$ is the probability of rolling a 6 on both dice, so $P(A \text{ and } B) = 1/36$. Now we can check for independence.

$$P(A \text{ and } B) = P(A) \cdot P(B)$$

$$\frac{1}{36} = \frac{1}{6} \cdot \frac{1}{6}$$

$$\frac{1}{36} = \frac{1}{36}$$

Because this equation is true, the events are independent, not dependent.