Topic: Bernoulli random variables

Question: Which of the following is not an example of Bernoulli trials?

Answer choices:

A   Flip a coin and observe whether it landed on heads or tails

B   Randomly choose restaurants and observe whether or not they have a children's menu

C   Select cards from a standard 52-card deck without replacement and observe whether or not each card is a face card

D   Buy lottery tickets and observe whether or not they paid out any money

Solution: C

In order for trials to be Bernoulli trials,

- each trial must be independent,

- each trial can be called a "success" or a "failure," and

- the probability of success on each trial is constant.

Answer choices A, B, and D are all examples of Bernoulli trials because the trials are independent, we can observe the outcome of each trial as a "success" or "failure," and the probability of each trial remains constant.

Answer choice C is not an example of Bernoulli trials because, while we can observe the outcome of each trial as a "success" or "failure," the probability of success does not remain constant and the trials are not independent. When drawing cards out of a deck without replacement, our trials are dependent.

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Question: Suppose we're conducting Bernoulli trials with a probability of success $p = 0.345$. If we conduct three trials in a row, find the probability that all three are failures.

Answer choices:

A   0.655

B   0.0411

C   1.965

D   0.2810

Solution: D

If each trial has a probability of success of $p = 0.345$, then the probability of failure on any one trial is

$$1 - p$$

$$1 - 0.345$$

$$0.655$$

If we want three trials in a row to be failures and our trials are independent, we can multiply the probabilities to find the chance of three failures in a row.

$$P(3 \text{ failures}) = (0.655)^3$$

$$P(3 \text{ failures}) = 0.2810$$

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Question: 68% of U.S. households own a pet. Suppose we start randomly surveying households and asking whether or not they are pet owners. When a household is selected, we can consider it a Bernoulli trial because each trial is independent, a success can be noted as finding a household with a pet, and the probability of success remains constant for each trial. What is the mean and standard deviation for each trial?

Answer choices:

A $\mu = 0.68$ and $\sigma = 0.2176$

B $\mu = 0.68$ and $\sigma = 0.4665$

C $\mu = 0.68$ and $\sigma = 0.32$

D $\mu = 0.68$ and $\sigma = 6.8$

Solution: B

Each trial will result in either a success or a failure (either the household owns a pet, or it doesn't). But the average can be found for each trial as $\mu = p$. So for these Bernoulli trials, $\mu = 0.68$.

The standard deviation is

$$\sigma = \sqrt{p(1-p)}$$

So for these Bernoulli trials,

$$\sigma = \sqrt{0.68(1 - 0.68)}$$

$$\sigma = \sqrt{0.68(0.32)}$$

$$\sigma = \sqrt{0.2176}$$

$$\sigma = 0.4665$$