Sampling Distributions for Sample Proportions Quiz

1. A bag contains chips of which 27.5 percent are blue. A random sample of 5 chips will be selected one at a time and with replacement. What are the mean and standard deviation of the sampling distribution of the sample proportion of blue chips for samples of size 5 ?

(A) The mean is $5(0.275)$, and the standard deviation is $\sqrt{5(0.275)(0.725)}$.

(B) The mean is 0.275, and the standard deviation is $\sqrt{5(0.275)(0.725)}$.

(C) The mean is 0.275, and the standard deviation is $\sqrt{\frac{0.275(0.725)}{5}}$. ✓

(D) The mean is 27.5, and the standard deviation is $\sqrt{5(27.5)(72.5)}$.

(E) The mean is 27.5, and the standard deviation is $\sqrt{\frac{27.5(72.5)}{5}}$.

Answer C

Correct. The mean is the population proportion $p = 0.275$, and the standard deviation is $\sqrt{\frac{0.275(0.725)}{5}}$.

2. A manufacturer of cell phone screens has found that 5 percent of all screens produced have defects. Let p_d represent the population proportion of all cell phone screens with a screen defect, therefore $p_d = 0.05$. For the sampling distribution of the sample proportion of cell phone screens from this manufacturer with a screen defect for sample size 400, $\mu_{\hat{p}_d} = 0.05$. Which of the following is the best interpretation of $\mu_{\hat{p}_d} = 0.05$?

(A) For a randomly selected cell phone screen from this population, the mean number of screen defects for the selected screen will be equal to 0.05.

(B) For every sample of size 400 from this population, the proportion of cell phone screens with a screen defect will be 0.05.

(C) For all samples of size 400 from this population, the mean number of screen defects for the samples is 0.05.

(D) For all samples of size 400 from this population, the mean of all resulting sample proportions of cell phone screens with a screen defect is 0.05. ✓

(E) For all samples of size 400 from this population, the standard deviation of all resulting sample proportions of cell phone screens with a screen defect is 0.05.

Answer D

Correct. $\mu_{\hat{p}_d}$ represents the mean of all sample proportions of cell phone screens with a defect for samples of size 400, which in this case is 0.05.

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3. A national charity contacted 100 randomly selected people by phone, and 7 percent of those contacted made a donation to the charity. The population proportion of those who make a donation when contacted by phone is known to be $p = 0.05$. For samples of size 100, which of the following best interprets the mean of the sampling distribution of the sample proportion of people who make a donation when contacted by phone?

(A) For all random samples of 100 people contacted by phone, the sample proportion of those who make a donation will be 0.05.

(B) For all random samples of 100 people contacted by phone, the sample proportion of those who make a donation will be 0.07.

(C) The mean of all sample proportions of those who make a donation from all random samples of 100 people contacted by phone is 0.05. ✓

(D) The mean of all sample proportions of those who make a donation from all random samples of 100 people contacted by phone is 0.07.

(E) The probability that the mean of the sampling distribution of sample proportions is greater than 0.07 is 0.05.

Answer C

Correct. The mean of the sampling distribution of the sample proportion is equal to the population proportion of 0.05.

4. On any given day, the proportion of workers at a factory who are more than 5 minutes late to work is 0.11. A random sample of 20 workers will be selected. Which of the following is the best interpretation of the mean of the sampling distribution of the sample proportion of workers in the sample who are more than 5 minutes late to work for samples of size 20 ?

(A) For all samples of size 20, the mean of all possible sample proportions is equal to 0.11. ✓

(B) For a randomly selected worker, the probability the worker will be more than 5 minutes late to work is 0.11.

(C) For a random sample of 20 workers, the proportion of workers who are more than 20 minutes late to work will be 0.11.

(D) For a random sample of 20 workers, the probability that 2.2 workers will be more than 5 minutes late to work is very high.

(E) For repeated samples of size 20, the proportion of workers who are more than 5 minutes late to work varies in each sample by no more than 0.11.

Answer A

Correct. The mean of a sampling distribution is the mean of all possible sample proportions for samples of size 20 taken from the population. In repeated sampling, the long-run relative frequencies will approach the population mean.

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5. City officials estimate that 46 percent of all city residents are in favor of building a new city park. A random sample of 150 city residents will be selected. Suppose that 51 percent of the sample are in favor of building a new city park. Which of the following is true about the sampling distribution of the sample proportion for samples of size 150 ?

(A) The distribution is not normal, and the mean is 0.46.

(B) The distribution is not normal, and the mean is 0.51.

(C) The distribution is not normal, and the mean is the average of 0.46 and 0.51.

(D) The distribution is approximately normal, and the mean is 0.46. ✓

(E) The distribution is approximately normal, and the mean is 0.51.

Answer D

Correct. The values of $np = 150(0.46)$ and $n(1-p) = 150(0.54)$ are both greater than or equal to 10, and the mean of the sampling distribution is equal to the population proportion, which is assumed to be 0.46.

6. A sample of size n will be selected from a population with population proportion p. Which of the following must be true for the sampling distribution of the sample proportion to be approximately normal?

(A) Both np and $n(1-p)$ are at least 10. ✓

(B) n is greater than 30.

(C) p is greater than 0.5.

(D) The mean is equal to np.

(E) The variance is equal to $np(1-p)$.

Answer A

Correct. The conditions $np \geq 10$ and $n(1-p) \geq 10$ ensure that the sampling distribution of the sample proportion will be approximately normal when a value of n is chosen that is large enough to make the conditions true.

7. For a certain population of sea turtles, 18 percent are longer than 6.5 feet. A random sample of 90 sea turtles will be selected. What is the standard deviation of the sampling distribution of the sample proportion of sea turtles longer than 6.5 feet for samples of size 90 ?

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(A) $\sqrt{\frac{6.5(18-6.5)}{90}}$

(B) $\sqrt{\frac{0.18(1-0.18)}{90}}$ ✓

(C) $\sqrt{\frac{0.18(1-0.18)}{6.5}}$

(D) $\sqrt{\frac{18(90-18)}{100}}$

(E) $\sqrt{\frac{18(100-18)}{90}}$

Answer B

Correct. The standard deviation of the sampling distribution of the sample proportion is found using the formula $\sigma_{\hat{p}} = \sqrt{\frac{p(1-p)}{n}}$, where p is the population proportion 0.18 and n is the sample size 90.

8. A certain skin cream is 80 percent effective in curing a common rash. A random sample of 100 people with the rash will use the cream. Which of the following is the best description of the shape of the sampling distribution of the sample proportion of those who will be cured?

(A) Bimodal

(B) Uniform

(C) Approximately normal ✓

(D) Strongly skewed to the left

(E) Strongly skewed to the right

Answer C

Correct. The sample size of 100 allows for both $np = 100(0.8) = 80$ and $n(1-p) = 100(0.2) = 20$ to be greater than or equal to 10. This satisfies the condition for the sampling distribution of sample proportions to be approximately normal.

9. At a large corporation, 6,000 employees from department A and 4,000 employees from department B are attending a training session. A random sample of 500 employees attending the session will be selected. Consider two sampling methods: with replacement and without replacement. How will the methods affect the standard deviations of the sampling distribution of the sample proportion of employees from department B?

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(A) The standard deviations will be equal from either method.

(B) Sampling without replacement will result in a standard deviation less than but close to $\sqrt{\frac{0.4(0.6)}{500}}$.

(C) Sampling without replacement will result in a standard deviation greater than but close to $\sqrt{\frac{0.4(0.6)}{500}}$.

(D) Sampling with replacement will result in a standard deviation less than but close to $\sqrt{\frac{0.4(0.6)}{500}}$.

(E) Sampling with replacement will result in a standard deviation greater than but close to $\sqrt{\frac{0.4(0.6)}{500}}$.

Answer B

Correct. The proportion of the employees from department B is $\frac{4{,}000}{10{,}000} = 0.4$. The sample size of 500 is less than 10 percent of 10,000, so sampling without replacement results in a standard deviation less than but very close to $\sqrt{\frac{0.4(0.6)}{500}}$.