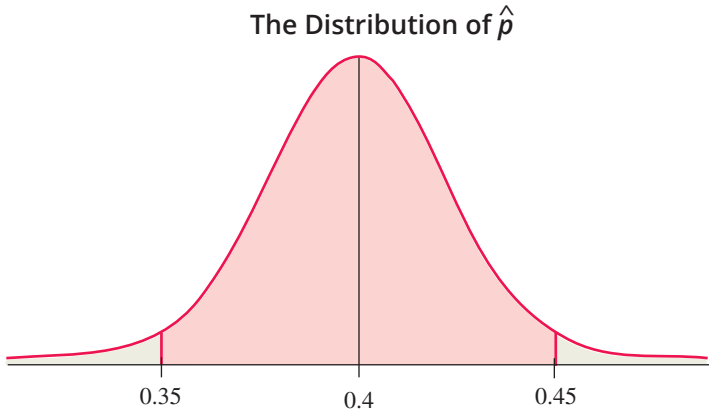
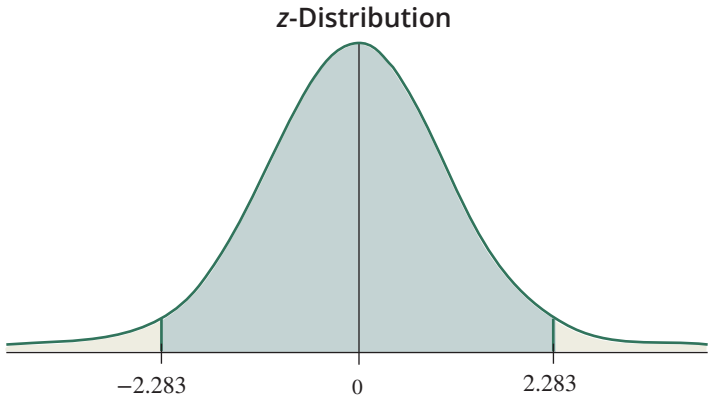


Using the z-transformation,



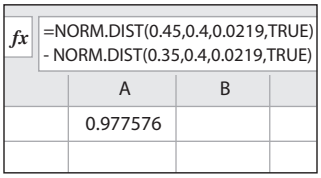
$$P\left(\frac{(0.35-0.4)}{0.0219} < z < \frac{(0.45-0.4)}{0.0219}\right)$$

$$= P(-2.283 < z < 2.283)$$
$$= P(z < 2.283) - P(z < -2.283)$$
$$= 0.9888 - 0.0112$$
$$= 0.9776$$

For a sample of 500, it is very probable (0.9776) that the error of estimation will be less than 0.05.

Technology

For directions on calculating the probability, please visit stat.hawkeslearning.com and navigate to **Discovering Statistics and Data, Fourth Edition > Technology Instructions > Normal Distribution > Normal Probability (cdf)**.



9.3 Exercises

Basic Concepts

1. What does the symbol $\hat{p}$ represent?
2. What is the connection between $\hat{p}$ and p?
3. Is $\hat{p}$ an unbiased estimator? If so, of what?

4. What are the conditions that make the sample size n "sufficiently large" for a sample proportion?

5. Describe the sampling distribution of $\hat{p}$ if n is sufficiently large.

6. Explain what it means for a sample proportion to have a normal distribution.

Exercises

7. Suppose that the true proportion of registered voters who favor a mayoral candidate is 0.45. Find the mean and standard deviation of the sample proportion for samples of the following sizes.

a. $n = 30$

b. $n = 45$

c. $n = 65$

d. What happens to the size of the standard deviation of the sample proportion as the sample size increases?

8. Suppose that the true proportion of Americans over 25 years old that have a 4-year college degree is 0.35. Find the mean and the standard deviation of the distribution of the sample proportion for the following sample sizes.

a. $n = 38$

b. $n = 52$

c. $n = 75$

d. What happens to the size of the standard deviation of the sample proportion as the sample size increases?

9. Suppose that the true population proportion of Americans over 60 years old with high blood pressure is $p = 0.50$. In a random sample of twenty Americans over the age of 60, what is the probability that the proportion with high blood pressure will be greater than 0.60?

10. Suppose the true population proportion of people with blood type A+ is $p = 0.30$. What is the probability that the sample proportion for a sample of size 60 ($n = 60$) will be less than 0.25?

11. Suppose that the true proportion of Americans who save at least 10% of their income is 0.15. If $\hat{p}$ is the sample proportion of Americans surveyed who save at least 10% of their income from a sample of size 68, find the following probabilities.

a. $P\left(\hat{p} > 0.25\right)$

b. $P\left(\hat{p} < 0.09\right)$

c. $P\left(0.10 < \hat{p} < 0.20\right)$

d. $P\left(0.18 < \hat{p} < 0.25\right)$

12. Suppose that the true proportion of companies in the United States who requested financial assistance during the Coronavirus pandemic through the Paycheck Protection Program (PPP) was 62%. If $\hat{p}$ is the sample proportion of U.S. companies surveyed who requested financial assistance using PPP from a sample of size 100, find the following probabilities.

a. $P\left(\hat{p} > 0.75\right)$

b. $P\left(\hat{p} < 0.50\right)$

c. $P\left(0.40 < \hat{p} < 0.80\right)$

d. $P\left(0.70 < \hat{p} < 0.90\right)$

13. The director of a radio station in a large metropolitan area believes that the proportion of young professionals (his target market) in the area who prefer country music has increased from 25% to 35%. The director randomly decides to select 50 young professionals and ask them if they prefer country to any other type of music. If the sample proportion is greater than 0.35, he will switch to a new format emphasizing country.

a. If the true proportion of young professionals who prefer country has not changed, find the probability that the radio director will switch to the new format.

b. If the true proportion of young professionals who prefer country has changed as the director suspects, find the probability that the radio director will switch to the new format.

14. The owner of a large office building plans on building a dedicated smoking area outside, but will not do so if less than 30% of his employees smoke. He decides to randomly select 50 of the workers in the building and ask them whether or not they smoke. If the sample proportion of workers who smoke is less than 0.30, the owner will not create the smoking area.

a. Find the probability that the owner will not create the smoking area when the true proportion of smokers is 0.5.

b. Find the probability that the owner will create the smoking area when the true proportion of smokers is 0.2.

15. Eighty percent of the flights arriving in Atlanta for a large US airline are on time. If the FAA randomly selects 50 of the airline's flights, find the probability that:

a. at least 85% of the sampled flights will be on time.

b. at most 70% of the sampled flights will be on time.

c. between 75% and 85% of the sampled flights will be on time.

16. Approximately 7% of the nation's public-school children in grades 2 through 5 take medication for attention deficit hyperactivity disorder (ADHD), a developmental disorder characterized by impulsiveness or difficulty concentrating or sitting still. The main treatment prescribed for ADHD is Ritalin, a relatively safe drug with few side effects. A sample of 286 students is taken.

a. Find the probability that at least 4% of the school children in the sample take medication for ADHD.

b. Find the probability that between 5% and 8% of the school children in the sample take medication for ADHD.

9.4 Other Forms of Sampling

Random sampling is an effective means of obtaining a sample that is representative of the population. As we discussed previously, acquiring an exact sampling frame for the population under study is a requirement for simple random sampling, a requirement which can be time-consuming and expensive. There are other sampling strategies that