

1. For each of the following scenarios, state appropriate hypotheses for a hypothesis test. Be sure to define the parameter of interest.
  - a. Research shows that about 11% of the general population is left-handed. Andrew believes that this percentage is higher among math teachers, so he selects a random sample of 100 math teachers and finds that 17 are left-handed.
  - b. According to a recent online article, 20.3% of teenagers nationwide have a job while enrolled in school. Julibel wonders if the percentage is different at her large high school. She selects a random sample of 50 students and finds that 19 have jobs.
  
2. It has been determined that about 74% of birds found in zoos were born in captivity. A curious student believes that the percentage might be different for birds at the San Diego Zoo. The student contacts the bird keeper at the zoo and gets access to a database of all the birds at the zoo. A random sample of 200 of these birds reveals that 63% of them were born in captivity. Is this convincing statistical evidence that the true proportion of all birds at the San Diego Zoo that were born in captivity is different than the overall proportion found in all zoos?

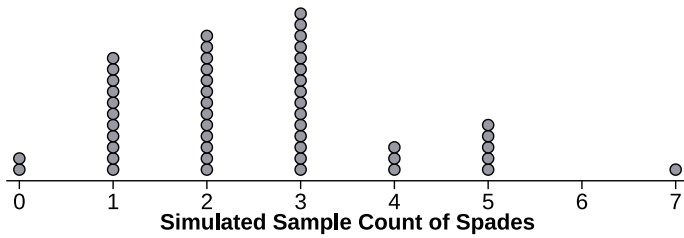
For each set of hypotheses, explain the error that has been made.

a.  $H_0 : p = 0.74$  ,  $H_a : p < 0.74$

b.  $H_0 : p = 0.63$  ,  $H_a : p \neq 0.63$

c.  $H_0 : \hat{p} = 0.74$  ,  $H_a : \hat{p} \neq 0.74$

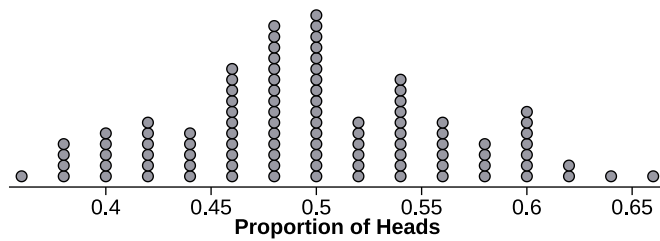
3. José plays a simple card game called “Search for Spades” in which a player randomly draws 10 cards with replacement from a standard deck and counts the number of spades drawn. After getting only one spade in his game, José suspects this is not a standard deck of cards. He performs 50 simulations of drawing 10 random cards from a standard deck to investigate. Here are the results:



- Based on the dotplot, what is the probability of getting one or fewer spades when selecting 10 cards from a standard deck?
- Interpret the probability from part (a).
- Does José’s result provide convincing statistical evidence that the deck was not standard? Explain.

4. Research shows that 75 percent of people can taste PTC (a harmless chemical compound) as bitter, while others cannot taste it at all. This genetic trait interests Chloe, who believes the percentage might be less for students at her large high school. She obtains a random sample of 100 students, gives each a PTC taste strip, and finds that 66 students report tasting it as bitter. She performs a hypothesis test of  $H_0 : p = 0.75$  versus  $H_a : p < 0.75$ , which results in a  $p$ -value of 0.019.
- Explain what is incorrect about this interpretation of the  $p$ -value: There is a 0.019 probability of getting a  $\hat{p}$  of 0.66 or less purely by chance.
  - Explain what is incorrect about this interpretation of the  $p$ -value: Assuming  $H_0$  is true ( $p = 0.75$ ), there is a 0.019 probability of getting a  $\hat{p}$  of 0.66 purely by chance.
  - Correctly interpret the  $p$ -value.
  - Is there convincing statistical evidence that the true proportion of all students at Chloe's school who can taste PTC is less than 0.75?

5. An AP Statistics teacher demonstrates coin flipping by tossing a coin 50 times and getting 32 heads ( $\hat{p} = 0.64$ ). The students believe this coin might be weighted. To investigate, they use an online applet to perform 100 simulations of 50 tosses of a fair coin, calculating the proportion of heads for each simulation. Here are their simulation results:



- Based on the dotplot, what is the probability of getting a proportion of heads greater than or equal to 0.64 when tossing a fair coin 50 times?
- What are the mean and standard deviation of the sampling distribution of  $\hat{p}$ ?
- What is the shape of the sampling distribution of  $\hat{p}$ ? Justify.
- Use a normal approximation to calculate the approximate probability of getting a proportion of heads greater than or equal to 0.64 in 50 tosses of a fair coin.

6. A coffee store manager claims that more than half of their customers request a receipt for their order. She selects a random sample of customers and finds that 62% of them request a receipt. Let  $p$  = the true proportion of all customers who request a receipt. Which of the following would be the appropriate hypotheses for a hypothesis test?
- A)  $H_0 : p = 0.62, H_a : p > 0.62$
  - B)  $H_0 : p > 0.62, H_a : p = 0.62$
  - C)  $H_0 : p = 0.5, H_a : p > 0.5$
  - D)  $H_0 : p > 0.5, H_a : p = 0.5$
7. A home inspector believes that more than 80% of homes in a large city have lead paint hazards. He selects a random sample of 100 homes in the city and finds that 84 have lead paint hazards. A hypothesis test of  $H_0 : p = 0.8$  versus  $H_a : p > 0.8$  results in a  $p$ -value of 0.159. Assuming that the null hypothesis is true, which of the following is the correct interpretation of the  $p$ -value?
- A) 15.9% of all possible random samples of size  $n = 100$  will result in a sample proportion equal to 0.8.
  - B) 15.9% of all possible random samples of size  $n = 100$  will result in a sample proportion greater than or equal to 0.8.
  - C) 15.9% of all possible random samples of size  $n = 100$  will result in a sample proportion equal to 0.84.
  - D) 15.9% of all possible random samples of size  $n = 100$  will result in a sample proportion greater than or equal to 0.84.