

Exercises

REVIEW QUESTIONS

1. What is statistical inference? Why is it important?
2. Describe the meaning of statistical significance. What does it mean for a result to be statistically significant at the 0.05 level? at the 0.01 level?
3. How does the idea of statistical significance apply to the question of whether results from a sample can be generalized to conclusions about a population? Explain.
4. Explain why you should usually expect that a proportion found in a single sample will be close to, but not exactly, the true proportion in a population.
5. Briefly describe the use of the formula for margin of error. Give an example in which you interpret the margin of error in terms of 95% confidence.
6. What is the purpose of a hypothesis test? How do we formulate the null and alternative hypotheses for a test?
7. What are the two possible conclusions of a hypothesis test? Explain, and also explain why accepting the null hypothesis is *not* a possible outcome.
8. Briefly discuss how the idea of statistical significance helps us decide whether to reject or not reject a null hypothesis.

DOES IT MAKE SENSE?

Decide whether each of the following statements makes sense (or is clearly true) or does not make sense (or is clearly false).

Explain your reasoning.

9. The study found that more people were cured by the new drug than by the old drug, but the result was not statistically significant.
10. There can no longer be any doubt that our product, the Magic Diet Pill, really works. We financed a study in which the pill led to more weight loss than a placebo, with results significant at the 0.05 level.
11. Both agencies conducted their surveys carefully, both asked the same question and found about the same proportion of "yes" responses, and both interviewed the same number of people. However, the margin of error was smaller for Agency A's survey than for Agency B's survey.
12. If you want to reduce the margin of error in your pre-election survey, you should use a larger sample.
13. We began the trial with the null hypothesis stating that the toxic waste dump had no effect on disease rates among the residents nearby. The alternative hypothesis therefore stated that the toxic waste dump did have an effect on disease rates among the residents nearby.
14. We began the trial with the null hypothesis stating that the toxic waste dump had no effect on the residents nearby, and our trial proved this hypothesis to be true.

BASIC SKILLS & CONCEPTS

15–20: **Subjective Significance.** For each of the following events, state whether you think the difference between what occurred and what you would expect by chance is statistically significant.

15. In 60 rolls of a standard six-sided die, you get 2 sixes.
16. In 100 tosses of a fair coin, you get 48 heads.
17. An airline with a 95% on-time departure rate has 11 out of 200 flights with late departures.
18. A basketball player with a 92% free-throw percentage misses 18 free throws in a row.
19. Ten winners of the Power Ball lottery in a row bought their tickets at the same 7–11 store.
20. Of the 45 students in your mathematics class, 42 have the same birthday.
21. **Human Body Temperature.** A study by University of Maryland researchers measured the body temperatures of 106 individuals. The mean for the sample was 98.20°F. The accepted value for human body temperature is 98.60°F. If we assume that the mean body temperature is actually 98.60°F, the probability of getting a sample with a mean of 98.20°F or less turns out to be less than 1 in 1 million. Is this result significant at the 0.05 level? at the 0.01 level? Would it be reasonable to conclude that the accepted value for human body temperature is wrong? Explain.
22. **Seat Belts and Children.** In a study of children injured in automobile crashes (*American Journal of Public Health*, Vol. 82, No. 3), those wearing seat belts had a mean stay of 0.83 day in an intensive care unit. Those not wearing seat belts had a mean stay of 1.39 days. The probability of this difference in means occurring by chance turns out to be less than 1 in 10,000. Is this result significant at the 0.05 level? at the 0.01 level? Would it be reasonable to conclude that seat belts reduce the severity of injuries? Explain.
23. **SAT Preparation.** A study of 75 students who took an SAT preparation course (*American Education Research Journal*, Vol. 19, No. 3) concluded that the mean improvement on the SAT was 0.6 point. If we assume that the preparation course has no effect, the probability of getting a mean improvement of 0.6 point by chance is 0.08, or 8 in 100. Discuss whether this preparation course results in statistically significant improvement.
24. **Weight by Age.** A National Health Survey determined that the mean weight of a sample of 804 men aged 25 to 34 was 176 pounds, while the mean weight of a sample of 1657 men aged 65 to 74 was 164 pounds. The difference is significant at the 0.01 level. Interpret this result.

25–32: Margin of Error. Find the margin of error and the 95% confidence interval for the following studies. Briefly interpret the 95% confidence interval.

25. According to a Gallup poll of 1012 people, about one-third (32%) of Americans keep a dog for protection.



26. A recent survey of 65,000 households by the U.S. Department of Labor reported an unemployment rate of 8.9%.
27. A 2009 poll of 540 people aged 12–17, conducted by ICR of Media, Pennsylvania, concluded that 64% of American teenagers support the current legal drinking age of 21.
28. A 2009 study by the Pew Forum on Religion and Public Life, based on surveys of 1110 people, concluded that 59% of Americans oppose legalizing gay marriage.
29. A CBS News poll of 1003 American adults concluded that 48% of Americans feel that people with strong religious convictions face discrimination in this country.
30. A Yankelovich survey of 2818 Americans, conducted in 14 U.S. cities, concluded that while 73% of Americans know that health experts recommend drinking eight or more eight-ounce servings of water each day, 51% fall short of that goal.



31. A 2009 CBS poll of 1100 parents concluded that 41% of all parents believe that the future for the next generation will be worse.
32. A CBS/*New York Times* poll of 1229 adults concluded that 28% of all American adults did not have very much trust and confidence in the news media, while 15% had “a great deal” of trust and confidence.

33–38: Formulating Hypotheses. Consider the following claims related to statistical studies.

- a. State the null and alternative hypotheses for a hypothesis test.
b. Describe the two possible outcomes of the test, using the context of the given situation.

33. The governor claims that the percentage of adults over 25 who have graduated from high school is greater than 85%, the national average.
34. The Food and Drug Administration claims that the amount of vitamin C in tablets produced by a company is less than the advertised 500 milligrams.
35. The head of the state school board claims that the mean teacher salary in her state is above the national average of \$47,750.
36. The director of public works for a small town claims that the mean water usage among households exceeds 1675 gallons per month, the level required for the water supply to last through the year.
37. An external review team claims that the percentage of under-represented students in the incoming freshman class is less than the target of 20%.
38. A chemical company wishes to defend its claim that the levels of pollution downstream from its plant are less than the minimum level specified by the Environmental Protection Agency.

39–44: Hypothesis Tests. The following exercises describe the results of a hypothesis test in terms of the probability of obtaining a particular sample. In each case, use the given context to formulate the null and alternative hypotheses. Then discuss whether the sample provides evidence for rejecting or not rejecting the null hypothesis.

39. The owner of a car rental company claims that the mean annual mileage for the population of all cars in his fleet is more than 11,725 miles (which is the mean annual mileage for all cars in the United States). A random sample of $n = 225$ cars from his fleet has a mean annual mileage of 12,000 miles. Assuming that the mean annual mileage for all cars in his fleet is 11,725 miles, the probability of selecting a random sample with a mean annual mileage of 12,000 miles or more is 0.01.
40. A Senate candidate claims that a majority of voters support her. A poll of 400 voters finds that the proportion of voters who support the candidate is 0.51 (51%). Assuming that the proportion of people in the population who support her is $p = 0.5$, the probability of selecting a sample in which the proportion is 0.51 or more is 0.345.
41. A hospital administrator finds that the mean hospital stay for a sample of 81 women after childbirth is 2.3 days. She claims that the mean stay at her hospital is greater than the national average of 2.1 days. Assuming that the average at her hospital is the same as the national average, the probability of observing a sample with a mean of 2.3 days or more is 0.17.