

16. IRS Wait Times The Internal Revenue Service claims that the mean wait time for callers during a recent tax filing season was at most 15 minutes. A random sample of 40 callers has a mean wait time of 16.7 minutes and a standard deviation of 2.7 minutes. Is there enough evidence to reject the claim at $\alpha = 0.01$? (*Adapted from Internal Revenue Service*)

17. Credit Card Balances A credit card company claims that the mean credit card debt for individuals is greater than \$5000. You want to test this claim. You find that a random sample of 37 cardholders has a mean credit card balance of \$5122 and a standard deviation of \$625. At $\alpha = 0.05$, can you support the claim? (*Adapted from TransUnion*)

18. Battery Life A company claims that the mean battery life of their MP3 player is at least 30 hours. You suspect this claim is incorrect and find that a random sample of 18 MP3 players has a mean battery life of 28.5 hours and a standard deviation of 1.7 hours. Is there enough evidence to reject the claim at $\alpha = 0.01$?

19. Waste Recycled An environmentalist estimates that the mean amount of waste recycled by adults in the United States is more than 1 pound per person per day. You want to test this claim. You find that the mean waste recycled per person per day for a random sample of 13 adults in the United States is 1.51 pounds and the standard deviation is 0.28 pound. At $\alpha = 0.10$, can you support the claim? (*Adapted from U.S. Environmental Protection Agency*)

20. Waste Generated As part of your work for an environmental awareness group, you want to test a claim that the mean amount of waste generated by adults in the United States is less than 5 pounds per day. In a random sample of 19 adults in the United States, you find that the mean waste generated per person per day is 4.43 pounds with a standard deviation of 1.21 pounds. At $\alpha = 0.01$, can you support the claim? (*Adapted from U.S. Environmental Protection Agency*)

21. Annual Salary An employment information service claims the mean annual salary for full-time male workers over age 25 and without a high school diploma is \$26,000. The annual salaries (in dollars) for a random sample of 10 full-time male workers without a high school diploma are shown in the table at the left. At $\alpha = 0.05$, test the claim that the mean salary is \$26,000. (*Adapted from U.S. Bureau of Labor Statistics*)

22. Annual Salary An employment information service claims the mean annual salary for full-time female workers over age 25 and without a high school diploma is more than \$18,500. The annual salaries (in dollars) for a random sample of 12 full-time female workers without a high school diploma are shown in the table at the left. At $\alpha = 0.10$, is there enough evidence to support the claim that the mean salary is more than \$18,500? (*Adapted from U.S. Bureau of Labor Statistics*)

Annual salaries			
25,685	23,314	21,874	24,689
25,818	20,267	30,282	29,041
24,097	28,455		

TABLE FOR EXERCISE 21

Annual salaries			
19,665	17,312	19,794	20,403
21,864	20,177	18,328	22,445
21,354	20,143	19,316	20,237

TABLE FOR EXERCISE 22

Testing Claims Using P-Values In Exercises 23–28, (a) identify the claim and state H_0 and H_a , (b) use technology to find the P-value, (c) decide whether to reject or fail to reject the null hypothesis, and (d) interpret the decision in the context of the original claim. Assume the population is normally distributed.

23. Speed Limit A county is considering raising the speed limit on a road because they claim that the mean speed of vehicles is greater than 45 miles per hour. A random sample of 25 vehicles has a mean speed of 48 miles per hour and a standard deviation of 5.4 miles per hour. At $\alpha = 0.10$, do you have enough evidence to support the county's claim?

Class sizes					
35	28	29	33	32	40
26	25	29	28	30	36
33	29	27	30	28	25

TABLE FOR EXERCISE 27

Classroom hours			
11.8	8.6	12.6	7.9
6.4	10.4	13.6	9.1

TABLE FOR EXERCISE 28

- 24. Oil Changes** A repair shop believes that people travel more than 3500 miles between oil changes. A random sample of 8 cars getting an oil change has a mean distance of 3375 miles since having an oil change with a standard deviation of 225 miles. At $\alpha = 0.05$, do you have enough evidence to support the shop's claim?
- 25. Dive Depth** An oceanographer claims that the mean dive depth of a North Atlantic right whale is 115 meters. A random sample of 34 dive depths has a mean of 121.2 meters and a standard deviation of 24.2 meters. Is there enough evidence to reject the claim at $\alpha = 0.10$? (*Marine Ecology Progress Series*)
- 26. Dive Duration** A marine biologist claims that the mean dive duration of a harbor seal in Monterey Bay is at least 5.8 minutes. A random sample of 35 dive durations has a mean of 4.9 minutes and a standard deviation of 1.8 minutes. Is there enough evidence to reject the claim at $\alpha = 0.01$? (*Adapted from Moss Landing Marine Laboratories*)
- 27. Class Size** You receive a brochure from a large university. The brochure indicates that the mean class size for full-time faculty is fewer than 32 students. You want to test this claim. You randomly select 18 classes taught by full-time faculty and determine the class size of each. The results are shown in the table at the left. At $\alpha = 0.05$, can you support the university's claim?
- 28. Faculty Classroom Hours** The dean of a university estimates that the mean number of classroom hours per week for full-time faculty is 11.0. As a member of the student council, you want to test this claim. A random sample of the number of classroom hours for eight full-time faculty for one week is shown in the table at the left. At $\alpha = 0.01$, can you reject the dean's claim?

EXTENDING CONCEPTS

Deciding on a Distribution In Exercises 29 and 30, decide whether you should use the standard normal sampling distribution or a t -sampling distribution to perform the hypothesis test. Justify your decision. Then use the distribution to test the claim. Write a short paragraph about the results of the test and what you can conclude about the claim.

- 29. Gas Mileage** A car company claims that the mean gas mileage for its luxury sedan is at least 23 miles per gallon. You believe the claim is incorrect and find that a random sample of 5 cars has a mean gas mileage of 22 miles per gallon and a standard deviation of 4 miles per gallon. At $\alpha = 0.05$, test the company's claim. Assume the population is normally distributed.
- 30. Private Law School** An education publication claims that the mean in-state tuition for a private law school is more than \$25,000 per year. A random sample of 31 private law schools has a mean in-state tuition of \$24,045. Assume the population standard deviation is \$9365. At $\alpha = 0.01$, test the publication's claim. (*Adapted from U.S. News and World Report*)
- 31. Writing** You are testing a claim and incorrectly use the standard normal sampling distribution instead of the t -sampling distribution. Does this make it more or less likely to reject the null hypothesis? Is this result the same no matter whether the test is left-tailed, right-tailed, or two-tailed? Explain your reasoning.