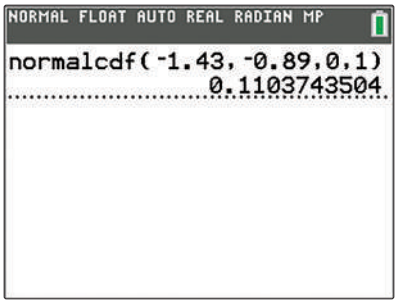
Technology

For instructions on how to compute this probability using technology, please visit stat.hawkeslearning.com and navigate to **Discovering Business Statistics, Second Edition > Technology Instructions > Normal Distribution > Normal Probability (cdf)**.



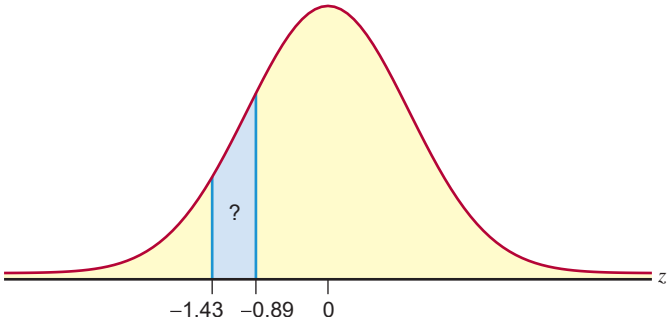


Figure 7.4.19

To find the probability that z is between −1.43 and −0.89, we will need to find the probability that z is less than −0.89 and subtract the probability that z is less than −1.43. Using Table A in Appendix A, we have the following.

$$P(-1.43 < z < -0.89) = P(z < -0.89) - P(z < -1.43) = 0.1867 - 0.0764 = 0.1103$$

Thus, there is approximately an 11% chance that the flight will last between 100 and 150 hours.

7.4 Exercises

Basic Concepts

1. What is the standard normal distribution? What are the parameters of the distribution?
2. Why is the standard normal distribution important?
3. Describe the connection between the z-transformation and the standard normal random variable.

Exercises

4. What proportion of the area under the standard normal curve falls between the following z-values?
   - **a.** 0 and 0.67
   - **b.** 0 and 1.645
   - **c.** 0 and 1.96
   - **d.** 0 and 2.575
5. What proportion of the area under the standard normal curve falls between the following z-values?
   - **a.** −0.67 and 0
   - **b.** −1.645 and 0
   - **c.** −1.96 and 0
   - **d.** −2.575 and 0
6. What proportion of the area under the standard normal curve falls between the following z-values?
   - **a.** −0.85 and 0.85
   - **b.** −0.55 and 0.55
   - **c.** −1.56 and 1.98
   - **d.** −2.23 and 2.96
7. What proportion of the area under the standard normal curve falls between the following z-values?
   - **a.** −0.97 and 0.97
   - **b.** −0.54 and 1.82
   - **c.** −1.95 and 2.28
   - **d.** −2.89 and 1.59

8. Using the standard normal tables in Appendix A, determine the following probabilities. Sketch the associated areas.

a. $z \le 0$ **c.** $z \le -1$ **e.** $z \ge -1$

b. $z \ge 0$ **d.** $z \le 1$ **f.** $z \ge 1$

9. Using the standard normal tables in Appendix A, determine the following probabilities. Sketch the associated areas.

a. $z \le -0.44$ **d.** $z \le -0.67$

b. $z \ge 0.44$ **e.** $z \ge 0.67$

c. $-0.44 \le z \le 0.44$ **f.** $-0.67 \le z \le 0.67$

10. Using the standard normal tables in Appendix A, determine the following probabilities. Sketch the associated areas.

a. $z \le -1.28$ **d.** $z \le -1.96$

b. $z \ge 1.28$ **e.** $z \ge 1.96$

c. $-1.28 \le z \le 1.28$ **f.** $-1.96 \le z \le 1.96$

11. Using the standard normal tables in Appendix A, determine the following probabilities. Sketch the associated areas.

a. $P(0 \le z \le 0.79)$ **c.** $P(z \ge 1.89)$

b. $P(-1.57 \le z \le 2.33)$ **d.** $P(z \le -2.77)$

12. Using the standard normal tables in Appendix A, determine the following probabilities. Sketch the associated areas.

a. $P(0 \le z \le 1.24)$ **c.** $P(z \ge 3.22)$

b. $P(-2.64 \le z \le 3.32)$ **d.** $P(z \le -3.39)$

13. Find the value of z such that 0.05 of the area under the curve lies to the right of z.

14. Find the value of z such that 0.01 of the area under the curve lies to the right of z.

15. Find the value of z such that 0.10 of the area under the curve lies to the right of z.

16. Find the value of z such that 0.05 of the area under the curve lies to the left of z.

17. Find the value of z such that 0.01 of the area under the curve lies to the left of z.

18. Find the value of z such that 0.10 of the area under the curve lies to the left of z.

19. Find the value of z such that 0.7458 of the area under the curve lies between $-z$ and z.

20. Find the value of z such that 0.9505 of the area under the curve lies between $-z$ and z.

21. Find the value of z such that 0.90 of the area under the curve lies between $-z$ and z.

22. The random variable X has a normal distribution with a mean of 30 and a standard deviation of 5.

a. Find the probability that X is between 25 and 35.

b. Find the probability that X is greater than 40.

c. Find the probability that X is less than 20.

23. The random variable X has a normal distribution with a mean of 200 and a standard deviation of 25.

a. Find the probability that X is between 160 and 220.

b. Find the probability that X is greater than 240.

c. Find the probability that X is less than 150.

24. The Arc Electronic Company had an income of $200,000 last year. Suppose the mean income of firms in the industry for the year is $1,000,000 with a standard deviation of $500,000. If incomes for the industry are normally distributed, what proportion of the firms in the industry earned less than Arc?

25. A certain component for the newly developed electronic diesel engine is considered to be defective if its diameter is less than 8.0 mm or greater than 10.5 mm. The distribution of the diameters of these parts is known to be normal with a mean of 9.0 mm and a standard deviation of 1.5 mm. If a component is randomly selected, what is the probability that it will be defective?

26. A television manufacturer is studying television remote control unit usage. One of the criteria they are measuring is the distance at which people attempt to activate the television set with the remote unit. They have discovered that activation distances are normally distributed with an average activation distance of six feet with a standard deviation of three feet. If a remote unit's maximum range is ten feet, what fraction of the time will users attempt to operate the remote outside of the operating limit?

27. According to the Bureau of Labor Statistics, the mean weekly earnings for people working in a sales related profession in 2010 was $631. Assume that the weekly earnings are approximately normally distributed with a standard deviation of $90.

Source: Bureau of Labor Statistics

- **a.** What are the mean weekly earnings for people working in a sales related profession in 2010?
- **b.** If a salesperson was randomly selected, find the probability that his or her weekly earnings exceed $700.
- **c.** If a salesperson was randomly selected, find the probability that his or her weekly earnings are at most $525.
- **d.** If a salesperson was randomly selected, find the probability that his or her weekly earnings are between $400 and $615.
- **e.** Do you feel that it is reasonable to assume that the weekly earnings have a normal distribution? Why or why not?

28. The repair time for air conditioning units is believed to have a normal distribution with a mean of 38 minutes.

- **a.** What is the standard deviation of repair time if 40% of the units are repaired between 33 and 43 minutes?
- **b.** Using the value of the standard deviation that you calculated in **a.**, what is the probability that a repair will be longer than an hour?
- **c.** Using the value of the standard deviation that you calculated in **a.**, what is the probability that the repair time for an air conditioning unit will be less than 25 minutes?

29. VGA monitors manufactured by TSI Electronics have life spans which have a normal distribution with an average life span of 15,000 hours and a standard deviation of 2000 hours. If a VGA monitor is selected at random, find the following probabilities.

- **a.** The probability that the life span of the monitor will be less than 12,000 hours.
- **b.** The probability that the life span of the monitor will be more than 18,000 hours.
- **c.** The probability that the life span of the monitor will be between 13,000 hours and 17,000 hours.

30. A beer distributor believes the amount of beer in a 12-ounce can of beer has a normal distribution with a mean of 12 ounces and a standard deviation of 1 ounce. If a 12-ounce beer can is randomly selected, find the following probabilities.

- **a.** The probability that the 12-ounce can of beer will actually contain less than 11 ounces of beer.
- **b.** The probability that the 12-ounce can of beer will actually contain more than 12.5 ounces of beer.
- **c.** The probability that the 12-ounce can of beer will actually contain between 10.5 and 11.5 ounces of beer.

31. A statistics teacher believes that the final exam grades for her business statistics class have a normal distribution with a mean of 82 and a standard deviation of 8.

- **a.** Find the score which separates the top 10% of the scores from the lowest 90% of the scores.
- **b.** The teacher plans to give all students who score in the top 10% of scores an A. Will a student who scored a 90 on the exam receive an A? Explain.
- **c.** Find the score which separates the lowest 20% of the scores from the highest 80% of the scores.
- **d.** The teacher plans to give all students who score in the lowest 10% of scores an F. Will a student who scored a 65 on the exam receive an F? Explain.

32. An investor believes that the yields of his mutual funds have a normal distribution with an average yield of 10% and a standard deviation of 2%. The investor would like to identify the stocks which yield the highest 5% to keep in his portfolio.

- **a.** Calculate the yield which separates the highest 5% of yields from the lowest 95% of yields.
- **b.** If a stock yielded 14% would it be kept? Explain.
- **c.** If a stock yielded 13% would it be kept? Explain.

33. In order for you to become a member of Mensa, a worldwide organization with approximately 100,000 members, your IQ score must be in the top 2%. The word *mensa* is Latin for "table," and was chosen to denote a group or round table of people with equal ability. In 1996, Mensa, which was founded by two British barristers, celebrated its 50^{th} birthday. American Mensa Ltd., which was founded in 1960 has almost 50,000 members. Marilyn vos Savant, who is reputed to have the highest recorded IQ, is a member. Assuming that IQ scores have an approximately normal distribution with a mean and standard deviation of 100 and 15, respectively, answer the following questions.

- **a.** What IQ must one have in order to become a member of Mensa?
- **b.** What percent of all Americans have an IQ of at least 145?
- **c.** What percent of all members of Mensa have an IQ of at least 145?
- **d.** If Mensa decided to become more exclusive, and accepted only the top 1% instead of the top 2% as members, what IQ would one need in order to become a member of Mensa?