

Normal Curve Calculations: Choose one

- 17. Egg Incubation Times** The mean incubation time of fertilized chicken eggs kept at 100.5°F in a still-air incubator is 21 days. Suppose that the incubation times are approximately normally distributed with a standard deviation of 1 day.

Source: University of Illinois Extension

- What is the probability that a randomly selected fertilized chicken egg hatches in less than 20 days?
 - What is the probability that a randomly selected fertilized chicken egg takes over 22 days to hatch?
 - What is the probability that a randomly selected fertilized chicken egg hatches between 19 and 21 days?
 - Would it be unusual for an egg to hatch in less than 18 days? Why?
- 18. Reading Rates** The reading speed of sixth-grade students is approximately normal, with a mean speed of 125 words per minute and a standard deviation of 24 words per minute.
- What is the probability that a randomly selected sixth-grade student reads less than 100 words per minute?
 - What is the probability that a randomly selected sixth-grade student reads more than 140 words per minute?
 - What is the probability that a randomly selected sixth-grade student reads between 110 and 130 words per minute?
 - Would it be unusual for a sixth-grader to read more than 200 words per minute? Why?

19. Chips Ahoy! Cookies The number of chocolate chips in an **NW** 18-ounce bag of Chips Ahoy! chocolate chip cookies is approximately normally distributed with a mean of 1,262 chips and standard deviation 118 chips according to a study by cadets of the U.S. Air Force Academy.

Source: Brad Warner and Jim Rutledge, *Chance* 12(1): 10–14, 1999

- (a) What is the probability that a randomly selected 18-ounce bag of Chips Ahoy! contains between 1,000 and 1,400 chocolate chips, inclusive?
- (b) What is the probability that a randomly selected 18-ounce bag of Chips Ahoy! contains fewer than 1,000 chocolate chips?
- (c) What proportion of 18-ounce bags of Chips Ahoy! contains more than 1,200 chocolate chips?
- (d) What proportion of 18-ounce bags of Chips Ahoy! contains fewer than 1,125 chocolate chips?
- (e) What is the percentile rank of an 18-ounce bag of Chips Ahoy! that contains 1,475 chocolate chips?
- (f) What is the percentile rank of an 18-ounce bag of Chips Ahoy! that contains 1,050 chocolate chips?

20. Wendy's Drive-Through Fast-food restaurants spend quite a bit of time studying the amount of time cars spend in their drive-throughs. Certainly, the faster the cars get through the drive-through, the more the opportunity for making money. In 2007, *QSR Magazine* studied drive-through times for fast-food restaurants and Wendy's had the best time, with a mean time spent in the drive-through of 138.5 seconds. Assuming drive-through times are normally distributed with a standard deviation of 29 seconds, answer the following.

- (a) What is the probability that a randomly selected car will get through Wendy's drive-through in less than 100 seconds?
- (b) What is the probability that a randomly selected car will spend more than 160 seconds in Wendy's drive-through?
- (c) What proportion of cars spend between 2 and 3 minutes in Wendy's drive-through?
- (d) Would it be unusual for a car to spend more than 3 minutes in Wendy's drive-through? Why?

21. Gestation Period The lengths of human pregnancies are approximately normally distributed, with mean $\mu = 266$ days and standard deviation $\sigma = 16$ days.

- (a) What proportion of pregnancies lasts more than 270 days?
- (b) What proportion of pregnancies lasts less than 250 days?
- (c) What proportion of pregnancies lasts between 240 and 280 days?
- (d) What is the probability that a randomly selected pregnancy lasts more than 280 days?
- (e) What is the probability that a randomly selected pregnancy lasts no more than 245 days?
- (f) A “very preterm” baby is one whose gestation period is less than 224 days. Are very preterm babies unusual?

23. Manufacturing Steel rods are manufactured with a mean length of 25 centimeter (cm). Because of variability in the manufacturing process, the lengths of the rods are approximately normally distributed, with a standard deviation of 0.07 cm.

- (a) What proportion of rods has a length less than 24.9 cm?
- (b) Any rods that are shorter than 24.85 cm or longer than 25.15 cm are discarded. What proportion of rods will be discarded?
- (c) Using the results of part (b), if 5,000 rods are manufactured in a day, how many should the plant manager expect to discard?
- (d) If an order comes in for 10,000 steel rods, how many rods should the plant manager manufacture if the order states that all rods must be between 24.9 cm and 25.1 cm?

24. Manufacturing Ball bearings are manufactured with a mean diameter of 5 millimeters (mm). Because of variability in the manufacturing process, the diameters of the ball bearings are approximately normally distributed, with a standard deviation of 0.02 mm.

- (a) What proportion of ball bearings has a diameter more than 5.03 mm?
- (b) Any ball bearings that have a diameter less than 4.95 mm or greater than 5.05 mm are discarded. What proportion of ball bearings will be discarded?
- (c) Using the results of part (b), if 30,000 ball bearings are manufactured in a day, how many should the plant manager expect to discard?
- (d) If an order comes in for 50,000 ball bearings, how many bearings should the plant manager manufacture if the order states that all ball bearings must be between 4.97 mm and 5.03 mm?

- 27. Chips Ahoy! Cookies** The number of chocolate chips in an 18-ounce bag of Chips Ahoy! chocolate chip cookies is approximately normally distributed, with a mean of 1,262 chips and a standard deviation of 118 chips, according to a study by cadets of the U.S. Air Force Academy.

Source: Brad Warner and Jim Rutledge, *Chance* 12(1):10–14, 1999

- (a) Determine the 30th percentile for the number of chocolate chips in an 18-ounce bag of Chips Ahoy! cookies.
- (b) Determine the number of chocolate chips in a bag of Chips Ahoy! that make up the middle 99% of bags.

- 28. Wendy's Drive-Through** Fast-food restaurants spend quite a bit of time studying the amount of time cars spend in their drive-through. Certainly, the faster the cars get through the drive-through, the more the opportunity for making money. In 2007, *QSR Magazine* studied drive-through times for fast-food restaurants, and Wendy's had the best time, with a mean time a car spent in the drive-through equal to 138.5 seconds. Assume that drive-through times are normally distributed, with a standard deviation of 29 seconds. Suppose that Wendy's wants to institute a policy at its restaurants that it will not charge any patron that must wait more than a certain amount of time for an order. Management does not want to give away free meals to more than 1% of the patrons. What time would you recommend Wendy's advertise as the maximum wait time before a free meal is awarded?

- 29. Speedy Lube** The time required for Speedy Lube to complete an oil change service on an automobile approximately follows a normal distribution, with a mean of 17 minutes and a standard deviation of 2.5 minutes.
- (a) Speedy Lube guarantees customers that the service will take no longer than 20 minutes. If it does take longer, the customer will receive the service for half-price. What percent of customers receive the service for half price?
 - (b) If Speedy Lube does not want to give the discount to more than 3% of its customers, how long should it make the guaranteed time limit?