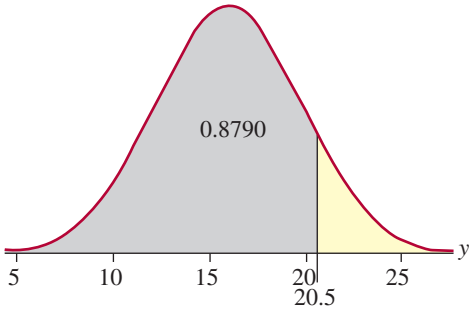
Using continuity correction,

$$P(Y \le 20.5) = P\left(z \le \frac{20.5 - 16}{3.8367}\right) \approx P(z \le 1.17) = 0.8790.$$

Normal Approximation to the Binomial, $n = 200$, $p = 0.08$



Thus, using the normal approximation and continuity correction, the probability that the restaurant will have no more than 20 no-shows is 0.8790. Notice that the continuity correction has a significant impact on the accuracy of the approximation. Using the binomial distribution, the exact probability is 0.8775.

Technology

For directions on computing a binomial probability using technology, please visit stat.hawkeslearning.com and navigate to **Discovering Statistics and Data, Fourth Edition > Technology Instructions > Binomial Distribution > Binomial Probability (cdf)**.

8.6 Exercises

Basic Concepts

1. Why would you want to use the normal distribution to approximate a binomial distribution?
2. What are the parameters of a normal distribution used to approximate a binomial distribution?
3. What is continuity correction? How does it improve the normal approximation to the binomial?

Exercises

4. The pandemic has closed the generational technology divide as more older adults have adopted technology. A recent AARP survey revealed that 44% of Americans 50 years old and older enjoy playing video games at least once a month.[9] Consider the probability that fewer than 15 out of the 123 seniors surveyed at a local shopping mall play video games Assume that the probability of a given senior playing video games is 44%. Verify that a normal distribution can be used to approximate the binomial probability, or show how the conditions have not been met.

5. Only 4% of Americans are truly vegetarian, including vegans.[10] For a survey of what vegetarian foods to include in a new product line at Whole Foods grocery stores, would a sample of 100 customers be sufficient to use a normal distribution to approximate probabilities for this survey? Verify that a normal distribution can be used to approximate a binomial probability for the survey or show how the conditions have not been met.

6. Management at a small engineering company is considering the addition of a company cafeteria area. A random sample of 50 persons out of the total number of persons employed by the firm will be surveyed to see if they are in favor of the addition. Assume that the true percentage of persons that favor the addition is 90%.

a. Find the expected number of employees in the sample who will favor the addition of the cafeteria area.

b. Find the standard deviation of the number of employees in the sample who will favor the addition of the cafeteria area.

c. What is the probability that between 35 and 37 employees (inclusive) in the sample will favor the cafeteria?

d. What is the probability that more than 40 of the employees in the sample will favor the cafeteria?

e. What is the probability that at most 38 of the employees in the sample will favor the cafeteria?

7. The accounting department of a large corporation checks the addition of expense reports submitted by executives before paying them. Historically, they have found that 15% of the reports contain addition errors. An auditor randomly selects 60 expense reports and audits them for addition errors.

a. Find the expected number of reports in the sample that will have addition errors.

b. Find the standard deviation of the number of reports sampled that will have addition errors.

c. Find the probability that fewer than 10 of the sampled expense reports will have addition errors.

d. Find the probability that at least 30 of the sampled expense reports will have addition errors.

e. Find the probability that between 5 and 15 (inclusive) of the sampled expense reports will have addition errors.

8. A local electronics store purchased a market research study which suggests that 40 percent of all homes have a video doorbell. A sample of 200 homes is selected to confirm the study's findings. If the marketing study is correct, answer the following questions.

a. Find the expected number of homes sampled which will have video doorbells.

b. Find the standard deviation of the number of homes in the sample which will have video doorbells.

c. What is the probability that at most 80 of the sampled homes will have video doorbells?

d. What is the probability that between 100 and 120 (inclusive) homes sampled will have video doorbells?

e. What is the probability that at least 130 of the sampled homes will have video doorbells?

9. Suppose a virus is believed to infect two percent of the population. If a sample of 3000 randomly selected subjects are tested, answer the following questions.

a. Find the expected number of subjects sampled that will be infected.

b. Find the standard deviation of the number of subjects sampled that will be infected.

c. What is the probability that fewer than 30 of the subjects in the sample will be infected?

d. What is the probability that between 40 and 80 (inclusive) of the subjects in the sample will be infected?

e. Find the probability that at least 70 of the subjects in the sample will be infected.

10. Based on a recent survey, approximately 71% of Americans who shop at Walmart purchase the store brands. A random sample of 200 shoppers at Walmart was conducted. If the survey is correct, answer the following questions.

a. Find the expected number of people that will purchase a Walmart store brand from the random sample of 200 Walmart shoppers.

b. Find the standard deviation of the number of people that will purchase a Walmart store brand from the sample of Walmart shoppers.

c. Find the probability that more than 150 Walmart shoppers will purchase a store brand.

d. Find the probability that less than 100 Walmart shoppers will purchase a store brand.

e. Find the probability that between 120 and 150 shoppers (inclusive) will purchase a store brand.

CR Chapter Review

Key Terms and Ideas

- Continuous Random Variables
- Continuous Uniform Distribution
- Probability Density Function
- Uniform Probability Density Function
- Normal Distribution
- Normal Probability Density Function
- Standard Normal Distribution
- z-Distribution
- z-Score
- Standard Normal Random Variable
- Normal Probability Plot
- Normal Approximation to the Binomial Distribution
- Continuity Correction

Key Formulas

Section	
8.1	**Uniform Probability Density Function** $f(x)=\begin{cases}\dfrac{1}{b-a} & \text{for } a\le x\le b\\ 0 & \text{otherwise}\end{cases}$ **Expected Value for a Continuous Uniform Random Variable** $\mu=E(x)=\dfrac{a+b}{2}$ **Standard Deviation for a Continuous Uniform Random Variable** $\sigma=\dfrac{b-a}{\sqrt{12}}$