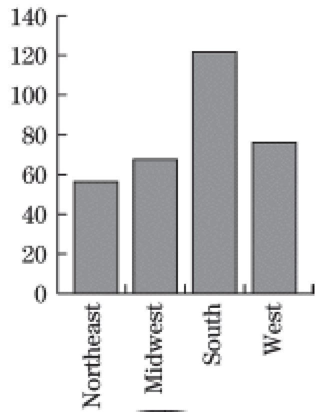
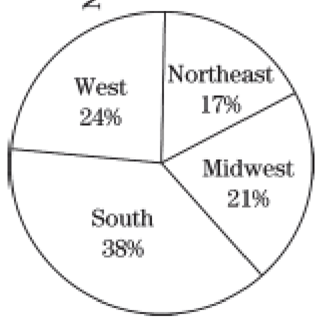
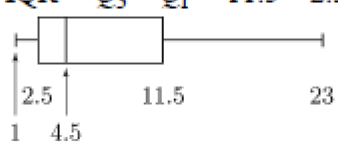
1. 



2. min = 1,

$Q_1 = 2.5,\ Q_2 = 4.5, Q_3 = 11.5, \text{max} = 23;$

$\text{IQR} = Q_3 - Q_1 = 11.5 - 2.5 = 9\,;$



3.

Number Waiting in Line	Relative Frequency
0	0.04
1	0.10
2	0.18
3	0.26
4	0.22
5	0.14
6	0.06

Pr(at most 3 customers in line)

$= 0.04 + 0.10 + 0.18 + 0.26$

$= 0.58$

4. a. Possible outcomes are HH, HT, TH, TT

Number of Heads, k	$\Pr(X = k)$
0	0.25
1	0.50
2	0.25

b.

k	$\Pr(2X + 5 = k)$
5	0.25
7	0.50
9	0.25

5. $n = 3,\ p = \dfrac{1}{3}$

a.

k	$\Pr(X = k)$
0	$\binom{3}{0}\left(\frac{1}{3}\right)^0\left(\frac{2}{3}\right)^3 = \frac{8}{27}$
1	$\binom{3}{1}\left(\frac{1}{3}\right)^1\left(\frac{2}{3}\right)^2 = \frac{12}{27}$
2	$\binom{3}{2}\left(\frac{1}{3}\right)^2\left(\frac{2}{3}\right)^1 = \frac{6}{27}$
3	$\binom{3}{3}\left(\frac{1}{3}\right)^3\left(\frac{2}{3}\right)^0 = \frac{1}{27}$

b. $\mu = 0\left(\dfrac{8}{27}\right) + 1\left(\dfrac{12}{27}\right) + 2\left(\dfrac{6}{27}\right) + 3\left(\dfrac{1}{27}\right) = 1$

$$\sigma^2 = (0-1)^2\left(\frac{8}{27}\right) + (1-1)^2\left(\frac{12}{27}\right) + (2-1)^2\left(\frac{6}{27}\right) + (3-1)^2\left(\frac{1}{27}\right)$$

$$= \frac{2}{3}$$

6. $n = 4, p = .3$

$$\Pr(X = 2) = \binom{4}{2}(0.3)^2(0.7)^2 = 0.2646$$

7. The student has a .6 probability of guessing correctly on the six questions with answer *true* and a 0.4 probability of guessing correctly on the four questions with answer *false*. Therefore the student's expected score is 6(0.6) + 4(0.4) = 5.2 correct answers which gives 52 points or 52%.
A better strategy is to choose true for all the questions which guarantees a score of 60%.

8. **a.** $\Pr(\text{get 7 twice}) = \binom{12}{2}\left(\frac{1}{6}\right)^2\left(\frac{5}{6}\right)^{10} \approx 0.2961$

b. $\Pr(\text{get 7 at least twice})$

$= 1 - \Pr(\text{get 7 zero or one time})$

$= 1 - \binom{12}{0}\left(\frac{1}{6}\right)^0\left(\frac{5}{6}\right)^{12} - \binom{12}{1}\left(\frac{1}{6}\right)^1\left(\frac{5}{6}\right)^{11}$

≈ 0.6187

c. The expected number of 7's is $12 \cdot \frac{1}{6} = 2$.

9. $\mu = 0(0.2) + 1(0.3) + 5(0.1) + 10(0.4) = 4.8$

$\sigma^2 = (0-4.8)^2(0.2) + (1-4.8)^2(0.3) + (5-4.8)^2(0.1) + (10-4.8)^2(0.4)$

$= 19.76$

10. Let X be the number of red balls.

k	$\Pr(X=k)$
0	$\frac{\binom{4}{0}\binom{4}{4}}{\binom{8}{4}} = \frac{1}{70}$
1	$\frac{\binom{4}{1}\binom{4}{3}}{\binom{8}{4}} = \frac{16}{70}$
2	$\frac{\binom{4}{2}\binom{4}{2}}{\binom{8}{4}} = \frac{36}{70}$
3	$\frac{\binom{4}{3}\binom{4}{1}}{\binom{8}{4}} = \frac{16}{70}$

4 $\qquad \dfrac{\binom{4}{4}\binom{4}{0}}{\binom{8}{4}} = \dfrac{1}{70}$

$$\mu = 0\left(\frac{1}{70}\right) + 1\left(\frac{16}{70}\right) + 2\left(\frac{36}{70}\right) + 3\left(\frac{16}{70}\right) + 4\left(\frac{1}{70}\right) = 2$$

$$\sigma^2 = (0-2)^2\left(\frac{1}{70}\right) + (1-2)^2\left(\frac{16}{70}\right) + (2-2)^2\left(\frac{36}{70}\right) + (3-2)^2\left(\frac{16}{70}\right) + (4-2)^2\left(\frac{1}{70}\right)$$

$$= \frac{4}{7}$$

11. X has mean

$\mu = (-2)(0.3) + 0(0.1) + 1(0.4) + 3(0.2) = 0.4,$

variance

$\sigma^2 = (-2-0.4)^2(0.3) + (0-0.4)^2(0.1) + (1-0.4)^2(0.4) + (3-0.4)^2(0.2)$

$= 3.24,$

and standard deviation

$\sigma = \sqrt{3.24} = 1.8.$

12. When a pair of fair dice is rolled, the probabilities that the result is 7 or 11 are $\frac{1}{6}$ and $\frac{1}{18}$ respectively. Hence Lucy's expected winnings are $(-10)\frac{2}{9} + 3 \cdot \frac{7}{9} = \frac{1}{9} \approx .11,$ or 11 cents per roll.

13. $\mu = 10,\ \sigma = \frac{1}{3}$

$10 - c = 9$ and $10 + c = 11 \qquad c = 1$

Probability: $\geq 1 - \dfrac{\left(\frac{1}{3}\right)^2}{1^2} = \dfrac{8}{9}$

14. $\mu = 50, \sigma = 8$

$50 - c = 38$ and $50 + c = 62 \qquad c = 12$

Probability $\geq 1 - \dfrac{8^2}{12^2} = \dfrac{5}{9}$

15. $\Pr(6.5 \leq X \leq 11) = \Pr\left(\dfrac{6.5-5}{3} \leq Z \leq \dfrac{11-5}{3}\right)$

$= A(2) - A(0.5)$

$= 0.9772 - 0.6915$

$= 0.2857$

16. $\Pr(Z \geq 0.75) = 1 - 0.7734 = 0.2266$

17. $\mu = 5.75, \sigma = 0.2$

$$\Pr(X \geq 6) = \Pr\left(Z \geq \frac{6-5.75}{0.2}\right)$$
$$= \Pr(Z \geq 1.25)$$
$$= 1 - 0.8944$$
$$= 0.1056$$

10.56%

18. $\Pr(Z \geq z) = 0.7734$
$\Pr(Z < z) = 1 - 0.7734 = 0.2266$
$z = -0.75$

19. $\mu = 80, \sigma = 15$
$\Pr(80 - h \leq X \leq 80 + h) = 0.8664$
$\frac{1 - 0.8664}{2} = 0.0668 \Rightarrow$ (area left of $80 - h$)
$\Pr(Z \leq z) = 0.0668$ when $z = -1.5$
$\Pr(-1.5 \leq Z \leq 1.5) = 0.8664$
Therefore, $\frac{x-\mu}{\sigma} = -1.5$ and $\frac{x+\mu}{\sigma} = 1.5.$
$\frac{(80-h)-80}{15} = -1.5$ and $\frac{(80+h)-80}{15} = 1.5$
$h = 22.5$

20. **a.** $\Pr(133 \leq X) \approx \Pr\left(\frac{132.5-100}{15} \leq Z\right)$

$$\approx \Pr(2.167 \leq Z)$$
$$\approx \Pr(2.20 \leq Z)$$
$$= 1 - 0.9861$$
$$= 0.0139$$
$$= 1.39\%$$

b. $x_{95} = 100 + 15z_{95}$
$= 100 + 15 \cdot 1.65$
$= 124.75$

21. $n = 54,\ p = \frac{2}{5}$

$$\mu = 54\left(\frac{2}{5}\right) = 21.6$$

$$\sigma = \sqrt{54\left(\frac{2}{5}\right)\left(\frac{3}{5}\right)} = 3.6$$

$$\Pr(X \leq 13) \approx \Pr\left(Z \leq \frac{13.5-21.6}{3.6}\right) = \Pr(Z \leq -2.25) = 0.0122$$

22. $n = 75,\ p = \dfrac{1}{4}$

$$\mu = 75\left(\frac{1}{4}\right) = 18.75$$

$$\sigma = \sqrt{75\left(\frac{1}{4}\right)\left(\frac{3}{4}\right)} = 3.75$$

$$\Pr(8 \le X \le 22) \approx \Pr\left(\frac{7.5 - 18.75}{3.75} \le Z \le \frac{22.5 - 18.75}{3.75}\right) = \Pr(-3 \le Z \le 1) = 0.8413 - 0.0013 = 0.84$$

Conceptual Exercises

23. **a.** scoring in the third quartile is not very good: 100, 40, 40, 40,

b. scoring in the third quartile corresponds to a perfect grade: 100, 100, 90, 80, 70

24. **a.** The mean and median are equal: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 : The mean is 5.5; the median is 5.5

b. the mean is less than the median: 1, 1, 1, 1, 4, 5, 6, 7, 8, 9 : The mean is 4.3; the median is 4.5

c. the median is less than the mean 1, 2, 3, 4, 5, 6, 10, 12, 14, 100. The median is 5.5; the mean is 15.7

25. A population mean is the average of all the data in the entire population. When a sample is taken from a population, the sample mean is the average of all the data in that particular sample. Sample means vary whereas the population mean is fixed.

26. A sample mean is taken from the population and is the average of all the data values in a particular sample, which is a subset of the population.

27. Yes; in general, if we add a constant to each number in a set, then the mean will increase by that constant.

28. Yes; in general, if we multiply each number in a set by some constant, then the standard deviation will be multiplied by that constant.

29. The binomial probability distribution applies when there is a fixed number of independent trials when the probability of success is constant. The outcome of each trial is classified as either a "success" or a "failure".

30. Repeated trials that do not produce a binomial distribution: 1) tossing a coin until a head appears. 2) Having children until a girl is born.