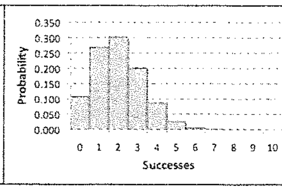
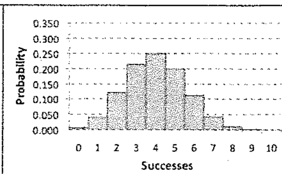
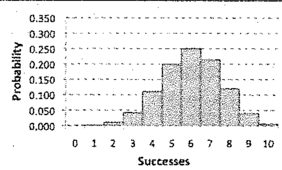
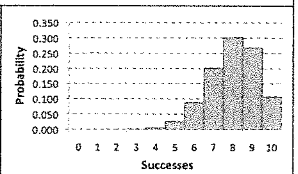
ii)–iii)

$p = 0.2$	
$E(X) = 2$	
$p = 0.4$	
$E(X) = 4$	
$p = 0.6$	
$E(X) = 6$	
$p = 0.8$	
$E(X) = 8$	

b) Sample answer: The distributions for $p = 0.2$ and $p = 0.8$ are reverses of each other, as are the distributions for $p = 0.4$ and $p = 0.6$. If there were 100 trials, the general shapes would be the same; however, the probabilities would be lower and the spread of the histograms would be greater.

12. The histograms have the same general shape, although the individual probabilities drop for each bar.

13. **a)** 2.1 **b)** 3.5 **c)** 13.3

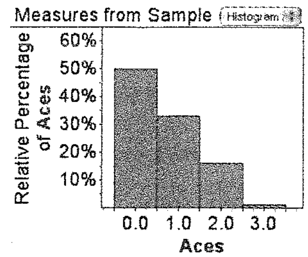
14. **a)** 0.196 **b)** 1 return with a probability of 0.2
c) No, because the chance is 1 in 5.

15. **a)** The probability that one boy cycles to school (success) is $p = 0.033$. The probability that two or more boys cycle to school is 1 minus the probability that fewer than two boys cycle to school:
$P(x) = 1 - ({}_{15}C_0(0.033)^0(0.967)^{15} + {}_{15}C_1(0.033)^1(0.967)^{14})$
$= 0.086$ or 8.6%.
b) The probability of success (boy smokes cigarettes) is $p = 0.146$. The probability that exactly three boys smoke cigarettes is
$P(3) = {}_{15}C_3(0.146)^3(0.854)^{12}$
$= 0.213$ or 21.3%.
c) The probability of success (not right handed) is $p = 0.125$, so the expected value is $E(X) = 12(0.125) = 1.5$. The probability of exactly four girls not being right handed is
$P(4) = {}_{12}C_4(0.125)^4(0.875)^8$
$= 0.042$ or 4.2%,
which is low. The probability of having four girls who are not right handed is much higher than predicted.

16. 9

17. **a)** 1.7% **b)** 27 **c)** 20

18.



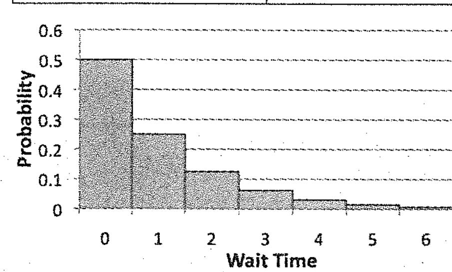
19. **a)** Assuming that men and women applied in equal numbers and that they were equally qualified, the probability of hiring a woman is $p = 0.5$, so $E(X) = 15(0.5) = 7.5$.
b) Assuming that the number of male and female applicants was equal, the probability that a female would be hired is $P(\text{female hired}) = P(\text{female}) \times P(\text{qualified female}) = (0.5)(0.3) = 0.15$. So, the expected number of female hires is $E(X) = 15(0.15) = 2.25$. Based on this, the fact that 3 women have been hired is in line with the company's claim.

7.3 Geometric Distributions, pages 110–112

1. **a)** yes **b)** yes **c)** yes
d) no, since the draws are not independent (no replacement)
e) no, since with each jump the ice will weaken more

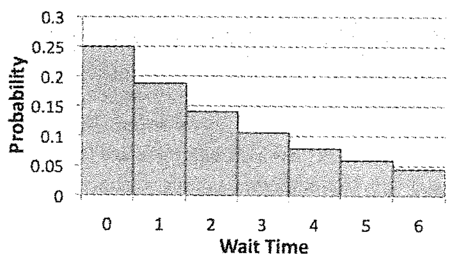
2. **a)** $p = 0.5$, $q = 1 - 0.5 = 0.5$, waiting time: $E(X) = 1$

Number of Trials Before Success (Wait Time), x	$P(x) = q^x p$
0	$(0.5)^0(0.5) = 0.5$
1	$(0.5)^1(0.5) = 0.25$
2	$(0.5)^2(0.5) = 0.125$
3	$(0.5)^3(0.5) = 0.062\ 5$
4	$(0.5)^4(0.5) = 0.031\ 25$
5	$(0.5)^5(0.5) = 0.015\ 63$
6	$(0.5)^6(0.5) = 0.007\ 81$



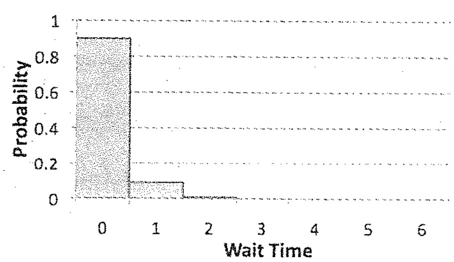
b) $p = 0.25$, $q = 1 - 0.25 = 0.75$, waiting time: $E(X) = 3$

Number of Trials Before Success (Waiting Time), x	$P(x) = q^x p$
0	$(0.75)^0(0.25) = 0.25$
1	$(0.75)^1(0.25) = 0.187\ 5$
2	$(0.75)^2(0.25) = 0.140\ 63$
3	$(0.75)^3(0.25) = 0.105\ 47$
4	$(0.75)^4(0.25) = 0.079\ 10$
5	$(0.75)^5(0.25) = 0.059\ 33$
6	$(0.75)^6(0.25) = 0.044\ 49$



c) $p = 0.9$, $q = 1 - 0.9 = 0.1$, waiting time: $E(X) = 0.111$

Number of Trials Before Success (Waiting Time), x	$P(x) = q^x p$
0	$(0.1)^0(0.9) = 0.9$
1	$(0.1)^1(0.9) = 0.09$
2	$(0.1)^2(0.9) = 0.009$
3	$(0.1)^3(0.9) = 0.000\ 9$
4	$(0.1)^4(0.9) = 0.000\ 09$
5	$(0.1)^5(0.9) = 0.000\ 009$
6	$(0.1)^6(0.9) = 0.000\ 001$



3. **a)** In **L2**, enter **geometpdf(0.5,L1+1)**.

L1	L2	L3 2
0	.5	------
1	.25	
2	.125	
3	.0625	
4	.03125	
5	.01563	
6	.00781	

L2 =...f(0.5,L1+1)

b)

	A	B	C	D
1	x	P(x)		p= 0.25
2	0	=(1-D$1)^A2*D$1		
3	1	0.1875		
4	2	0.140625		
5	3	0.10546875		
6	4	0.07910156		
7	5	0.05932617		
8	6	0.04449463		

c)

	WaitTime	Prob
=		geometricProbability (waittime, 0.9, 1, 1)
1	0	0
2	1	0.9
3	2	0.09
4	3	0.009
5	4	0.0009
6	5	9e-05
7	6	9e-06

4. Sample answer: Each histogram goes down at an exponential rate; however, as the probability of success becomes smaller, the rate of decrease from bar to bar becomes smaller and the expected waiting time increases.

5. **a)** $p = \frac{4}{52} = \frac{1}{13}$, $q = 1 - \frac{1}{13} = \frac{12}{13}$

Number of Trials Before an Ace, (Waiting Time), x	$P(x) = q^x p$
0	0.076 92
1	0.071 01
2	0.065 54
3	0.060 50
4	0.055 85
5	0.051 55
6	0.047 59

b) 12 draws

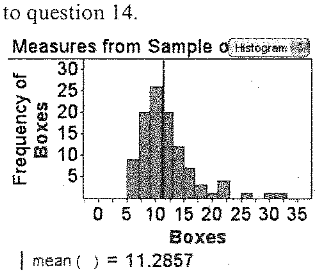
6. **a)** $p = 0.85$, $q = 1 - 0.85$, or 0.15

Number of Trials Before Success (Waiting Time), x	$P(x) = q^x p$
0	0.85
1	0.127 5
2	0.019 13
3	0.002 87
4	0.000 43
5	0.000 065
6	0.000 010

b) 5.67

7. **a)** 2.33 **b)** 6.41; about 4 more discs
8. **a)** about 5 **b)** 2
9. waiting time: 1.86, or approximately after every 2 people
10. The probability hardly changes: at start of year $p = \frac{1}{13\ 983\ 816}$, at end of year $p = \frac{1}{13\ 983\ 712}$.
11. **a)** 1% **b)** 9.6%

12. In this case, a failure of a parachute to open is considered the "success" outcome. Because the probability is low ($p = 0.001$), the waiting time will be long. Use a spreadsheet to calculate when the cumulative probability will exceed 50%. This occurs on the 693rd jump, after 692 "failures" of the parachute opening successfully.
b) At the higher failure rate, the cumulative probability will exceed 50% on the 69th jump, 624 fewer jumps than in part a).
13. The best strategy is to stop after 5 rolls, because the expected waiting time for rolling 1 is 5.
14. **a)** Since you will get any prize in the first box, it has a probability of $p = 1$. The waiting time is $E(X) = \frac{0}{1} = 0$.
b) The probability of getting any prize other than the first prize is $p = \frac{4}{5}$. The expected waiting time is $E(X) = \frac{\frac{1}{5}}{\frac{4}{5}} = \frac{1}{4} = 0.25$. You can expect to have two different prizes after 1.25 additional boxes, for a total of 2.25 boxes.
c) The probability of getting any prize other than the first two prizes is $p = \frac{3}{5}$. The expected waiting time is $E(X) = \frac{\frac{2}{5}}{\frac{3}{5}} = \frac{2}{3} = 0.67$. You can expect to have three different prizes after another 1.67 boxes, for a total of 3.92 boxes.
d) The expected waiting time for four different prizes is $E(X) = \frac{\frac{3}{5}}{\frac{2}{5}} = \frac{3}{2} = 1.5$, so you can expect to have four different prizes after 2.5 additional boxes, for a total of 6.42 boxes.
e) The expected waiting time to have all five prizes is $E(X) = \frac{\frac{4}{5}}{\frac{1}{5}} = \frac{4}{1} = 4$, so you can expect to have five different prizes after an additional 5 boxes, for a total of 11.42 boxes.
15. 18
16. The simulation gives a result close to the theoretical answer to question 14.



17. Determine the average waiting time. Then, use the expected waiting time formula to calculate the probability, p. Average waiting time is 70.5 and $p = 0.014$ or 1.4%.

7.4 Hypergeometric Distributions, pages 113–117

1. **a)** not hypergeometric: The trials are independent.
b) not hypergeometric: Only one part is being tested. Once the part is broken, it is not possible to have a successful trial after that.
c) hypergeometric; There two outcomes: 10 (success) or not 10 (failure), and they are dependent events, since there is no replacement.
d) hypergeometric; Each team member can be a girl (success) or not a girl (failure), and they are dependent events, since no girl can be chosen more than once.
e) hypergeometric; Any name can be drawn (success) or not drawn (failure), and since they are all drawn at once, this is like being drawn without replacement.
f) hypergeometric; There are two possibilities: pulling a red chip (success) or pulling a blue chip (failure), and since they are all drawn at once, this is like being drawn without replacement. (However, there is not enough information given to do any calculations, since only a percentage is available.)
g) hypergeometric; Even though there are three items, there are still only two outcomes: getting a blue marble (success) or not getting a blue marble (failure), and it is also done without replacement.

2. **a)**

x	$P(x)$	$xP(x)$
0	$\frac{(_{10}C_0)(_{20}C_6)}{(_{30}C_6)} = 0.065\ 28$	0
1	$\frac{(_{10}C_1)(_{20}C_5)}{(_{30}C_6)} = 0.261\ 11$	0.261 11
2	$\frac{(_{10}C_2)(_{20}C_4)}{(_{30}C_6)} = 0.367\ 18$	0.734 37
3	$\frac{(_{10}C_3)(_{20}C_3)}{(_{30}C_6)} = 0.230\ 39$	0.691 17
4	$\frac{(_{10}C_4)(_{20}C_2)}{(_{30}C_6)} = 0.067\ 20$	0.268 79
5	$\frac{(_{10}C_5)(_{20}C_1)}{(_{30}C_6)} = 0.008\ 49$	0.042 44
6	$\frac{(_{10}C_6)(_{20}C_0)}{(_{30}C_6)} = 0.000\ 35$	0.002 12
	Sum	= 2

b) $E(X) = \frac{ra}{N} = \frac{(6)(10)}{(30)} = 2$. Thus, $E(X) = \sum_{i=0}^{r} x_i P(x_i) = \frac{ra}{N}$

3. **a)** $E(X) = 1.67$