9. a) 0.0819 b) 0.0064 c) 0.992
10. a) 0.0184 b) 0.183
11. 5 **12.** 50 **13.** 20 calls **14.** 100 donors
15. a) 25 b) 0.185 c) 0.217 d) 0.693
16. a) 12.5 b) 0.716 c) 0.0527 d) 0.528
17. a) 0.0745 b) 0.502 c) 0.211
    d) 0.0166 e) 0.0179 f) 0.9987
18. a) 0.032 b) 0.738 c) 0.00768
    d) 0.246 e) 0.901 f) 0.345
19. a) 0.65 b) 0.75 c) 7.69 picks
20. a) 4.8 b) 0.98 c) 1.25 shots
21. a) $\mu = 10.44, \sigma = 1.16$
    b) i) 0.812 ii) 0.475 iii) 0.00193 iv) 0.998
22. a) $\mu = 8, \sigma = 1.26$
    b) i) 0.107 ii) 0.624 iii) 0.302 iv) 0.967
23. $\mu = 20.28, \sigma = 4.22$
24. $\mu = 2.4, \sigma = 1.5$
25. a) 0.118 b) 0.324 c) 0.744 d) 0.580
26. a) 0.201 b) 0.453 c) 0.171 d) 0.989
27. a) $\mu = 56, \sigma = 4.10$
    b) Yes, $np = 56 \geq 10$, $nq = 24 \geq 10$, serves are independent.
    c) In a match with 80 serves, approximately 68% of the time she will have between 51.9 and 60.1 good serves, approximately 95% of the time she will have between 47.8 and 64.2 good serves, and approximately 99.7% of the time she will have between 43.7 and 68.3 good serves.
    d) Normal, approx.: 0.014; Binomial, exact: 0.016
28. a) $\mu = 160, \sigma = 5.66$
    b) Yes, $np = 160 \geq 10$, $nq = 40 \geq 10$.
    c) In matches with 200 arrows, about 68% of the time she will have between 154.34 and 165.66 bull's-eyes, about 95% of the time between 148.68 and 171.32 bull's-eyes, and about 99.7% of the time between 143.02 and 176.98 bull's-eyes.
    d) Yes, that's more than 3 SDs below the mean. The probability this happens is less than 0.0015.
29. a) Assuming apples fall and become blemished independently of each other, Binom(300, 0.06) is appropriate. Since $np \geq 10$ and $nq \geq 10$, $N(18, 4.11)$ is also appropriate.
    b) Normal, approx.: 0.072; Binomial, exact: 0.085
    c) No, 50 is 7.8 SDs above the mean.
30. a) $\mu = 18.75, \sigma = 4.05$
    b) Yes, $np = 18.75 \geq 10$, $nq = 131.25 \geq 10$.
    c) No, 22 is only 0.8 SD above the mean; this is likely to happen by natural sampling variability.
31. Normal, approx.: 0.053; Binomial, exact: 0.061
32. Normal, approx.: 0.094; Binomial, exact: 0.116
33. The mean number of sales should be 24 with SD 4.60. Ten sales is more than 3.0 SDs below the mean. He was probably misled.
34. If the coin is fair, expect 125 heads, with SD 7.91; 140 is 1.9 SDs above the mean. From the Normal approximation, the chance of 140 or more heads is 2.9%. That's pretty unlikely to happen.
35. a) 5 b) 0.066 c) 0.107 d) $\mu = 24, \sigma = 2.19$
    e) Normal, approx.: 0.819; Binomial, exact: 0.848
36. a) 0.042 b) 0.107 c) 5 d) $\mu = 10, \sigma = 2.83$
    e) Normal, approx.: 0.025; Binomial, exact: 0.027
37. $\mu = 20, \sigma = 4$. I'd want *at least* 32 (3 SDs above the mean). (Answers will vary.)
38. $\mu = 25, \sigma = 3.54$. I'd want *at least* 36 (3 SDs above the mean). (Answers will vary.)
39. Probably not. There's a more than 9% chance that he could hit 4 shots in a row, so he can expect this to happen nearly once in every 10 sets of 4 shots he takes. That does not seem unusual.
40. No. If she were to shoot several flights of 6 arrows, an archer of her ability could be expected to get all bull's-eyes about 26% of the time. That's not an unusual result.
41. Yes. We'd expect him to make 22 shots, with a standard deviation of 3.15 shots. 32 shots is more than 3 standard deviations above the expected value, an unusually high rate of success.
42. No. We'd expect her to hit the bull's-eye with 40 of the 50 arrows, with a standard deviation of 2.83 bull's-eyes. She got 45, less than 2 standard deviations above the mean. Good shooting, but probably not unusual for her.

PART IV REVIEW

1. a) 0.34 b) 0.27 c) 0.069
   d) No, 2% of cars have both types of defects.
   e) Of all cars with cosmetic defects, 6.9% have functional defects. Overall, 7.0% of cars have functional defects. The probabilities here are estimates, so these are probably close enough to say the defects are independent.
2. a) i) 0.60 ii) 0.90 iii) 0.615 iv) 0.80
   b) No. Fewer than half of the managers are female, but 60% of all workers are female.
3. a) C = Price to China; F = Price to France; Total = $3C + 5F$
   b) $\mu = \$5500, \sigma = \$672.68$ c) $\mu = \$500, \sigma = \$180.28$
   d) Means—no. Standard deviations—yes; ticket prices must be independent of each other for different countries, but all tickets to the same country are at the same price.
4. $np = 100 \geq 10$ and $nq = 9900 \geq 10$, so Success/Failure Condition is verified. Also, we assume that cases are independent. $\mu = 100, \sigma = 9.95$. Over 200 would be more than 10 SDs above the mean. Probability is essentially 0.
5. a) $\mu = -\$0.20, \sigma = \$1.89$ b) $\mu = -\$0.40, \sigma = \$2.67$
6. a) 3%
   b) No; 62% of those who can do it with their right hand can do it with their left, but 83.3% of those who can't do it with their right hand can do it with their left.
   c) No; 51% can use either hand.
7. a) 0.106 b) 0.651 c) 0.442
8. Expected (extra) cost of the cheaper policy with the deductible is \$2.50, much less than the \$12 for the no-deductible surcharge, so on average, she will save money by going with the deductible. But the standard deviation (\$35.27) is evidence of risk. Value of the car shouldn't influence the decision.
9. a) 0.590 b) 0.328 c) 0.00856
10. a) $\mu = 6.775, \sigma = 2.60$ b) No, since $np = 6.78 < 10$
11. a) $\mu = 15.2, \sigma = 3.70$ b) Yes, $np \geq 10$ and $nq \geq 10$
    c) Normal, approx.: 0.080; Binomial, exact: 0.097
12. a)

Spaces	5	10	20
P(Spaces)	0.5	0.25	0.25

    b) $\mu = 10, \sigma = 6.12$
    c)

Spaces	0	1	2	3	4
P(Spaces)	1/3	1/6	1/6	1/6	1/6

    d) $\mu = 1.67, \sigma = 1.49$ e) $\mu = 11.67, \sigma = 6.30$
13. a) 0.0173 b) 0.591
    c) Left: 960; right: 120; both: 120
    d) $\mu = 120, \sigma = 10.39$
    e) About 68% chance of between 110 and 130; about 95% between 99 and 141; about 99.7% between 89 and 151.
14. $\mu = 8.33, \sigma = 6.30$
15. a) Men's heights are more variable than women's.
    b) Men (1.75 SD vs 2.4 SD for women)
    c) M = Man's height; W = Woman's height; $M - W$ is how much taller the man is.
    d) 5.1" e) 3.75" f) 0.913
    g) If independent, it should be about 91.3%. We are told 92%. This difference seems small and may be due to natural sampling variability.
16. a) 0.389 b) 0.284 c) 0.793 d) 0.896
17. a) The chance is 1.6×10^{-7}. b) 0.952 c) 0.063
18. a) No, this does not confirm the advice. If you follow the advice, it seems there's only a 75% chance it goes up in the 3rd year.

b) It actually has risen in 73% of all years. Not much difference from their strategy.

19. $240
20. a) 0.240 b) 0.050 c) 0.383
21. a) 0.717 b) 0.588
22. a) 36 b) 5.02
    c) Because both $np = 36 \geq 10$ and $nq = 84 \geq 10$.
    d) There is a 68% chance between 30.98 and 41.02 (31 and 41 students); 95% chance between 25.96 and 46.04 (26 and 46 students); 99.7% chance between 20.94 and 51.06 (21 and 51 students).
23. a) $\mu = 100, \sigma = 8$ b) $\mu = 1000, \sigma = 60$
    c) $\mu = 100, \sigma = 8.54$ d) $\mu = -50, \sigma = 10$
    e) $\mu = 100, \sigma = 11.31$
24. Assuming policies are independent, we add the profit variances. The resulting standard deviation of total profit is less than the sum of the SDs of individual profits. This means the profit for the large company will be less variable than the total of profits for the smaller companies.
25. a) Many do both, so the two categories can total more than 100%.
    b) No. They can't be disjoint. If they were, the total would be 100% or less.
    c) No. Probabilities are different for boys and girls.
    d) 0.0524
26. a) $\mu = \$27.00, \sigma = \$9.90$
    b) Spending on different days is independent. This might not be reasonable, since a student may be more likely to spend less on a day after he had spent a lot.
    c) $\mu = \$94.50, \sigma = \$18.52$
    d) No. $50 is 2.4 SDs below the mean. We assumed independence of costs each day.
27. a) 21 days b) 1649.73 som
    c) 3300 som extra. About 157-som "cushion" each day.
28. a) 4 lb b) 3.20 lb c) 0.894
29. No, you'd expect 541.2 homeowners, with an SD of 13.56. 523 is 1.34 SDs below the mean; not unusual.
30. $\mu = \$2.54, \sigma = \$0.94$
31. a) 0.018 b) 0.300 c) 0.26
32. a) 0.0156 b) 0.0039
    c) Answer b would become 0.0026.
33. a) 6 b) 15 c) 0.402
34. a) 3
    b) Expect to lose 1/6 of your current score. c) 18
    d) Roll until you score 18 points, then stop.
35. a) 34% b) 35% c) 31.4%
    d) 31.4% of classes that used calculators used computer assignments, while in classes that didn't use calculators, 30.6% used computer assignments. These are close enough to think the choice is probably independent.
36. a) 0.5929 b) 0.407 c) 0.053 d) 0.0025
37. a) 1/11 b) 7/22 c) 5/11 d) 0 e) 19/66
38. a) $\mu = 18, \sigma = 3$ b) 6 c) No, σ is now 5. d) 10 or more
    e) What appears "surprising" in the short run becomes expected in a large number of trials.
39. a) Expected number of stars with planets.
    b) Expected number of planets with intelligent life.
    c) Probability of a planet with a suitable environment having intelligent life.
    d) f_l: If a planet has a suitable environment, the probability that life develops.
    f_i: If a planet develops life, the probability that the life evolves intelligence.
    f_c: If a planet has intelligent life, the probability that it develops radio communication.
40. a) 0.017 b) 0.824 **41.** 0.991
42. a) 0.01 b) 0.0098 c) 0.366 d) First
    e) The chance of winning is 0.01 anywhere in line, so position does not matter.

CHAPTER 18

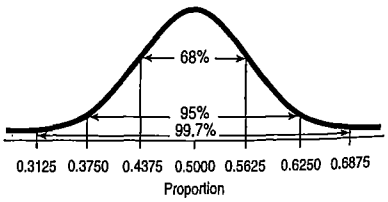
1. All the histograms are centered near 0.05. As n gets larger, the histograms approach the Normal shape, and the variability in the sample proportions decreases.
2. All the histograms are centered near 0.85. As n gets larger, the histograms approach the Normal shape, and the variability in the sample proportions decreases.
3. a)

n	Observed mean	Theoretical mean	Observed st. dev.	Theoretical st. dev.
20	0.0497	0.05	0.0479	0.0487
50	0.0516	0.05	0.0309	0.0308
100	0.0497	0.05	0.0215	0.0218
200	0.0501	0.05	0.0152	0.0154

   b) They are all quite close to what we expect from the theory.
   c) The histogram is unimodal and symmetric for $n = 200$.
   d) The success/failure condition says that np and nq should both be at least 10, which is not satisfied until $n = 200$ for $p = 0.05$. The theory predicted my choice.
4. a)

n	Observed mean	Theoretical mean	Observed st. dev.	Theoretical st. dev.
20	0.8481	0.85	0.0803	0.0798
50	0.8507	0.85	0.0509	0.0505
75	0.8481	0.85	0.0406	0.0412
100	0.8488	0.85	0.0354	0.0357

   b) They are all quite close to what we expect from the theory.
   c) The histogram is unimodal and symmetric for $n = 75$.
   d) The success/failure condition says that np and nq should both be at least 10, which, for $p = 0.85$ and $q = 0.15$, would be satisfied at a sample size of about 67. So my choice of $n = 75$ is reasonable.
5. a) Symmetric, because probability of heads and tails is equal.
   b) 0.5 c) 0.125 d) $np = 8 < 10$
6. a) Probability skewed right.
   b) No. $np = 5 < 10$ c) 0.10 d) 0.042
7. a) About 68% should have proportions between 0.4 and 0.6, about 95% between 0.3 and 0.7, and about 99.7% between 0.2 and 0.8.
   b) $np = 12.5$, $nq = 12.5$; both are ≥ 10.
   c)



   $np = nq = 32$; both are ≥ 10.
   d) Becomes narrower (less spread around 0.5).
8. a) $np = 20$, $np = 180$; both are ≥ 10.
   b) About 68% will be between 7.9% and 12.1%, about 95% will be between 5.8% and 14.2%, and about 99.7% should be between 3.7% and 16.3%.
   c) Same center, less spread.
9. This is a fairly unusual result: about 2.26 SDs below the mean. The probability of that is about 0.012. So, in a class of 100 this is certainly a reasonable possibility.
10. No. It's only 1.49 SDs above the mean.