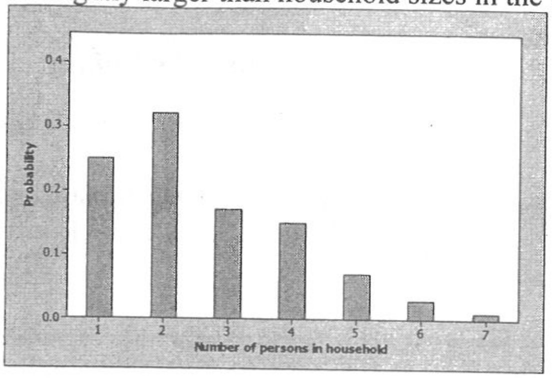
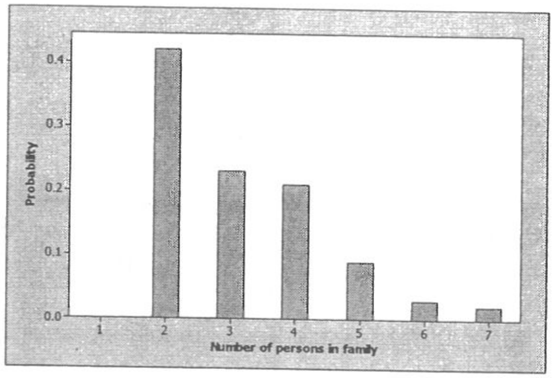
(d) P(X=7 or X=11) = 6/36 + 2/36 = 8/36 or 2/9. (e) P (any sum other than 7) = $P(X \neq 7) = 1 - P(X = 7) = 1 - 6/36 = 30/36 = 5/6$.

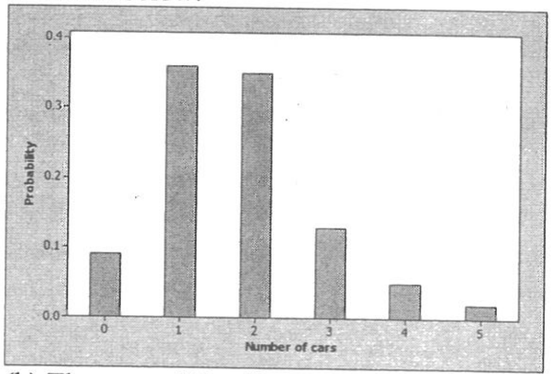
7.12 (a) All of the probabilities are between 0 and 1, and both sets of probabilities sum to 1. (b) Both distributions are skewed to the right. However, the event {X = 1} has a much higher probability in the household distribution. This reflects the fact that a family must consist of two or more persons. A closer look reveals that all of the values above one, except for 6, have slightly higher probabilities in the family distribution. These observations and the fact that the mean and median numbers of occupants are higher for families indicates that family sizes tend to be slightly larger than household sizes in the U.S.





7.13 (a) "More than one person lives in this household" can be written as {Y > 1} or {Y ≥ 2}. $P(Y > 1) = 1 - P(Y = 1) = 0.75$. (b) $P(2 < Y \leq 4) = P(Y = 3) + P(Y = 4) = 0.32$. (c) $P(Y \neq 2) = 1 - P(Y = 2) = 1 - 0.32 = 0.68$.

7.14 (a) All of the probabilities are between 0 and 1 and they add to 1. A probability histogram is shown below.



(b) The event {X ≥ 1} means that the household owns at least one car. $P(X \geq 1) = P(X = 1) + P(X = 2) + P(X=3) + P(X=4) + P(X = 5) = 0.91$. Or $P(X \geq 1) = 1 - P(X < 1) = 1 - P(X = 0) = 1 - 0.09 = 0.91$. (c) $P(X > 2) = P(X = 3) + P(X = 4) + P(X = 5) = 0.20$, so 20% of households own more cars than a two-car garage can hold.

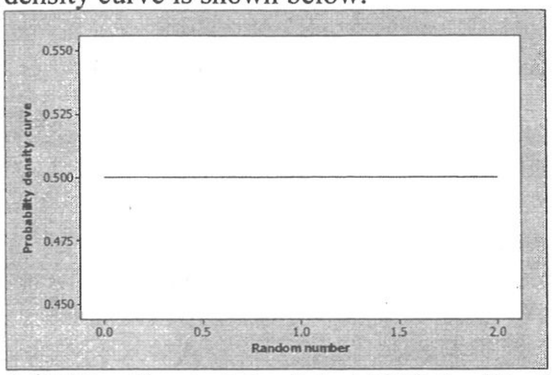
7.15 (a) All of the probabilities are between 0 and 1 and they add to 1. (b) 75.2% of fifth-graders eventually finished twelfth grade. (c) $P(X \geq 6) = 1 - 0.010 - 0.007 = 0.983$. Or $P(X \geq 6) =$

P(X=6) + P(X=7) + P(X=8) + P(X=9) + P(X=10) + P(X=11) + P(X=12) = 0.983. (d) P(X > 6) = 1 − 0.010 − 0.007 − 0.007 = 0.976. Or P(X > 6) = P(X=7) + P(X=8) + P(X=9) + P(X=10) + P(X=11) + P(X=12) = 0.976. (e) Either $X \geq 9$ or X > 8. The probability is $P(X \geq 9)$ = P(X=9) + P(X=10) + P(X=11) + P(X=12) = 0.068 + 0.070 + 0.041 + 0.752 = 0.931.

7.16 (a) Let S = {student supports funding} and O = {student opposes funding}. P(SSO) = 0.6×0.6×0.4 = 0.144. (b) The possible combinations are SSS, SSO, SOS, OSS, SOO, OSO, OOS, and OOO. P(SSS) = 0.6^3 = 0.216, P(SSO) = P(SOS) = P(OSS) = 0.6^2×0.4 = 0.144, P(SOO) = P(OSO) = P(OOS) = 0.6×0.4^2 = 0.096, and P(OOO) = 0.4^3 = 0.064. (c) The probability distribution of X is given in the table below. The probabilities are found by adding the probabilities from (b). For example, P(X = 1) = P(SSO or SOS or OSS) = 0.144 + 0.144 + 0.144 = 3×0.144 = 0.432. (d) The event "a majority of the advisory board opposes funding" can be written as $\{X \geq 2\}$ or {X > 1}. The probability of this event is $P(X \geq 2)$ = 0.288 + 0.064 = 0.352.

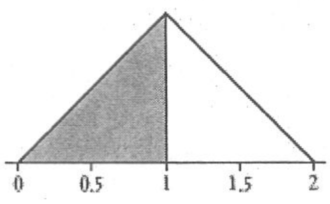
Value of X	0	1	2	3
Probability	0.216	0.432	0.288	0.064

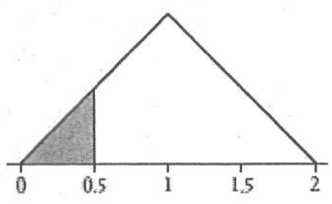
7.17 (a) The height should be 1/2 or 0.5 since the area under the curve must be 1. A graph of the density curve is shown below.



(b) $P(Y \leq 1)$ = 1×0.5 = 0.5. (c) P(0.5 < Y < 1.3) = 0.8×0.5 = 0.4. (d) $P(Y \geq 0.8)$ = 1.2×0.5 = 0.6.

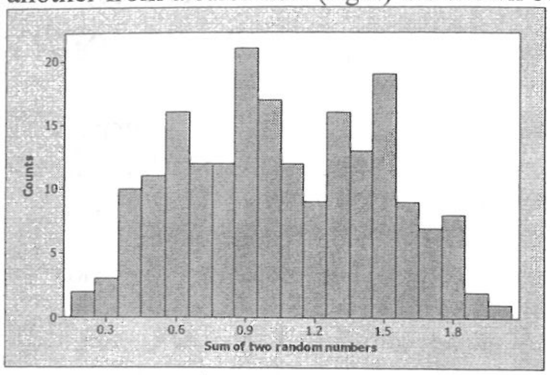
7.18 (a) The area of a triangle is $\frac{1}{2} \times b \times h$ = 0.5×2×1 = 1. (b) A sketch is shown below. P(Y < 1) = 0.5×1×1 = 0.5. (c) A sketch is shown below. P(Y < 0.5) = 0.5×0.5×0.5 = 0.125.

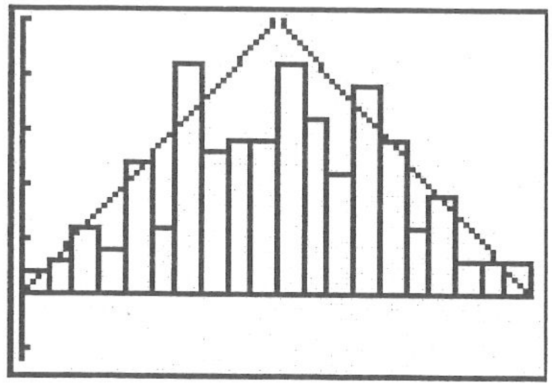




(d) Answers will vary. In one simulation 94 of the 200 sums were less than 1, and 20 of the 200 sums were less than 0.5. Thus, the relative frequencies are 0.47 and 0.1, respectively. These values are close to the theoretical values of 0.5 and 0.125 in parts (b) and (c).

7.19 Answers will vary. The resulting histogram should approximately resemble the triangular density curve of Figure 7.8, with any deviations or irregularities depending upon the specific random numbers generated. Two histograms, one example from computer software (left) and another from a calculator (right) are shown below.





7.20 (a) $P(\hat{p} \geq 0.16) = P\left(Z \geq \frac{0.16-0.15}{0.0092}\right) = P(Z \geq 1.09) = 1 - 0.8621 = 0.1379.$

(b) $P(0.14 \leq \hat{p} \leq 0.16) = P\left(\frac{0.14-0.15}{0.0092} \leq Z \leq \frac{0.16-0.15}{0.0092}\right) = P(-1.09 \leq Z \leq 1.09) = 0.8621 -$ $0.1379 = 0.7242.$

7.21 Answers will vary. One possibility is to simulate 500 observations from the N(0.15, 0.0092) distribution. The required TI-83 commands are as follows:

ClrList L_1
randNorm (0.15, 0.0092, 500) $\rightarrow L_1$
sortA(L_1)

Scrolling through the 500 simulated observations, we can determine the relative frequency of observations that are at least 0.16 by using the complement rule. For one simulation, there were 435 observations less than 0.16, thus the desired relative frequency is 1 − 435/500 = 65/500 = 0.13. The actual probability is $P(\hat{p} \geq 0.16) = 0.1379$. 500 observations yield a reasonably close approximation.

7.22 The table below shows the possible observations of Y that can occur when we roll one standard die and one "weird" die. As in Exercise 7.11, there are 36 possible pairs of faces; however, a number of the pairs are identical to each other.

		Standard Die					
		1	2	3	4	5	6
	0	1	2	3	4	5	6
	0	1	2	3	4	5	6
Weird	0	1	2	3	4	5	6
Die	6	7	8	9	10	11	12
	6	7	8	9	10	11	12
	6	7	8	9	10	11	12

The possible values of Y are 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, and 12. Each value of Y has probability 3/36 = 1/12.

7.23 The expected number of girls is $\mu_X = \sum x_i p_i = 0\left(\frac{1}{8}\right)+1\left(\frac{3}{8}\right)+2\left(\frac{3}{8}\right)+3\left(\frac{1}{8}\right)=1.5$ and the variance is $\sigma_X^2 = \sum (x_i - \mu_x)^2 p_i = (0-1.5)^2\left(\frac{1}{8}\right)+(1-1.5)^2\left(\frac{3}{8}\right)+(2-1.5)^2\left(\frac{3}{8}\right)+(3-1.5)^2\left(\frac{1}{8}\right)= 0.75$ so the standard deviation is $\sigma_X \doteq 0.866$ girls.

7.24 The mean grade is $\mu = 0\times0.01 + 1\times0.05 + 2\times0.30 + 3\times0.43 + 4\times0.21 = 2.78$.

7.25 The mean for owner-occupied units is μ= (1)(0.003) + (2)(0.002) + (3)(0.023) + (4)(0.104) + (5)(0.210) + (6)(0.224) + (7)(0.197) + (8)(0.149) + (9)(0.053) + (10)(0.035) = 6.284 rooms. The mean for renter-occupied units is μ = (1)(0.008) + (2)(0.027) + (3)(0.287) + (4)(0.363) + (5)(0.164) + (6)(0.093) + (7)(0.039) + (8)(0.013) + (9)(0.003) + (10)(0.003) = 4.187 rooms. The larger value of μ for owner-occupied units reflects the fact that the owner distribution was symmetric, rather than skewed to the right, as was the case with the renter distribution. The "center" of the owner distribution is roughly at the central peak class, 6, whereas the "center" of the renter distribution is roughly at the class 4. A comparison of the centers (6.284 > 4.187) matches the observation in Exercise 7.4 that the number of rooms for owner-occupied units tended to be higher than the number of rooms for renter-occupied units.

7.26 If your number is abc, then of the 1000 three-digit numbers, there are six—abc, acb, bac, bca, cab, cba—for which you will win the box. Therefore, you win nothing with probability 994/1000 = 0.994 and \$83.33 with probability 6/1000 = 0.006. The expected payoff on a \$1 bet is μ = \$0×0.994 + \$83.33×0.006 = \$0.50. Thus, in the long run, the Tri-State lottery commission will make \$0.50 per play of this lottery game.

7.27 (a) The payoff is either \$0, with a probability of 0.75, or \$3, with a probability of 0.25. (b) For each \$1 bet, the mean payoff is μ_X= (\$0)(0.75) + (\$3)(0.25) = \$0.75. (c) The casino makes 25 cents for every dollar bet (in the long run).

7.28 In Exercise 7.24, we computed the mean grade of μ = 2.78. Thus, the variance is $\sigma_X^2 = (0-2.78)^2(0.01)+(1-2.78)^2(0.05)+(2-2.78)^2(0.30)+(3-2.78)^2(0.43)+(4-2.78)^2(0.21) \doteq$ 0.7516 and the standard deviation is $\sigma_X \doteq 0.8669$.

7.29 The means are: $\mu_H = 1\times0.25 + 2\times0.32 + 3\times0.17 + 4\times0.15 + 5\times0.07 + 6\times0.03 + 7\times0.01 =$ 2.6 people for a household and $\mu_F = 1\times0 + 2\times0.42 + 3\times0.23 + 4\times0.21 + 5\times0.09 + 6\times0.03 +$ $7\times0.02 = 3.14$ people for a family. The standard deviations are: $\sigma_H^2 = (1-2.6)^2\times0.25 + (2-2.6)^2\times 0.32 + (3-2.6)^2\times0.17 + (4-2.6)^2\times0.15 + (5-2.6)^2\times0.07 + (6-2.6)^2\times0.03 + (7-2.6)^2\times0.01 = 2.02$, and $\sigma_H = \sqrt{2.02} \doteq 1.421$ people for a household and $\sigma_F^2 = (1-3.14)^2(0) + (2-3.14)^2(0.42) + (3-3.14)^2(0.23) + (4-3.14)^2(0.21) + (5-3.14)^2(0.09) + (6-3.14)^2(0.03) + (7-3.14)^2(0.02) \doteq 1.5604$, and $\sigma_F = \sqrt{1.5604} \doteq 1.249$ people for a family. The family distribution has a slightly larger mean than the household distribution, matching the observation in Exercise 7.12 that family sizes tend to be larger than household sizes. The standard deviation for households is only slightly larger, mainly due to the fact that a household can have only 1 person.

7.30 We would expect the owner distribution to have a slightly wider spread than the renter distribution. Even though the distribution of renter-occupied units is skewed to the right, it is more concentrated (contains less variability) about the "peak" than the symmetric distribution for owner-occupied units. Thus, the average distance between a value and the mean is slightly larger for owners. The variances and standard deviations are: $\sigma_O^2 = (1-6.284)^2\times 0.003 + (2-6.284)^2\times 0.002 + (3-6.284)^2\times 0.023 + (4-6.284)^2\times 0.104 + (5-6.284)^2\times 0.210 + (6-6.284)^2\times 0.224 + (7-6.284)^2\times 0.197 + (8-6.284)^2\times 0.149 + (9-6.284)^2\times 0.053 + (10-6.284)^2\times 0.035 \doteq 2.68934$ and $\sigma_O \doteq 1.6399$ rooms for owner-occupied units and $\sigma_R^2 = (1-4.187)^2\times 0.008 + (2-4.187)^2\times 0.027 + (3-4.187)^2\times 0.287 + (4-4.187)^2\times 0.363 + (5-4.187)^2\times 0.164 + (6-4.187)^2\times 0.093 + (7-4.187)^2\times 0.039 + (8-4.187)^2\times 0.013 + (9-4.187)^2\times 0.003 + (10-4.187)^2\times 0.003 \doteq 1.71003$ and $\sigma_R \doteq 1.3077$ rooms for renter-occupied units.

7.31 The graph for $X_{max} = 10$ displays visible variation for the first ten sample averages, whereas the graph for $X_{max} = 100$ gets closer and closer to $\mu = 64.5$ as the number of observations increases. This illustrates that as the sample size (represented by the integers in L_1) increases, the sample mean converges to (or gets closer to) the population mean $\mu = 64.5$. (In other words, this exercise illustrates the law of large numbers graphically.)

7.32 (a) The wheel is not affected by its past outcomes—it has no memory; outcomes are independent. So on any one spin, black and red remain equally likely. (b) The gambler is wrong again. Removing a card changes the composition of the remaining deck, so successive draws are not independent. If you hold 5 red cards, the deck now contains 5 fewer red cards, so your chance of another red decreases.

7.33 Below is the probability distribution for L, the length of the longest run of heads or tails. P(You win) = P(run of 1 or 2), so the expected outcome is $\mu = \$2\times 0.1738 + -\$1\times 0.8262 \doteq -\$0.4786$. On the average, you will lose about 48 cents each time you play. (Simulated results should be close to this exact result; how close depends on how many trials are used.)

Value of L	1	2	3	4	5	6	7	8	9	10
Probability	$\frac{1}{512}$	$\frac{88}{512}$	$\frac{185}{512}$	$\frac{127}{512}$	$\frac{63}{512}$	$\frac{28}{512}$	$\frac{12}{512}$	$\frac{5}{512}$	$\frac{2}{512}$	$\frac{1}{512}$

7.34 No, the TV commentator is incorrectly applying the law of large numbers to a small number of at bats for Tony Gwynn.

7.35 (a) The expected result of a single die is 3.5. The green mean of the applet does not agree with the expected sum. As the number of tosses increases, the mean fluctuates less and stabilizes close to the expected sum. This is called the Law of Large Numbers. (b) The expected result for two dice is 7. Again, the mean fluctuates and then stabilizes close to the expected sum. (c) The sample averages for 3, 4, and 5 dice converge to 10.5, 14, and 17.5, repectively. (d) The table is shown below.

Number of Dice	Expected sum
1	3.5
2	7
3	10.5
4	14
5	17.5

The greatest number of dice possible for this applet is 10 with an expected value of 35. The expected sum is 3.5×(the number of dice).

7.36 The relative frequencies obtained from invoices can be viewed as means. As more invoices are examined, the relative frequencies should converge to the probabilities specified by Benford. The Law of Large Numbers does not say anything about a small number of invoices, but the regularity in the relative frequencies will become apparent when a large number of invoices are examined.

7.37 (a) The probability distribution for the new random variable $a+bX$ is shown below.

$a+bX$	5	8	17
$P(a+bX)$	0.2	0.5	0.3

(b) The mean of the new variable is $\mu_{a+bX} = 5\times0.2 + 8\times0.5 + 17\times0.3 = 10.1$, and the variance is $\sigma^2_{a+bX} = (5-10.1)^2\times0.2 + (8-10.1)^2\times0.5 + (17-10.1)^2\times0.3 = 21.69$. (c) The mean of X is $\mu_X =$ 2.7. Using Rule 1 for means, the mean of the new variable is $\mu_{a+bX} = a + b\mu_X = 2 + 3\times2.7 = 10.1$, so the variance will stay the same as the calculation shown in part (b). (d) The variance of X is $\sigma^2_X = 2.41$, so Rule 1 for variances implies that the variance of the new variable is $\sigma^2_{a+bX} = b^2\sigma^2_X = 3^2\times2.41 = 21.69$. This is exactly the same as the variance we obtained in part (b), so var(2 + 3X) = $\sigma^2_{a+bx} = 9\,\mathrm{var}(X) = 21.69$. (e) Using the rules is much easier than using the definitions. The rules are quicker and enable users to avoiding tedious calculations where mistakes are easy to make.

7.38 (a) Independent: Weather conditions a year apart should be independent. (b) Not independent: Weather patterns tend to persist for several days; today's weather tells us something about tomorrow's. (c) Not independent: The two locations are very close together, and would likely have similar weather conditions.

7.39 (a) Dependent: since the cards are being drawn from the deck without replacement, the nature of the third card (and thus the value of Y) will depend upon the nature of the first two cards that were drawn (which determine the value of X). (b) Independent: X relates to the outcome of the first roll, Y to the outcome of the second roll, and individual dice rolls are independent (the dice have no memory).

7.40 The total mean is 40 + 5 + 25 = 70 minutes.

7.41 (a) The total mean is 11 + 20 = 31 seconds. (b) No, the mean time required for the entire operations is not changed by the decrease in the standard deviation. (c) The standard deviation for the total time to position and attach the part is $\sqrt{2^2+4^2} \doteq 4.4721$ seconds.

7.42 (a) The total resistance $T = R_1 + R_2$ is Normal with mean 100 + 250 = 350 ohms and standard deviation $\sqrt{2.5^2+2.8^2} \doteq 3.7537$ ohms. (b) The probability is $P(345 \le T \le 355) =$ $P\left(\frac{345-350}{3.7537} \le Z \le \frac{355-350}{3.7537}\right) = P(-1.332 \le Z \le 1.332) = 0.9086 - 0.0914 = 0.8172$ (Table A gives $0.9082 - 0.0918 = 0.8164$).

7.43 (a) The mean is $\mu_X = 0\times0.03 + 1\times0.16 + 2\times0.30 + 3\times0.23 + 4\times0.17 + 5\times0.11 = 2.68$ toys. The variances of X is $\sigma_X^2 = (0-2.68)^2\times0.03 + (1-2.68)^2\times0.16 + (2-2.68)^2\times0.30 + (3-2.68)^2\times0.23 + (4-2.68)^2\times0.17 + (5-2.68)^2\times0.11 \doteq 1.7176$, so the standard deviation is $\sigma_X = \sqrt{1.7176} \doteq 1.3106$ toys. (b) To simulate (say) 500 observations of X, using the T1-83, we will first simulate 500 random integers between 1 and 100 by using the command:

randInt(1,100,500) $\rightarrow L_1$

The command sortA(L_1) sorts these random observations in increasing order. We now identify 500 observations of X as follows: integers 1 to 3 correspond to X = 0, integers 4 to 19 correspond to X = 1, integers 20 to 49 correspond to X = 2, integers 50 to 72 correspond to X = 3, integers 73 to 89 correspond to X = 4, and integers 90 to 100 correspond to X = 5. For a sample run of the simulation, we obtained 12 observations of X = 0, 86 observations of X = 1, 155 observations of X = 2, 118 observations of X = 3, 75 observations of X = 4, and 54 observations of X = 5. These data yield a sample mean and standard deviation of $\bar{x} = 2.64$ toys and $s = 1.291$ toys, very close to μ_X and σ_X.

7.44 (a) Let X denote the value of the stock after two days. The possible combinations of gains and losses on two days are presented in the table below, together with the calculation of the corresponding values of X.

1st day	2nd day	Value of X
Gain 30%	Gain 30%	$1000 + 0.3\times1000 = 1300$
		$1300 + 0.3\times1300 = 1690$
Gain 30%	Lose 25%	$1000 + 0.3\times1000 = 1300$
		$1300 - 0.25\times1300 = 975$
Lose 25%	Gain 30%	$1000 - 0.25\times1000 = 750$
		$750 + 0.3\times750 = 975$
Lose 25%	Lose 25%	$1000 - 0.25\times1000 = 750$
		$750 - 0.25\times750 = 562.50$

Since the returns on the two days are independent and P(gain 30%) = P(lose 25%) = 0.5, the probability of each of these combinations is $0.5\times0.5 = 0.25$. The probability distribution of X is therefore

x	1690	975	562.5
P(X = x)	0.25	0.5	0.25

The probability that the stock is worth more than \$1000 is P(X = 1690) = 0.25. (b) The mean value of the stock after two days is $\mu_X = 1690\times0.25 + 975\times0.5 + 562.5\times0.25 = 1050.625$, or approximately \$1051.

7.45 (a) Randomly selected students would presumably be unrelated. (b) The mean of the difference $\mu_{F-M} = \mu_F - \mu_M = 120 - 105 = 15$ points. The variance of the difference is $\sigma^2_{F-M} = \sigma^2_F + \sigma^2_M = 28^2 + 35^2 = 2009$, so the standard deviation of the difference is $\sigma_{F-M} = \sqrt{2009} \doteq 44.8219$ points. (c) We cannot find the probability based on only the mean and standard deviation. Many different distributions have the same mean and standard deviation. Many students will assume normality and do the calculation, but we are not given any information about the distributions of the scores.

7.46 (a) The mean for the first die (X) is $\mu_X = 1\times1/6 + 3\times1/6 + 4\times1/6 + 5\times1/6 + 6\times1/6 + 8\times1/6 = 4.5$ spots. The mean for the second die (Y) is $\mu_Y = 1\times1/6 + 2\times1/6 + 2\times1/6 + 3\times1/6 + 3\times1/6 + 4\times1/6 = 2.5$ spots. (b) The table below gives the possible values of T = total sum of spots for the two dice. Each of the 36 possible outcomes has probability 1/36.

		Die #1					
		1	**3**	**4**	**5**	**6**	**8**
	1	2	4	5	6	7	9
	2	3	5	6	7	8	10
Die	**2**	3	5	6	7	8	10
#2	**3**	4	6	7	8	9	11
	3	4	6	7	8	9	11
	4	5	7	8	9	10	12

The probability distribution of T is

t	2	3	4	5	6	7	8	9	10	11	12
P(T=t)	1/36	2/36	3/36	4/36	5/36	6/36	5/36	4/36	3/36	2/36	1/36

(c) Using the distribution for (b), the mean is $\mu_T = 2\times1/36 + 3\times2/36 + 4\times3/36 + 5\times4/36 + 6\times5/36 + 7\times6/36 + 8\times5/36 + 9\times4/36 + 10\times3/36 + 11\times2/36 + 12\times1/36 = 7$ spots. Using properties of means (the mean of the sum is the sum of the means) from (a), $\mu_T = \mu_X + \mu_Y = 4.5 + 2.5 = 7$ spots.

7.47 (a) The mean temperature is $\mu_X = 550$°C. The variance is $\sigma^2_X = 32.5$, so the standard deviation is $\sigma_X = \sqrt{32.5} \doteq 5.7009$ °C. (b) The mean number of degrees off target is 550 − 550 = 0°C, and the standard deviation stays the same, 5.7009°C, because subtracting a constant does not change the variability. (c) In degrees Fahrenheit, the mean is $\mu_Y = \frac{9}{5}\mu_X + 32 = 1022$ °F and the standard deviation is $\sigma_Y = \sqrt{\left(\frac{9}{5}\right)^2 \sigma^2_x} = \left(\frac{9}{5}\right)\sigma_x \doteq 10.2616$ °F.

7.48 Read two-digit random numbers from Table B. Establish the correspondence 01 to 10 ⇒ 540°, 11 to 35 ⇒545°, 36 to 65 ⇒ 550°, 66 to 90 ⇒ 555°, and 91 to 99, 00 ⇒ 560°. Repeat many times, and record the corresponding temperatures. Average the temperatures to approximate μ_X; find the standard deviation of the temperatures to approximate σ_X. In one simulation with

200 repetitions, the sample mean of 550.03°C is very close to μ_X and the standard deviation of 5.46°C is slightly smaller than σ_X.

7.49 (a) Yes. The mean of a sum is always equal to the sum of the means. (b) No. The variance of the sum is not equal to the sum of the variances, because it is not reasonable to assume that X and Y are independent.

7.50 (a) The machine that makes the caps and the machine that applies the torque are not the same. (b) Let T denote the torque applied to a randomly selected cap and S denote the cap strength. T is N(7, 0.9) and S is N(10, 1.2), so T – S is Normal with mean 7 – 10 = –3 inch-pounds and standard deviation $\sqrt{0.9^2+1.2^2}=1.5$ inch-pounds. Thus, P(T > S) = P(T – S > 0) = P(Z > 2) = 0.0228.

7.51 (a) The variance of the number of trucks and SUVs is $\sigma_Y^2 = (0-0.7)^2\times0.4 + (1-0.7)^2\times0.5 + (2-0.7)^2\times0.1 = 0.41$ so $\sigma_Y = \sqrt{0.41} \doteq 0.6403$ vehicles. (b) The variance of total sales is $\sigma_{X+Y}^2 = \sigma_X^2 + \sigma_Y^2 = 0.89 + 0.41 = 1.3$, so the standard deviation of total sales is $\sigma_{X+Y} = \sqrt{1.3} \doteq 1.1402$ vehicles. (c) The variance of Linda's estimated earnings is $\sigma_{350X+400Y}^2 = 350^2\sigma_X^2 + 400^2\sigma_Y^2 = 350^2\times0.89 + 400^2\times0.41 = 174{,}625$, so the standard deviation is $\sigma_{350X+400Y} = \sqrt{174{,}625} \doteq \$417.88$.

7.52 Let L and F denote the respective scores of Leona and Fred. The difference L – F has a Normal distribution with mean μ_{L-F} = 24 – 24 = 0 points and standard deviation $\sigma_{L-F} = \sqrt{2^2+2^2} \doteq 2.8284$ points. The probability that the scores differ by more than 5 points is $P(|L-F|>5) = P\left(|Z| > \frac{5-0}{2.8284}\right) = P(|Z|>1.7678) \doteq 0.0771$ (Table A gives 0.0768).

CASE CLOSED!

1. The random variable X of interest is the possible score in the golf tournament.

2. Yes, all of the probabilities are between 0 and 1, and they sum to 1.

3. The expected score is $\mu_X = 210\times0.07 + 213\times0.16 + 216\times0.23 + 219\times0.24 + 222\times0.17 + 225\times0.09 + 228\times0.03 + 231\times0.01 = 218.16$ strokes.

4. The variance is $\sigma_X^2 = (210-218.16)^2\times0.07 + (213-218.16)^2\times0.16 + (216-218.16)^2\times0.23 + (219-218.16)^2\times0.24 + (222-218.16)^2\times0.17 + (225-218.16)^2\times0.09 + (228-218.16)^2\times0.03 + (231-218.16)^2\times0.01 \doteq 21.4344$ and the standard deviation is $\sigma_X = \sqrt{21.4344} \doteq 4.6297$ strokes.

5. To find the probability that Blaylock's score would be 218 or less, the probability that she would score exactly 218 needs to be approximated. Since the discrete distribution includes three

scores, 218, 219, and 220, at the value of 219, the probability provided will be divided by three. Thus, the approximate probability that Blaylock would score exactly 218 is 0.24/3 = 0.08. Thus, $P(X \le 218) = 0.07 + 0.16 + 0.23 + 0.08 = 0.54$. The probability that Blaylock's score would be no more than 220 is $P(X \le 220) = 0.07 + 0.16 + 0.23 + 0.24 = 0.70$. According to this probability distribution, $P(209 \le X \le 218) = P(X \le 218) = 0.54$.

7.53 Let V = vault, P = parallel bars, B = balance beam, and F = floor exercise. Carly's expected score is $\mu_{V+P+B+F} = \mu_V + \mu_P + \mu_B + \mu_F = 9.314 + 9.553 + 9.461 + 9.543 = 37.871$ points. The variance of her total score is $\sigma^2_{V+P+B+F} = \sigma^2_V + \sigma^2_P + \sigma^2_B + \sigma^2_F = 0.216^2 + 0.122^2 + 0.203^2 + 0.099^2 \doteq 0.1126$, so $\sigma_{V+P+B+F} = \sqrt{0.1126} \doteq 0.3355$ points. The distribution of Carly Patterson's total score T will be N(37.871, 0.3355). The probability that she will beat the score of 38.211 is $P(T > 38.211) = P\left(Z > \frac{38.211 - 37.871}{0.3355}\right) = P(Z > 1.0134) \doteq 0.1554$ (Table A gives 0.1562).

7.54 (a) The 16 possible outcomes are shown in the table below, with Ann's choice first and Bob's choice second.

(A, A)	(A, B)	(A, C)	(A, D)	(B, A)	(B, B)	(B, C)	(B, D)
0	2	−3	0	−2	0	0	3
(C, A)	(C, B)	(C, C)	(C, D)	(D, A)	(D, B)	(D, C)	(D, D)
3	0	0	−4	0	−3	4	0

(b) The values of X, Ann's winnings on a play, are listed below each possible outcome above.
(c) The probability distribution of X is shown below.

x	−4	−3	−2	0	2	3	4
P(X = x)	1/16	2/16	1/16	8/16	1/16	2/16	1/16

(d) The mean winnings is μ_X = \$0, because the distribution is symmetric about 0. Thus, the game is fair. The variance is $\sigma^2_X = (-4)^2 \times 1/16 + (-3)^2 \times 2/16 + (-2)^2 \times 1/16 + 0^2 \times 8/16 + 2^2 \times 1/16 + 3^2 \times 2/16 + 4^2 \times 1/16 = 4.75$, so the standard deviation of the winnings is $\sigma_X = \sqrt{4.75} \doteq \$2.18$.

7.55 The missing probability is 0.99058 (so that the sum is 1). The mean earnings is $\mu_X \doteq \$303.35$.

7.56 The mean μ_X of the company's "winnings" (premiums) and their "losses" (insurance claims) is about \$303.35. Even though the company will lose a large amount of money on a small number of policyholders who die, it will gain a small amount from many thousands of 21-year-old men. In the long run, the insurance company can expect to make \$303.35 per insurance policy. The insurance company is relying on the Law of Large Numbers.

7.57 The variance is $\sigma^2_X = 94{,}236{,}826.64$, so the standard deviation is $\sigma_X = \$9707.57$.

7.58 (a) Using properties of means, the mean of Z is $\mu_Z = 0.5\mu_X + 0.5\mu_Y = 0.5 \times \$303.35 + 0.5 \times \$303.35 = \$303.35$. Using properties of variances, the variance of Z is