Chapter 7

7.1 a 0, 1, 2, …

b Yes, we can identify the first value (0), the second (1), and so on.

c It is finite, because the number of cars is finite.

d The variable is discrete because it is countable.

7.2 a any value between 0 and several hundred miles

b No, because we cannot identify the second value or any other value larger than 0.

c No, uncountable means infinite.

d The variable is continuous.

7.3 a The values in cents are 0 ,1 ,2, …

b Yes, because we can identify the first ,second, etc.

c Yes, it is finite because students cannot earn an infinite amount of money.

d Technically, the variable is discrete.

7.4 a 0, 1, 2, …, 100

b Yes.

c Yes, there are 101 values.

d The variable is discrete because it is countable.

7.5 a No the sum of probabilities is not equal to 1.

b Yes, because the probabilities lie between 0 and 1 and sum to 1.

c No, because the probabilities do not sum to 1.

7.6 P(x) = 1/6 for x = 1, 2, 3, 4, 5, and 6

7.7 a

x	P(x)
0	24,750/165,000 = .15
1	37,950/165,000 = .23
2	59,400/165,000 = .36
3	29,700/165,000 = .18
4	9,900/165,000 = .06
5	3,300/165,000 = .02

b (i) $P(X \le 2) = P(0) + P(1) + P(2) = .15 + .23 + .36 = .74$

(ii) $P(X > 2) = P(3) + P(4) + P(5) = .18 + .06 + .02 = .26$

(iii) $P(X \ge 4) = P(4) + P(5) = .06 + .02 = .08$

7.8 a $P(2 \le X \le 5) = P(2) + P(3) + P(4) + P(5) = .310 + .340 + .220 + .080 = .950$

$P(X > 5) = P(6) + P(7) = .019 + .001 = .020$

$P(X < 4) = P(0) + P(1) + P(2) + P(3) = .005 + .025 + .310 + .340 = .680$

b. b. $E(X) = \sum xP(x) = 0(.005) + 1(.025) + 2(.310) + 4(.340) +5(.080) + 6(.019) + 7(.001) = 3.066$

c. $\sigma^2 = V(X) = \sum (x-\mu)^2 P(x) = (0–3.066)^2 (.005) + (1–3.066)^2 (.025) + (2–3.066)^2 (.310)$

$+ (3–3.066)^2 (.340) + (4–3.066)^2 (.220) + (5–3.066)^2 (.080) + (6–3.066)^2 (.019)$

$+ (7–3.066)^2 (.001) = 1.178$

$\sigma = \sqrt{\sigma^2} = \sqrt{1.178} = 1.085$

7.9 $P(0) = P(1) = P(2) = . . . = P(10) = 1/11 = .091$

7.10 a $P(X > 0) = P(2) + P(6) + P(8) = .3 + .4 + .1 = .8$

b $P(X \ge 1) = P(2) + P(6) + P(8) = .3 + .4 + .1 = .8$

c $P(X \ge 2) = P(2) + P(6) + P(8) = .3 + .4 + .1 = .8$

d $P(2 \le X \le 5) = P(2) = .3$

7.11a $P(3 \le X \le 6) = P(3) + P(4) + P(5) + P(6) = .04 + .28+ .42 + .21 = .95$

b. $P(X > 6) = P(X \ge 7) = P(7) + P(8) = .02 + .02 = .04$

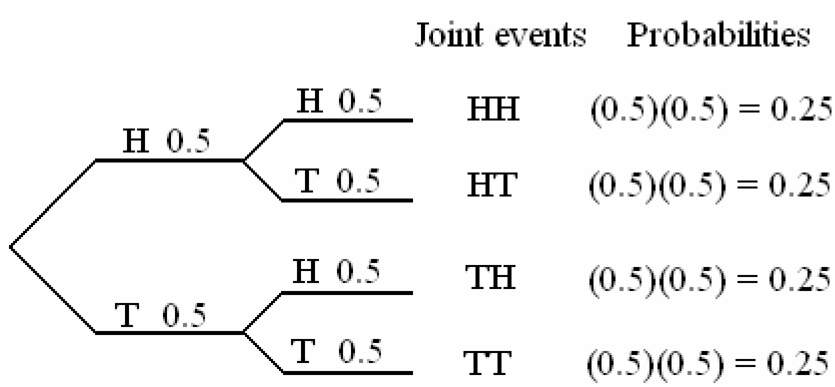
c. $P(X < 3) = P(X \le 2) = P(0) + P(1) + P(2) = 0 + 0 + .01 = .01$

7.12 P(Losing 6 in a row) = $.5^6 = .0156$

7.13 a $P(X < 2) = P(0) + P(1) = .05 + .43 = .48$

b $P(X > 1) = P(2) + P(3) = .31 + .21 = .52$

7.14



a $P(HH) = .25$

b $P(HT) = .25$

c $P(TH) = .25$

d $P(TT) = .25$

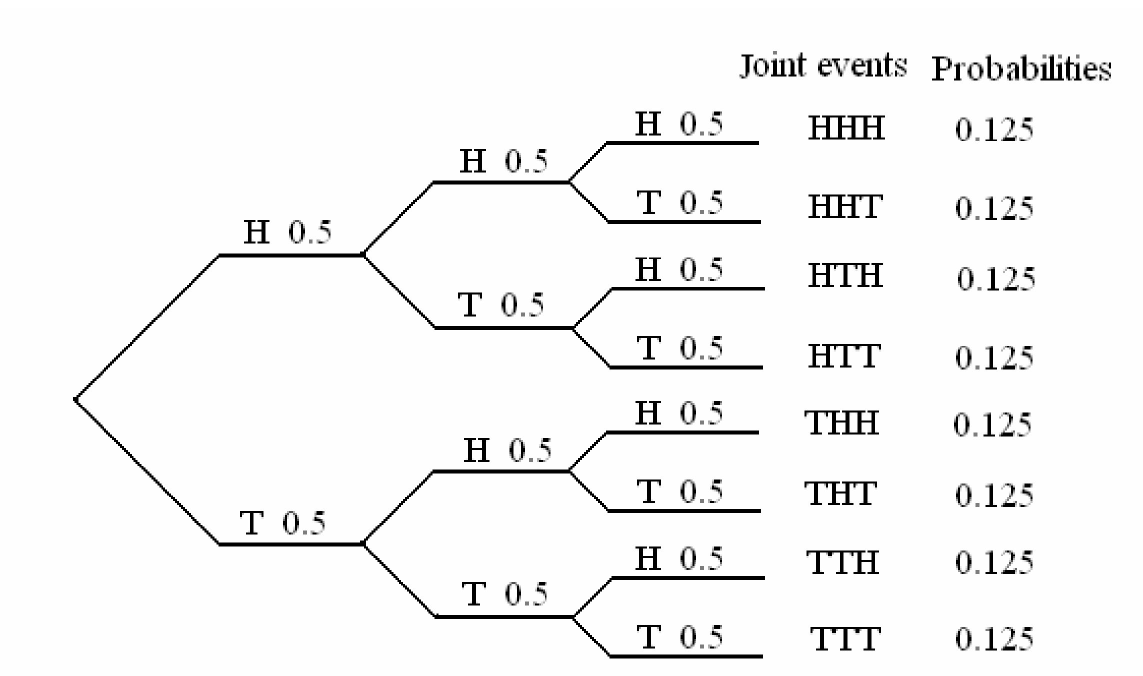
7.15 a $P(0 \text{ heads}) = P(TT) = .25$

b $P(1 \text{ head}) = P(HT) + P(TH) = .25 + .25 = .50$

c $P(2 \text{ heads}) = P(HH) = .25$

d $P(\text{at least } 1 \text{ head}) = P(1 \text{ head}) + P(2 \text{ heads}) = .50 + .25 = .75$

7.16



7.17 a $P(2 \text{ heads}) = P(HHT) + P(HTH) + P(THH) = .125 + .125 + .125 = .375$

b $P(1 \text{ heads}) = P(HTT) + P(THT) = P(TTH) = .125 + .125 + .125 = .375$

c $P(\text{at least } 1 \text{ head}) = P(1 \text{ head}) + P(2 \text{ heads}) + P(3 \text{ heads}) = .375 + .375 + .125 = .875$

d $P(\text{at least } 2 \text{ heads}) = P(2 \text{ heads}) + P(3 \text{ heads}) = .375 + .125 = .500$

7.18a. $\mu = E(X) = \sum xP(x) = -2(.59) + 5(.15) + 7(.25) + 8(.01) = 1.40$

$$\sigma^2 = V(X) = \sum (x - \mu)^2 P(x) = (-2-1.4)^2 (.59) + (5-1.4)^2 (.15) + (7-1.4)^2 (.25) + (8-1.4)^2 (.01)$$

$$= 17.04$$

b.

x	–2	5	7	8
y	–10	25	35	40
P(y)	.59	.15	.25	.01

c. $E(Y) = \sum yP(y) = -10(.59) + 25(.15) + 35(.25) + 40(.01) = 7.00$

$V(Y) = \sum (y-\mu)^2 P(y) = (-10-7.00)^2(.59) + (25-7.00)^2(.15) + (35-7.00)^2(.25)$

$+ (40-7.00)^2(.01) = 426.00$

d. $E(Y) = E(5X) = 5E(X) = 5(1.4) = 7.00$

$V(Y) = V(5X) = 5^2 V(X) = 25(17.04) = 426.00$.

7.19a $\mu = E(X) = \sum xP(x) = 0(.4) + 1(.3) + 2(.2) + 3(.1) = 1.0$

$\sigma^2 = V(X) = \sum (x-\mu)^2 P(x) = (0-1.0)^2(.4) + (1-1.0)^2(.3) + (2-1.0)^2(.2) + (3-1.0)^2(.1)$

$= 1.0$

$\sigma = \sqrt{\sigma^2} = \sqrt{1.0} = 1.0$

b.

x	0	1	2	3
y	2	5	8	11
P(y)	.4	.3	.2	.1

c. $E(Y) = \sum yP(y) = 2(.4) + 5(.3) + 8(.2) + 11(.1) = 5.0$

$\sigma^2 = V(Y) = \sum (y-\mu)^2 P(y) = (2-5)^2(.4) + (5-5)^2(.3) + (8-5)^2(.2) + (11-5)^2(.1) = 9.0$

$\sigma = \sqrt{\sigma^2} = \sqrt{9.0} = 3.0$

d. $E(Y) = E(3X + 2) = 3E(X) + 2 = 3(1) + 2 = 5.0$

$\sigma^2 = V(Y) = V(3X + 2) = V(3X) = 3^2 V(X) = 9(1) = 9.0$.

$\sigma = \sqrt{\sigma^2} = \sqrt{9.0} = 3.0$

The parameters are identical.

7.20a. $P(X \geq 2) = P(2) + P(3) = .4 + .2 = .6$

b. $\mu = E(X) = \sum xP(x) = 0(.1) + 1(.3) + 2(.4) + 3(.2) = 1.7$

$\sigma^2 = V(X) = \sum (x-\mu)^2 P(x) = (0-1.7)^2(.1) + (1-1.7)^2(.3) + (2-1.7)^2(.4) + (3-1.7)^2(.2) = .81$

7.21 E(Profit) = E(5X) = 3E(X) = 3(1.7) = 5.1

$V(\text{Profit}) = V(3X) = 3^2 V(X) = 9(.81) = 7.29$

7.22 a $P(X > 4) = P(5) + P(6) + P(7) = .20 + .10 + .10 = .40$

b $P(X \geq 2) = 1 - P(X \leq 1) = 1 - P(1) = 1 - .05 = .95$

7.23 $\mu = E(X) = \sum xP(x) = 1(.05) + 2(.15) + 3(.15) + 4(.25) + 5(.20) + 6(.10) + 7(.10) = 4.1$

$\sigma^2 = V(X) = \sum (x-\mu)^2 P(x) = (1–4.1)^2(.05) + (2–4.1)^2(.15) + (3–4.1)^2(.15) + (4–4.1)^2(.25)$

$+ (5–4.1)^2(.20) + (6–4.1)^2(.10) + (7–4.1)^2(.10) = 2.69$

7.24 $Y = .25X$; $E(Y) = .25E(X) = .25(4.1) = 1.025$

$V(Y) = V(.25X) = (.25)^2(2.69) = .168$

7.25 a.

x	1	2	3	4	5	6	7
y	.25	.50	.75	1.00	1.25	1.50	1.75
P(y)	.05	.15	.15	.25	.20	.10	.10

b. $E(Y) = \sum yP(y) = .25(.05) + .50(.15) + .75(.15) +1.00(.25) + 1.25(.20) + 1.50(.10) + 1.75(.10)$

$= 1.025$

$V(Y) = \sum (y-\mu)^2 P(y) = (.25–1.025)^2(.05) + (.50–1.025)^2(.15) + (.75–1.025)^2(.15)$

$+ (1.00–1.025)^2(.25) + (1.25–1.025)^2(.20) + (1.50–1.025)^2(.10) + (1.75–1.1025)^2(.10) = .168$

c. The answers are identical.

7.26 a $P(4) = .06$

b $P(8) = 0$

c $P(0) = .35$

d $P(X \geq 1) = 1 - P(0) = 1 - .35 = .65$

7.27 a $P(X \geq 20) = P(20) + P(25) + P(30) + P(40) + P(50) + P(75) + P(100)$

$= .08 + .05 + .04 + .04 + .03 + .03 + .01 = .28$

b $P(X = 60) = 0$

c $P(X > 50) = P(75) + P(100) = .03 + .01 = .04$

d $P(X > 100) = 0$

7.28 a $P(X = 3) = P(3) = .21$

b $P(X \geq 5) = P(5) + P(6) + P(7) + P(8) = .12 + .08 + .06 + .05 = .31$

c $P(5 \leq X \leq 7) = P(5) + P(6) + P(7) = .12 + .08 + .06 = .26$

7.29 a $P(X > 1) = P(2) + P(3) + P(4) = .17 + .06 + .01 = .24$

b $P(X = 0) = .45$

c $P(1 \le X \le 3) = P(1) + P(2) + P(3) = .31 + .17 + .06 = .54$

7.30 $\mu = E(X) = \sum xP(x) = 0(.04) + 1(.19) + 2(.22) + 3(.28) + 4(.12) + 5(.09) + 6(.06) = 2.76$

$\sigma^2 = V(X) = \sum (x-\mu)^2 P(x) = (1–2.76)^2(.04) + (2–2.76)^2(.19) + (3–2.76)^2(.28)$

$+ (4–2.76)^2(.12) + (5–2.76)^2(.09) + (6–2.76)^2(.06) = 2.302$

$\sigma = \sqrt{\sigma^2} = \sqrt{2.302} = 1.517$

7.31 $Y = 10X$; $E(Y) = E(10X) = 10E(X) = 10(2.76) = 27.6$

$V(Y) = V(10X) = 10^2 V(X) = 100(2.302) = 230.2$

$\sigma = \sqrt{\sigma^2} = \sqrt{230.2} = 15.17$

7.32 $\mu = E(X) = \sum xP(x) = 1(.24) + 2(.18) + 3(.13) + 4(.10) + 5(.07) + 6(.04) + 7(.04) + 8(.20) = 3.86$

$\sigma^2 = V(X) = \sum (x-\mu)^2 P(x) = (1–3.86)^2(.24) + (2–3.86)^2(.18) + (3–3.86)^2(.13) + (4–3.86)^2(.10)$

$+ (5–3.86)^2(.07) + (6–3.86)^2(.04) + (7–3.86)^2(.04) + (8–3.86)^2(.20) = 6.78$

$\sigma = \sqrt{\sigma^2} = \sqrt{6.78} = 2.60$

7.33 Revenue = 2.50X; E(Revenue) = E(2.50X) = 2.50E(X) = 2.50(3.86) = 9.65

V(Revenue) = V(2.50X) = 2.50^2 (V(X) = 6.25(6.78) = 42.38

$\sigma = \sqrt{\sigma^2} = \sqrt{42.38} = 6.51$

7.34 E(Value of coin) = 400(.40) + 900(.30) + 100(.30) = 460. Take the $500.

7.35 $\mu = E(X) = \sum xP(x) = 0(.10) + 1(.20) + 2(.25) + 3(.25) + 4(.20) = 2.25$

$\sigma^2 = V(X) = \sum (x-\mu)^2 P(x) = (0–2.25)^2(.10) + (1–2.25)^2(.20) + (2–2.25)^2(.25) + (3–2.25)^2(.13)$

$+ (4–2.25)^2(.20) = 1.59$

$\sigma = \sqrt{\sigma^2} = \sqrt{1.59} = 1.26$

7.36 E(damage costs) = .01(400) + .02(200) + .10(100) + .87(0) = 18. The owner should pay up to $18 for the device.

7.37 $E(X) = \sum xP(x) = 1{,}000{,}000(1/10{,}000{,}000) + 200{,}000(1/1{,}000{,}000) + 50{,}000(1/500{,}000)$

$+ 10{,}000(1/50{,}000) + 1{,}000(1/10{,}000) = .1 + .2 + .1 + .2 + .1 = .7$

Expected payoff = 70 cents.

7.38 $\mu = E(X) = \sum xP(x) = 1(.05) + 2(.12) + 3(.20) + 4(.30) + 5(.15) + 6(.10) + 7\,(.08) = 4.00$

$\sigma^2 = V(X) = \sum (x-\mu)^2 P(x) = (1–4.0)^2\,(.05) + (2–4.0)^2\,(.12) + (3–4.0)^2\,(.20) + (4–4.0)^2\,(.30)$

$+ (5–4.0)^2\,(.15) + (6–4.0)^2\,(.10) + (7–4.0)^2\,(.08) = 2.40$

7.39 $Y = .25X$; $E(Y) = E(.25X) = .25E(X) = .25(4.0) = 1.0$

$V(Y) = V(.25X) = (.25)^2\,V(X) = .0625(2.40) = .15$

7.40 $\mu = E(X) = \sum xP(x) = 0(.10) + 1(.25) + 2(.40) + 3(.20) + 4(.05) = 1.85$

7.41 Profit = 4X; Expected profit = E(4X) = 4E(X) = 4(1.85) = \$7.40

7.42 Breakeven point = 15,000/(7.40 – 3.00) = 3,409

7.43 a

x	P(x)
1	.6
2	.4

b

y	P(y)
1	.6
2	.4

c $\mu = E(X) = \sum xP(x) = 1(.6) + 2(.4) = 1.4$

$\sigma^2 = V(X) = \sum (x-\mu)^2 P(x) = (1–1.4)^2\,(.6) + (2–1.4)^2\,(.4) = .24$

d $\mu = 1.4$, $\sigma^2 = .24$

7.44 a $\sum_{\text{all } x} \sum_{\text{all } y} xyP(x, y) = (1)(1)(.5) + (1)(2)(.1) + (2)(1)(.1) + (2)(2)(.3) = 2.1$

$COV(X, Y) = \sum_{\text{all } x} \sum_{\text{all } y} xyP(x, y) - \mu_x\mu_y = 2.1 – (1.4)(1.4) = .14$

$\sigma_x = \sqrt{\sigma_x^2} = \sqrt{.24} = .49,\ \sigma_y = \sqrt{\sigma_y^2} = \sqrt{.24} = .49$

$$\rho = \frac{COV(X,Y)}{\sigma_x \sigma_y} = \frac{.14}{(.49)(.49)} = .58$$

7.45 E(X + Y) = E(X) + E(Y) = 1.4 + 1.4 = 2.8

V(X + Y) = V(X) + V(Y) + 2COV(X, Y) = .24 + .24 + 2(.14) = .76

7.46 a

x + y	P(x + y)
2	.5
3	.2
4	.3

b $\mu_{x+y} = E(X+Y) = \sum (x+y)P(x+y) = 2(.5) + 3(.2) + 4(.3) = 2.8$

$\sigma^2_{x+y} = V(X+Y) = \sum [(x+y) - \mu_{x+y}]^2 P(x+y) = (2–2.8)^2(.5) + (3–2.8)^2(.2) + (4–2.8)^2(.3) = .76$

c Yes

7.47 a

x	P(x)
1	.4
2	.6

b

y	P(y)
1	.7
2	.3

c $\mu = E(X) = \sum xP(x) = 1(.4) + 2(.6) = 1.6$

$\sigma^2 = V(X) = \sum (x - \mu)^2 P(x) = (1–1.6)^2(.4) + (2–1.6)^2(.6) = .24$

d $\mu = E(Y) = \sum yP(y) = 1(.7) + 2(.3) = 1.3$

$\sigma^2 = V(Y) = \sum (y - \mu)^2 P(y) = (1–1.3)^2(.7) + (2–1.3)^2(.3) = .21$

7.48 a $\sum_{\text{all } x} \sum_{\text{all } y} xyP(x,y) = (1)(1)(.28) + (1)(2)(.12) + (2)(1)(.42) + (2)(2)(.18) = 2.08$

$COV(X, Y) = \sum_{\text{all } x} \sum_{\text{all } y} xyP(x,y) - \mu_x\mu_y = 2.08 – (1.6)(1.3) = 0$

$\sigma_x = \sqrt{\sigma_x^2} = \sqrt{.24} = .49,\ \sigma_y = \sqrt{\sigma_y^2} = \sqrt{.21} = .46$

$$\rho = \frac{COV(X,Y)}{\sigma_x \sigma_y} = \frac{0}{(.49)(.46)} = 0$$

7.49 E(X + Y) = E(X) + E(Y) = 1.6 + 1.3 = 2.9

V(X + Y) = V(X) + V(Y) + 2COV(X, Y) = .24 + .21 + 2(0) = .45

7.50 a

x + y	P(x + y)
2	.28
3	.54
4	.18

b μ_{x+y} = E(X+Y) = $\sum (x+y)P(x+y)$ = 2(.28) + 3(.54) + 4(.18) = 2.9

σ^2_{x+y} = V(X+Y) = $\sum [(x+y)-\mu_{x+y}]^2 P(x+y)$ = $(2–2.9)^2$ (.28) + $(3–2.9)^2$ (.54) + $(4–2.9)^2$ (.18) = .45

c Yes

7.51 a

x	P(x)
1	.7
2	.2
3	.1

y	P(y)
1	.6
2	.4

b μ_x = E(X) = $\sum xP(x)$ = 1(.7) + 2(.2) + 3(.1) = 1.4

σ^2 = V(X) = $\sum (x-\mu)^2 P(x)$ = $(1–1.4)^2$ (.7) + $(2–1.4)^2$ (.2) + $(3–1.4)^2$ (.1) = .44

μ_y = E(Y) = $\sum yP(y)$ = 1(.6) + 2(.4) = 1.4

σ^2 = V(Y) = $\sum (y-\mu)^2 P(y)$ = $(1–1.4)^2$ (.6) + $(2–1.4)^2$ (.4) = .24

$\sum_{\text{all x}} \sum_{\text{all y}} xyP(x,y)$ = (1)(1)(.42) + (1)(2)(.28) + (2)(1)(.12) + (2)(2)(.08) + (3)(1)(.06) + (3)(2)(.04) = 1.96

COV(X, Y) = $\sum_{\text{all x}} \sum_{\text{all y}} xyP(x,y) - \mu_x\mu_y$ = 1.94 – (1.4)(1.4) = 0

$\sigma_x = \sqrt{\sigma_x^2} = \sqrt{.44}$ = .66, $\sigma_y = \sqrt{\sigma_y^2} = \sqrt{.24}$ = .49

$$\rho = \frac{COV(X,Y)}{\sigma_x \sigma_y} = \frac{0}{(.66)(.49)} = 0$$

c

x + y	P(x + y)
2	.42
3	.40
4	.14
5	.04

7.52

y	x = 0	1	2
1	.42	.21	.07
2	.18	.09	.03

7.53

y	x = 0	1
1	.04	.16
2	.08	.32
3	.08	.32

7.54 a

Refrigerators, x	P(x)
0	.22
1	.49
2	.29

b

Stoves, y	P(y)
0	.34
1	.39
2	.27

c $\mu_x = E(X) = \sum xP(x) = 0(.22) + 1(.49) + 2(.29) = 1.07$

$\sigma^2 = V(X) = \sum (x-\mu)^2 P(x) = (0–1.07)^2(.22) + (1–1.07)^2(.49) + (2–1.07)^2(.29) = .505$

d $\mu_y = E(Y) = \sum yP(y) = 0(.34) + 1(.39) + 2(.27) = .93$

$\sigma^2 = V(Y) = \sum (y-\mu)^2 P(y) = (0–.93)^2(.34) + (1–.93)^2(.39) + (2–.93)^2(.27) = .605$

e $\sum_{\text{all x}} \sum_{\text{all y}} xyP(x, y) = (0)(0)(.08) + (0)(1)(.09) + (0)(2)(.05) + (1)(0)(.14) + (1)(1)(.17)$

$+ (1)(2)(.18) + (2)(0)(.12) + (2)(1)(.13) + (2)(2)(.04) = .95$

$COV(X, Y) = \sum_{\text{all x}} \sum_{\text{all y}} xyP(x, y) - \mu_x\mu_y = .95 - (1.07)(.93) = -.045$

$\sigma_x = \sqrt{\sigma_x^2} = \sqrt{.505} = .711,\ \sigma_y = \sqrt{\sigma_y^2} = \sqrt{.605} = .778$

$$\rho = \frac{COV(X, Y)}{\sigma_x\sigma_y} = \frac{-.045}{(.711)(.778)} = -.081$$

7.55 a

Bottles, x	P(x)
0	.72
1	.28

b

Cartons, y	P(y)
0	.81
1	.19

c $\mu_x = E(X) = \sum xP(x) = 0(.72) + 1(.28) = .28$

$\sigma^2 = V(X) = \sum (x-\mu)^2 P(x) = (0-.28)^2(.72) + (1-.28)^2(.28) = .202$

d $\mu_y = E(Y) = \sum yP(y) = 0(.81) + 1(.19) = .19$

$\sigma^2 = V(Y) = \sum (y-\mu)^2 P(y) = (0-.19)^2(.81) + (1-.19)^2(.19) = .154$

e $\sum_{\text{all } x} \sum_{\text{all } y} xyP(x, y) = (0)(0)(.63) + (0)(1)(.09) + (1)(0)(.18) + (1)(1)(.10) = .100$

$COV(X, Y) = \sum_{\text{all\_x}} \sum_{\text{all\_y}} xyP(x, y) - \mu_x\mu_y = .100 - (.28)(.19) = .0468$

$\sigma_x = \sqrt{\sigma_x^2} = \sqrt{.202} = .449,\ \sigma_y = \sqrt{\sigma_y^2} = \sqrt{.154} = .392$

$\rho = \dfrac{COV(X,Y)}{\sigma_x\sigma_y} = \dfrac{.0468}{(.449)(.392)} = .266$

7.56 a P(X = 1 | Y = 0) = P(X =1 and Y = 0)/P(Y = 0) = .14/.34 = .412

b P(Y = 0 | X = 1) = P(X =1 and Y = 0)/P(X = 1) = .14/.49 = .286

c P(X = 2 | Y = 2) = P(X =2 and Y = 2)/P(Y = 2) = .04/.27 = .148

7.57 $E\left(\sum X_i\right) = \sum E(X_i) = 18 + 12 + 27 + 8 = 65$

$V\left(\sum X_i\right) = \sum V(X_i) = 8 + 5 + 6 + 2 = 21$

7.58 $E\left(\sum X_i\right) = \sum E(X_i) = 35 + 20 + 20 + 50 + 20 = 145$

$V\left(\sum X_i\right) = \sum V(X_i) = 8 + 5 + 4 + 12 + 2 = 31$

$\sigma = \sqrt{31} = 5.57$

7.59 $E\left(\sum X_i\right) = \sum E(X_i) = 8 + 14 + 5 + 3 + 30 + 30 + 10 = 100$

$V\left(\sum X_i\right) = \sum V(X_i) = 2 + 5 + 1 + 1 + 8 + 10 + 3 = 30$

7.60 $E\left(\sum X_i\right) = \sum E(X_i) = 10 + 3 + 30 + 5 + 100 + 20 = 168$

$V\left(\sum X_i\right) = \sum V(X_i) = 9 + 0 + 100 + 1 + 400 + 64 = 574$

$\sigma = \sqrt{574} = 24.0$

7.61 The expected value does not change. The standard deviation decreases.

7.62 $E(R_p) = w_1E(R_1) + w_2E(R_2) = (.30)(.12) + (.70)(.25) = .2110$

a. $V(R_p) = w_1^2\,\sigma_1^2 + w_2^2\,\sigma_2^2 + 2\,w_1\,w_2\,\rho\,\sigma_1\,\sigma_2$

$= (.30)^2(.02)^2 + (.70)^2(.15^2) + 2(.30)(.70)(.5)(.02)(.15) = .0117$

$\sigma_{R_p} = \sqrt{.0117} = .1081$

b. $V(R_p) = w_1^2\,\sigma_1^2 + w_2^2\,\sigma_2^2 + 2\,w_1\,w_2\,\rho\,\sigma_1\,\sigma_2$

$= (.30)^2(.02)^2 + (.70)^2(.15^2) + 2(.30)(.70)(.2)(.02)(.15) = .0113$

$\sigma_{R_p} = \sqrt{.0113} = .1064$

c. $V(R_p) = w_1^2\,\sigma_1^2 + w_2^2\,\sigma_2^2 + 2\,w_1\,w_2\,\rho\,\sigma_1\,\sigma_2$

$= (.30)^2(.02)^2 + (.70)^2(.15^2) + 2(.30)(.70)(0)(.02)(.15) = .0111$

$\sigma_{R_p} = \sqrt{.0111} = .1052$

7.63 a She should choose stock 2 because its expected value is higher.

b. She should choose stock 1 because its standard deviation is smaller.

7.64 $E(R_p) = w_1E(R_1) + w_2E(R_2) = (.60)(.09) + (.40)(.13) = .1060$

$V(R_p) = w_1^2\,\sigma_1^2 + w_2^2\,\sigma_2^2 + 2\,w_1\,w_2\,\rho\,\sigma_1\,\sigma_2$

$= (.60)^2(.15)^2 + (.40)^2(.21^2) + 2(.60)(.40)(.4)(.15)(.21) = .0212$

$\sigma_{R_p} = \sqrt{.0212} = .1456$

7.65 $E(R_p) = w_1E(R_1) + w_2E(R_2) = (.30)(.09) + (.70)(.13) = .1180$

$V(R_p) = w_1^2\,\sigma_1^2 + w_2^2\,\sigma_2^2 + 2\,w_1\,w_2\,\rho\,\sigma_1\,\sigma_2$

$= (.30)^2(.15)^2 + (.70)^2(.21^2) + 2(.30)(.70)(.4)(.15)(.21) = .0289$

$\sigma_{R_p} = \sqrt{.0289} = .1700$

The statistics used in Exercises 7.66 to 7.78 were computed by Excel. The variances were taken from the variance-covariance matrix. As a result they are the population parameters. To convert to statistics multiply the variance of the portfolio returns by n/(n–1).

7.66 a

Stock	Mean	Variance
Coca-Cola	−.00022	.00261
Genentech	.01658	.01533
General Electric	.00031	.00354
General Motors	.00234	.01117
McDonalds	.00791	.00549
Motorola	.00800	.01042

b

	A	B	C	D	E	F	G
1		*Coca Cola*	*Genentech*	*GE*	*GM*	*McDonalds*	*Motorola*
2	Coca Cola	0.00257					
3	Genentech	0.00199	0.01511				
4	GE	0.00014	0.00150	0.00349			
5	GM	0.00133	0.00018	0.00108	0.01102		
6	McDonalds	0.00145	0.00129	0.00153	0.00199	0.00541	
7	Motorola	0.00165	0.00201	0.00093	0.00413	0.00251	0.01028

7.67The stocks with the largest mean returns are Genentech (mean = .01658) and Motorola (mean = .00800)

	A	B	C	D
1	**Portfolio of 2 Stocks**			
2			**Genentech**	**Motorola**
3	**Variance-Covariance Matrix**	**Genentech**	0.01511	
4		**Motorola**	0.00201	0.01028
5				
6	**Expected Returns**		0.01658	0.00800
7				
8	**Weights**		0.50000	0.50000
9				
10	**Portfolio Return**			
11	**Expected Value**	**0.01229**		
12	**Variance**	**0.00735**		
13	**Standard Deviation**	**0.08576**		

The expected value is .01229 and the standard deviation is .08576.

7.68 The stocks with the smallest variances are Coca-Cola (.00261) and General Electric (.00354).

	A	B	C	D
1	**Portfolio of 2 Stocks**			
2			**Coca Cola**	**GE**
3	**Variance-Covariance Matrix**	**Coca Cola**	0.00257	
4		**GE**	0.00014	0.00349
5				
6	**Expected Returns**		-0.00022	0.00031
7				
8	**Weights**		0.50000	0.50000
9				
10	**Portfolio Return**			
11	**Expected Value**	**0.00005**		
12	**Variance**	**0.00158**		
13	**Standard Deviation**	**0.03981**		

The expected value is .00005 and the standard deviation is .03981.

7.69 The two-stock portfolio with the largest expected value is composed of Genentech and Motorola, the two stocks with the highest means. Its expected value is .01229 and its standard deviation is .08576. The two-stock portfolio with the smallest variance is composed of Coca-Cola and General Electric, the two stocks with both the smallest variances and the smallest covariance. The expected value is .00005 and the standard deviation is .03981.

7.70

	A	B	C	D	E
1	**Portfolio of 3 Stocks**				
2			**Coca Cola**	**Genentech**	**GE**
3	**Variance-Covariance Matrix**	**Coca Cola**	0.0026		
4		**Genentech**	0.0020	0.0151	
5		**GE**	0.0001	0.0015	0.0035
6					
7	**Expected Returns**		-0.0002	0.0166	0.0003
8					
9	**Weights**		0.3333	0.3333	0.3333
10					
11	**Portfolio Return**				
12	**Expected Value**	**0.0056**			
13	**Variance**	**0.0032**			
14	**Standard Deviation**	**0.0562**			

The expected value is .0056 and the standard deviation is .0562.

7.71

	A	B	C	D	E	F
1	**Portfolio of 4 Stocks**					
2			**GE**	**GM**	**McDonalds**	**Motorola**
3	**Variance-Covariance Matrix**	**GE**	0.0035			
4		**GM**	0.0011	0.0110		
5		**McDonalds**	0.0015	0.0020	0.0054	
6		**Motorola**	0.0009	0.0041	0.0025	0.0103
7						
8	**Expected Returns**		0.0003	0.0023	0.0079	0.0080
9						
10	**Weights**		0.3000	0.2000	0.1000	0.4000
11						
12	**Portfolio Return**					
13	**Expected Value**	**0.0045**				
14	**Variance**	**0.0038**				
15	**Standard Deviation**	**0.0620**				

The expected value is .0045 and the standard deviation is .0620.

7.72

	A	B	C	D	E	F
1	**Portfolio of 4 Stocks**					
2			**GE**	**GM**	**McDonalds**	**Motorola**
3	**Variance-Covariance Matrix**	**GE**	0.0035			
4		**GM**	0.0011	0.0110		
5		**McDonalds**	0.0015	0.0020	0.0054	
6		**Motorola**	0.0009	0.0041	0.0025	0.0103
7						
8	**Expected Returns**		0.0003	0.0023	0.0079	0.0080
9						
10	**Weights**		0.3000	0.1000	0.4000	0.2000
11						
12	**Portfolio Return**					
13	**Expected Value**	**0.0051**				
14	**Variance**	**0.0030**				
15	**Standard Deviation**	**0.0545**				

The expected value is .0051 and the standard deviation is .0545.

7.73a

Stock	Mean	Variance
Barrick Gold	.00845	.00586
Bell Canada Enterprises	−.00317	.00254
Bank of Montreal	.01027	.00202
MDS Laboratories	.00319	.00688
Petro-Canada	.01553	.00472
Research in Motion	.03113	.03694

b

	A	B	C	D	E	F	G
1		*Barrick*	*BCE*	*BMO*	*MDS*	*Petro-Can*	*RIM*
2	Barrick	0.00578					
3	BCE	-0.00016	0.00250				
4	BMO	0.00024	0.00006	0.00199			
5	MDS	0.00135	0.00059	0.00040	0.00679		
6	Petro-Can	0.00191	0.00024	-0.00027	0.00153	0.00465	
7	RIM	0.00005	0.00252	0.00075	0.00221	0.00135	0.03643

7.74 The stocks with the largest means are Petro-Canada (.01533) and Research in Motion (.03113).

	A	B	C	D
1	**Portfolio of 2 Stocks**			
2			**Petro-Can**	**RIM**
3	**Variance-Covariance Matrix**	**Petro-Can**	0.00465	
4		**RIM**	0.00135	0.03643
5				
6	**Expected Returns**		0.01533	0.03113
7				
8	**Weights**		0.50000	0.50000
9				
10	**Portfolio Return**			
11	**Expected Value**	**0.02323**		
12	**Variance**	**0.01095**		
13	**Standard Deviation**	**0.10462**		

The expected value is .02323 and the standard deviation is .10462.

7.75 The stocks with the smallest variances are Bell Canada Enterprises (.00254) and Bank of Montreal (.00202).

	A	B	C	D
1	**Portfolio of 2 Stocks**			
2			**BCE**	**BMO**
3	**Variance-Covariance Matrix**	**BCE**	0.00250	
4		**BMO**	0.00006	0.00199
5				
6	**Expected Returns**		-0.00317	0.01027
7				
8	**Weights**		0.50000	0.50000
9				
10	**Portfolio Return**			
11	**Expected Value**	**0.00355**		
12	**Variance**	**0.00115**		
13	**Standard Deviation**	**0.03398**		

The expected value is .00355 and the standard deviation is .03398.

7.76 The two-stock portfolio with the largest expected value is composed of Petro-Canada and Research in Motion, the two stocks with the highest means. Its expected value is .02323 and its standard deviation is .10462. The two-stock portfolio with the smallest variance is composed of Bell Canada Enterprises and Bank of Montreal, the two stocks with the smallest variances. The expect value is .00355 and the standard deviation is .03398.

7.77

	A	B	C	D	E
1	**Portfolio of 3 Stocks**				
2			**Barrick**	**BCE**	**BMO**
3	**Variance-Covariance Matrix**	**Barrick**	0.00578		
4		**BCE**	-0.00016	0.00250	
5		**BMO**	0.00024	0.00006	0.00199
6					
7	**Expected Returns**		0.00845	-0.00317	0.01027
8					
9	**Weights**		0.30000	0.20000	0.50000
10					
11	**Portfolio Return**				
12	**Expected Value**	**0.00704**			
13	**Variance**	**0.00118**			
14	**Standard Deviation**	**0.03439**			

The expected value is .00704 and the standard deviation is .03439.

7.78

	A	B	C	D	E	F
1	**Portfolio of 4 Stocks**					
2			**BMO**	**MDS**	**Petro-Can**	**RIM**
3	**Variance-Covariance Matrix**	**BMO**	0.00199			
4		**MDS**	0.00040	0.00679		
5		**Petro-Can**	-0.00027	0.00153	0.00465	
6		**RIM**	0.00075	0.00221	0.00135	0.03643
7						
8	**Expected Returns**		0.01027	0.00319	0.01553	0.03113
9						
10	**Weights**		0.20000	0.30000	0.30000	0.20000
11						
12	**Portfolio Return**					
13	**Expected Value**	**0.01390**				
14	**Variance**	**0.00334**				
15	**Standard Deviation**	**0.05783**				

The expected value is .01390 and the standard deviation is .05783.

7.79

	A	B	C	D	E	F
1	**Portfolio of 4 Stocks**					
2			**BMO**	**MDS**	**Petro-Can**	**RIM**
3	**Variance-Covariance Matrix**	**BMO**	0.00199			
4		**MDS**	0.00040	0.00679		
5		**Petro-Can**	-0.00027	0.00153	0.00465	
6		**RIM**	0.00075	0.00221	0.00135	0.03643
7						
8	**Expected Returns**		0.01027	0.00319	0.01553	0.03113
9						
10	**Weights**		0.50000	0.10000	0.30000	0.10000
11						
12	**Portfolio Return**					
13	**Expected Value**	**0.01323**				
14	**Variance**	**0.00160**				
15	**Standard Deviation**	**0.03999**				

The expected value is .01323 and the standard deviation is .03999.

7.80a

Stock	Mean	Variance
Amgen	.00358	.00557
Ballard Power Systems	−.01510	.03427
Cisco Systems	.00412	.01701
Intel	.00313	.01575
Microsoft	.00994	.00752
Research in Motion	.03538	.03855

b. Stocks, Research in Motion, Microsoft, Cisco Systems, and Amgen have the largest means.

c. Stocks Amgen, Microsoft, Intel, and Cisco Systems have the smallest variances.

7.81

	A	B	C	D	E	F
1	**Portfolio of 4 Stocks**					
2			**Cisco**	**Intel**	**Microsoft**	**RIM**
3	**Variance-Covariance Matrix**	**Cisco**	0.01677			
4		**Intel**	0.01062	0.01553		
5		**Microsoft**	0.00449	0.00514	0.00742	
6		**RIM**	0.01480	0.01233	0.00687	0.03802
7						
8	**Expected Returns**		0.00412	0.00313	0.00994	0.03538
9						
10	**Weights**		0.30000	0.15000	0.25000	0.30000
11						
12	**Portfolio Return**					
13	**Expected Value**	**0.01480**				
14	**Variance**	**0.01256**				
15	**Standard Deviation**	**0.11208**				

The expected value is .01480 and the variance is .11208.

7.83

	A	B	C	D	E	F
1	**Portfolio of 4 Stocks**					
2			**Cisco**	**Intel**	**Microsoft**	**RIM**
3	**Variance-Covariance Matrix**	**Cisco**	0.01677			
4		**Intel**	0.01062	0.01553		
5		**Microsoft**	0.00449	0.00514	0.00742	
6		**RIM**	0.01480	0.01233	0.00687	0.03802
7						
8	**Expected Returns**		0.00412	0.00313	0.00994	0.03538
9						
10	**Weights**		0.11350	0.03520	0.81330	0.03790
11						
12	**Portfolio Return**					
13	**Expected Value**	**0.01000**				
14	**Variance**	**0.00699**				
15	**Standard Deviation**	**0.08358**				

The expected value is .01000 and the variance is .08358.

7.84 $P(X = x) = \frac{n!}{x!(n-x)!} p^x (1-p)^{n-x}$

a $P(X = 3) = \frac{10!}{3!(10-3)!} (.3)^3 (1-.3)^{10-3} = .2668$

b $P(X = 5) = \frac{10!}{5!(10-5)!} (.3)^5 (1-.3)^{10-5} = .1029$

c $P(X = 8) = \frac{10!}{8!(10-8)!} (.3)^8 (1-.3)^{10-8} = .0014$

7.85 a $P(X = 3) = P(X \leq 3) - P(X \leq 2) = .6496 - .3828 = .2668$

b $P(X = 5) = P(X \leq 5) - P(X \leq 4) = .9527 - .8497 = .1030$

c $P(X = 8) = P(X \leq 8) - P(X \leq 7) = .9999 - .9984 = .0015$

7.86 a .26683

b .10292

c .00145

7.87 $P(X = x) = \frac{n!}{x!(n-x)!} p^x (1-p)^{n-x}$

a $P(X = 2) = \frac{6!}{2!(6-2)!} (.2)^2 (1-.2)^{6-2} = .2458$

b $P(X = 3) = \frac{6!}{3!(6-3)!}(.2)^3(1-.2)^{6-3} = .0819$

c $P(X = 5) = \frac{6!}{5!(6-5)!}(.2)^5(1-.2)5 = .0015$

7.88 a $P(X = 2) = P(X \leq 2) - P(X \leq 1) = .9011 - .6554 = .2457$

b $P(X = 3) = P(X \leq 3) - P(X \leq 2) = .9830 - .9011 = .0819$

c $P(X = 5) = P(X \leq 5) - P(X \leq 4) = .9999 - 9984 = .0015$

7.89 a .24576

b .08192

c .00154

7.90 a $P(X = 18) = P(X \leq 18) - P(X \leq 17) = .6593 - .4882 = .1711$

b $P(X = 15) = P(X \leq 15) - P(X \leq 14) = .1894 - .0978 = .0916$

c $P(X \leq 20) = .9095$

d $P(X \geq 16) = 1 - P(X \leq 15) = 1 - .1894 = .8106$

7.91 a .17119

b .09164

c .90953

d .81056

7.92 Binomial distribution with p = .25

a $P(X = 1) = \frac{4!}{1!(4-1)!}(.25)^1(1-.25)^{4-1} = .4219$

b Table 1 with n = 8: $p(2) = P(X \leq 2) - P(X \leq 1) = .6785 - .3671 = .3114$

c Excel: p(3) = .25810

7.93 Table 1 with n = 25 and p = .3: $P(X \leq 10) = .9022$

7.94 Table 1 with n = 25 and p = .90

a $P(X = 20) = P(X \leq 20) - P(X \leq 19) = .0980 - .0334 = .0646$

b $P(X \geq 20) = 1 - P(X \leq 19) = 1 - .0334 = .9666$

c $P(X \leq 24) = .9282$

d $E(X) = np = 25(.90) = 22.5$

7.95 Table 1 with n = 25 and p = .75: $P(X \geq 15) = 1 - P(X \leq 14) = 1 - .0297 = .9703$

7.96 $P(X = 0) = \dfrac{4!}{01!(4-0)!}(.7)^0(1-.7)^{4-0} = .0081$

7.97 Table 1 with n = 25 and p = .10

a $P(X = 0) = P(X \leq 0) = .0718$

b $P(X < 5) = P(X \leq 4) = .9020$

c $P(X > 2) = P(X \geq 3) = 1 - P(X \leq 2) = 1 - .5371 = .4629$

7.98 $P(X = 0) = \dfrac{25!}{0!(25-0)!}(.08)^0(1-.08)^{25-0} = .1244$

7.99 Excel with n = 100 and p = .20: $P(X > 25) = P(X \geq 26) = 1 - P(X \leq 25) = 1 - .91252 = .08748$

7.100 $P(X = 20) = \dfrac{20!}{20!(20-20)!}(.75)^{20}(1-.75)^{20-20} = .00317$

7.01a Excel with n = 10 and p = 244/495: $P(X \geq 5) = 1 - P(X \leq 4) = 1 - .39447 = .60553$

b $E(X) = np = 100(244/495) = 49.29$

7.102 a $P(X = 2) = \dfrac{5!}{2!(5-2)!}(.45)^2(1-.45)^{5-2} = .3369$

b Excel with n = 25 and p = .45: $P(X \geq 10) = 1 - P(X \leq 9) = 1 - .24237 = .75763$

7.103 a Table 1 with n = 5 and p = .5: $P(X = 2) = P(X \leq 2) - P(X \leq 1) = .5 - .1875 = .3125$

b: Table 1 with n = 25 and p = .5: $P(X \geq 10) = 1 - P(X \leq 9) = 1 - .1148 = .8852$

7.104 a $P(X = 2) = \dfrac{5!}{2!(5-2)!}(.52)^2(1-.52)^{5-2} = .2990$

b Excel with n = 25 and p = .52: $P(X \geq 10) = 1 - P(X \leq 9) = 1 - .08033 = .91967$

7.105 a Excel with n = 25 and p = 2/38: $P(X \geq 2) = 1 - P(X \leq 1) = 1 - .61826 = .38174$

b Excel with n = 25 and p = 2/38: $P(X = 0)) = .25880$

c Excel with n = 25 and p = 18/38: $P(X \geq 15) = 1 - P(X \leq 14) = 1 - .85645 = .14355$

d Excel with n = 25 and p = 18/38: $P(X \leq 10) = .29680$

7.106 a Excel with n = 100 and p = .52: $P(X \geq 50) = 1 - P(X \leq 49) = 1 - .30815 = .69185$

b Excel with n = 100 and p = .36: $P(X \leq 30) = .12519$

c Excel with n = 100 and p = .06: $P(X \leq 5) = .44069$

7.107 Excel with n = 20 and p = .38: $P(X \geq 10) = 1 - P(X \leq 9) = 1 - .81032 = .18968$

7.108a. Excel with n = 10 and p = .23: $P(X \geq 5) = 1 - P(X \leq 4) = 1 - .94308 = .05692$

b. Excel with n = 25 and p = .23: $P(X \leq 5) = .47015$

7.109 Excel with n = 50 and p = .45: $P(X \geq 19) = 1 - P(X \leq 18) = 1 - .12735 = .87265$

7.110 a $P(X = 0) = \frac{e^{-\mu}\mu^{x}}{x!} = \frac{e^{-2}2^{0}}{0!} = .1353$

b $P(X = 3) = \frac{e^{-\mu}\mu^{x}}{x!} = \frac{e^{-2}2^{3}}{3!} = .1804$

c $P(X = 5) = \frac{e^{-\mu}\mu^{x}}{x!} = \frac{e^{-2}2^{5}}{5!} = .0361$

7.111a $P(X = 0) = \frac{e^{-\mu}\mu^{x}}{x!} = \frac{e^{-.5}.5^{0}}{0!} = .6065$

b $P(X = 1) = \frac{e^{-\mu}\mu^{x}}{x!} = \frac{e^{-.5}.5^{1}}{1!} = .3033$

c $P(X = 2) = \frac{e^{-\mu}\mu^{x}}{x!} = \frac{e^{-.5}.5^{2}}{2!} = .0758$

7.112 a Table 2 with $\mu = 3.5$: $P(X = 0) = P(X \leq 0) = .0302$

b Table 2 with $\mu = 3.5$: $P(X \geq 5) = 1 - P(X \leq 4) = 1 - .7254 = .2746$

c Table 2 with $\mu = 3.5/7$: $P(X = 1) = P(X \leq 1) - P(X \leq 0) = .9098 - .6065 = .3033$

7.113 a P(X = 5 with μ = 14/3) $= \frac{e^{-\mu}\mu^{x}}{x!} = \frac{e^{-14/3}(14/3)^{5}}{5!} = .1734$

b. P(X = 1 with μ = 14/3) $= \frac{e^{-\mu}\mu^{x}}{x!} = \frac{e^{-1/3}(1/3)^{1}}{1!} = .2388$

7.114 a P(X = 0 with μ = 2) = $\frac{e^{-\mu}\mu^{x}}{x!} = \frac{e^{-2}(2)^{0}}{0!}$ = .1353

b P(X = 10 with μ = 14) = $\frac{e^{-\mu}\mu^{x}}{x!} = \frac{e^{-14}(14)^{10}}{10!}$ = .0663

7.115 a Table 2 with μ = 5: P(X $\geq$ 10) = 1 – P(X $\leq$ 9) = 1 – .9682 = .0318

b Table 2 with μ = 10: P(X $\geq$ 20) = 1 – P(X $\leq$ 19) = 1 – .9965 = .0035

7.116 a Excel with μ = 30: P(X $\geq$ 35) = 1 – P(X $\leq$ 34) = 1 – .79731 = .20269

b Excel with μ = 15:P(X $\leq$ 12 = .26761

7.117 a Excel with μ = 1.8: P(X $\geq$ 3) = 1 – P(X $\leq$ 2) = 1 – .73062 = .26938

b Table 2 with μ = 9: P(10 $\leq$ X $\leq$ 15) = P(X $\leq$ 15) – P(X $\leq$ 9) = .9780 – .5874 = .3906

7.118 P(X = 0 with μ = 80/200) = $\frac{e^{-\mu}\mu^{x}}{x!} = \frac{e^{-.4}(.4)^{0}}{0!}$ =.6703

7.119 a Table 2 with μ = 5: P(X $\geq$ 10) = 1 – P(X $\leq$ 9) = 1 – .9682= .0318

b Excel with μ = 25: P(X $\geq$ 25) = 1 – P(X $\leq$ 24) = 1 – .47340 = .52660

7.120 a Table 2 with μ = 1.5: P(X $\geq$ 2) = 1 – P(X $\leq$ 1) = 1 – .5578 = .4422

b Table 2 μ = 6: P(X < 4) = P(X $\leq$ 3) = .1512

7.121 a P(X = 1 with μ = 5) = $\frac{e^{-\mu}\mu^{x}}{x!} = \frac{e^{-5}(5)^{1}}{1!}$ = .0337

b Table 2 with μ = 15: P(X > 20) = P(X $\geq$ 21) = 1 – P(X $\leq$ 20) = 1 – .9170 = .0830

7.122 a P(X = 0 with μ = 1.5) = $\frac{e^{-\mu}\mu^{x}}{x!} = \frac{e^{-1.5}(1.5)^{0}}{0!}$ = .2231

b Table 2 with μ = 4.5: P(X $\leq$ 5) = .7029

c Table 2 with μ = 3.0: P(X $\geq$ 3) = 1 – P(X $\leq$ 2 = 1 – .4232 = .5768

7.123 Binomial with n = 5 and p = .01. (using Excel)

x	p(x)
0	.95099
1	.04803
2	.00097
3	.00001
4	0
5	0

7.124 a $P(X = 2) = \frac{10!}{2!(10-2)!}(.05)^2(1-.05)^{10-2} = .0746$

b Excel with n = 400 and p = .05: P(X = 25) = .04455

c .05

7.125 Excel with n = 100 and p = .60: $P(X > 50) = P(X \geq 51) = 1 - P(X \leq 50) = 1 - .02710 = .97290$

7.126 Table 1 with n = 10 and p = .20: $P(X \geq 6) = 1 - P(X \leq 5) = 1 - .9936 = .0064$

7.127 p = .08755 because $P(X \geq 1) = 1 - P(X = 0$ with n = 10 and p = .08755) = 1– .40 = .60

7.128 a $\mu = E(X) = \sum xP(x) = 5(.05) + 6(.16) + 7(.41) + 8(.27) + 9(.07) + 10(.04) = 7.27$

$\sigma^2 = V(X) = \sum (x-\mu)^2 P(x) = (5-7.27)^2(.05) + (6-7.27)^2(.16) + (7-7.27)^2(.41)$

$+ (8-7.27)^2(.27) + (9-7.27)^2(.07) + (10-7.27)^2(.04) = 1.1971$

$\sigma = \sqrt{\sigma^2} = \sqrt{1.1971} = 1.0941$

7.129 Excel with n = 25 and p = 1/3: $P(X \geq 10) = 1 - P(X \leq 9) = 1 - .69560 = .30440$

7.130 Table 1 with n = 10 and p = .3: $P(X > 5) = P(X \geq 6) = 1 - P(X \leq 5) = 1 - .9527 = .0473$

7.131 a $\mu = E(X) = \sum xP(x) = 0(.36) + 1(.22) + 2(.20) + 3(.09) + 4(.08) + 5(.05) = 1.46$

$\sigma^2 = V(X) = \sum (x-\mu)^2 P(x) = (0-1.46)^2(.36) + (1-1.46)^2(.22) + (2-1.46)^2(.20)$

$+ (3-1.46)^2(.09) + (4-1.46)^2(.08) + (5-1.46)^2(.05) = 2.23$

$\sigma = \sqrt{\sigma^2} = \sqrt{2.23} = 1.49$

b $\mu = E(X) = \sum xP(x) = 0(.15) + 1(.18) + 2(.23) + 3(.26) + 4(.10) + 5(.08) = 2.22$

$\sigma^2 = V(X) = \sum (x-\mu)^2 P(x) = (0–2.22)^2 (.15) + (1–2.22)^2 (.18) + (2–2.22)^2 (.23)$

$+ (3–2.22)^2 (.26) + (4–2.22)^2 (.10) + (5–2.22)^2 (.08) = 2.11$

$\sigma = \sqrt{\sigma^2} = \sqrt{2.11} = 1.45$

7.132 a E(X) = np = 100(.15) = 15

b $\sigma = \sqrt{np(1-p)} = \sqrt{100(.15)(1-.15)} = 3.57$

c Excel with n = 100 and p = .15: P(X $\geq$ 20) = 1 – P(X $\leq$ 19) = 1 – .89346 = .10654

7.133 Excel with n = 100 and p = .45:

a P(X > 50) = P(X $\geq$ 49) = 1 – P(X $\leq$ 50) = 1 – .86542 = .13458

b P(X < 44) = P(X $\leq$ 43) = .38277

c P(X = 45) = .07999

7.134 a P(X = 10 with $\mu = 8$) = $\dfrac{e^{-\mu}\mu^x}{x!} = \dfrac{e^{-8}(8)^{10}}{10!} = .0993$

b Table 2 with $\mu = 8$: P(X > 5) = P(X $\geq$ 6) = 1 – P(X $\leq$ 5) = 1 – .1912 = .8088

c Table 2 with $\mu = 8$: P(X < 12) = P(X $\leq$ 11) = .8881

7.135 Table 1 with n = 25 and p = .40:

a P(X = 10) = P(X $\leq$10) – P(X $\leq$ 9) = .5858 – .4246 = .1612

b P(X < 5) = P(X $\leq$ 4) = .0095

c P(X > 15) = P(X $\geq$ 16) = 1 – P(X $\leq$ 15) = 1 – .9868 = .0132

7.136 a $\mu = E(X) = \sum xP(x) = 0(.48) + 1(.35) + 2(.08) + 3(.05) + 4(.04) = .82$

$\sigma^2 = V(X) = \sum (x-\mu)^2 P(x) = (0–.82)^2 (.48) + (1–.82)^2 (.35) + (2–.82)^2 (.08)$

$+ (3–.82)^2 (.05) + (4–.82)^2 (.04) = 1.0876$

$\sigma = \sqrt{\sigma^2} = \sqrt{1.0876} = 1.0429$

7.137 a Excel with $\mu = 9.6$: P(X ≥ 10) = 1 – P(X ≤ 9) = 1 − .5089 = .4911

b. Excel with $\mu = 6$: P(X ≤ 5) = .4457

c Excel with $\mu = 2.3$: P(X ≥ 3) = 1 – P(X ≤ 2) = 1 − .5960 = .4040

7.138 a E(X) = np = 40(.02) = .8

b $P(X = 0) = \frac{40!}{0!(40-0)!}(.02)^0(1-.02)^{40-0} = .4457$

7.139 a Excel with n = 80 and p = .70: $P(X > 65) = P(X \geq 66) = 1 - P(X \leq 65) = 1 - .99207 = .00793$

b E(X) = np = 80(.70) = 56

c $\sigma = \sqrt{np(1-p)} = \sqrt{80(.70)(1-.70)} = 4.10$

7.140 $P(X = 5) = \frac{5!}{5!(5-5)!}(.774)^5(1-.774)^{5-5} = .2778$

Case 7.1

Expected number of runs without bunting = .85.

If batter bunts:

Outcome	Probability	Bases Occupied	Outs	Expected Number of Runs	
1	.75	2nd	1	.69	.5175
2	.10	1st	1	.52	.0520
3	.10	none	2	.10	.0100
4	.05	1st and 2nd	0	1.46	.0730

Expected number of runs = .6255

Decision: Don't bunt.