**CHAPTER 7 SOLUTIONS**

The answers are rounded to the nearest hundredth.

**7.1.** The frequency distribution table is constructed using the R command **table(NELS$edexpect)**.   
  
../../../Desktop/Screen%20Shot%202019-03-03%20at%208.33.57%20P  
  
A percent distribution table can be created using the R command **percent.table(NELS$edexpect)**.  
  
../../../Desktop/Screen%20Shot%202019-03-03%20at%208.34.16%20P

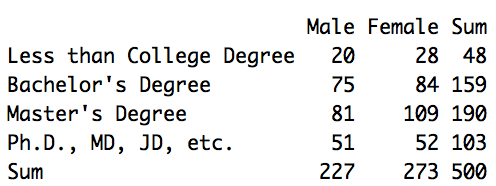
a) 159/500 = 0.32

b) 190/500 = 0.38

c) (159+190)/500 = 0.32 + 0.38 = 0.70

d) 1 - .32 = 0.68

**7.2.**  The crosstabulation is constructed using the R command **addmargins(table(NELS$edexpect, NELS$gender)).**

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a) 48/500 = 0.10

b) 273/500 = 0.55

c) 28/500 = 0.06

d) 48/500 + 273/500 – 28/500 = 293/500 = 0.59

e) 1 - 0.10 = 0.90 or (159+190+103)/500 = 452/500 = 0.90

f) 28/48 = 0.58

g) 28/273 = 0.10

h) 245/452 = 0.54

**7.3.**

a) 159/500 = 0.32

b) 190/500 = 0.38

c) .32 x .38 = 0.12

d) Yes, the Multiplicative Rule of Probability can be used. Because the sampling is with replacement, the events are independent.

**7.4.**

a) 159/500 = 0.32

b) (159/500)(190/499) = (0.32)(0.38) = 0.12

c) No, the Multiplicative Rule of Probability cannot be used. Because the sampling is without replacement, the events are not independent.

**7.5.**

a) 318

b) 380

c) 318 + 380 = 698

d) 1000 - 318 = 682

**7.6.**

a) 0.5

b) 0.5

c) 1

d) 0.7

e) 0.9

**7.7.**  The two events are not equally likely.

**7.8.**  The statement is false. The fact that the urn contains equal numbers of black and white marbles is enough to conclude that the probability that one marble selected at random from this urn is white is 0.5.

**7.9.**

a) They are not mutually exclusive because the outcome HH satisfies both E1 and E2.

b) Step 1: The sample space is {HH, HT, TH, TT}, thus P(E2) = 0.5. Step 2: The modified sample space is {HH, HT}, thus P(E2 given that E1 has occurred) = 0.5.

**7.10.**

a) They are mutually exclusive because the sample space is {H, TH, TT}. None of these outcomes satisfies both E1 and E2.

b) P(E2) = 0.33. P(E2 given that E1 has occurred) = 0 because the modified sample space is {H}. Because these values are not the same, E1 and E2 are dependent.

**7.11.**

a) They are not mutually exclusive because the outcome TT satisfies both E1 and E2.

b) P(E2) = 0.25. P(E2 given that E1 has occurred) = .50 because the modified sample space is {TH, TT}. Because these values are not the same, E1 and E2 are dependent.

**7.12.**

a) We use the Law of Total Probability, Equation 7.8.

P(A) = P(A|E1)P(E1) + P(A|E1c)P(E1c) = (0.5)(0.6) + (0.7)(0.4) = 0.58

b) We use Bayes’ Theorem, Equation 7.9.

= = .52

**7.13.**

a) Let E1 be the event that John forgot his umbrella. Let E2 be the event that it is raining. Then P(E1 and E2) = 0.4 and P(E2) = 0.6. Using Equation 7.6, we have

P(E1|E2) = = = 0.67

b) We have that P(E1c|E2c) = 0.8. Therefore, P(E1|E2c) = 0.2. According to the Law of Total Probability, Equation 7.8,

P(E1) = P(E1|E2)P(E2) + P(E1|E2c)P(E2c) = (0.67)(0.6) + (0.2)(0.4) = 0.48.

c) We use Bayes’ Theorem, Equation 7.9.

= = .83

**7.14** To create a crosstabulation of proportions with marginal sums for the ed and marr variables of the Wages dataset, use the following command:  
**addmargins(percent.table(Wages$ed,Wages$marr))/100**  
  
For a randomly selected individual from the Wages dataset, let A be the event that the individual has completed graduate school, and let E1 be the event that the individual is married. Then, by the Law of Total Probability (Equation 7.8),  
  
P(A) = P(A|E1)P(E1) + P(A|E1c)P(E1c).  
  
By Equation 7.6, P(A|E1)P(E1) = P(A and E1) and P(A|E1c)P(E1c) = P(A and E1c). Thus, by substitution,   
  
P(A) = P(A and E1) + P(A and E1c).   
  
Since “Married” and “Not married” are the only two possibilities for the marr variable, by the definition of complements, P(E1c) is the probability that the individual is not married. This means the cell in the fifth row, first column is equal to P(A and E1c), and the cell in the fifth row, second column is equal to P(A and E1), so by substitution,   
  
P(A) = 0.130 + 0.070 = 0.200,  
  
which is the same value as the marginal sum for the fifth row of the table.

**7.15**

a) There are ten pairs of socks, so there are twenty socks total. One pair of purple socks has polka dots and one pair of green socks has polka dots, so there is a total of four socks with polka dots in the drawer. Thus, the probability that the first sock selected of the two socks to be selected has polka dots is 4/20 = .20.

b) For a randomly selected sock, let A be the event that the sock is purple and let B be the event that the sock has stripes. Then the probability of a randomly selected sock being purple given that it is striped is P(A|B). Since one pair of socks is both purple and striped, P(A and B) = 2/20, or 0.10. Ten of the socks have stripes—one purple pair, one green pair, and three blue pairs—so P(B) = 10/20 = 0.50. Therefore, by Equation 7.6, P(A|B) = P(A and B)/P(B) = 0.10/0.50 = 0.20.

c) The probability that the second sock is green given that the first sock is green with argyle is a conditional probability, so we limit the possible outcomes to those nineteen socks remaining after the first sock selected is green with argyle. Of those nineteen socks, there are five green socks remaining: one pair with polka dots, one pair with stripes, and the remaining green sock with argyle. Therefore, the probability that the second sock is green given that the first sock is green with argyle is 5/19, or about 0.263.

d) If the first sock selected is blue, there are nineteen remaining socks, five of which are blue. Since all blue socks are striped, any one of these five would make a perfect match with the first sock, so the probability of a perfect match is 5/19, or about 0.263. If the first sock is black, there are again nineteen remaining socks, but only one remaining black sock. Thus, the probability of a perfect match in this situation is 1/19, or about 0.053.

e) If four individual socks already have been tried on and not returned to the drawer, there are sixteen socks remaining. There are eight socks remaining that would make a pair with one of the previously tried-on socks: one purple with argyle, five blue with stripes, one green with argyle, and one black with rainbows. Then the probability of a match is 8/16 = 0.50.

**7.16** Let S be the event that a dog is adopted from a shelter, and let U be the event that a dog is purebred. Then we are asked for P(S|U), and by Bayes’ theorem (Equation 7.9), this is equal to P(U|S)P(S)/P(U|S)P(S) + P(U|Sc)P(Sc). We are given P(S) = 0.22 and P(U|Sc) = 0.53, and P(Sc) = 1 - P(S) = 1 – 0.22 = 0.78 by Equation 7.2. Since a dog can only be purebred or mixed breed, the complement of U, Uc, can be stated as the event that a dog is mixed breed. Therefore, P(Uc|S) = 0.75, and by Equation 7.7, P(U|S) = 1 - P(Uc|S) = 1 - 0.75 = 0.25. Making the substitutions into our Bayes’ theorem equation, we get P(S|U) = 0.25\*0.22 / 0.25\*0.22 + 0.53\*0.78, or approximately 0.117.