Chapter 12 – Introducing Probability

12.1 In the long run, of a large number of five-card poker hands, the fraction in which you will be dealt a straight flush is about 1/64,974. It *does not* mean that exactly 1 out of 64,974 such hands would yield a straight flush. The probability of an event is the long-run frequency of times the event occurs if the experiment is repeated endlessly ... not even almost 65,000 times.

12.2 (a) An impossible event has probability 0. **(b)** A certain event has probability 1. **(c)** A probability of 0.99 would correspond to an event that is very likely but will not occur once in a while in a long sequence of trials. **(d)** An event with probability 0.45 will occur slightly less often than it occurs (a bit less than 50% of the time).

12.5 (a) *S* = {lives on campus, lives off campus}. **(b)** *S* = {All numbers between ______ and ______ years}. (Choices of upper and lower limits will vary, most likely due to the characteristics of your institution.) **(c)** *S* = {0000, 0001, 0002, ... , 9999}. **(d)** *S* = {A, B, C, D, F} (students might also include W, "+", and "–").

12.9 (a) Event *B* specifically rules out obese subjects, so there is no overlap with event *A*. **(b)** *A* or *B* is the event "The person chosen is overweight or obese." $P(A \text{ or } B) = P(A) + P(B) = 0.36 + 0.33 = 0.69$. **(c)** $P(C) = 1 - P(A \text{ or } B) = 1 - 0.69 = 0.31$.

12.10 (a) *P*(either English or French) = 0.083 + 0.789 = 0.872. **(b)** *P*(other language) = 1 – 0.872 = 0.128. **(c)** *P*(not English) = 1 – 0.083 = 0.917. (Or, add the other two probabilities.)

12.11 (a) Disjoint. **(b)** Not disjoint; $300,000 is more than $100,000 and more than $250,000. **(c)** Disjoint; $3 + x$ cannot equal 3.

12.13 (a) $A = \{4, 5, 6, 7, 8, 9\}$, so $P(A) = 0.097 + 0.079 + 0.067 + 0.058 + 0.051 + 0.046 = 0.398$. **(b)** $B = \{2, 4, 6, 8\}$, so $P(B) = 0.176 + 0.097 + 0.067 + 0.051 = 0.391$. **(c)** *A* or $B = \{2, 4, 5, 6, 7, 8, 9\}$, so $P(A \text{ or } B) = 0.176 + 0.097 + 0.079 + 0.067 + 0.058 + 0.051 + 0.046 = 0.574$. This is different from $P(A) + P(B)$ because *A* and *B* are not disjoint.

12.14 (a) This is a legitimate probability model because the probabilities are all greater than 0 and sum to 1. **(b)** The event $\{X < 4\}$ is the event that somebody eats dinner at home with his or her family 3 or fewer days per week. $P(X < 4) = 0.05 + 0.00 + 0.07 + 0.08 = 0.20$. **(c)** This is the event $\{X \geq 1\}$. $P(X \geq 1) = 1 - P(X = 0) = 1 - 0.05 = 0.95$.

12.15 (a) $P(Y \leq 0.6) = 0.6$. **(b)** $P(Y < 0.6) = 0.6$. **(c)** $P(0.4 \leq Y \leq 0.8) = 0.4$. **(d)** $P(0.4 < Y \leq 0.8) = 0.4$. The only difference between parts (c) and (d) is the inclusion of the point $Y = 0.4$. This has 0 probability for a continuous variable.

12.17 (a) This is $P(X \geq 35)$. **(b)** $P(X \geq 35) = P\left(Z > \frac{35 - 25.3}{6.5}\right) = P(Z \geq 1.49) = 1 - 0.9319 = 0.0681$ (using Table A).

12.22 (a) Probabilities express the *approximate* fraction of occurrences out of many trials.

12.23 (b) The set {0, 1, 2, 3, 4, 5} lists all possible counts.

12.24 (b) This is a finite model with a limited number of outcomes.

12.25 (b) The other probabilities add to 0.97, so this must be 0.03.

12.26 (b) P(Republican or Democrat) = P(Republican) + P(Democrat) = 0.25 + 0.30 = 0.55.

12.27 (b) P(not Republican) = 1 − P(Republican) = 1 − 0.25 = 0.75.

12.28 (b) There are ten equally likely possibilities, so P(seven) = 1/10.

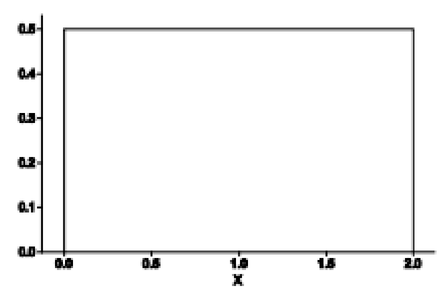
12.29 (c) "7 or greater" means 7, 8, or 9—three of the ten possibilities.

12.30 (b) 22% (0.14 + 0.05 + 0.02 + 0.01 = 0.22, or 22%) have three or more cars.

12.31 (c) $Y > 1$ standardizes to $Z > 2.56$, for which Table A gives 0.0052.

12.35 In computing the probabilities, we have dropped the trailing zeros from the land area figures. **(a)** P(area is forested) = 4176/9094 = 0.4592 **(b)** P(area is not forested) = 1 − 0.4592 = 0.5408

12.51 (a) This is a continuous random variable because the set of possible values is an interval. **(b)** The height should be 1/2 because the area under the curve must be 1. (For a rectangle, area = L × W.) The density curve is illustrated. **(c)** $P(Y \leq 1) = 1/2$



12.52 For these probabilities, compute the areas of the appropriate rectangle under the density shown for Exercise 12.51. **(a)** $P(0.5 < Y < 1.3) = (0.8)(0.5) = 0.4$ **(b)** $P(Y \geq 0.8) = (1.2)(0.5) = 0.6$.