1 3.7

a) The probability that both are affected is 0% because female offspring have no chance of getting the disease.

b) The probability that only one sibling is affected can be written as:

\[
P(\text{one child affected}) = P(\text{male affected and female not}) + P(\text{female affected and male not})
\]

\[
= \frac{50\%}{100\%} + \frac{0\%}{50\%}
\]

\[
= 50\% + 0\%
\]

\[
= 50\%
\]

2 3.8

a) \[P(\text{get question right}) = P(\text{studied the question}) + P(\text{didn’t study the question & got it right})\]

\[
= \frac{40\%}{52\%} + \frac{60\%}{20\%}
\]

b) \[P(\text{studied it — got it right}) = \frac{P(\text{studied question & got it right})}{P(\text{got it right})}\]

\[
= \frac{\frac{40\%}{52\%}}{\frac{52\%}{76.9\%}}
\]
3 3.11

There are two ways to test positive, a true positive and a false positive. \( P(\text{test positive}) = P(\text{true positive}) + P(\text{false positive}) = 0.146 \)

\[
P(\text{has disease} \rightarrow \text{test positive}) = \frac{P(\text{has disease} \& \text{test positive})}{P(\text{test positive})} = \frac{P(\text{true positive})}{P(\text{test positive})} = \frac{0.092}{0.146} = 0.63
\]

4 3.14

The law of independence states:

\[ A \text{ and } B \text{ are independent if and only if } P(A+B) = P(A) \cdot P(B). \]

But,

\[ P(\text{husband and wife smoke}) =? P(\text{husband smokes}) \cdot P(\text{wife smokes}) \]

\[ 8\% =? 30\% \cdot 20\% \]

\[ 8\% \neq 6\% \]

So the smoking status of the husband is not independent of the status of the wife.

5 3.18 and 3.20

\[ P(Y = 3) = \frac{\text{# of broods with } Y = 3}{\text{total # of broods}} \]

\[
a) \quad P(Y = 3) = \frac{610}{5000} = 0.122
\]
\[ P(Y \leq 7) = \frac{\text{\# of broods with } Y \leq 3}{\text{total \# of broods}} = \frac{130 + 26 + 3 + 1}{5000} = 0.032 \]

\[ P(4 \leq Y \leq 6) = \frac{\text{\# of broods with } 4 \leq Y \leq 6}{\text{total \# of broods}} = \frac{1400 + 1760 + 750}{5000} = 0.782 \]

\[ \text{mean} = \sum_{Y=1}^{10} Y \cdot (\text{proportion of nests with brood size } Y) = 1 \cdot \frac{90}{5000} + 2 \cdot \frac{230}{5000} + 3 \cdot \frac{610}{5000} + 4 \cdot \frac{1400}{5000} + 5 \cdot \frac{1760}{5000} + 6 \cdot \frac{1750}{5000} = 4.487 \]

6 3.12 and 3.22

\[ P(Y \geq 2) = P(Y = 2) + P(Y = 3) = 0.189 + 0.027 = 0.973 \]

\[ P(Y \leq 2) = P(Y = 0) + P(Y = 1) + P(Y = 2) = 0.343 + 0.441 + 0.189 = 0.973 \]

b) \[ P(Y \leq 2) = 1 - P(Y = 3) = 1 - 0.027 = 0.973 \]

\[ \text{mean} = \sum_{y=0}^{3} y \cdot P(# \text{ of black flies } = y) = 0 \cdot 0.343 + 1 \cdot 0.441 + 2 \cdot 0.189 + 3 \cdot 0.027 = 0.9 \]

7 3.28

a) \[ P(\text{all 20 will be cured}) = P(1^{st} \text{ will be cured}) \cdot P(2^{nd} \text{ will be cured}) \cdot \ldots \cdot P(20^{th} \text{ will be cured}) = 0.9^{20} = 0.1216 \]

b) \[ P(\text{all but 1 is cured}) = P(\text{all but the } 1^{st} \text{ will be cured}) \cdot P(\text{all but the } 2^{nd} \text{ will be cured}) \cdot \ldots \cdot P(\text{all but the } 20^{th} \text{ will be cured}) = 0.1 \cdot 0.9^{19} + 0.9 \cdot 0.1 \cdot 0.9^{18} + \ldots + 0.9^{19} \cdot 0.1 \]

\[ = (20) \cdot 0.1 \cdot 0.9^{19} = 0.2702 \]

c) \[ P(\text{exactly 18 are cured}) = (\# \text{ of ways to choose the 2 uncured children}) \cdot 0.1^2 \cdot 0.9^{18} = 20 \cdot C_2 \cdot 0.1^2 \cdot 0.9^{18} = 190 \cdot 0.1^2 \cdot 0.9^{18} = 0.2852 \]

d) \[ P(\text{90\% will be cured}) = P(0.9 \cdot 20 \text{ will be cured}) = P(18 \text{ will be cured}) = 0.2852 \text{ (part c)} \]
a) Let us consider a success as “high blood lead level.” Then we have a binomial problem with $n = 16$ and $p = \frac{1}{8}$. Then,

$$P(\text{none have high blood lead level}) = P(\text{no successes}) = 16C_0 \cdot \left( \frac{7}{8} \right)^{16} = 0.1181$$

b) $P(\text{one has high blood lead level}) = P(1 \text{ success})$

$$= 16C_1 \cdot \left( \frac{7}{8} \right)^{15} \cdot \left( \frac{1}{8} \right)^1 = 0.2699$$

c) $P(\text{two have high blood lead level}) = P(2 \text{ successes})$

$$= 16C_2 \cdot \left( \frac{7}{8} \right)^{14} \cdot \left( \frac{1}{8} \right)^2 = 0.2891$$

d) $P(\text{three or more have high blood lead level})$

$$= 1 - P(2 \text{ or fewer have high blood lead level}) = 1 - \left( P(0 \text{ have high blood lead level}) + P(1 \text{ have high blood lead level}) + P(2 \text{ have high blood lead level}) \right)$$

$$= 1 - (0.1181 + 0.2699 + 0.2891) = 0.3229$$