41. Note that $X \sim \text{Bin}(1500, .002)$ and that X is approximately Poisson with $\lambda = np = 3$. Then, since $P(X = x) \approx \lambda^x e^{-\lambda}/x!$, $P(X = 0) \approx e^{-3} = 0.04979$.

47. Let X denote the number of passengers that don't show up. The distribution of X is binomial with $n = 160$ and $p = .1$. The desired probability is $P(X \geq 10)$. Also, X is approximately Poisson with $\lambda = np = 16$. Using R to compute the Poisson probabilities, $P(X \geq 10) = 1 - P(X \leq 9) \approx 1 - 0.0434 = 0.9567$. The exact calculation (using the binomial distribution) yields $P(X \geq 10) = 1 - P(X \leq 9) = 1 - 0.03590 = 0.96409$.

75. The probability of at least one is $P(A \bigcup B \bigcup C) = P(A) + P(B) + P(C) - [P(A \bigcap B) + P(A \bigcap C) + P(B \bigcap C)] + P(A \bigcap B \bigcap C) = .6 + .5 + .4 - (.1 + .2 + .3) + 0 = .9$, so the desired percentage is 90%.

1. Let A = at least one H $= \{HHH, HHT, HTH, THH, TTH, THT, HTT\}$ and B = first is H $= \{HHH, HHT, HTH, HTT\}$. Then, $P(A) = 7/8$ and $P(A \bigcap B) = 4/8$ since $A \bigcap B = B$. Thus

$$P(B|A) = \frac{P(A \bigcap B)}{P(A)} = 4/7.$$

3. There are 6 ways to get a seven, two of which involve a six, namely $(6, 1)$ and $(1, 6)$. The number of outcomes that don't include a six are $5 \times 5 = 25$; hence, the desired probability is $4/25$.

6. Let A = balls are different colors and $B = \{(r, b), (b, r)\}$. Then $A \bigcap B = B$ and $P(A \bigcap B) = 2\frac{8 \cdot 7}{20 \cdot 19} = 0.2947$ and

$$\begin{aligned} P(A) &= 1 - P[(r, r), (b, b), (g, g)] \\ &= 1 - \frac{8 \cdot 7 + 7 \cdot 6 + 5 \cdot 4}{20 \cdot 19} \\ &= 0.6894. \end{aligned}$$

Thus, $P(B|A) = 0.2947/0.6894 = 0.42747$.

7. Note that the proportion of people that subscribe to at least one is $.6 + .4 - .3 = .7$. The proportion of these that subscribe to A is $.3/.7$ and so the desired probability is $3/7$.

10. Let E be the event that a pregnancy is ectopic and S denote the event that a woman smokes. Let $\alpha = P(E|S^c)$. Then $P(E|S) = 2\alpha$. Further, $P(S) = 1/4$ and $P(S^c) = 3/4$. To compute the probability that an ectopic pregnancy occurs to a smoker, that is $P(S|E)$, we need $P(E \bigcap S) = P(S)P(E|S) = 2\alpha/4$, and $P(E) = P(E \bigcap S) + P(E \bigcap S^c)$. Since $P(E \bigcap S^c) = P(S^c)(E|S^c) = 3\alpha/4$,

$$\begin{aligned} P(S|E) &= \frac{P(E \bigcap S)}{P(E)} \\ &= \frac{2\alpha/4}{2\alpha/4 + 3\alpha/4} \\ &= \frac{2}{5}. \end{aligned}$$

So, even though only 25% of pregnant women smoke, 40% of ectopic pregnancies occur to smokers.

11. Your parents are both Bb and contribute B or b with equal probability. Therefore, you are $(B, B), (B, b)$ or (b, B). The outcome (b, b) is impossible (b, b) gives blue eyes and your eyes are brown. As each of the 3 pairs are equally likely, there is a 1/3 probability that you are a homozygote (that is (B, B)).

16. If the first ball is a one, then there are 6 other balls that give a difference of more than 3; if the first ball is a 2, then there are 5 that give a difference greater than 3. Counting in this manner shows that there are $6+5+4+3+3+3+3+4+5+6 = 42$ such outcomes out of $10 \cdot 9$ total outcomes. Hence, the desired probability is $42/90 = 7/15$.

24. Let B denote the event he takes the bus and L is the event that he is late. Then, $P(L) = P(L|B)P(B) + P(L|B^c)P(B^c)$, where $P(L|B)P(B) = .4 \cdot .3$ and $P(L|B^c)P(B^c) = .2 \cdot .7$. Finally, $P(L) = .12 + .14 = .26$.