CS573 Assignment 1

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Problem 1

Sub-problem a

1. Solution:
   P(second card is heart|first card is heart))
   = P(second card is heart) (as probability of drawing second card is independent of first card being a heart) = $\frac{12}{51}$

2. Solution:
   P(none of the cards are hearts|atmost one card is heart) =
   $\frac{P(\text{none of the cards are hearts,atmost one card is heart})}{P(\text{atmost one card is heart})}$
   P(none of the cards are hearts,atmost one card is heart) = P(none of the cards are hearts)
   P(none of the cards are hearts) = $\frac{39}{52}$
   P(atmost one card is heart) = $1 - P$(atleast one card is heart)
   P(atleast one card is heart) = $\frac{1}{13}$
   P(atmost one card is heart) = $1 - \frac{1}{13} = \frac{12}{13}$
   P(none of the cards are hearts|atmost one card is heart) = $\frac{\frac{39}{52}}{\frac{12}{13}} = \frac{3}{4}$

Sub-problem b

1. Solution:
   P(card drawn from second deck is ace) =
   P(card drawn from first deck is ace) + P(card drawn from first deck is not ace)
   = $\frac{48}{52} \times \frac{4}{53} + \frac{4}{52} \times \frac{5}{53} = 0.0769$

2. Solution:
   P(card drawn from second deck is ace) =
   P(card drawn from first deck is ace) + P(card drawn from first deck is not ace)
   = $\frac{48}{52} \times \frac{4}{55} + \frac{4}{52} \times \frac{5}{55} = 0.0741$

3. Solution:
   P(ace was transferred from first deck|ace was drawn from second deck))
   = $\frac{P(\text{ace was transferred from first deck, ace was drawn from second deck})}{P(\text{ace was drawn from second deck})}$
   P(ace was transferred from first deck, ace was drawn from second deck) = $\frac{4}{52} \times \frac{5}{55}$
   P(ace was drawn from second deck) = $\frac{48}{52} \times \frac{4}{55} + \frac{4}{52} \times \frac{5}{55}$
   (We have calculated the probability of drawing an ace from the second deck in the previous problem b.2)

   P(ace was transferred from first deck|ace was drawn from second deck))
   = $\frac{\frac{4}{52} \times \frac{5}{55}}{\frac{48}{52} \times \frac{4}{55} + \frac{4}{52} \times \frac{5}{55}} = 0.094$