Case 1 (sampling without replacement)

$H_1:$ the first card to be a heart

$H_2:$ the second card to be a heart

Then we have

$$P(H_1) = \frac{1}{4}$$

$$\begin{aligned} P(H_2) &= P(H_2 \cap H_1) + P(H_2 \cap H_1^c) \\ &= P(\text{Both 1st and 2nd are hearts}) + \\ &\quad + P(\text{1st is NOT a heart and 2nd is a heart}) \\ &= \frac{13 \times 12}{52 \times 51} + \frac{39 \times 13}{52 \times 51} \\ &= \frac{1 \cdot 12}{4 \cdot 51} + \frac{3 \cdot 13}{4 \cdot 51} \\ &= \frac{1}{4} \end{aligned}$$

$$P(H_1 \cap H_2) = \frac{13 \times 12}{52 \times 51} = \frac{1}{17}$$

$$\neq P(H_1) \cdot P(H_2) = \frac{1}{16}$$

Case 2 (sampling with replacement)

$K_1:$ the first card to be a heart

$K_2:$ the second card to be a heart

Then we have

$$P(K_1) = \frac{1}{4}$$

$$P(K_2) = \frac{1}{4}$$

$$P(K_1 \cap K_2) = \frac{13 \times 13}{52 \times 52} = \frac{1}{16}$$

$$= P(K_1) \cdot P(K_2)$$