

P(1)

$$\begin{aligned}(a) P(W = \text{groot}) &= P(W = \text{groot} / \text{doc} = 1) P(\text{doc} = 1) + \\ &\quad P(W = \text{groot} / \text{doc} = 2) P(\text{doc} = 2) + \\ &\quad P(W = \text{groot} / \text{doc} = 3) P(\text{doc} = 3) \\ &= \frac{1}{3} \left[\frac{13}{39} + \frac{17}{17 \times 3} + \frac{15}{47} \right] \\ &= \underline{0.3286} \text{ Am.}\end{aligned}$$

$$\begin{aligned}(b) P(\text{doc} = 1 / W = \text{we}) &= \frac{P(W = \text{we} / \text{doc} = 1) P(\text{doc} = 1)}{P(W = \text{we})} \\ &= \frac{1}{39} \times \frac{1}{3 \times P(W = \text{we})},\end{aligned}$$

$$\begin{aligned}P(W = \text{we}) &= \sum_{d=1}^3 P(W = \text{we} / \text{doc} = d) \\ &= \frac{1}{3} \left[\frac{1}{39} + 0 + \frac{2}{47} \right] = 0.0227314.\end{aligned}$$

$$\begin{aligned}\therefore \text{Am} &= \frac{1}{39} \times \frac{1}{3} \times \frac{1}{0.0227314} \\ &= \underline{0.376} \text{ Am.}\end{aligned}$$

$$(c) P(\text{doc} = 2 / \text{word} = \text{am} \cup \text{word} = \text{are})$$

$$= \frac{P(W = \text{am} \cup W = \text{are} / \text{doc} = 2) \cdot P(\text{doc} = 2)}{P(W = \text{are} \cup W = \text{am})} \quad - \textcircled{1}.$$

$$P(\text{doc} = 2) = \frac{1}{3}$$

$$P(u = \text{am} \mid u = \text{are} / \text{doc} = 2) = \frac{17+0}{17 \times 3} = \frac{1}{3}.$$

$$\begin{aligned} P(u = \text{am} \mid u = \text{are}) &= \sum_{d=1}^3 P(u = \text{am} \mid u = \text{are} / \text{doc} = d) \cdot P(\text{doc} = d) \\ &= \frac{1}{3} \left[\frac{1}{3} + \frac{17}{51} + \frac{16}{47} \right] \\ &= \frac{142}{423} \end{aligned}$$

$$\therefore, \text{from } \textcircled{1} \rightarrow \text{Ans} = \frac{1}{3} \times \frac{1}{3 \times \frac{142}{423}} = \frac{0.3309859}{0.3310} = \text{Ans}$$

$$\begin{aligned} \text{(d)} \quad P(u = \text{groot}) &= \sum_{d=1}^3 P(u = \text{groot} / \text{doc} = d) \cdot P(\text{doc} = d) \\ &= \frac{1}{6} \left(\frac{13}{13 \times 3} \right) + \frac{1}{3} \left(\frac{17}{51} \right) + \frac{1}{2} \left(\frac{15}{47} \right) \\ &= \frac{1}{18} + \frac{1}{9} + \frac{15}{94} \\ &= \frac{0.326241}{0.3262} = \text{Ans} \end{aligned}$$

$$\text{(e)} \quad P(d=1 \mid u = \text{we}) = \frac{P(u = \text{we} / d=1) \cdot P(d=1)}{P(u = \text{we})}$$

$$= \frac{1}{39} \times \frac{1}{6 \times P(u = \text{we})} \quad \text{--- } \textcircled{1}$$

$$\begin{aligned} P(u = \text{we}) &= \sum_{d=1}^3 P(u = \text{we} / \text{doc} = d) \\ &= \frac{1}{6} \times \frac{1}{39} + 0 + \frac{1}{2} \times \frac{2}{47} = \frac{281}{10998} \end{aligned}$$

$$\begin{aligned} \therefore, \text{from } \textcircled{1} \quad \text{Ans} &= \frac{1}{39} \times \frac{1}{6} \times \frac{10998}{281} = \frac{0.167259}{0.1673} = \text{Ans} \end{aligned}$$

$$\begin{aligned} \underline{(f)} \quad & P(\text{doc} = 2 \mid \text{word} = \text{am or word} = \text{are}) \\ &= \frac{P(w = \text{am} \cup w = \text{are} \mid \text{doc} = 2) \cdot P(\text{doc} = 2)}{P(w = \text{am} \cup w = \text{are})} \end{aligned}$$

$$P(\text{doc} = 2) = \frac{1}{3}$$

$$P(w = \text{am} \cup w = \text{are} \mid \text{doc} = 2) = \frac{17}{51} = \frac{1}{3}$$

$$\begin{aligned} P(w = \text{am} \cup w = \text{are}) &= \sum_{d=1}^3 P(w = \text{am} \cup w = \text{are} \mid \text{doc} = d) \cdot P(\text{doc} = d) \\ &= \frac{1}{6} \left(\frac{13}{39} \right) + \frac{1}{3} \left(\frac{17}{51} \right) + \frac{1}{2} \left(\frac{16}{47} \right) \\ &= \frac{95}{282} \end{aligned}$$

$$\begin{aligned} \therefore, \text{Ans} &\Rightarrow \frac{1}{3} \times \frac{1}{3} \times \frac{282}{95} = \underline{0.32982} \quad \text{Ans} \\ &\Rightarrow \underline{0.3298} \quad \text{Ans.} \end{aligned}$$