P(1)

(a) $P(w = groot) = P(w = groot / doc = 1)\, P(doc = 1) +$
$P(w = groot / doc = 2)\, P(doc = 2) +$
$P(w = groot / doc = 3)\, P(doc = 3)$

$= \frac{1}{3}\left[\frac{13}{39} + \frac{17}{17 \times 3} + \frac{15}{47}\right]$

$= 0.3286$ Ans.

(b) $P(doc = 1 / w = we) = \frac{P(w = we / doc = 1)\, P(doc = 1)}{P(w = we)}$

$= \frac{1}{39} \times \frac{1}{3 \times P(w = we)}.$

$P(w = we) = \sum_{d=1}^{3} P(w = we / doc = d)$

$= \frac{1}{3}\left[\frac{1}{39} + 0 + \frac{2}{47}\right] = 0.0227314.$

$\therefore$ Ans $= \frac{1}{39} \times \frac{1}{3} \times \frac{1}{0.0227314}$

$= 0.376$ Ans.

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

$= \frac{P(w = am \cup w = are / doc = 2) \cdot P(doc = 2)}{P(w = are \cup w = am)}$ - (1).

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

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

$$P(w = am \cup w = are) = \sum_{d=1}^{3} P(w = am \cup w = are / doc = d) \cdot P(doc = d)$$

$$= \frac{1}{3}\left[\frac{1}{3} + \frac{17}{51} + \frac{16}{47}\right]$$

$$= \frac{142}{423}$$

$\therefore$, from ① → Ans $\Rightarrow \frac{1}{3} \times \frac{1}{3 \times \frac{142}{423}} = 0.3309859$ = Ans

$= 0.3310$ Ans

(d) $$P(w = groot) = \sum_{d=1}^{3} P(w = groot / doc = d) \cdot P(doc = d)$$

$$= \frac{1}{6}\left(\frac{13}{13 \times 1}\right) + \frac{1}{3}\left(\frac{17}{51}\right) + \frac{1}{2}\left(\frac{15}{47}\right)$$

$$= \frac{1}{18} + \frac{1}{9} + \frac{15}{94}$$

$= 0.326241$ Ans. $= 0.3262$ Ans

(e) $$P(d = 1 / w = we) = \frac{P(w = we / d = 1) \cdot P(d = 1)}{P(w = we)}.$$

$$= \frac{1}{39} \times \frac{1}{6 \times P(w = we)}. \quad \text{— ①}.$$

$$P(w = we) = \sum_{d=1}^{3} P(w = we / doc = d)$$

$$= \frac{1}{6} \times \frac{1}{39} + 0 + \frac{1}{2} \times \frac{2}{47} = \frac{281}{10998}$$

$\therefore$, from ① Ans $\Rightarrow \frac{1}{39} \times \frac{1}{6} \times \frac{10998}{281} = 0.167259$

= Ans

$= 0.1673$ Ans

(g) $P(doc = 2 \mid word = am \text{ or } word = are)$

$$= \frac{P(w = am \cup w = are \mid doc = 2) \cdot P(doc = 2)}{P(w = am \cup w = are)}$$

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

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

$$P(w = am \cup w = are) = \sum_{d=1}^{3} P(w = am \cup w = are \mid doc = d) \cdot P(doc = d)$$

$$= \frac{1}{6}\left(\frac{13}{39}\right) + \frac{1}{3}\left(\frac{17}{51}\right) + \frac{1}{2}\left(\frac{16}{47}\right)$$

$$= \frac{95}{282}$$

$\therefore$ Ans $\Rightarrow \frac{1}{3} \times \frac{1}{3} \times \frac{282}{95} = 0.32982$ Ans

$\Rightarrow 0.3298$ Ans.