

Required Activity 11.2

9/11/23

$$\begin{aligned} 1) \quad P(\text{Spam} | V \cap U) &\propto P(V \cap U | \text{Spam}) \cdot P(\text{Spam}) \\ P(\text{Ham} | V \cap U) &\propto P(V \cap U | \text{Ham}) \cdot P(\text{Ham}) \end{aligned}$$

$$P(V \cap U | \text{Spam}) \approx P(V | \text{Spam}) \cdot P(U | \text{Spam}) \quad (\text{Bayes Assumption})$$

$$\begin{aligned} \therefore P(\text{Spam} | V \cap U) &\propto P(V | \text{Spam}) \cdot P(U | \text{Spam}) \cdot P(\text{Spam}) \\ &= 0.1 \cdot \frac{1}{40} \cdot 0.2 = 5.5 \times 10^{-3} \end{aligned}$$

$$\begin{aligned} P(\text{Ham} | V \cap U) &\propto P(V | \text{Ham}) \cdot P(U | \text{Ham}) \cdot P(\text{Ham}) \\ &= \frac{1}{160} \cdot \frac{10}{160} \cdot 0.8 = 3.125 \times 10^{-4} \end{aligned}$$

$$P(\text{Spam} | V \cap U) = \frac{88}{93} \approx 0.946 \quad P(\text{Ham} | V \cap U) = \frac{5}{93} \approx 0.054$$

Classified as spam

$$\begin{aligned}
 2) \quad P(\text{Spam} | \bar{V} \cap \bar{U}) &\propto P(\bar{V} | \text{Spam}) \cdot P(\bar{U} | \text{Spam}) \cdot P(\text{Spam}) \\
 &= \frac{36}{40} \cdot \frac{29}{40} \cdot 0.2 \\
 &= 0.1305
 \end{aligned}$$

$$\begin{aligned}
 P(\text{Ham} | \bar{V} \cap \bar{U}) &\propto P(\bar{V} | \text{Ham}) \cdot P(\bar{U} | \text{Ham}) \cdot P(\text{Ham}) \\
 &= \frac{154}{160} \cdot \frac{150}{160} \cdot 0.8 \\
 &= \frac{477}{640}
 \end{aligned}$$

$$P(\text{Spam} | \bar{V} \cap \bar{U}) = \frac{232}{1557}$$

$$\approx 0.149$$

$$P(\text{Ham} | \bar{V} \cap \bar{U}) = \frac{1325}{1557}$$

$$\approx 0.851$$

Classified as Ham