P2)

(a) $P(R) = P(R|S) P(S) + P(R|\neg S) P(\neg S)$

$\quad = (0.7)(0.25) + (0.3)(0.75)$

$\quad = \underline{0.4}$ Ans

(b) $P(We) = P(We, R, Wo) + P(We, R, \neg Wo) + P(We, \neg R, Wo)$

$\quad + P(We, \neg R, \neg Wo)$

$\quad = P(We|R, Wo) \, P(Wo|R) P(R) + P(We|R, \neg Wo)$
$\quad\quad P(\neg Wo|R) P(R) + P(We|\neg R, Wo) \, P(Wo|\neg R) P(\neg R)$
$\quad\quad + P(We|\neg R, \neg Wo) \, P(\neg Wo|\neg R) P(\neg R) .$

$\quad = (0.12)(0.7)(0.4) + (0.25)(0.3)(0.4) + (0.1)(0.2)(0.6) +$
$\quad\quad (0.08)(0.8)(0.6)$

$\quad = \underline{0.114}$ Ans.

(c) $P(M|S) = \dfrac{P(M,S)}{P(S)}.$

$P(S) = 0.25 .$

$P(M,S) = P(M,S,We,Wo,R) + P(M,S,We,Wo,\neg R) + P(M,S,We,\neg Wo,R) +$
$\quad\quad P(M,S,We,Wo,\neg R) + P(M,S,\neg We,Wo,R) + P(M,S,\neg We,Wo,\neg R) +$
$\quad\quad P(M,S,\neg We,\neg Wo,R) + P(M,S,\neg We,\neg Wo,\neg R) .$

$P(M,S,We,Wo,R) = P(M|We) \, P(We|Wo,R) \, P(Wo|R) \, P(R|S) \, P(S)$

$\quad\quad = (0.02)(0.12)(0.7)(0.7)(0.25)$

$\quad\quad = 0.000294 .$

$P(M,S,We,Wo,\neg R) = P(M|We) \, P(We|Wo,\neg R) \, P(Wo|\neg R) \, P(\neg R|S) \, P(S)$

$\quad\quad = (0.02)(0.1)(0.2)(0.3)(0.25)$

$\quad\quad = 0.00003$

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$$P(M, S, Ve, \neg Vo, R) = P(M|Ve)\, P(Ve|\neg Vo, R)\, P(\neg Vo|R)\, P(R|S)\, P(S)$$
$$= (0.02)(0.25)(0.3)(0.7)(0.25)$$
$$= 0.0002625$$

$$P(M, S, Ve, \neg Vo, \neg R) = P(M|Ve)\, P(Ve|\neg Vo, \neg R)\, P(\neg Vo|\neg R)\, P(\neg R|S)\, P(S)$$
$$= (0.02)(0.08)(0.8)(0.3)(0.25)$$
$$= 0.000096.$$

$$P(M, S, \neg Ve, Vo, R) = P(M|\neg Ve)\, P(\neg Ve|Vo, R)\, P(Vo|R)\, P(R|S)\, P(S)$$
$$= (0.42)(0.88)(0.7)(0.7)(0.25)$$
$$= 0.045276.$$

$$P(M, S, \neg Ve, Vo, \neg R) = P(M|\neg Ve)\, P(\neg Ve|Vo, \neg R)\, P(Vo, \neg R)\, P(\neg R|S)\, P(S)$$
$$= (0.42)(0.9)(0.2)(0.3)(0.25)$$
$$= 0.00567.$$

$$P(M, S, \neg Ve, \neg Vo, R) = P(M, \neg Ve)\, P(\neg Ve|\neg Vo|R)\, P(\neg Vo|R)\, P(R|S)\, P(S)$$
$$= (0.42)(0.75)(0.3)(0.7)(0.25)$$
$$= 0.0165375$$

$$P(M, S, \neg Ve, \neg Vo, \neg R) = P(M, \neg Ve)\, P(\neg Ve|\neg Vo, \neg R)\, P(\neg Vo|\neg R)\, P(\neg R|S)\, P(S)$$
$$= (0.42)(0.92)(0.8)(0.3)(0.25)$$
$$= 0.023184.$$

$$P(M|S) = \frac{P(M,S)}{P(S)} = \frac{0.09133}{0.25} = 0.3654 \quad \bullet \text{ Ans.}$$

(d) $$P(B|S) = \frac{P(B,S)}{P(S)}$$

$$P(B,S) = P(B,S,Vo,R) + P(B,S,Vo,\neg R) + P(B,S,\neg Vo,R) + P(B,S,\neg Vo,\neg R)$$

$$P(B,S,Vo,R) = P(B|Vo,S)\, P(S)\, P(Vo|R)\, P(R|S)$$
$$= (0.8)(0.25)(0.7)(0.7) = 0.098 \quad \bullet \text{ Ans}$$

$P(B, S, W_0, \neg R) = P(B|W_0, S)\, P(S)\, P(W_0|\neg R)\, P(\neg R|S)$

$$= (0.8)(0.25)(0.2)(0.3)$$

$$= 0.012$$

$P(B, S, \neg W_0, R) = P(B|\neg W_0, S)\, P(S),\, P(\neg W_0|R)\, P(R|S)$

$$= (0.4)(0.25)(0.3)(0.7)$$

$$= 0.021$$

$P(B, S, \neg W_0, \neg R) = P(B|\neg W_0, S)\, P(S)\, P(\neg W_0|\neg R)\, P(\neg R|S)$

$$= (0.4)(0.25)(0.8)(0.3)$$

$$= 0.024$$

$$\therefore \quad P(B|S) = \frac{0.155}{0.25} = 0.12 = \text{Ans}$$

(e). $P(S|B_0, \neg W_0) = \dfrac{P(S, B, \neg W_0)}{P(B, \neg W_0)}$

$P(S, B, \neg W_0) = P(S, B, \neg W_0, R) + P(S, B, \neg W_0, \neg R)$

$$= 0.021 + 0.024$$

$$= 0.045$$

$P(B, \neg W_0) = P(B, \neg W_0, R, S) + P(B, \neg W_0, R, \neg S) + P(B, \neg W_0, \neg R, S) +$
$P(B, \neg W_0, \neg R, \neg S).$

$P(B, \neg W_0, R, S) = P(B, S, \neg W_0, R) = 0.021$

$P(B, \neg W_0, R, \neg S) = P(B|\neg W_0, \neg S)\, P(\neg W_0|R)\, P(R|\neg S)\, P(\neg S)$

$$= (0.4)(0.3)(0.3)(0.75) \Rightarrow 0.027$$

$P(B, \neg W_0, \neg R, S) = P(B, S, \neg W_0, \neg R) = 0.024$.

$P(B, \neg W_0, \neg R, \neg S) = P(B|\neg W_0, \neg S)\, P(\neg W_0|\neg R)\, P(\neg R|\neg S)\, P(\neg S)$
$$= (0.4)(0.8)(0.7)(0.75) \Rightarrow 0.168.$$

$$\therefore \quad P(S|B, \neg W_0) = \frac{0.045}{0.24} = 0.1875 \ \text{Ans},$$

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