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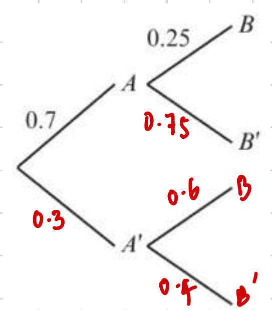
2.5: Tree diagrams

① $P(B|A) = 0.25$ $P(B|A') = 0.6$ $P(A) = 0.7$

a)



b) i) $P(A\cap B) = 0.7\times 0.25 = 0.175$ iii) $P(B'|A) = 0.75$

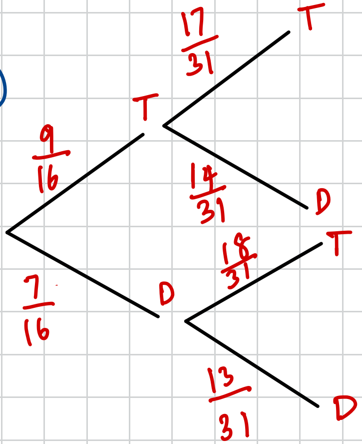
ii) $P(A'\cap B') = 0.3\times 0.4 = 0.12$ iv) $P(A|B) = \dfrac{P(B|A)\times P(A)}{P(B)}$

$\Rightarrow P(B) = P(B|A)\times P(A) + P(B|A')\times P(A')$

$\Rightarrow 0.25\times 0.7 + 0.6\times 0.3 = 0.355$

$\Rightarrow P(A|B) = \dfrac{0.25\times 0.7}{0.355} = \dfrac{35}{71}$

② a)



b) $P(T=2) = \dfrac{9}{16}\times\dfrac{17}{31} = \dfrac{153}{496}$

c) $P(T\cap D) = \dfrac{9}{16}\times\dfrac{14}{31} + \dfrac{7}{16}\times\dfrac{18}{31} = \dfrac{63}{124}$

d) Atleast one (D) $= \dfrac{63}{124} + \dfrac{7}{16}\times\dfrac{13}{31} = \dfrac{343}{496}$

(Two daffodils | at least one daffodil) $= \dfrac{\frac{91}{496}}{\frac{343}{496}}$

$\Rightarrow \dfrac{91}{343} = \dfrac{13}{49}$

③ Bag A → Black (B) = White (W) = m Bag B ⇒ White (W) = 2n; Black (B) m

a) Total no. of counters from both bags: $2n+3m$

Bag A: → $\dfrac{1}{2} \Rightarrow \dfrac{n}{2n} = \dfrac{1}{2}$ ⇒ Bag: B → $\dfrac{2}{3} = \dfrac{2m}{3m}$

$P(\text{Black}) = P(A)\times P(\text{Black}|A) + P(B)\times P(\text{Black}|B) = \dfrac{1}{2}\times\dfrac{1}{2} + \dfrac{1}{2}\times\dfrac{2}{3}$

$P(\text{Black}) = \dfrac{1}{4} + \dfrac{1}{3} = \dfrac{7}{12}$

b) Bag A: $\frac{n}{2n} = \frac{1}{2}$ Bag B: $\frac{m}{2m} = \frac{1}{3}$

$P(\text{White}) = P(A) \times P(\text{White}|A) + P(B) \times P(\text{White}|B) = \frac{1}{2} \times \frac{1}{2} + \frac{1}{2} \times \frac{1}{3}$

$\Rightarrow \frac{1}{4} + \frac{1}{6} = \frac{5}{12}$ $\quad P(\text{White}) = \frac{5}{12}$

$\Rightarrow P(A|\text{White}) = \frac{P(A) \times P(\text{White}|A)}{P(\text{White})} = \frac{\frac{1}{2} \times \frac{1}{2}}{\frac{5}{12}} = \frac{\frac{1}{\cancel{4}}}{\frac{5}{\cancel{12}_3}} = \frac{3}{5} = 0.6$

④ $P(T|T) = 0.5$ $\quad P(E|E) = 0.6$ $\quad P(T|E) = 0.4$ $\quad P(E|T) = 0.5$

$\Rightarrow P(X_2 = E | X_1 = T) \times P(T|E) = 0.4 \times 0.5 = 0.2$

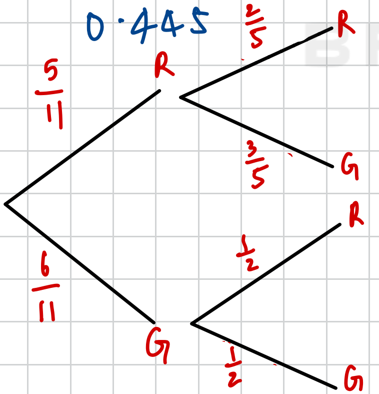
$\Rightarrow P(X_1 = T$ and T on Thursday$) = 0.25 + 0.2 = 0.45$

$P(E$ on Tuesday$) = 1 - 0.45 = 0.55.$

$P(E$ on Tuesday$) = (0.55 \times 0.4) + (0.5 \times 0.45) = 0.225 + 0.22$
$= 0.445$

$\Rightarrow \frac{0.4 \times 0.55}{0.445} = \frac{44}{89}$

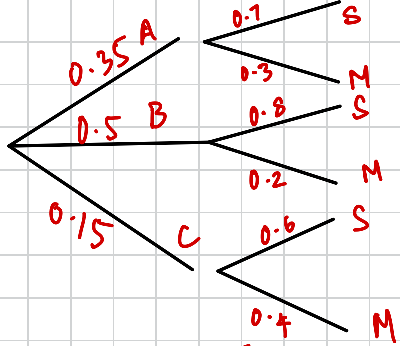
⑤ a)



b) $P(G \cup R|R) = \left(\frac{\cancel{5}}{11} \times \frac{2}{\cancel{5}}\right) + \left(\frac{\cancel{6}^{3}}{11} \times \frac{1}{\cancel{2}}\right) = \frac{5}{11}$

c) $P(R|R) = \frac{2}{5} = 0.4$

6) a)



b) i) $P(M|B) = 0.5 \times 0.2 = 0.1$

ii) $P(S) = (0.7 \times 0.35) + (0.5 \times 0.8) + (0.15 \times 0.6)$

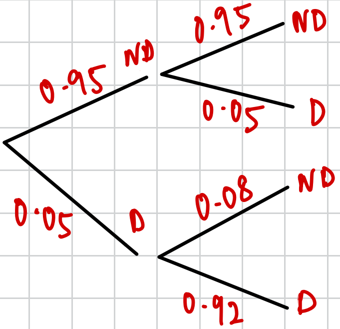
$= 0.735$

c) $P(C|M) \Rightarrow P(M) = 1 - P(S) = 1 - 0.735 = 0.265$

$P(C \cap M) = 0.15 \times 0.4$

$\Rightarrow P(C|M) = \dfrac{0.4 \times 0.15}{0.265} = \dfrac{12}{53}$

7) a)



b) $P(ND) = (0.95 \times 0.95) + (0.05 \times 0.08) = 0.9065$

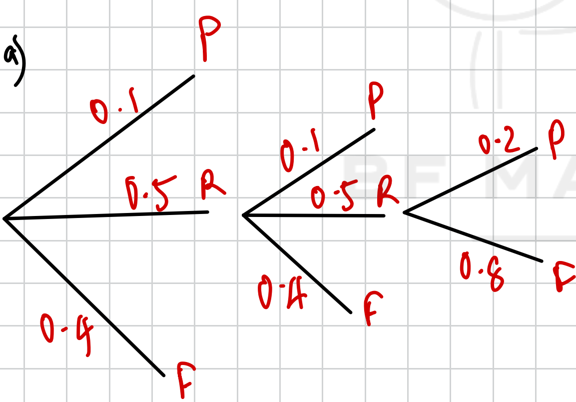
c) $P(ND|D) \Rightarrow 1 - P(ND) = 0.0935$

$P(ND \cap D) = 0.05 \times 0.95$

$\Rightarrow P(ND|D) = \dfrac{0.05 \times 0.95}{0.0935} = \dfrac{95}{187}$

d) Only 49% of the microchips that fail the test actually have defeats. Therefore the test is not effective.

8) a)



b) $P(P) = 0.1 + (0.5 \times 0.1) + (0.5 \times 0.5 \times 0.2) = 0.2$

c) $P(R|P) = \dfrac{(0.5 \times 0.1) + (0.25 \times 0.2)}{0.2}$

$= \dfrac{0.1}{0.2} = 0.5$