Section 1: Working with probability

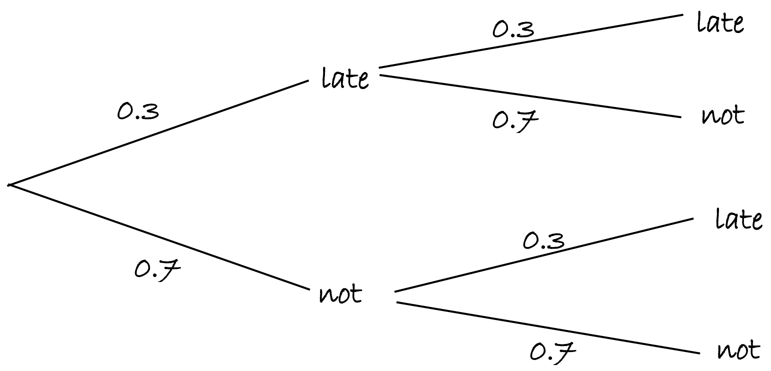
Solutions to Exercise level 2

1.

	1	2	3	4	5	6	7	8
1	0	1	2	3	4	5	6	7
2	1	0	1	2	3	4	5	6
3	2	1	0	1	2	3	4	5
4	3	2	1	0	1	2	3	4
5	4	3	2	1	0	1	2	3
6	5	4	3	2	1	0	1	2
7	6	5	4	3	2	1	0	1
8	7	6	5	4	3	2	1	0

Outcome	Probability
0	$\frac{8}{64}=\frac{1}{8}$
1	$\frac{14}{64}=\frac{7}{32}$
2	$\frac{12}{64}=\frac{3}{16}$
3	$\frac{10}{64}=\frac{5}{32}$
4	$\frac{8}{64}=\frac{1}{8}$
5	$\frac{6}{64}=\frac{3}{32}$
6	$\frac{4}{64}=\frac{1}{16}$
7	$\frac{2}{64}=\frac{1}{32}$

2. (i)



(ii) (A) P(both on time) $=0.7\times0.7=0.49$

(B) P(one on time) $=0.7\times0.3+0.3\times0.7=0.42$

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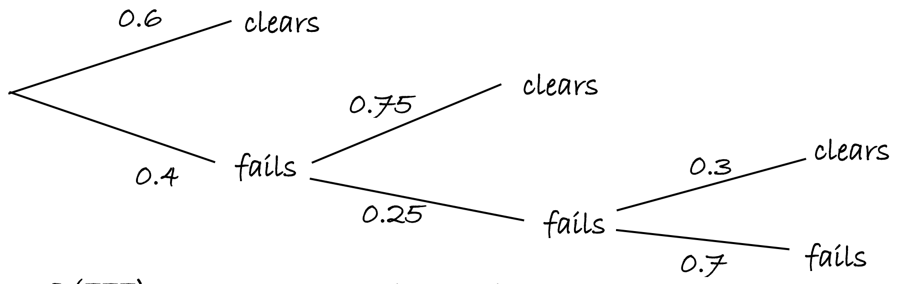
3. (i)



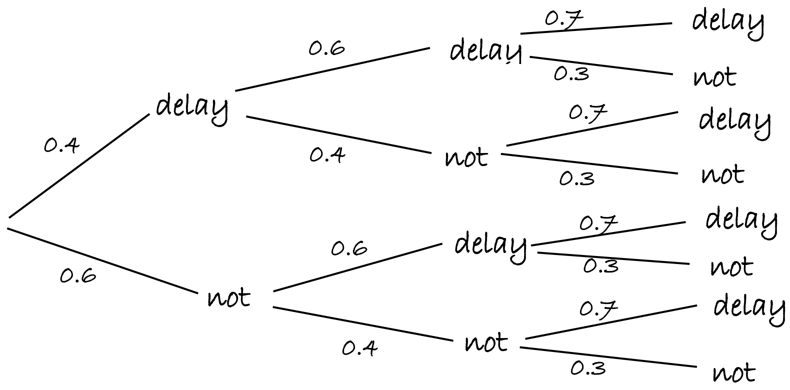
(ii) (A) $P(FFF) = 0.4 \times 0.25 \times 0.7 = 0.07$

(B) $P(FP) + P(FFP) = (0.4 \times 0.75) + (0.4 \times 0.25 \times 0.3)$

$= 0.3 + 0.03 = 0.33$

(C) $P(\text{successfully clears}) = 1 - P(FFF) = 1 - 0.07 = 0.93$

4. (i)



(ii) (A) $P(DDD) = 0.4 \times 0.6 \times 0.7 = 0.168$

(B) $P(\text{delayed at one}) = P(DNN) + P(NDN) + P(NND)$

$= (0.4 \times 0.4 \times 0.3) + (0.6 \times 0.6 \times 0.3) + (0.6 \times 0.4 \times 0.7)$

$= 0.324$

(C) $P(\text{delayed at none}) = 0.6 \times 0.4 \times 0.3 = 0.072$

$P(\text{delayed at one}) = 0.324$ (from (ii))

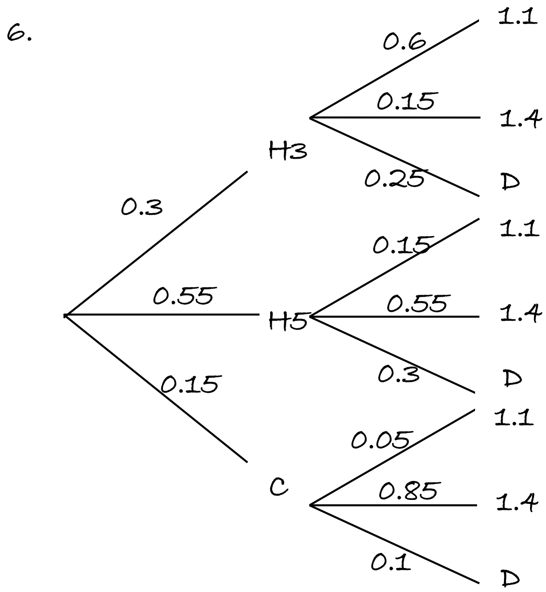
$P(\text{delayed at two or more}) = 1 - 0.072 - 0.324 = 0.604$

5. (i) $P(RB) = \frac{2}{5} \times \frac{3}{5} = \frac{6}{25}$

(ii) $P(BB) = \frac{3}{5} \times \frac{3}{5} = \frac{9}{25}$

(iii) $P(\text{same colours}) = P(RR \text{ or } BB) = P(RR) + P(BB) = \frac{2}{5} \times \frac{2}{5} + \frac{9}{25} = \frac{13}{25}$

6.



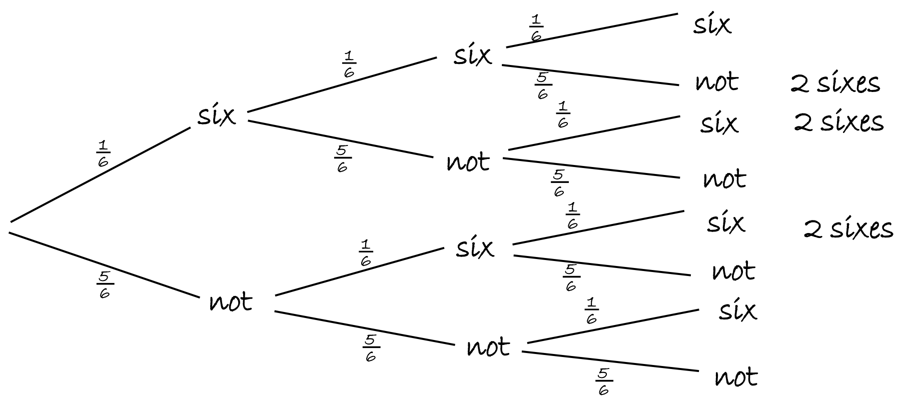
(i) (a) P(5 door hatchback, 1.4 petrol) $= 0.55 \times 0.55 = 0.3025$

(b) P(Diesel) = P(H3D) + P(H5D) + P(CD)
$= 0.3 \times 0.25 + 0.55 \times 0.3 + 0.15 \times 0.1 = 0.255$

(c) P(Convertible or 1.4-litre) = P(C) + P(1.4)
= P(C) + P(H3 1.4) + P(H5 1.4)
$= 0.15 + 0.3 \times 0.15 + 0.3025 = 0.4975$

(ii) P(same engine) = P(DD) + P(1.4 , 1.4) + P (1.1 , 1.1)
$= 0.255^2 + 0.475^2 + (0.3 \times 0.6 + 0.55 \times 0.15 + 0.15 \times 0.05)^2$
$= 0.364$

7.



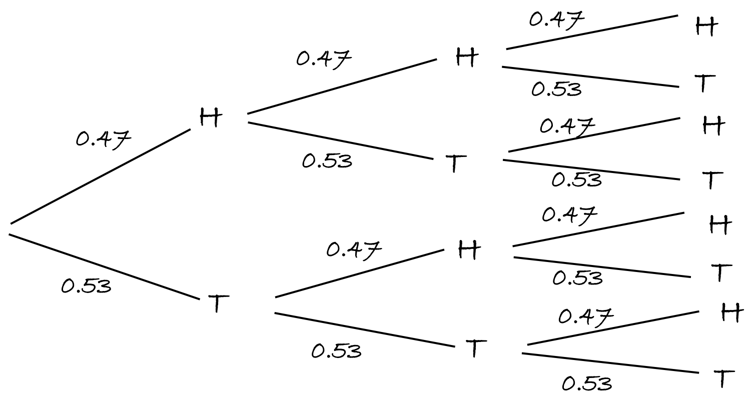
$$P(\text{exactly 2 sixes}) = \left(\tfrac{1}{6}\times\tfrac{1}{6}\times\tfrac{5}{6}\right)+\left(\tfrac{1}{6}\times\tfrac{5}{6}\times\tfrac{1}{6}\right)+\left(\tfrac{5}{6}\times\tfrac{1}{6}\times\tfrac{5}{6}\right)$$
$$= \tfrac{5}{216}+\tfrac{5}{216}+\tfrac{5}{216}$$
$$= \tfrac{15}{216}$$
$$= \tfrac{5}{72}$$

8. P(a bulb is not faulty) $= 0.95$

P(all 10 are not faulty) $= (0.95)^{10} = 0.599$ (3 s.f.)

P(at least one is faulty) $= 1 - 0.599 = 0.401$ (3 s.f.)

9.



P(three heads) $= 0.47 \times 0.47 \times 0.47 = 0.103823$

P(three tails) $= 0.53 \times 0.53 \times 0.53 = 0.148877$

P(two heads and one tail) $= (0.47 \times 0.47 \times 0.53) + (0.47 \times 0.53 \times 0.47)$

$+ (0.53 \times 0.47 \times 0.47)$

$= 0.351231$

P(two tails and one head) $= (0.53 \times 0.53 \times 0.47) + (0.53 \times 0.47 \times 0.53)$

$+ (0.47 \times 0.53 \times 0.53)$

$= 0.396069$

The most likely outcome is two tails and one head.

Clearly 2 tails and 1 head will have a larger probability than 1 tail and 2 heads, since 0.53 is greater than 0.47.

10. Win: I gain £10, probability 0.05

Lose: I lose 50p, probability 0.95

Expected winnings $= 10 \times 0.05 + (-0.5 \times 0.95) = 0.025$

Expected winnings = 2.5p gain.