

Task 1

mark	1st	2:1	2:2	3 (Pass)	Fail
# students	4	10	12	5	3

Total students: $4 + 10 + 12 + 5 + 3 = 34$

- a) $P(\text{mark} = 1st) = 4/34 = 0.11764$
 b) $P(\text{mark} = 2:1) = 10/34 = 0.29411$
 c) $P(\text{mark} = 2:2) = 12/34 = 0.35294$
 d) $P(\text{mark} = 3) = 5/34 = 0.147058$
 e) $P(\text{mark} = \text{fail}) = (4 + 10 + 12 + 5) / 34 = 31/34 = 0.91176$

	Pass	Fail	
male	20	2	22
Female	11	1	12
	31	3	34

- f) $P(\text{Pass}) = \text{Pass} / \text{total} = 31/34 = 0.91176$
 g) $P(\text{Pass, female}) = \frac{\text{Females pass}}{\text{females}} = 11/12 = 0.91666$

	Sunny	Rainy
hot	0.3	0.1
Cold	0.1	0.5

- h) $P(\text{sunny}) = 0.3 + 0.1 = 0.4$
 i) $P(\text{hot}) = 0.3 + 0.1 = 0.4$
 j) $P(\text{hot} | \text{sunny}) = \text{hot/sunny} = 0.3/0.4 = 0.75$
 k) $P(\text{rainy} | \text{cold}) = \text{rain/cold} = 0.5/0.6 = 0.8333$

x	y	$P(x, y)$
x	y	0.2
x	$\neg y$	0.3
$\neg x$	y	0.4
$\neg x$	$\neg y$	0.1
		$= 1.0$

becomes:

x	y	$\neg y$	
x	0.2	0.3	0.5
$\neg x$	0.4	0.1	0.5
	0.6	0.4	1.0

$\sum_{e \in S} P(e) = 1$

$$\begin{aligned}
 1) P(x \cap y) &= 0.2 \text{ intersection of } x \text{ and } y \\
 2) P(x) &= P(x \cap y) + P(x \cap \neg y) = 0.2 + 0.3 = 0.5 \\
 3) P(x \cup y) &= P(x) + P(y) - P(x \cap y) \\
 &= 0.5 + P(y) - P(x \cap y) \\
 &= 0.5 + P(y \cap x) + P(y \cap \neg x) - 0.2 \\
 &= 0.5 + 0.6 - 0.2 \\
 &= 0.9
 \end{aligned}$$

$$\begin{aligned}
 1) P(x) &= 0.5 \\
 2) P(y) &= 0.6 \\
 3) P(x|y) &= P(x \cap y) / P(y) \\
 &= 0.2 / 0.6 \\
 &= 0.333
 \end{aligned}$$

$$\begin{aligned}
 4) P(\neg x|y) &= P(\neg x \cap y) / P(y) \\
 &= 0.4 / 0.6 \\
 &= 0.6666
 \end{aligned}$$

$$s) P(\neg y | x) =$$

	y	$\neg y$	
x	0.2	0.3	0.5
$\neg x$	0.4	0.1	0.5
	0.6	0.4	1.0

$$\begin{aligned}
 &= P(x \cap \neg y) / P(x) \\
 &= 0.3 / 0.5 \\
 &= 0.6
 \end{aligned}$$

$$\begin{aligned}
 t) P(\text{sun}) &= P(w=\text{sun}) \\
 &= P(0.3 + 0.1 + 0.1 + 0.15) \\
 &= 0.65
 \end{aligned}$$

$$\begin{aligned}
 u) P(\text{sun} | \text{winter}) &= P(w=\text{sun} | s=\text{winter}) \\
 &= 0.1 + 0.15 / 0.1 + 0.1 + 0.05 \\
 &\quad + 0.15 + 0.2 \\
 &= 0.25 / 0.6 \\
 &= 0.41666
 \end{aligned}$$

$$\begin{aligned}
 v) P(\text{sun} | \text{winter}, \text{hot}) &= P(w=\text{sun} | s=\text{winter}, T=\text{hot}) \\
 &= 0.1 / 0.15 \\
 &= 0.66667
 \end{aligned}$$

Task 2

HAMBURGER EATEN = HE

$$a) P(HE | KJ) = 0.9$$

$$P(KJ) = 1/100,000$$

$$P(HE) = 0.5$$

$$P(KJ | HE) = \underline{\underline{2/100,000}}$$

$d = \text{disease}$ $+$ = test

$$b) P(d) = 1/10000$$

$$P(+|d) = 0.99$$

$$P(-|+d) = 0.95$$

$$P(d|+) = \underline{\underline{1.976285 \times 10^{-3}}}$$

Task 2b)

$$P(+|d) = P(+ \wedge d) / P(d) = 0.99$$

$$P(+| \neg d) = P(+ \wedge \neg d) / P(\neg d) = 0.95$$

$$\textcircled{a} P(d) = 1/10,000$$

There for:

$$\begin{aligned} \textcircled{b} P(\neg d) &= \frac{9999}{10,000} = 0.9999 \\ &= 1 - P(d) \end{aligned}$$

	D	$\neg D$
T	$\textcircled{c} \quad 9.9 \times 10^{-5}$	
$\neg T$	$\textcircled{d} \quad 1 \times 10^{-6}$	
	$\textcircled{a} \quad 1 \times 10^{-4}$	$\textcircled{b} \quad 0.9999$

$$\textcircled{c} = P(+|d) = P(+ \wedge d) / P(d) = 0.99$$

$$= \frac{+}{d} = 0.99$$

$$= \frac{+}{1 \times 10^{-4}} = 0.99 \rightarrow + = \frac{0.99 \times 1 \times 10^{-4}}{1} = \underline{\underline{9.9 \times 10^{-5}}}$$

$$\textcircled{d} = 1 \times 10^{-4} - 9.9 \times 10^{-5} = 1 \times 10^{-6}$$

PTO

	D	$\neg D$	
T	(E) 9.9×10^{-5}	(G) 0.049995	(H) 0.050094
$\neg T$	(A) 1×10^{-6}	(F) 0.949905	(J) 0.949906
	(I) 1×10^{-4}	(B) 0.9999	(C) 1

$$(e) \quad P(\neg T | \neg D) = P(\neg T \wedge \neg D) / P(\neg D) = 0.95$$

$$= \frac{\neg T}{P(\neg D)} = 0.95$$

$$= \frac{\neg T}{0.9999} = 0.95$$

$$= \neg T = 0.95 \times 0.9999$$

$$\neg T = 0.949905$$

$$(F) = 1 \times 10^{-6} + 0.949905 = 0.949906$$

$$(G) = 0.9999 - 0.949905 = 0.049995$$

$$(H) = 0.049995 + 9.9 \times 10^{-5} = 0.050094$$

$$(I) = 1 \times 10^{-4} + 0.9999 = 1$$

$$(J) = 0.050094 + 0.949906 = 1$$

$$\therefore P(D | T) = P(D \wedge T) / P(T)$$

$$= \frac{9.9 \times 10^{-5}}{0.050094}$$

$$= \underline{\underline{1.976285 \times 10^{-3}}}$$