(1) (a)

$$P(L=l_1) = \frac{1000}{3000} = \frac{1}{3}$$

$$P(L=l_2) = \frac{2000}{3000} = \frac{2}{3}$$

$$P(D=+d \mid L=l_1) = \frac{100}{1000}$$

$$P(P=+d \mid L=l_2) = \frac{150}{2000} = \frac{3}{40}$$

$$P(D=+d) = P(D=+d, L=l_1) + P(D=+d, L=l_2)$$

$$= P(+d \mid l_1) \cdot P(l_1) + P(+d \mid l_2)\, P(l_2)$$

$$= \frac{1}{10} \times \frac{1}{3} + \frac{3}{40} \times \frac{2}{3} = \frac{1}{12}$$

$$P(L=l_1 \mid D=+d) = \frac{P(D=+d \mid L=l_1)\, P(L=l_1)}{P(D=+d)}$$

$$= \frac{\left(\frac{1}{10}\right)\left(\frac{1}{3}\right)}{\left(\frac{1}{12}\right)} = \frac{2}{5} \quad \text{(Ans)}$$

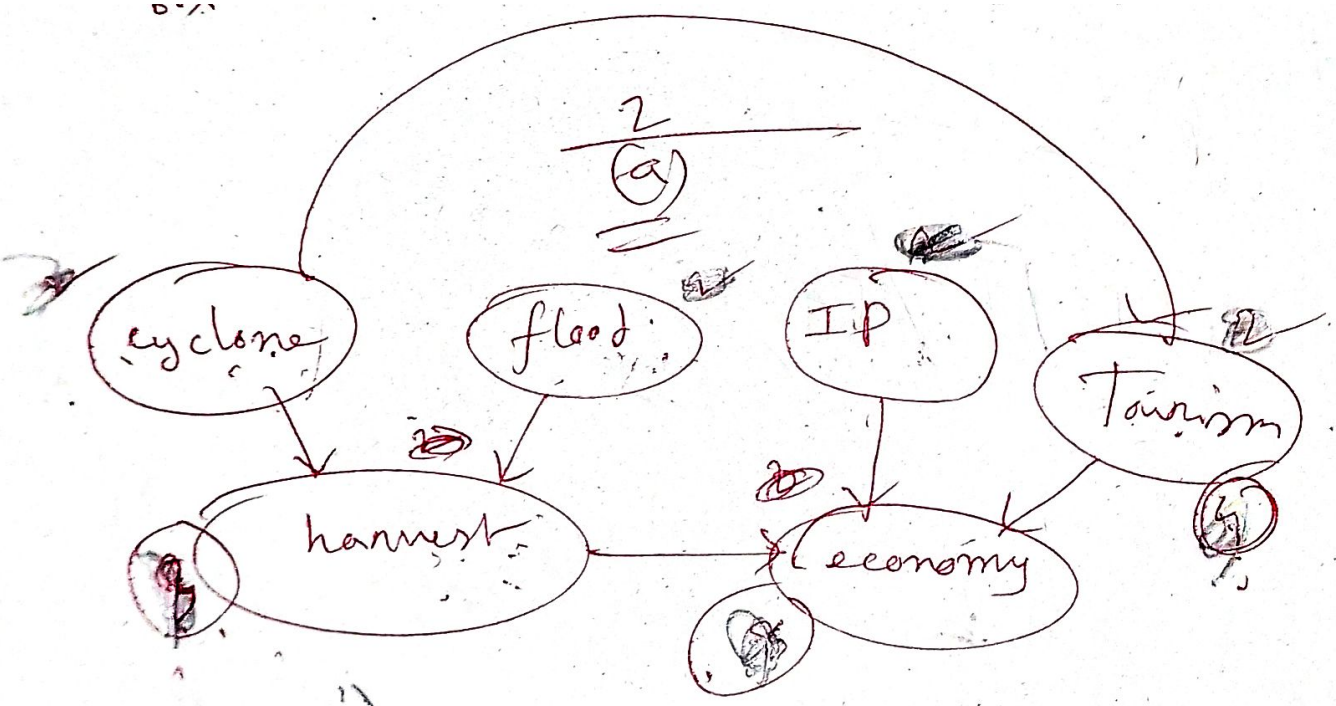
(1)(b)

i)

Gender (G)	Age (A)	Playtype (P)	P(G, A, P)
M	4	OT	20/200
M	4	SB	20/200
M	4	PG	10/200
M	5	OT	12/200
M	5	SB	6/200
M	5	PG	12/200
M	6	OT	6/200
M	6	SB	6/200
M	6	PG	8/200
F	4	OT	16/200
F	4	SB	12/200
F	4	PG	12/200
F	5	OT	6/200
f	5	SB	6/200
F	5	PG	8/200
F	6	OT	12/200
f	6	SB	8/200
F	6	PG	20/200

2

(a)



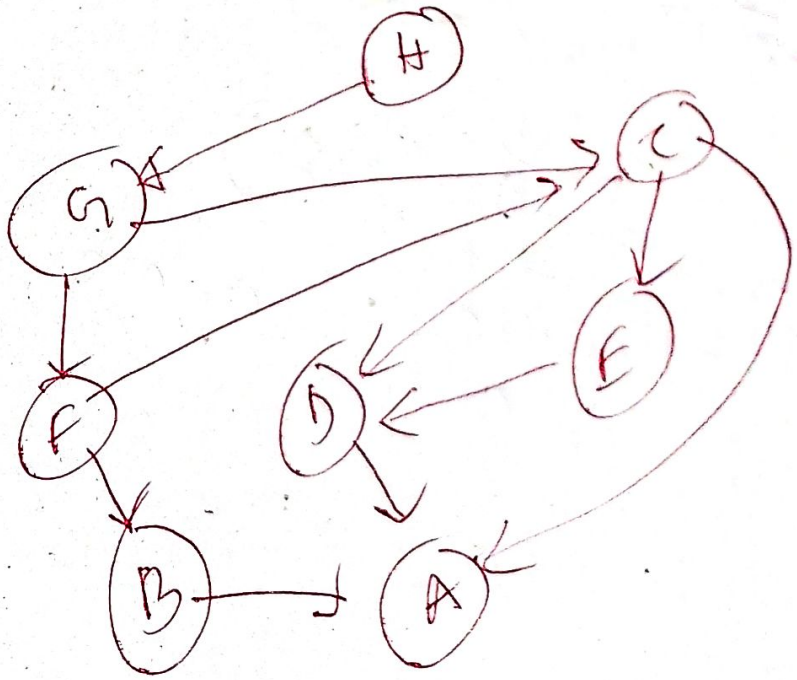
$= 34$

ii) assumming binary values for each random variables. there are 6 nodes, so

2^6

4)

(1)



(e)

i)

$$P(d_2) = P(d_2|B)\,P(B)$$

$$= P(d_2|b_1)\,P(b_1) + P(d_2|b_2)\,P(b_2) + P(d_2|b_3)\,P(b_3)$$

$$= (0.25)(0.5) + (0.45)(0.3) + (0.15)(0.2)$$

$$= 0.375 + 0.135 + 0.03$$

$$= 0.29$$

ii)

$$P(e_2|a_3, c_1, d_2) = \frac{P(e_2, a_3, c_1, d_2)}{P(a_3, c_1, d_2)}$$

$$\therefore P(e_2, a_3, c_1, d_2)$$

$$= P(e_2, a_3, b_1, c_1, d_2) + P(e_2, a_3, b_2, c_1, d_2) + P(e_2, a_3, b_3, c_1, d_2)$$

$$= P(a_3, b_1, c_1, d_2, e_2)$$

$$= P(e_2 | c_1, d_2) P(a_3) P(b_1) P(c_1 | a_3, d_2) P(d_2 | b_1)$$

$$+ P(e_2 | c_1, d_2) P(a_3) P(b_2) P(c_1 | a_3, d_2) P(d_2 | b_2)$$

$$+ P(e_2 | c_1, d_2) P(a_3) P(b_3) P(c_1 | a_3, d_2) P(d_2 | b_3)$$

$$= 0.85 \times 0.7 \times 0.5 \times 0.8 \times 0.25$$

$$+ 0.85 \times 0.7 \times 0.3 \times 0.8 \times 0.45$$

$$+ 0.85 \times 0.7 \times 0.2 \times 0.8 \times 0.15$$

$= 0.0595 + 0.06426 + 0.01428$

$= 0.13804.$

$\therefore P(a_3, c_1, d_2) = P(a_3, c_1, d_2, e_2) + P(a_3, c_1, d_2, e_1)$

$P(a_3, c_1, d_2, e_1) =$

$P(a_3, b_1, c_1, d_2, e_1) +$

$P(a_3, b_2, c_1, d_2, e_1) +$

$P(a_3, b_3, c_1, d_2, e_1)$

$= (0.1 \times 0.5)$

$= P(a_3) P(b_1) P(c_1 | a_3, d_2) P(d_2 | b_1) P(e_1 | c_1, d_2)$

$+ P(a_3) P(b_2) P(c_1 | a_3, d_2) P(d_2 | b_2) P(e_1 | c_1, d_2)$

$$+ P(a3)\,P(b3)\,P(c_1 \mid a3, d2)\,P(d2 \mid b3)\,P(e_1 \mid c_1, d2)$$

$$= 0.7 \times 0.5 \times 0.8 \times 0.25 \times 0.15 +$$

$$0.7 \times 0.5 \times 0.8 \times 0.45 \times 0.15 +$$

$$0.7 \times 0.2 \times 0.8 \times 0.15 \times 0.15$$

$$= 0.0105 + 0.01134 + 0.00252$$

$$= 0.02436$$

$$P(a3, c_1, d2) = 0.13804 + 0.02436$$

$$= 0.1624$$

$$P(e_2 \mid a3, c_1, d2) = \frac{P(e_2, a3, c_1, d2)}{P(a3, c_1, d2)}$$

$$= \frac{0.13804}{0.1624}$$

$$= 0.85$$

(4)

		category	
		sports	informatic
goal	yes	3/6	1/5
	no	3/6	4/5

		category	
		sports	informatics
tutor	yes	1/6	3/5
	no	5/6	2/5

		category	
		sports	informatic
variance	yes	2/6	3/5
	no	4/6	2/5

		category	
		sports	informatics
speed	yes	3/6	1/5
	no	3/6	4/5

		category	
		sports	informatics
drink	yes	3/6	1/5
	no	3/6	4/5

		category	
		sports	informatics
defence	yes	4/6	1/5
	no	2/6	4/5

		category	
		sports	informatics
performance	yes	4/6	3/5
	no	2/6	2/5

		category	
		sports	informatics
field	yes	4/6	1/5
	no	2/6	4/5

$$P(\text{sports}) = \frac{6}{11}$$

$$P(\text{informatics}) = \frac{5}{11}$$

Here Given new

(goal=yes, Tuton=No, variance=No, speed=yes, drink=yes, defence=No, performance=Yes, field=Yes)

Nd = New document

$$P(sports \mid Nd) = \frac{P(sports, Nd)}{P(Nd)}$$

$$P(informatics \mid Nd) = \frac{P(informatics, Nd)}{P(Nd)}$$

$$P(sports \mid Nd) = P(sports) \; P(goal=yes \mid spo) \; P(tutor=No \mid spo) \; P(variance=No \mid spo) \; P(speed=yes \mid spo) \; P(drink=yes \mid spo) \; P(defence=No \mid spo) \; P(performance=yes \mid spo) \; P(field=yes \mid spo)$$

$$= \frac{6}{11} \times \frac{3}{6} \times \frac{5}{6} \times \frac{4}{6} \times \frac{3}{6} \times \frac{3}{6} \times \frac{2}{6} \times \frac{4}{6} \times \frac{4}{6}$$

$$= 0.000561$$

$$= 0.000561$$

$$P(info, No) = P(info)\, P(goal=yes \mid info)$$
$$P(tutor=No \mid info)\, P(variance=No \mid info)$$
$$P(speed=yes \mid info)\, P(drink=yes \mid info)$$
$$P(defence=No \mid info)\, P(performance=yes \mid info)$$
$$P(field=yes \mid info)$$

$$= \left(\frac{5}{11}\right) \times \left(\frac{1}{5}\right) \times \left(\frac{2}{5}\right) \times \left(\frac{2}{5}\right) \times \left(\frac{1}{5}\right) \times \left(\frac{1}{5}\right) \times \left(\frac{4}{5}\right) \times \left(\frac{2}{5}\right) \times \left(\frac{1}{5}\right)$$

$$= 5.585454545 \times 10^{-5}$$

$$P(No) = 5.667854545 \times 10^{-3}$$

$$P(sports \mid No) = \frac{P(sport, No)}{P(No)}$$

$$= \frac{0.005612}{5.667854545 \times 10^{-3}}$$

$$= 0.09$$

$P(\text{informatics} \mid \text{No}) = \frac{5.58 \times 5.4 \times 5.4 \times 5 \times 10^{-5}}{5.6678 \times 5.4 \times 5.4 \times 5 \times 10^{-3}}$

$= 9.85461871 \times 10^{-3}$

≈ 0.0099

Ans: sports.

(iii) ~~$P(b_1 | c_2, d_1)$~~

$$P(b_1 | c_2, d_1) = \frac{P(b_1, c_2, d_1)}{P(c_2, d_1)}$$

~~$3 \times 2 = 6$~~

a_1
~~a_2~~
a_3

e_1 a_1
e_1 a_2
e_1 a_3
e_2 a_1
e_2 a_2
e_2 a_3

$$P(b_1, c_2, d_1) = P(e_1, a_1, b_1, c_2, d_1)$$
$$+ P(e_1, a_2, b_1, c_2, d_1)$$
$$+ P(e_1, a_3, b_1, c_2, d_1)$$
$$+ P(e_2, a_1, b_1, c_2, d_1)$$
$$+ P(e_2, a_2, b_1, c_2, d_1)$$
$$+ P(e_2, a_3, b_1, c_2, d_1)$$

$$= P(e_1 | c_2, d_1)\, P(a_1)\, P(b_1)\, P(c_2 | a_1, d_1)\, P(d_1 | b_1) +$$

$$P(e_1 | c_2, d_1)\, P(a_2)\, P(b_1)\, P(c_2 | a_2, d_1)\, P(d_1 | b_1) +$$

$$P(e_1 | c_2, d_1)\, P(a_3)\, P(b_1)\, P(c_2 | a_3, d_1)\, P(d_1 | b_1) +$$

$$P(e_2 | c_2, d_1)\, P(a_1)\, P(b_1)\, P(c_2 | a_1, d_1)\, P(d_1 | b_1) +$$

$$P(e_2 | c_2, d_1)\, P(a_2)\, P(b_1)\, P(c_2 | a_2, d_1)\, P(d_1 | b_1) +$$

$$P(e_2 | c_2, d_1)\, P(a_3)\, P(b_1)\, P(c_2 | a_3, d_1)\, P(d_1 | b_1)$$

$$= (0.8 \times 0.2 \times 0.5 \times 0.5 \times 0.75) + (0.8 \times 0.1 \times 0.5 \times 0.8 \times 0.75) + (0.8 \times 0.7 \times 0.5 \times 0.9 \times 0.75) + (0.2 \times 0.2 \times 0.5 \times 0.5 \times 0.75) + (0.2 \times 0.1 \times 0.5 \times 0.8 \times 0.75) + (0.2 \times 0.7 \times 0.5 \times 0.9 \times 0.75)$$

$$= 0.03 + 0.024 + 0.189 + 0.0075 + 0.006 + 0.041725$$

$$= 0.303775$$

$$P(b_2, c_2, d_1) = P(e_1, a_1, b_2, c_2, d_1) + P(e_1, a_2, b_2, c_2, d_1) + P(e_1, a_3, b_2, c_2, d_1) + P(e_2, a_1, b_2, c_2, d_1) + P(e_2, a_2, b_2, c_2, d_1) + P(e_2, a_3, b_2, c_2, d_1)$$

$$= P(e_1 | c_2, d_1) P(a_1) P(b_2) P(c_2 | a_1, d_1) P(d_1 | b_2) + P(e_1 | c_2, d_1) P(a_2) P(b_2) P(c_2 | a_2, d_1) P(d_1 | b_2) + P(e_1 | c_2, d_1) P(a_3) P(b_2) P(c_2 | a_3, d_1) P(d_1 | b_2) + P(e_2 | c_2, d_1) P(a_1) P(b_2) P(c_2 | a_1, d_1) P(d_1 | b_2) + P(e_2 | c_2, d_1) P(a_2) P(b_2) P(c_2 | a_2, d_1) P(d_1 | b_2) + P(e_2 | c_2, d_1) P(a_3) P(b_2) P(c_2 | a_3, d_1) P(d_1, b_2)$$

$$= (0.8 \times 0.2 \times 0.3 \times 0.5 \times 0.55) + (0.8 \times 0.1 \times 0.3 \times 0.8 \times 0.55) + (0.8 \times 0.7 \times 0.3 \times 0.9 \times 0.55) + (0.2 \times 0.2 \times 0.3 \times 0.5 \times 0.55) + (0.2 \times 0.1 \times 0.3 \times 0.8 \times 0.55) + (0.2 \times 0.7 \times 0.3 \times 0.9 \times 0.55)$$

$$= 0.13365$$

$P(b_3, e_2, d_1) = P(e_1, a_1, b_3, c_2, d_1) + P(e_1, a_2, b_3, c_2, d_1) + P(e_1, a_3, b_3, c_2, d_1) + P(e_2, a_1, b_3, c_2, d_1) + P(e_2, a_2, b_3, c_2, d_1) + P(e_2, a_3, b_3, c_2, d_1)$

$= P(e_1|c_2, d_1) P(a_1) P(b_3) P(c_2|a_1, d_1) P(d_1|b_3)$
$+ P(e_1|c_2, d_1) P(a_2) P(b_3) P(c_2|a_2, d_1) P(d_1|b_3)$
$+ P(e_1|c_2, d_1) P(a_3) P(b_3) P(c_2|a_3, d_1) P(d_1|b_3)$
$+ P(e_2|c_2, d_1) P(a_1) P(b_3) P(c_2|a_1, d_1) P(d_1|b_3)$
$+ P(e_2|c_2, d_1) P(a_2) P(b_3) P(c_2|a_2, d_1) P(d_1|b_3)$
$+ P(e_2|c_2, d_1) P(3) P(b_3) P(c_2|a_3, d_1) P(d_1|b_3)$

$= (0.8 \times 0.2 \times 0.2 \times 0.5 \times 0.85) + (0.8 \times 0.1 \times 0.2 \times 0.8 \times 0.85)$
$+ (0.8 \times 0.7 \times 0.2 \times 0.9 \times 0.85) + (0.2 \times 0.2 \times 0.2 \times 0.5 \times 0.85)$
$+ (0.2 \times 0.1 \times 0.2 \times 0.8 \times 0.85) + (0.2 \times 0.7 \times 0.2 \times 0.9 \times 0.85)$

$= 0.1377$

$\therefore P(c_2, d_1) = 0.30375 + 0.13365 + 0.1377$

$= 0.5751$

$$P(b_1 | c_2, d_1) = \frac{P(b_1, c_2, d_1)}{P(c_2 d_1)}$$

$$= \frac{0.30375}{0.57751}$$

$$= 0.528169$$

$$= 0.53$$