Q2

(a) confidence $= \frac{15}{20} = 75\%$

However, in total the coffee frequency is $\frac{90}{100} = 90\%$ larger than the confidence, therefore. the confidence isn't a useful measure for the Rule.

(b) ① when $Lift(X,Y) = \frac{P(Y|X)}{P(Y)} = \frac{P(X,Y)}{P(X)P(Y)} = 1$

$P(X,Y) = P(X)P(Y)$ X and Y are independent

② when $Lift(X,Y) > 1 \Rightarrow \begin{cases} P(Y|X) > P(Y) \\ P(X|Y) > P(X) \end{cases}$

The probability of Y event happen in condition of X happen is Larger than the probability of Y happen itself.

shows that $X \to Y$ Similarly $Y \to X$. They are positively related

③ when $Lift(X,Y) < 1 \Rightarrow P(Y|X) < P(Y)$

The probability of Y event happen in condition of X happen is Smaller than the probability of Y happen itself.

shows that $X \to Y'$ .Similarly $Y \to X'$

They are negatively related

(c) Let X = Tea, Y = coffee. $Lift(X,Y) = \frac{15/20}{90/100} = \frac{5}{6}$

	Y	Y'
X	$\frac{5}{6}$	$\frac{5}{2}$
X'	$\frac{25}{24}$	$\frac{5}{8}$

$Lift(X,Y') = \frac{5/20}{10/100} = \frac{5}{2}$

$Lift(X',Y) = \frac{75/80}{90/100} = \frac{25}{24}$

$Lift(X',Y') = \frac{5/80}{10/100} = \frac{5}{8}$

$C = Lift(X,Y) = \frac{5}{6} < 1$ therefore they are negatively related.

Q2 :

First

Consignment	cluster
1	1
2	1
3	2
4	2
5	3
6	1

the cluster center is

$C_1 = (7.0, 4.667)$

$C_2 = (2.0, 7.0)$

$C_3 = (2.0, 8.0)$

Second

Consignment	cluster
1	1
2	2
3	2
4	2
5	3
6	1

the cluster center is

$C_1 = (8, 5)$

$C_2 = (3, 14/3)$

$C_3 = (2, 8)$

Third.

Consignment	cluster
1	1
2	2
3	2
4	3
5	3
6	1

the cluster center is

$C_1 = (8, 5)$

$C_2 = (7/2, 4)$

$C_3 = (2, 7)$

Q3 (a)

P(B|S,A)

	P(B=1 | S, A)	P(B=0 | S, A)
P(B | S=0, A=0)	0	1.0
P(B | S=0, A=1)	0.8	0.2
P(B | S=1, A=0)	0.9	0.1
P(B | S=1, A=1)	0.99	0.01

P(S|A)

	P(S=1 | A)	P(S=0 | A)
P(S | A=0)	0.4	0.6
P(S | A=1)	0.01	0.99

P(A)

P(A=1)	P(A=0)
0.2	0.8

(b) $P(B, S, A) = P(B, S \mid A) \cdot P(A)$

$= P(B \mid S, A) \cdot P(S \mid A) \cdot P(A)$.

Q4 : (a)

B	S	A	P(B, A, S)
F	F	F	$1 \times 0.6 \times 0.8 = 0.48$
F	F	T	$0.2 \times 0.99 \times 0.2 = 0.0396$
F	T	F	$0.4 \times 0.4 \times 0.8 = 0.032$
F	T	T	$0.01 \times 0.01 \times 0.2 = 0.00002$
T	F	F	$0 \times 0.6 \times 0.8 = 0$
T	F	T	$0.8 \times 0.99 \times 0.2 = 0.1584$
T	T	F	$0.9 \times 0.4 \times 0.8 = 0.288$
T	T	T	$0.99 \times 0.01 \times 0.2 = 0.00198$

(b). $P(A=T \mid B=T) = \frac{P(A, B)}{P(B)} = \frac{0.1584 + 0.00198}{0.288 + 0.00198 + 0.1584 + 0}$

$= 0.3577$

Q5 (a) $X \rightarrow Y$.

$$\#|X| = \binom{5}{1} + \binom{5}{2} + \binom{5}{3} + \binom{5}{4} + \binom{5}{5} = 2^5 - 1 = 31$$

$$\#|Y| = 5$$

Total $= 5 \times (2^5 - 1) = 155$

(b) $(2^N - 1) \cdot N = 2^N \cdot N - N$

Q6

$S(A) = \frac{5}{6}$
$S(B) = \frac{1}{2}$
$S(C) = \frac{5}{6}$
$\Rightarrow$. $\{A, B, C\}$

$S(D) = \frac{1}{3}$ $< 50\%$ (discard)

$S(E) = \frac{1}{3}$ $< 50\%$ (discard)

$c(A \rightarrow B) = \frac{3}{5}$ $< 70\%$ (discard)

$c(A \rightarrow C) = \frac{4}{5}$

$c(B \rightarrow A) = \frac{3}{4}$

$c(B \rightarrow C) = \frac{3}{4}$

$c(C \rightarrow A) = \frac{3}{5}$

the 4 rule having minimum $S = 50\%$ minimum confidence 70%

$c(C \rightarrow B) = \frac{3}{5}$ $< 70\%$ (discard)