UTM UNIVERSITI TEKNOLOGI MALAYSIA	DEPARTMENT OF APPLIED COMPUTING		
	SUBJECT: PROBABILITY & STATISTICAL DATA ANALYSIS		
	ASSESSMENT: ASSIGNMENT 2	**CODE:** SECI 2143	**WEEK:** 7

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Question 1, 2 ,3	Wong Hui Shi
Question 4 ,5	Soh Zen Ren
Question 6 ,7	Teoh Wei Jian

Assignment 2 : Discrete & Continuous Probability Distribution

ANSWERS SHEET

Question 1

$P(A) = 0.08$ $P(B) = 0.29$ $P(C) = 0.34$ $P(D) = 0.17$ $P(E) = 0.12$

a) Average, P(C), easy, P(B) or very easy, P(A)

$P(C \cup B \cup A) = P(C) + P(B) + P(A)$

$= 0.34 + 0.29 + 0.08$

$= 0.71$

b) Average, P(C), difficult, P(D) or very difficult, P(E)

$P(C \cup D \cup E) = P(C) + P(D) + P(E)$

$= 0.34 + 0.17 + 0.12$

$= 0.63$

c) Neither very difficult, P(E) nor very easy, P(A)

$P(E' \cup A') = 1 - P(E \cup A)$

$= 1 - P(E) - P(A)$

$= 1 - 0.12 - 0.08$

$= 0.80$

(d) Difficult, P(D) or very easy, P(A)

$P(D \cup A) = P(D) + P(A)$

$= 0.17 + 0.08$

$= 0.25$

Question 2

$P(A) = 0.60 \quad P(B) = 0.30 \quad P(A \cup B) = 0.80$

$P(A') = 1 - P(A)$
$= 1 - 0.60$
$= 0.40$

$P(B') = 1 - P(B)$
$= 1 - 0.30$
$= 0.70$

a) $P(A \cap B)$

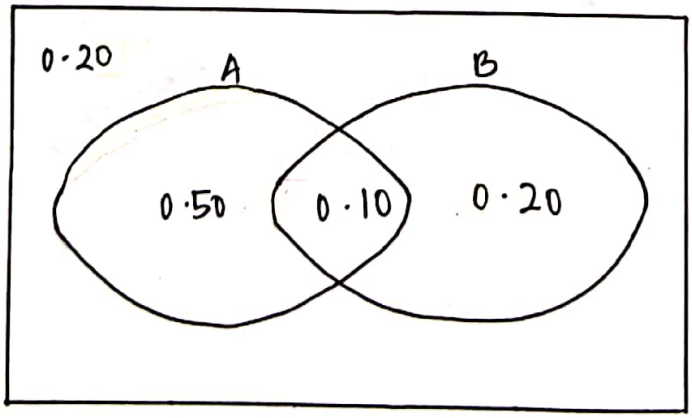
$P(A \cup B) = P(A) + P(B) - P(A \cap B)$
$P(A \cap B) = P(A) + P(B) - P(A \cup B)$
$= 0.60 + 0.30 - 0.80$
$= 0.10$

(b) $P(A \text{ only}) = P(A) - P(A \cap B)$
$= 0.60 - 0.10$
$= 0.50$

$P(B \text{ only}) = P(B) - P(A \cap B)$
$= 0.30 - 0.10$
$= 0.20$

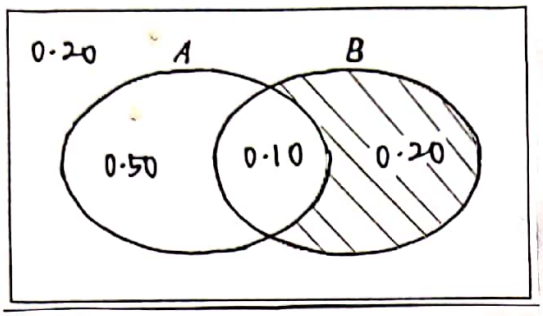
$P(A \cap B) = 0.10$

$P(A' \cap B') = 1 - P(A \text{ only}) - P(B \text{ only}) - P(A \cap B)$
$= 1 - 0.50 - 0.20 - 0.10$
$= 0.20$



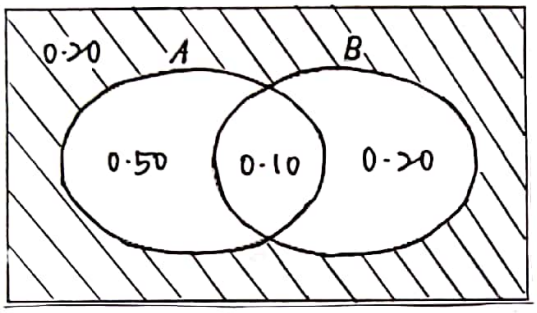
Question 2

(c)



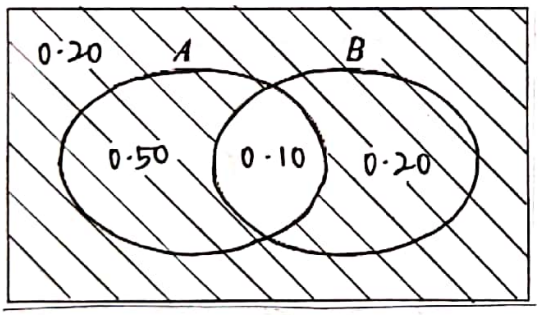
$P(A' \cap B) = 0.2$

(d)



$P(A' \cap B') = 0.2$

(e)

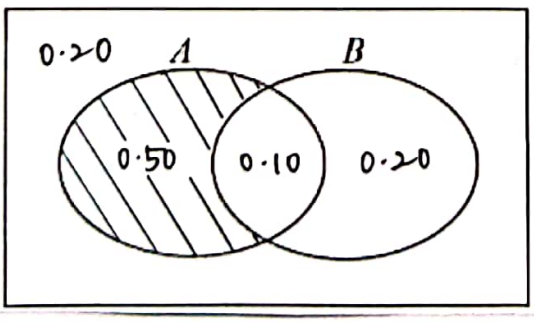


$P(A' \cup B') = 1 - P(A \cap B)$

$= 1 - 0.10$

$= 0.90$

(f)



$P(A \cap B') = P(A \text{ only})$

$= 0.50$

Question 3

(a) $P(A) = \frac{20}{100} = 0.2$

$P(B) = \frac{45}{100} = 0.45$

$P(C) = \frac{35}{100} = 0.35$

BS = Bad service
GS = Good Service

For A: $P(BS|A) = 0.002$

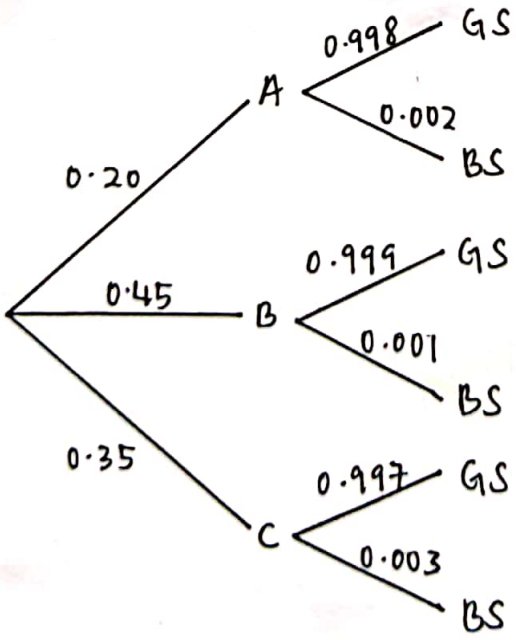
$P(GS|A) = 1 - P(BS|A)$
$= 1 - 0.002$
$= 0.998$

For B: $P(BS|B) = 0.001$

$P(GS|B) = 1 - P(GS|B)$
$= 1 - 0.001$
$= 0.999$

For C: $P(BS|C) = 0.003$

$P(GS|C) = 1 - P(GS|C)$
$= 1 - 0.003$
$= 0.997$



Question 3

(b) $P(GS) = P(GS|A)P(A) + P(GS|B)P(B) + P(GS|C)P(C)$

$= (0.998)(0.2) + (0.999)(0.45) + (0.997)(0.35)$

$= 0.1996 + 0.44955 + 0.34895$

$= 0.9981$

(c) $P(B|GS) = \dfrac{P(GS|B)P(B)}{P(GS)}$

$= \dfrac{(0.999)(0.45)}{0.9981}$

$= 0.4504$

Question 4

a) x is a binomial random variable.

b) $b(x; n, p) = \binom{n}{x} p^x q^{n-x}$

$p \rightarrow$ probability of success

$q \rightarrow$ probability of failure

$x \rightarrow$ number of successes in n.

Based on the question given,

p refers to the probability that product purchased are banana flavor milk.

q refers to the probability that product purchased are kurma flavor milk.

x is 8 number of successes in 20 customers.

$$\therefore \binom{20}{8}(0.7)^8(0.3)^{20-8} = \frac{20!}{8!(20-8)!}(0.7)^8(0.3)^{12}$$

$$= 125970(0.05764801)(5.3\times10^{-7})$$

$$= 3.86\times10^{-3} \#$$

c) $7 - 10 \Rightarrow$ banana flavor milk.

$$\binom{20}{7}(0.7)^7(0.3)^{20-7} + \binom{20}{8}(0.7)^8(0.3)^{20-8} + \binom{20}{9}(0.7)^9(0.3)^{20-9} + \binom{20}{10}(0.7)^{10}(0.3)^{20-10}$$

$$= \frac{20!}{7!(20-7)!}(0.7)^7(0.3)^{13} + \frac{20!}{8!(20-8)!}(0.7)^8(0.3)^{12} + \frac{20!}{9!(20-9)!}(0.7)^9(0.3)^{11} + \frac{20!}{10!(20-10)!}(0.7)^{10}(0.3)^{10}$$

$$= 0.0477 \#$$

$$P(7 \le X \le 10) = 0.0477$$

d) 3-5 ⇒ kurma flavor milk. $p \Rightarrow 0.3$ (kurma), $q \Rightarrow 0.7$ (banana)

$$\binom{20}{3}(0.3)^3(0.7)^{20-3} + \binom{20}{4}(0.3)^4(0.7)^{20-4} + \binom{20}{5}(0.3)^5(0.7)^{20-5}$$

$$= \frac{20!}{3!(20-3)!}(0.3)^3(0.7)^{17} + \frac{20!}{4!(20-4)!}(0.3)^4(0.7)^{16} + \frac{20!}{5!(20-5)!}(0.3)^5(0.7)^{15}$$

$$= 0.3809$$

$\therefore P(3 \le X \le 5) = 0.3809$

Question 5

probability pass the test $\Rightarrow 0.7$

Due to the trials are independent, the x which is number of trials to obtain 1st success is geometry random variable or negative binomial variable.

The trials are considered independent because the person is considered success after passes the test, so he/she just needs to pass the test once and we are looking for the number of trials to obtain the one success.

(i) Thus, based on this question, the person just needs to pass once on the third try.

$$b^*(x;k,p) = \binom{x-1}{k-1} p^k q^{x-k}$$

$P(X=3)$ $\quad (x=3,\ k=1,\ p=0.7,\ q=0.3)$

$= b^*(3;1,0.7)$

$$= \binom{3-1}{1-1} (0.7)^1 (0.3)^{3-1}$$

$$= \frac{2!}{0!(2-0)!} (0.7)^1 (0.3)^2$$

$$= 1 \times (0.7) \times (0.3)^2$$

$$= 0.063 \ \#$$

(ii) Before the fourth try

$P(X<4) = P(X \leq 3)$ $\quad g(x;p) = p(1-p)^{x-1}$

~~$P(X \leq 3) = p + p(1-p)^{3-2} + p(1-p)^{3-1}$~~ $\quad g(3;0.7)$

$P(X \leq 3) = p(1-p)^{3-3} + p(1-p)^{3-2} + p(1-p)^{3-1}$

$= p(1-p)^0 + p(1-p)^1 + p(1-p)^2$

$= 0.7 + (0.7)(1-0.7) + (1-0.7)^2$

$= 0.973$ #

(iii) At the fifth after seventh try

7 8 9 10 11 12

$P(X=12) = p(1-p)^{12-1}$ $\quad g(x;p) = g(12;0.7)$

$= p(1-p)^{11}$

$= 0.7(1-0.7)^{11}$

$= 1.24 \times 10^{-6}$ #

b) $\bar{x}$ & σ^2 if he/she pass with 5 trial.

$b^*(x;k,p) = b^*(5;1,0.7)$

$P(X=5) = \binom{x-1}{k-1} p^k q^{x-k}$

$= \binom{5-1}{1-1} (0.7)^1 (0.3)^{5-1}$

$= \binom{4}{0} (0.7)(0.3)^4$

$= \frac{4!}{0!(4-0)!} (0.7)(0.3)^4$

$= 5.67 \times 10^{-3}$

$\bar{x} = \frac{1}{p}$

$= \frac{1}{5.67 \times 10^{-3}}$

$= 176.3668$ #

$\sigma^2 = \frac{1-p}{p^2}$

$= \frac{1 - 5.67 \times 10^{-3}}{(5.67 \times 10^{-3})^2}$

$= 30928.85$ #

Question 6

a) $Z = \frac{x-\mu}{\sigma} = \frac{35.8-36.0}{0.1} = -2.00$

$Z = \frac{x-\mu}{\sigma} = \frac{36.2-36.0}{0.1} = 2.00$

$P(Z<-2.00) = 0.02275$

$P(Z<2.00) = 0.97725$

$P(Z>2.00) = 0.5-(0.97725-0.5)$

$= 0.02275$

$P(\text{out of control}) = P(Z<-2.00) + P(Z>2.00)$

$= 0.02275 + 0.02275$

$= 0.0455$

b) $b(16; 0, 0.0455) = \binom{n}{x} p^x q^{n-x}$

$= {}^{16}C_0 (0.0455)^0 (1-0.0455)^{16-0}$

$= {}^{16}C_0 (0.0455)^0 (0.9545)^{16}$

$= 0.4747$

c) $b(16; 1, 0.0455) = \binom{n}{x} p^x q^{n-x}$

$= {}^{16}C_1 (0.0455)^1 (1-0.0455)^{16-1}$

$= {}^{16}C_1 (0.0455)^1 (0.9545)^{15}$

$= 0.3621$

d) $Z = \frac{x-\mu}{\sigma} = \frac{36.2-37}{0.4} = -2.00 = 0.02275$

$Z = \frac{x-\mu}{\sigma} = \frac{35.8-37}{0.4} = -3.00 = 0.00135$

$P(\text{out of control}) = P(Z>-2.00) + P(Z<-3.00)$

$= 0.97725 + 0.00135$

$= 0.9786$

$P(Z<-2.00) = 0.02275$

$P(Z>-2.00) = (0.5-0.02275)+0.5$

$= 0.97725$

Question 7

a) $Z = \frac{x-\mu}{\sigma} = \frac{20-28}{8} = -1.00 = 0.15866$, $P(Z<-1.00) = 0.15866$

$Z = \frac{x-\mu}{\sigma} = \frac{40-28}{8} = 1.50 = 0.93319$, $P(Z<1.50) = 0.93319$

$P(Z \leq -1.00) = 0.15866$

$P(Z \geq -1.00) = 0.5 - 0.15866$

$= 0.34134$

$P(Z<1.50) = 0.93319 - 0.5$

$= 0.43319$

$P(-1.00 \leq Z \leq 1.50) = 0.34134 + 0.43319$

$= 0.77453$

b) $Z = \frac{x-\mu}{\sigma} = \frac{30-28}{8} = 0.25$

$P(Z \leq 0.25) = 0.59871$

c) $1 - 0.75 = 0.25$

$P(Z \leq y) = 0.25$

$y = -0.675$

$-0.675 = \frac{x-\mu}{\sigma}$

$= \frac{x-28}{8}$

$x = 22.6$ days