Subject – Math AI(Higher Level)
Topic - Statistics and Probability
Year - May 2021 – Nov 2022
Paper -1
Answers

Question 1

(a) $\mathrm{P}(X = 8)$ ***(M1)***

Note: Award ***(M1)*** for evidence of recognizing binomial probability.
eg, $\mathrm{P}(X = 8),\ X \sim \mathrm{B}\left(20, \frac{6}{15}\right)$.

$= 0.180\ (0.179705\ldots)$ ***A1***

[2 marks]

(b) let x be the number of male students

recognize that probability of selecting a male is equal to $\frac{x}{80}$ ***(A1)***

$\left(\text{set up equation } {}^{20}\mathrm{C}_8\left(\frac{x}{80}\right)^8\left(\frac{80-x}{80}\right)^{12} = \right) 0.153357$ ***(M1)***

number of male students $= 37$ ***(M1)A1***

Note: Award ***(M1)A0*** for 27.

[4 marks]

Total [6 marks]

Question 2

(a) $\mathrm{H}_0 : m = 3,\ \mathrm{H}_1 : m < 3$ ***A1***

(b) *(let X be the number of fish caught)*
$\mathrm{P}(X \leq 1 \mid m = 3) = 0.199$ ***M1A1***

(c) $\mathrm{P}(X \geq 2 \mid m = 2.5)\ \ (= 1 - \mathrm{P}(X \leq 1 \mid m = 2.5))$ ***M1A1***

$= 0.713$ ***A1***

[3 marks]

Total [6 marks]

Question 3

let T be the time to serve both customers and T_i the time to serve the ith customer

assuming independence of T_1 and T_2 ***R1***

T is normally distributed and $T = T_1 + T_2$ ***(M1)***

$E(T) = 1.5 + 1.5 = 3$ ***A1***

$\text{Var}(T) = 0.4^2 + 0.4^2 = 0.32$ ***M1A1***

$P(T < 4) = 0.961$ ***A1***

Total [6 marks]

Question 4

(a) $s_{n-1} = \sqrt{\frac{10}{9}} \times 0.0196 = 0.02066\ldots$ ***(M1)A1***

[2 marks]

(b) $(1.463, 1.493)$ ***(M1)A1***

Note: If s_n used answer is $(1.464, 1.492)$, award ***M1A0.***

[2 marks]

(c) 95% of the time these results would be produced by a population with mean of less than $1.5\,\text{kg}$, so it is likely the mean weight is less than $1.5\,\text{kg}$ ***R1***

[1 mark]

Total [5 marks]

Question 5

(a) $\frac{4}{18}\left(\frac{2}{9}\right)$ **A1**

[1 mark]

(b) $-3\times\frac{1}{18}+(-1)\times\frac{4}{18}+0\times\frac{3}{18}+\ldots+5\times\frac{7}{18}$ **(M1)**

Note: Award ***(M1)*** for their correct substitution into the formula for expected value.

$=1.83\left(\frac{33}{18}, 1.83333\ldots\right)$ **A1**

[2 marks]

(c) $2\times\frac{1}{18}\times\frac{3}{18}$ **(M1)(M1)**

Note: Award ***(M1)*** for $\frac{1}{18}\times\frac{3}{18}$, award ***(M1)*** for multiplying their product by 2.

$=\frac{1}{54}\left(\frac{6}{324}, 0.0185185\ldots, 1.85\%\right)$ **A1**

[3 marks]

Total [6 marks]

Question 6

(a) discrete **A1**

[1 mark]

(b) $\frac{24+60+3k+40+15+6}{88+k}=2$ **M1A1**

Note: Award ***M1*** for substitution into the formula for the mean, award ***A1*** for a correct equation.

attempt to solve their equation **(M1)**

$k=31$ **A1**

[4 marks]

(c) systematic **A1**

[1 mark]

Total [6 marks]

Question 7

(a) $158 \times 6 = 948\,(\text{g})$ **(M1)A1**

[2 marks]

(b) variance 6×13^2 **(M1)**

$\text{SD} = 31.8\,(\text{g})$ $(13\sqrt{6},\ 31.8433\ldots)$ **A1**

[2 marks]

(c) $X \sim \text{N}(948,\ 31.8433...^2)$

$\text{P}(X > 1000) = 0.0512$ $(0.0512350\ldots)$ **(M1)A1**

[2 marks]

Total [6 marks]

Question 8

(a) Convenience **A1**

[1 mark]

(b) H_0: 1% of the toys produced are faulty **A1**

H_1: More than 1% are faulty **A1**

[2 marks]

(c) $X \sim \text{B}(200,\ 0.01)$ **(M1)**

$\text{P}(X \geq 4) = 0.142$ **A1**

Note: Any attempt using Normal approximation to find p-value is awarded ***M0A0***.

[2 marks]

(d) $14\% > 10\%$ ***R1***

so there is insufficient evidence to reject H_0. ***A1***

Note: Do not award ***R0A1***. Accept "fail to reject H_0" or "accept H_0".

[2 marks]

Total [7 marks]

Question 9

(a)

t	1	2	3	4	5	6
$\mathrm{P}(T=t)$	$\frac{1}{36}$ (0.027777…)	$\frac{3}{36}$ (0.083333…)	$\frac{5}{36}$ (0.138888…)	$\frac{7}{36}$ (0.194444…)	$\frac{9}{36}$ (0.25)	$\frac{11}{36}$ (0.305555…)

A2

Note: Award ***A1*** if three to five probabilities are correct.

[2 marks]

(b) (i) $\frac{32}{36}$ $\left(\frac{8}{9}, 0.888888..., 88.9\%\right)$ ***(A1)***

(ii) use of conditional probability ***(M1)***
e.g. denominator of 32 **OR** denominator of $0.888888…$, etc.
$\frac{11}{32}$ $(0.34375, 34.4\%)$ ***A1***

[3 marks]

(c) $\frac{1\times1+3\times2+5\times3+...+11\times6}{36}$ ***(M1)***

$=\frac{161}{36}$ $\left(4\frac{17}{36}, 4.47, 4.47222...\right)$ ***A1***

[2 marks]

Total [7 marks]

Question 10

$X \sim \mathrm{Po}(8.8)$ ***(M1)***

Note: Award ***(M1)*** for calculating the mean, 8.8, of the distribution

$\mathrm{P}(X>9)=\mathrm{P}(X\geq10)$ **OR** $\mathrm{P}(X>9)=1-\mathrm{P}(X\leq9)$ ***(M1)***

$\mathrm{P}(X>9)=0.386$ $(0.386260...)$ ***(M1)A1***

Note: Award ***(M1)(M0)(M1)A0*** for finding $\mathrm{P}(X\geq9)=0.518$ $(0.517719...)$
OR $\mathrm{P}(X\leq9)=0.614$ $(0.613740...)$.

Total [4 marks]

Question 11

(a) $H_0 : m = 110$, $H_1 : m > 110$ ***A1***

Note: Accept other appropriate variables for the mean.
Accept 22 in place of 110.

[1 mark]

(b) $P(X \geq 128) = 0.05024$ ***(M1)(A1)***

$P(X \geq 129) = 0.04153$ ***(M1)***

(probability of making a type I error is) 0.0415 ***A1***

Note: If other probabilities are seen, the final ***A1*** cannot be awarded unless 0.0415 is clearly identified as the final answer.

[4 marks]

(c) $X \sim \text{Po}(110)$

$P(X \geq 126) = 0.072 > 0.05$ **OR** recognizing $126 < 129$ or ≤ 128 ***R1***

so there is insufficient evidence to reject H_0 ***A1***

(*ie* there is insufficient evidence to suggest that the number of coffees being sold has increased)

Note: Accept 'Accept H_0'.
Do not award ***R0A1***.

[2 marks]

Total [7 marks]

Question 12

(a) $\bar{x} = \frac{\sum x}{n} = \frac{2506}{30} = 83.5 \ \ (83.5333\ldots)$ **A1**

[1 mark]

(b) $\left(s_{n-1}^2 = \frac{\sum x^2 - \frac{\left(\sum x\right)^2}{n}}{n-1} = \right) \frac{209738 - \frac{2506^2}{30}}{29}$ **(M1)**

$= 13.9 \ \ (13.9126...)$ **A1**

[2 marks]

(c) $(82.1,\ 84.9) \ \ (82.1405...,\ 84.9261...)$ **A2**

[2 marks]

(d) 85 is outside the confidence interval and therefore Talha would suggest that the manufacturer's claim is incorrect **R1**

[1 mark]

Total [6 marks]

Question 13

(a) $\left(\frac{74+97+91+86+112}{5}\right) = 92$ **A1**

[1 mark]

(b) (i) H_0 : The data satisfies the model **A1**

H_1 : The data does not satisfy the model **A1**

Note: Do not accept "H_0 : The same number of copies will be sold each day" but accept a similar statement if the word 'expect' or 'expected' is included. Similarly for H_1.

(ii) 4 **A1**

(iii) $\chi^2_{calc} = 8.54 \ \ (8.54347...)$ **OR** $p\text{-value} = 0.0736 \ \ (0.0735802...)$ **A2**

$8.54 < 9.49$ **OR** $0.0736 > 0.05$ **R1**

therefore there is insufficient evidence to reject H_0 **A1**

(i.e. the data satisfies the model)

[7 marks]

Total [8 marks]

Question 14

(a) (let μ_c = population mean for chinchilla rabbits, μ_s = population mean for sable rabbits)

$H_0 : \mu_c = \mu_s$ ***A1***

$H_1 : \mu_c > \mu_s$ ***A1***

Note: Accept an equivalent statement in words, must include mean and reference to "**population** mean" / "mean for **all** chinchilla rabbits" for the first ***A1*** to be awarded. The terms "*on average*" and "*generally*" are also acceptable to indicate populations.
Do not accept an imprecise *"the means are equal"*.

[2 marks]

(b) p-value $= 0.0408$ $(0.0408065...)$ ***A2***

Note: Award ***A1*** for an answer of $0.041565\ldots$, from "unpooled" settings on GDC.

[2 marks]

(c) $0.0408 < 0.05$. ***R1***

(there is sufficient evidence to) reject (or not accept) H_0 ***A1***

(there is sufficient evidence to suggest that chinchilla rabbits are (generally) heavier than sable rabbits)

Note: Do not award ***R0A1***. Accept 'accept H_1'.

[2 marks]

Total [6 marks]

Question 15

(a) let X be the random variable "the weight of a sack of potatoes"

$P(X < 50)$ ***(M1)***

$= 0.588$ kg $(0.587929...)$ ***A1***

[2 marks]

(b) $P(X < l) = 0.25$ ***(M1)***

49.2 kg $(49.1929\ldots)$ ***A1***

[2 marks]

(c) attempt to sum 10 independent random variables ***(M1)***

$Y = \sum_{i=1}^{10} X_i \sim N(498, 10 \times 0.9^2)$ ***(A1)***

$P(Y > 500) = 0.241$ ***A1***

[3 marks]

Total: [7 marks]

Question 16

(a) 75 **A1**

[1 mark]

(b) recognition that all entries add up to 120 ***(M1)***

$a = 120 - 6 - 13 - 26 - b$ **OR** $a = 75 - b$ ***A1***

[2 marks]

(c) (i) $\dfrac{6\times1+13\times2+26\times3+(75-b)\times4+b\times5}{120} = 3.65$ ***(M1)(A1)***

Note: Award ***(M1)*** for attempt to substitute into mean formula, LHS expression is sufficient for the ***M*** mark. Award ***(A1)*** for correct substitutions in one variable **OR** in two variables, followed by evidence of solving simultaneously with $a + b = 75$.

$(b =)$ 28 ***A1***

(ii) 120 − their part (c)(i) seen (e.g. 92 indicated on graph) ***(M1)***

84 ***A1***

[5 marks]

Total: [8 marks]

Question 17

(a) $X \sim \text{Po}(324)$ ***A1***

Note: Both distribution and mean must be seen for ***A1*** to be awarded.

[1 mark]

(b) $\text{P}(X \leq 300)$ ***(M1)***

$= 0.0946831... \approx 0.0947$ ***A1***

[2 marks]

(c) (mean number of cars =) $4.5\times60 = 270$ ***(A1)***

$\text{P}(X > 300 \mid \lambda = 270)$ ***(M1)***

Note: Award ***M1*** for using $\lambda = 270$ to evaluate a probability.

$\text{P}(X \geq 301)$ **OR** $1 - \text{P}(X \leq 300)$ ***(M1)***

$= 0.0334207... \approx 0.0334$ ***A1***

[4 marks]

[Total 7 marks]

Question 18

(a) $\log_{10} 100 = a - 3$ **(M1)**

$a = 5$ **A1**

[2 marks]

(b) **EITHER**

$N = 10^{5-M}$ **(M1)**

$= \frac{10^5}{10^M} \left(= \frac{100000}{10^M} \right)$

OR

$100 = \frac{b}{10^3}$ **(M1)**

THEN

$b = 100000 \ \ (= 10^5)$ **A1**

[2 marks]

(c) $N = \frac{10^5}{10^{7.2}} = 0.00631 \ \ (0.0063095...)$ **A1**

Note: Do not accept an answer of $10^{-2.2}$.

[1 mark]

(d) **METHOD 1**

$Y > 100 \Rightarrow$ no earthquakes in the first 100 years **(M1)**

EITHER

let X be the number of earthquakes of at least magnitude 7.2 in a year

$X \sim \text{Po}(0.0063095\ldots)$

$(\text{P}(X = 0))^{100}$ **(M1)**

OR

let X be the number of earthquakes in 100 years

$X \sim \text{Po}(0.0063095\ldots \times 100)$ **(M1)**

$\text{P}(X = 0)$

THEN

0.532 (0.532082…) **A1**

METHOD 2

$Y > 100 \Rightarrow$ no earthquakes in the first 100 years **(M1)**

let X be the number of earthquakes in 100 years

since n is large and p is small

$X \sim \text{B}(100, 0.0063095\ldots)$ **(M1)**

$\text{P}(X = 0)$

0.531 (0.531019…) **A1**

[3 marks]

[Total 8 marks]

Question 19

(a) let X be the weight of sugar in the bag

$\mathrm{P}(X < 950) = 0.308537... \approx 0.309$ ***(M1)A1***

[2 marks]

(b) **METHOD 1**

let $\bar{X}$ be the mean weight of 5 bags of sugar

$\mathrm{E}(\bar{X}) = 1000$ ***(A1)***

use of $\mathrm{Var}(\bar{X}) = \frac{\sigma^2}{n}$ ***(M1)***

$\mathrm{Var}(\bar{X}) = \frac{100^2}{5} \ (= 2000)$ ***(A1)***

$\bar{X} \sim \mathrm{N}(1000,\ 2000)$

$\mathrm{P}(\bar{X} > 950) = 0.868223... \approx 0.868 \ (86.8\%)$ ***A1***

METHOD 2

let T be the total weight of 5 bags of sugar

$\mathrm{E}(T) = 5000$ ***(A1)***

use of $\mathrm{Var}(X_1 + X_2) = \mathrm{Var}(X_1) + \mathrm{Var}(X_2)$ for independent random variables ***(M1)***

$\mathrm{Var}(T) = 5 \times 100^2 \ (= 50\,000)$ ***(A1)***

$T \sim \mathrm{N}(5000,\ 50\,000)$

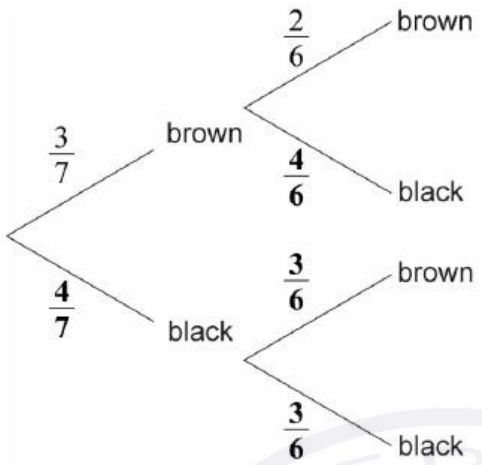
$\mathrm{P}(T > 4750) = 0.868223... \approx 0.868 \ (86.8\%)$ ***A1***

[4 marks]

[Total 6 marks]

Question 20

(a)



A1A1

[2 marks]

(b) multiplying along branches and then adding outcomes ***(M1)***

$$\frac{3}{7}\times\frac{2}{6}+\frac{4}{7}\times\frac{3}{6}$$

$$=\frac{18}{42}\left(=\frac{3}{7}\approx 0.429\ (42.9\%)\right)$$ ***A1***

[2 marks]

(c) use of conditional probability formula ***M1***

$$\frac{\left(\frac{3}{7}\times\frac{2}{6}\right)}{\left(\frac{3}{7}\right)}$$ ***A1***

$$=\frac{6}{18}\left(=\frac{1}{3}\right)\ \left(\frac{252}{756}, 0.333, 33.3\%\right)$$ ***A1***

[3 marks]

[Total 7 marks]

Question 21

(a) H_0: The die is fair **OR** $P(\text{any number}) = \frac{1}{6}$ **OR** probabilities are equal

H_1: The die is not fair **OR** $P(\text{any number}) \neq \frac{1}{6}$ **OR** probabilities are not equal ***A1***

[1 mark]

(b) 5 ***A1***

[1 mark]

(c) 10 ***A1***

[1 mark]

(d) (p-value =) 0.287 (0.28724163….) ***A2***

[2 marks]

(e) $0.287 > 0.05$ ***R1***

EITHER
Insufficient evidence to reject the null hypothesis ***A1***

OR
Insufficient evidence to reject that the die is fair ***A1***

Question 22

(a) $P(\text{Type I error}) = P(\text{stating female when male})$
$= P(W_{Male} > 11.5)$ ***(M1)***
$= 0.00135 \quad (0.00134996\ldots)$ ***A1***

[2 marks]

(b) $P(\text{Type II error}) = P(\text{stating male when female})$
$= P(W_{Female} < 11.5)$ ***(M1)***
$= 0.309 \quad (0.308537\ldots)$ ***A1***

[2 marks]

(c) attempt to use the total probability ***(M1)***
$P(\text{error}) = 0.9 \times 0.00134996\ldots + 0.1 \times 0.308537\ldots$
$= 0.0321 \quad (0.0320687\ldots)$ ***A1***

[2 marks]
Total [6 marks]

Question 23

(a) $\bar{x} = 4.63 \ (4.62686\ldots)$ ***A1***

[1 mark]

(b) $s_{n-1} = 1.098702$ ***(A1)***

$s_{n-1}^2 = 1.21 \ (1.207146\ldots)$ ***A1***

Note: Award ***A0A0*** for an answer of 1.19 from biased estimate.

[2 marks]

(c) (i) $H_1 : \mu > 4.4$ ***A1***

(ii) **METHOD 1**

using a z-test ***(M1)***

$p = 0.0454992\ldots$ ***A1***

$p < 0.05$ ***R1***

reject null hypothesis ***A1***

(therefore there is significant evidence that the IB HL math students know more digits of π than the population in general)

Note: Do not award ***R0A1***. Allow ***R1A1*** for consistent conclusion following on from their p-value.

METHOD 2

using a t-test ***(M1)***

$p = 0.0478584\ldots$ ***A1***

$p < 0.05$ ***R1***

reject null hypothesis ***A1***

(therefore there is significant evidence that the IB HL math students know more digits of π than the population in general)

Note: Do not award ***R0A1***. Allow ***R1A1*** for consistent conclusion following on from their p-value.

[5 marks]

Total [8 marks]

Question 24

(a) *Accept any one of the following (or equivalent):*
one minimum and one maximum point
three x-intercepts or three roots (or zeroes)
one point of inflexion **R1**

Note: Do not accept "S shape" as a justification.

[1 mark]

(b) (i) $(d =) -5$ **A1**

(ii) $8 = a + b + c$
$4 = 8a + 4b + 2c$
$0 = 27a + 9b + 3c$ **A2**

Note: Award ***A2*** if all three equations are correct.
Award ***A1*** if at least one is correct. Award ***A1*** for three correct equations that include the letter "d".

(iii) $a = 2,\ b = -12,\ c = 18$ **A1**

[4 marks]

(c) equating found expression to zero **(M1)**
$0 = 2t^3 - 12t^2 + 18t - 5$
$t = 0.358216\ldots,\ 1.83174\ldots,\ 3.81003\ldots$ **(A1)**

(so total time in debt is $3.81003\ldots - 1.83174\ldots + 0.358216 \approx$)
2.34 (2.33650…) years **A1**

[3 marks]
Total [8 marks]

Question 25

(a) $(\mathrm{E}(X) =) 10 \times 0.8$ **(M1)**
8 (people) **A1**

[2 marks]

(b) recognition of binomial probability **(M1)**
0.0881 (0.0880803…) **A1**

[2 marks]

(c) 0.8 and 6 seen **OR** 0.2 and 3 seen **(A1)**
attempt to use binomial probability **(M1)**
0.121 (0.120873…) **A1**

[3 marks]
Total [7 marks]

Question 26

(a) $\left(\frac{17+25}{130}=\right)\frac{42}{130}$ $\left(\frac{21}{65}, 0.323076\ldots\right)$ ***A1***

[1 mark]

(b) $\left(\frac{17}{17+25}=\right)\frac{17}{42}$ $(0.404761\ldots)$ ***A1A1***

Note: Award ***A1*** for correct numerator and ***A1*** for correct denominator. Award ***A1A0*** for working of $\frac{17/130}{\text{their answer to (a)}}$ if followed by an incorrect answer.

[2 marks]

(c) $\frac{41}{130}\times\frac{40}{129}$ ***A1M1***

Note: Award ***A1*** for two correct fractions seen, ***M1*** for multiplying their fractions.

$=\frac{1640}{16770}\approx 0.0978\left(0.0977936\ldots, \frac{164}{1677}\right)$ ***A1***

[3 marks]
Total [6 marks]

Question 27

(a) $D = S - R$

METHOD 1

$= \text{Re}(1.15\text{e}^{(0.0165t-2.97)\text{i}}) - \text{Re}(1.08\text{e}^{(0.0165t+0.413)\text{i}})\ (+18.9-4.94)$ ***(M1)(A1)***

$= \text{Re}\left(\text{e}^{0.0165t\text{i}}(1.15\text{e}^{-2.97\text{i}} - 1.08\text{e}^{0.413\text{i}})\right)\ (+13.96)$ ***(M1)***

$= \text{Re}\left(\text{e}^{0.0165t\text{i}}(2.21379...\text{e}^{-2.85310...\text{i}})\right)\ (+13.96)$ ***(A1)***

$= 2.21\cos(0.0165t - 2.85) + 13.96\ \ (2.21379...\cos(0.0165t - 2.85310...) + 13.96)$ ***A1A1***

$(a = 2.21,\ b = -2.85,\ c = 13.96)$

Note: Award ***A1*** for $2.21\cos(0.0165t - 2.85)$ and ***A1*** for "$+13.96$". The ***A1*** for 13.96 is independent of the previous marks.

METHOD 2

$c = 13.9 - 4.94\ldots = 13.96$ ***A1***

using a graph of D ***M1***

maximum $(172.915\ldots, 16.1738\ldots)$ ***(A1)***

minimum $(-17.4842\ldots, 11.7462\ldots)$ ***(A1)***

EITHER

amplitude $16.1738\ldots - 11.7462\ldots = 4.4276\ldots$

$a = 2.21\ (2.2138\ldots)$ ***A1***

OR

$a = 16.1738\ldots - 13.96 = 2.21\ (2.2138\ldots)$ ***A1***

THEN

EITHER

when $t = 0$, $D = 11.8377\ldots$

$11.8377\ldots = 2.2138\cos(b) + 13.96$

$b = -2.85\ \ (2.85309\ldots)$ ***A1***

OR

$b = -0.0165 \times 172.915\ldots = -2.85\ \ (2.85309\ldots)$ ***A1***

[6 marks]

(b) $16.2\ (16.1737\ldots)$ hours on day 173 ***A1A1***

Note: Accept an answer of "day 172" for the second ***A1***.

[2 marks]

Total [8 marks]

Question 28

(a) (let p be the probability of a student choosing healthy options)

$H_0: p = 0.3$ **A1**

$H_1: p > 0.3$ **A1**

Note: Award ***A0A1*** for correct hypotheses with μ in place of p. Accept equivalent hypotheses in words.

[2 marks]

(b) a type I error is rejecting H_0 when H_0 is true ***(M1)***

(let N = number of students choosing a healthy option)

$N \sim B(80, 0.3)$

$P(31 \leq N \leq 80)$ **OR** $P(N \geq 31)$ **OR** $1 - P(N \leq 30)$ ***(M1)***

Note: Do not accept the use of the Normal approximation.

0.0587 $(0.0587481\ldots)$ ***A1***

[3 marks]

(c) a type II error is accepting H_0 when H_0 is not true ***(M1)***

$N \sim B(80, 0.4)$

$P(0 \leq N \leq 30)$ **OR** $P(N \leq 30)$ ***(M1)***

0.369 $(0.368726\ldots)$ ***A1***

[3 marks]

Total [8 marks]

Question 29

(a) $0.5 \times 0.1 + 0.4 \times 0.4 + 0.1 \times 0.5$ ***(M1)(M1)(M1)***

Note: Award ***M1*** for 0.5×0.1 or 0.1×0.5, ***M1*** for 0.4×0.4, ***M1*** for adding three correct products.

0.26 ***A1***

[4 marks]

(b) $0 = -8 \times 0.5 + 4 \times 0.4 + 0.1k$ ***(M1)(M1)***

Note: Award ***M1*** for correct substitution into the formula for expected value, award ***M1*** for the expected value formula equated to zero.

$(k =)$ 24 (points) ***A1***

[3 marks]

Total [7 marks]

Question 30

(a) The favourite breakfast/berry (of adults) is independent of (their) income (level). ***A1***

[1 mark]

(b) $\chi^2 = 2.27 \ \ (2.26821...)$ ***A2***

[2 marks]

(c) **EITHER**

$2.27 < 7.78$ **OR** $2.27 <$ critical value ***R1***

OR

$0.687 > 0.1$ (using p-value)

THEN

(Do not reject H_0)

Insufficient evidence (at the 10% significance level) that the favourite berry depends on income level. ***A1***

[2 marks]

Total [5 marks]