PMT

Mark Scheme 4766 June 2007

Q1 (i)	$\begin{pmatrix} 8 \\ 4 \end{pmatrix}$ ways to s	select $= 70$				M1 for $\begin{pmatrix} 8\\4 \end{pmatrix}$	2
						A1 CAO	
(ii)	4! = 24					B1 CAO	1
						TOTAL	3
						IUIAL	3
Q2						D1 C	
(i)	Amount	0- <20	20-<50	50-<100	100-<200	B1 for amounts	2
	Frequency	800	480	400	200	B1 for frequencies	
(**)	Total ≈						
(ii)	$10 \times 10^{-10} \times 10^{-10}$	$5 \times 480 + 75$	$5 \times 400 + 15$	$0 \times 200 = \text{\pounds}8$	4800	M1 for their midpoints \times their frequencies	2
	10//000 + 55		100 113	o∧200 ≈0	1000	A1 CAO	_
						TOTAL	4
Q3 (i)	$Mean = \frac{302}{56}$					B1 for mean	
	$S_{xx} = 17889$	$0 - \frac{3026^2}{56}$	= 15378			M1 for attempt at S_{xx}	
	$s = \sqrt{\frac{15378}{55}} = 16.7$					A1 CAO	3
(ii)	$\overline{x} + 2s = 54.0$ So 93 is an out		= 87.4			M1 for their \overline{x} +2×their s A1 FT for 87.4 and	2
	50 95 is an ot					comment	
(iii)	New mean =					B1 FT	
	New $s = 1.2$	$\times 16.7 = 20$.1			M1A1 FT	3
						TOTAL	8
Q4	(A) D(at 1	ant ana) -	36 18	0.72		B1 aef	
(i)	(A) P(at least one) $=\frac{36}{50} = \frac{18}{25} = 0.72$ (B) P(exactly one) $=\frac{9+6+5}{50} = \frac{20}{50} = \frac{2}{5} = 0.4$					M1 for $(0+6+5)/50$	
						M1 for (9+6+5)/50 A1 aef	
							3
(ii)	13					M1 for denominator 24	
	P(not paper a	aluminium)	$=\frac{1}{24}$			or 24/50 or 0.48	2
						A1 CAO	
(iii)	D(11-1		18 32	576	470	M1 for both fractions	
	P(one kitchen waste) = $2 \times \frac{18}{50} \times \frac{32}{49} = \frac{576}{1225} = 0.470$					M1 for $2 \times$ product of	
						both, or sum of 2 pairs A1	3
						TOTAL	8
						IOTAL	

Q5 (i)	11 th value is 4,12 th value is 4 so median is 4 Interquartile range = $5 - 2 = 3$	B1 M1 for either quartile	
(ii)	 No, not valid any two valid reasons such as : the sample is only for two years, which may not be representative the data only refer to the local area, not the whole of Britain even if decreasing it may have nothing to do with global warming more days with rain does not imply more total rainfall a five year timescale may not be enough to show a long term trend 	A1 CAO B1 E1 E1	3
		TOTAL	6
Q6 (i)	Either P(all 4 correct) = $\frac{4}{7} \times \frac{3}{6} \times \frac{2}{5} \times \frac{1}{4} = \frac{1}{35}$	M1 for fractions, or $^{7}C_{4}$ seen	2
	or P(all 4 correct) = $\frac{1}{{}^7C_4} = \frac{1}{35}$	A1 NB answer given	
(ii)	$E(X) = 1 \times \frac{4}{35} + 2 \times \frac{18}{35} + 3 \times \frac{12}{35} + 4 \times \frac{1}{35} = \frac{80}{35} = 2\frac{2}{7} = 2.29$ $E(X^{2}) = 1 \times \frac{4}{35} + 4 \times \frac{18}{35} + 9 \times \frac{12}{35} + 16 \times \frac{1}{35} = \frac{200}{35} = 5.714$ $Var(X) = \frac{200}{35} - \left(\frac{80}{35}\right)^{2} = \frac{24}{49} = 0.490 \text{ (to 3 s.f.)}$	M1 for Σrp (at least 3 terms correct) A1 CAO M1 for $\Sigma x^2 p$ (at least 3 terms correct) M1 <i>dep</i> for – their E(X) ² A1 FT their E(X) provided Var(X) > 0	5
		TOTAL	7

0.910.01Has the disease ClearG1 labels(ii)P(negative and clear) = 0.91×0.99 = 0.9009 M1 for their 0.91×0.99 A1 CAOM1 for their 0.91×0.99 A1 CAO(iii)P(negative and clear) = $0.03 \times 0.95 + 0.06 \times 0.10 + 0.91 \times 0.01$ = $0.0285 + 0.006 + 0.0091$ = 0.0436 M1 three products M1 dep sum of three products A1 FT their tree(iv)P(negative has disease) = $\frac{P(negative and has disease)}{P(has disease)} = \frac{0.0091}{0.0436} = 0.2087$ M1 for their 0.01×0.91 or 0.0091 on its own or as numerator M1 indep for their 0.0436 as denominator A1 FT their tree32(v)Thus the test result is not very reliable. A relatively large proportion of people who have the disease will test negative.E1 FT for idea of 'not reliable' or 'could be improved', etc E1 FT23(vi)P(negative or doubtful and declared clear) = $0.91 + 0.06 \times 0.10 \times 0.02 + 0.06 \times 0.90 \times 1$ = $0.91 + 0.00012 + 0.054 = 0.96412M1 for their 0.91 +M1 for either tripletM1 for second tripletA1 CAO$		Section B		
Image: Construct of the probabilities of the construction of the probabilities of the construction of the probabilities of the construction of the co	-	Positive result		
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$		0.03 0.10 Has the disease	disease	
(ii)P(negative and clear) $= 0.91 \times 0.99$ M1 for their 0.91×0.99 A1 CAO2(iii)P(negative and clear) $= 0.91 \times 0.99$ A1 CAO2(iii)P(has disease) $= 0.03 \times 0.95 + 0.06 \times 0.10 + 0.91 \times 0.01$ M1 three productsM1 dep sum of three products $= 0.0285 + 0.006 + 0.0091$ $= 0.0285 + 0.006 + 0.0091$ M1 for their 0.01×0.91 3 $= 0.0436$ M1 for their 0.01×0.91 or 0.0091 on its own or as numerator M1 indep for their 0.0436 as denominator3(iv)P(negative has disease) $= 0.0091$ $= 0.2087$ M1 for their 0.0436 as denominator3(v)Thus the test result is not very reliable.E1 FT for idea of 'not reliable' or 'could be improved', etcE1 FT2(vi)P(negative or doubtful and declared clear)M1 for their $0.91 + M1$ for either tripletM1 for their $0.91 + M1$ for second triplet4(vi)P(negative or doubtful and declared clear)M1 for second tripletA1 CAO4		0.90 Clear 0.91 0.01 Has the disease	-	4
P(negative and clear) $= 0.91 \times 0.99$ M1 for their 0.91×0.99 A1 CAO2(iii)P(has disease) $= 0.03 \times 0.95 + 0.06 \times 0.10 + 0.91 \times 0.01$ M1 three productsM1 dep sum of three productsM1 dep sum of three products $= 0.0285 + 0.006 + 0.0091$ $= 0.0285 + 0.006 + 0.0091$ M1 for their 0.01×0.91 3 $= 0.0436$ P(negative has disease) $= 0.0436$ M1 for their 0.01×0.91 3(iv)P(negative has disease) $= \frac{0.0091}{P(has disease)} = \frac{0.0091}{0.0436} = 0.2087$ $One = 0.0091$ $One = 0.0091$ (v)Thus the test result is not very reliable.E1 FT for idea of 'not reliable' or 'could be improved', etcE1 FT2(vi)P(negative or doubtful and declared clear)M1 for their $0.91 + M1$ for either tripletM1 for their $0.91 + M1$ for either tripletA1 CAO(vi)P(negative or doubtful and declared clear)M1 for their $0.91 + M1$ for second tripletA1 CAO				
(iii)P(has disease)= $0.03 \times 0.95 + 0.06 \times 0.10 + 0.91 \times 0.01$ = $0.0285 + 0.006 + 0.0091$ = 0.0436 M1 three products M1dep sum of three products A1 FT their tree3(iv)P(negative has disease) = $\frac{P(negative and has disease)}{P(has disease)} = \frac{0.0091}{0.0436} = 0.2087$ M1 for their 0.01×0.91 	(ii)			2
P(negative has disease) = $\frac{P(negative and has disease)}{P(has disease)} = \frac{0.0091}{0.0436} = 0.2087$ or 0.0091 on its own or as numerator M1 indep for their 0.0436 as denominator A1 FT their tree333(v)Thus the test result is not very reliable. A relatively large proportion of people who have the disease will test negative.E1 FT for idea of 'not reliable' or 'could be improved', etc E1 FT243(vi)P(negative or doubtful and declared clear) = 0.91 + 0.06 × 0.10 × 0.02 + 0.06 × 0.90 × 1 = 0.91 + 0.00012 + 0.054 = 0.96412M1 for their 0.91 + M1 for second triplet A1 CAO44	(iii)	P(has disease) = $0.03 \times 0.95 + 0.06 \times 0.10 + 0.91 \times 0.01$ = $0.0285 + 0.006 + 0.0091$	M1 three products M1 <i>dep</i> sum of three products	3
A relatively large proportion of people who have the disease will test negative.reliable' or 'could be improved', etc E1 FT2(vi)P(negative or doubtful and declared clear) $=0.91 + 0.06 \times 0.10 \times 0.02 + 0.06 \times 0.90 \times 1$ $=0.91 + 0.00012 + 0.054 = 0.96412$ M1 for their 0.91 + M1 for second triplet A1 CAOM1 for second triplet A1 CAO	(iv)		or 0.0091 on its own or as numerator M1 <i>indep</i> for their 0.0436 as denominator	3
(vi) $= 0.91 + 0.06 \times 0.10 \times 0.02 + 0.06 \times 0.90 \times 1$ = 0.91 + 0.00012 + 0.054 = 0.96412 M1 for either triplet A1 CAO	(v)	A relatively large proportion of people who have the disease will	reliable' or 'could be improved', etc	2
	(vi)	$= 0.91 + 0.06 \times 0.10 \times 0.02 + 0.06 \times 0.90 \times 1$	M1 for either triplet M1 for second triplet	
			TOTAL	4

Q8	$X \sim B(17, 0.2)$		
(i)	$\mathbf{P}(X \ge 4) = 1 - \mathbf{P}(X \le 3)$	B1 for 0.5489	
	= 1 - 0.5489 = 0.4511	M1 for 1 – their 0.5489	3
		A1 CAO	
(ii)	$E(X) = np = 17 \times 0.2 = 3.4$	M1 for product	2
		A1 CAO	
(iii)	P(X=2) = 0.3096 - 0.1182 = 0.1914		
	P(X=3) = 0.5489 - 0.3096 = 0.2393	B1 for 0.2393	
	P(X = 4) = 0.7582 - 0.5489 = 0.2093	B1 for 0.2093	3
	So 3 applicants is most likely	A1 CAO <i>dep</i> on both	
		B1s	
(iv)	(A) Let $p =$ probability of a randomly selected maths graduate	B1 for definition of p in	
	applicant being successful (for population)	context	
	$H_0: p = 0.2$		
	H ₁ : $p > 0.2$	B1 for H ₀	
	(<i>B</i>) H_1 has this form as the suggestion is that mathematics	B1 for H ₁	4
	graduates are more likely to be successful.	E1	
(v)	Let $X \sim B(17, 0.2)$	B1 for 0.1057	
	$P(X \ge 6) = 1 - P(X \le 5) = 1 - 0.8943 = 0.1057 > 5\%$	B1 for 0.0377	
	$P(X \ge 7) = 1 - P(X \le 6) = 1 - 0.9623 = 0.0377 < 5\%$	M1 for at least one	
		comparison with 5%	4
	So critical region is {7,8,9,10,11,12,13,14,15,16,17}	A1 CAO for critical	
		region <i>dep</i> on M1 and at	
		least one B1	
(vi)	Because $P(X \ge 6) = 0.1057 > 10\%$	E1	
Ň	Either: comment that 6 is still outside the critical region		2
	Or comparison $P(X \ge 7) = 0.0377 < 10\%$	E1	
	• ```	TOTAL	18