RECOGNISING ACHIEVEMENT

GCE

Mathematics (MEI)

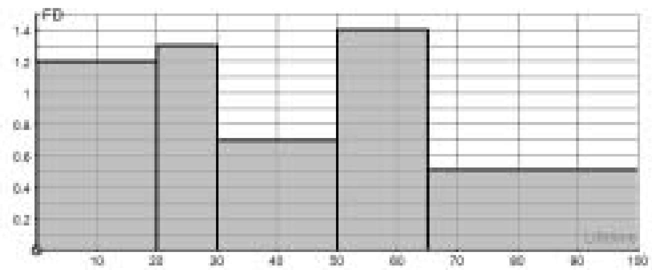
Advanced Subsidiary GCE **4766**

Statistics 1

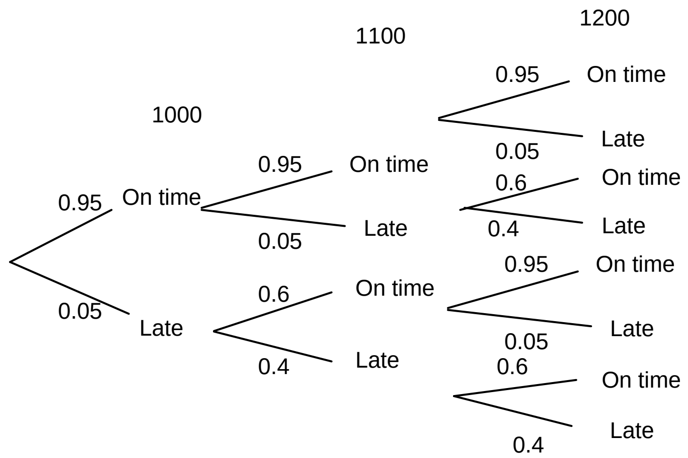
Mark Scheme for June 2010

Q1 (i)	Positive skewness	B1	**1**
(ii)	Inter-quartile range = 10.3 – 8.0 = 2.3 Lower limit 8.0 – 1.5 × 2.3 = 4.55 Upper limit 10.3 + 1.5 × 2.3 = 13.75 Lowest value is 7 so no outliers at lower end Highest value is 17.6 so at least one outlier at upper end.	B1 M1 for 8.0 – 1.5 × 2.3 M1 for 10.3 + 1.5 × 2.3 A1 A1	**5**
(iii)	Any suitable answers Eg minimum wage means no very low values Highest wage earner may be a supervisor or manager or specialist worker or more highly trained worker	E1 one comment relating to low earners E1 one comment relating to high earners	**2**
		TOTAL	**8**
Q2 (i)	$4k + 6k + 6k + 4k = 1$ $20k = 1$ $k = 0.05$	M1 A1 **NB Answer given**	**2**
(ii)	$E(X) = 1\times0.2+2\times0.3+3\times0.3+4\times0.2 = 2.5$ (or by inspection) $E(X^2) = 1\times0.2+4\times0.3+9\times0.3+16\times0.2 = 7.3$ $Var(X) = 7.3 - 2.5^2 = 1.05$	M1 for Σrp (at least 3 terms correct) A1 CAO M1 for $\Sigma r^2 p$ (at least 3 terms correct) M1dep for – their $E(X)^2$ A1 FT their E(X) provided Var(X) > 0	**5**
		TOTAL	**7**
Q3 (i)	see table and histogram below	M1 for fds A1 CAO Accept any suitable unit for fd such as eg freq per 10 hours. L1 linear scales on both axes and label on vert axis W1 width of bars H1 height of bars	**5**

Lifetime (x hours)	Frequency	Width	FD
$0 < x \leq 20$	24	20	1.2
$20 < x \leq 30$	13	10	1.3
$30 < x \leq 50$	14	20	0.7
$50 < x \leq 65$	21	15	1.4
$65 < x \leq 100$	18	35	0.51



(ii)	Median lies in third class interval ($30 < x \leq 50$) Median = 45.5th lifetime (which lies beyond 37 but not as far as 51)	B1 CAO E1 *dep* on B1	**2**
		TOTAL	**7**
Q4 (i)	$1 \times \frac{1}{5} = \frac{1}{5}$	M1 A1	**2**
(ii)	$1 \times \frac{4}{5} \times \frac{3}{5} \times \frac{2}{5} \times \frac{1}{5} = \frac{24}{625} = 0.0384$	M1 For $1 \times \frac{4}{5} \times$ *or just* $\frac{4}{5} \times$ M1 *dep* for fully correct product A1	**3**
(iii)	1 – 0.0384 = 0.9616 or 601/625	B1	**1**
		TOTAL	**6**
Q5 (i)	Mean = $\frac{0 \times 37 + 1 \times 23 + 2 \times 11 + 3 \times 3 + 4 \times 0 + 5 \times 1}{75} = \frac{59}{75} = 0.787$ S_{xx} = $0^2 \times 37 + 1^2 \times 23 + 2^2 \times 11 + 3^2 \times 3 + 4^2 \times 0 + 5^2 \times 1 - \frac{59^2}{75} = 72.59$ s = $\sqrt{\frac{72.59}{74}} = 0.99$	M1 A1 M1 for Σfx^2 s.o.i. M1 *dep* for good attempt at S_{xx} BUT NOTE M1M0 if their $S_{xx} < 0$ A1 CAO	**5**
(ii)	New mean = 0.787 × £1.04 = £0.818 or 81.8 pence New s = 0.99 × £1.04 = £1.03 or 103 pence	B1 ft their mean B1 ft their s B1 for correct units *dep* on at least 1 correct (ft)	**3**
		TOTAL	**8**
	Section B		
Q6 (i)	X ~ B(18, 0.1) (***A***) P(2 faulty tiles) $= \binom{18}{2} \times 0.1^2 \times 0.9^{16} = 0.2835$ OR from tables $0.7338 - 0.4503 = 0.2835$ (***B***) P(More than 2 faulty tiles) $= 1 - 0.7338 = 0.2662$	M1 $0.1^2 \times 0.9^{16}$ M1 $\binom{18}{2} \times p^2 q^{16}$ A1 CAO OR: M2 for 0.7338 – 0.4503 A1 CAO M1 P($X \leq 2$) M1 *dep* for 1-P($X \leq 2$) A1 CAO	**3** **3**

	(*C*) E(X) = $np = 18 \times 0.1 = 1.8$	M1 for product 18×0.1 A1 CAO	**2**
(ii)	(*A*) Let p = probability that a randomly selected tile is faulty H_0: $p = 0.1$ H_1: $p > 0.1$	B1 for definition of p in context B1 for H_0 B1 for H_1	**3**
	(*B*) H_1 has this form as the manufacturer believes that the number of faulty tiles may <u>increase</u>.	E1	**1**
(iii)	Let $X \sim B(18, 0.1)$ $P(X \geq 4) = 1 - P(X \leq 3) = 1 - 0.9018 = 0.0982 > 5\%$ $P(X \geq 5) = 1 - P(X \leq 4) = 1 - 0.9718 = 0.0282 < 5\%$ So critical region is {5,6,7,8,9,10,11,12,13,14,15,16,17,18}	B1 for 0.0982 B1 for 0.0282 M1 for at least one comparison with 5% A1 CAO for critical region *dep* on M1 and at least one B1	**4**
(iv)	4 does not lie in the critical region, (so there is insufficient evidence to reject the null hypothesis and we conclude that there is not enough evidence to suggest that the number of faulty tiles has increased.	M1 for comparison A1 for conclusion **in context**	**2**
		TOTAL	**18**
Q7 **(i)**		G1 first set of branches G1 *indep* second set of branches G1 *indep* third set of branches G1 labels	**4**

(ii)	(A) P(all on time) = $0.95^3 = 0.8574$	M1 for 0.95^3 A1 CAO	**2**
	(B) P(just one on time) = $0.95\times0.05\times0.4 + 0.05\times0.6\times0.05 + 0.05\times0.4\times0.6$ $= 0.019 + 0.0015 + 0.012 = 0.0325$	M1 first term M1 second term M1 third term A1 CAO	**4**
	(C) P(1200 is on time) = $0.95\times0.95\times0.95 + 0.95\times0.05\times0.6 + 0.05\times0.6\times0.95 +$ $0.05\times0.4\times0.6 = 0.857375+0.0285+0.0285+0.012 = 0.926375$	M1 any two terms M1 third term M1 fourth term A1 CAO	**4**
(iii)	P(1000 on time given 1200 on time) = P(1000 on time and 1200 on time) / P(1200 on time) = $\frac{0.95\times0.95\times0.95+0.95\times0.05\times0.6}{0.926375} = \frac{0.885875}{0.926375} = 0.9563$	M1 either term of numerator M1 full numerator M1 denominator A1 CAO	**4**
		Total	**18**