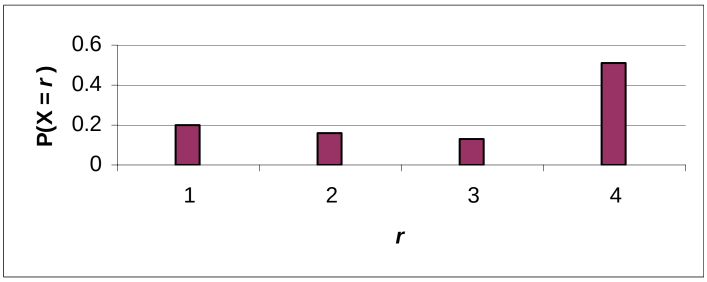
4766 Statistics 1

Q1 (i)	Mode = 7 Median = 12.5	B1 **cao** B1 **cao**	**2**
(ii)	Positive or positively skewed	E1	**1**
(iii)	(*A*) Median (*B*) There is a large outlier or possible outlier of 58 / figure of 58. Just 'outlier' on its own without reference to either 58 or large scores E0 Accept the large outlier affects the mean (more) E1	E1 cao E1indep	**2**
(iv)	There are $14.75 \times 28 = 413$ messages So total cost = 413×10 pence = £41.30	M1 for 14.75×28 but 413 can also imply the mark A1**cao**	**2**
		TOTAL	**7**
Q2 (i)	$\binom{4}{3} \times 3! = 4 \times 6 = 24$ codes or $^4P_3 = 24$ (M2 for $^4P_3$) *Or* $4 \times 3 \times 2 = 24$	M1 for 4 M1 for ×6 A1	**3**
(ii)	$4^3 = 64$ codes	M1 for 4^3 A1 **cao**	**2**
		TOTAL	**5**
Q3 (i)	Probability = $0.3 \times 0.8 = 0.24$	M1 for 0.8 from (1-0.2) A1	**2**
(ii)	*Either:* P(*A*U*B*) = P(*A*) **+** P(*B*) – P(*A*∩*B*) $= 0.3 + 0.2 - 0.3 \times 0.2$ $= 0.5 - 0.06 = 0.44$ *Or:* P(*A*U*B*) = $0.7 \times 0.2 + 0.3 \times 0.8 + 0.3 \times 0.2$ $= 0.14 + 0.24 + 0.06 = 0.44$ *Or:* P(*A*U*B*) = 1 – P(*A′*∩*B′*) $= 1 - 0.7 \times 0.8 = 1 - 0.56 = 0.44$	M1 for adding 0.3 and 0.2 M1 for **subtraction** of (0.3×0.2) A1 **cao** M1 either of first terms M1 for last term A1 M1 for 0.7×0.8 or 0.56 M1 for complete method as seen A1	**3**
(iii)	P(*A*|*B*) = $\frac{P(A \cap B)}{P(B)} = \frac{0.06}{0.44} = \frac{6}{44} = 0.136$	M1 for numerator of their 0.06 only M1 for 'their 0.44' in denominator A1 FT (must be valid p)	**3**
		TOTAL	**8**

Q4 **(i)**	E(X) = $1\times0.2+2\times0.16+3\times0.128+4\times0.512=2.952$ Division by 4 or other spurious value at end loses A mark E(X^2) = $1\times0.2+4\times0.16+9\times0.128+16\times0.512=10.184$ Var(X) = $10.184 - 2.952^2 = 1.47$ (to 3 s.f.)	M1 for Σ *rp* (at least 3 terms correct) A1 cao M1 for Σ x^2p *at least 3 terms correct* M1 for E(X^2) – E(X)^2 Provided ans > 0 A1 FT their E(X) but not a wrong E(X^2)	**5**
(ii)	Expected cost = 2.952 × £45000 = £133000 (3sf)	B1 FT (no extra multiples / divisors introduced at this stage)	**1**
(iii)		G1 labelled linear scales G1 height of lines	**2**
		TOTAL	**8**
Q5 **(i)**	Impossible because the competition would have finished as soon as Sophie had won the first 2 matches	E1	**1**
(ii)	**SS, JSS, JSJSS**	B1, B1, B1 (-1 each error or omission)	**3**
(iii)	$0.7^2 + 0.3\times0.7^2 + 0.7\times0.3\times0.7^2 = 0.7399$ or 0.74(0) { 0.49 + 0.147 + 0.1029 = 0.7399}	M1 for any correct term M1 for any other correct term M1 for sum of all three correct terms A1 cao	**4**
		TOTAL	**8**

<table>
<tr><td></td><td>Section B</td><td></td><td></td></tr>
<tr><td>Q6
(i)</td><td>Mean = $\frac{180.6}{12}$ = 15.05 or 15.1

S_{xx} = $3107.56 - \frac{180.6^2}{12}$ or 3107.56 – 12(their 15.05)^2 =
(389.53)
$s = \sqrt{\frac{389.53}{11}}$ = 5.95 or better
NB Accept answers seen without working (from calculator)</td><td>B1 for mean

M1 for attempt at S_{xx}

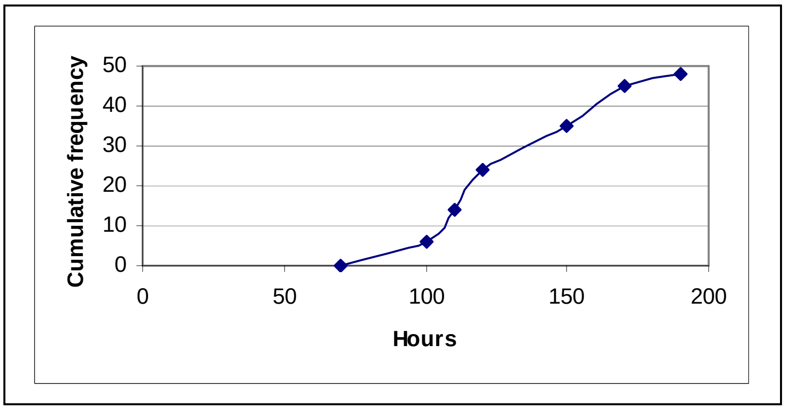
A1 cao</td><td>3</td></tr>
<tr><td>(ii)</td><td>$\bar{x}$ + 2s = 15.05 + 2 × 5.95 = 26.95
$\bar{x}$ – 2s = 15.05 – 2 × 5.95 = 3.15
So no outliers</td><td>M1 for attempt at either
M1 for both
A1 for limits and conclusion FT their mean and sd</td><td>3</td></tr>
<tr><td>(iii)</td><td>New mean = 1.8 × 15.05 + 32 = 59.1

New s = 1.8 × 5.95 = 10.7</td><td>B1FT

M1 A1FT</td><td>3</td></tr>
<tr><td>(iv)</td><td>New York has a higher mean or ‘ is on average’ higher (oe)

New York has greater spread /range /variation or SD (oe)</td><td>E1FT using ^{0}F ($\bar{x}$ dep)

E1FT using ^{0}F (σ dep)</td><td>2</td></tr>
<tr><td>(v)

(vi)</td><td><table><tr><td>Upper bound</td><td>(70)</td><td>100</td><td>110</td><td>120</td><td>150</td><td>170</td><td>190</td></tr><tr><td>Cumulative frequency</td><td>(0)</td><td>6</td><td>14</td><td>24</td><td>35</td><td>45</td><td>48</td></tr></table>


NB all G marks dep on attempt at cumulative frequencies.

NB All G marks dep on attempt at cumulative frequencies

Line on graph at cf = 43.2(soi) or used
90th percentile = 166</td><td>B1 for all correct cumulative frequencies (may be implied from graph). <u>Ignore cf of 0 at this stage</u>

G1 for linear scales
(linear from 70 to 190)
ignore x < 70
vertical: 0 to 50 but not beyond 100 (no inequality scales)

G1 for labels

G1 for points plotted as (UCB, their cf). <u>Ignore (70,0) at this stage</u>. No mid – point or LCB plots.

G1 for joining all of ‘their points’(line or smooth curve) AND now including (70,0)

M1 for use of 43.2
A1FT but dep on 3rd G mark earned</td><td>5

2</td></tr>
<tr><td></td><td></td><td>TOTAL</td><td>18</td></tr>
</table>

Q7 **(i)**	*X* ~ B(12, 0.05) (*A*) $P(X = 1) = \binom{12}{1} \times 0.05 \times 0.95^{11} = 0.3413$ OR from tables $0.8816 - 0.5404 = 0.3412$ (*B*) $P(X \geq 2) = 1 - 0.8816 = 0.1184$ (*C*) Expected number $E(X) = np = 12 \times 0.05 = 0.6$	M1 0.05×0.95^{11} M1 $\binom{12}{1} \times pq^{11}$ (p+q) = 1 A1 cao OR: M1 for 0.8816 seen and M1 for subtraction of 0.5404 A1 cao M1 for 1 – P(X ≤ 1) A1 cao M1 for 12×0.05 A1 cao (= 0.6 seen)	**3** **2** **2**
(ii)	*Either*: $1 - 0.95^n \leq ⅓$ $0.95^n \geq ⅔$ $n \leq \log ⅔ / \log 0.95$, so $n \leq 7.90$ Maximum *n* = 7 *Or:* (using tables with *p* = 0.05): *n* = 7 leads to P(*X* ≥ 1) = 1 - P(*X* = 0) = 1 – 0.6983 = 0.3017 (< ⅓) or 0.6983 (> 2/3) *n* = 8 leads to P(*X* ≥ 1) = 1 - P(*X* = 0) = 1 – 0.6634 = 0.3366 (> ⅓) or 0.6634 (< 2/3) Maximum *n* = 7 (total accuracy needed for tables) *Or:* (using trial and improvement): $1 - 0.95^7 = 0.3017$ (< ⅓) or $0.95^7 = 0.6983$ (> 2/3) $1 - 0.95^8 = 0.3366$ (> ⅓) or $0.96^8 = 0.6634$ (< 2/3) Maximum *n* = 7 (3 sf accuracy for calculations) NOTE: *n* = 7 unsupported scores SC1 only	M1 for equation in *n* M1 for use of logs A1 cao M1indep M1indep A1 cao dep on both M's M1indep (as above) M1indep (as above) A1 cao dep on both M's	**3**
(iii)	Let *X* ~ B(60, *p*) Let *p* = probability of a bag being faulty H_0: $p = 0.05$ H_1: $p < 0.05$ $P(X \leq 1) = 0.95^{60} + 60 \times 0.05 \times 0.95^{59} = 0.1916 > 10\%$ So not enough evidence to reject H_0 Conclude that there is not enough evidence to indicate that the new process reduces the failure rate or scientist incorrect/ wrong.	B1 for definition of *p* B1 for H_0 B1 for H_1 M1 A1 for probability M1 for comparison A1 E1	**8**
		TOTAL	**18**