Statistics – Paper 4 – Mark Scheme

Question 1

2 (a) (i)	4	1	
(ii)	5	1	
(iii)	4.75	3	**M1** for $1 \times 2 + 1 \times 3 + 17 \times 4 + 12 \times 5 + 6 \times 6 + 3 \times 7$ condone one slip **then M1** dependent result $(190) \div 40$
(b)	$\dfrac{190 + 3n}{40 + n}$	2	**SC1** for their $190 + 3n$

Question 2

6 (a)	32.5 cao www4	4	**M1** for mid-values seen **M1** for use of Σfx with x's anywhere in each interval $(10 \times 15 + 30 \times 30 + 20 \times 45)$ **M1** $\div 60$ dependent on second M1
(b)	Histogram drawn	3	**B1** Bars correct positions and widths – no gaps **B2** Heights of bars 1, 1.5 and 2 (**B1** for any two correct or for heights in the ratio 2:3:4)

Question 3

7 (a)	$12 \times 2.5 + 15 \times 7.5 + 23 \times 12.5 + 30 \times 17.5 + 40 \times 22.5 + 35 \times 27.5 + 25 \times 32.5 + 20 \times 37.5$	M1 M1	mid-values any three soi Use of Σfx dep on x anywhere in each interval (including lower bound) – allow 2 slips or omissions
	$\div 200$ 21.9 www 4	M1 A1	Depend on second M
(b)	155, 180	1	
(c)	8 points plotted ft, ignoring (0, 0) Reasonable <u>increasing</u> curve or polygon through their 8 points	P3ft C1ft	**P2ft** for 6 or 7 plotted , **P1ft** for 4 or 5 plotted Condone starting at (5, 12) and ft only if shape correct.
(d)	**Either** horizontal or vertical line at least 1 cm long at $y = 50$ on the curve	1	
(e) (i)	22 – 23	1	
(ii)	13.5 – 14.5	1	
(iii)	25.5 – 26.5	1	
(iv)	136 – 140 must be integer	2	**SC1** for 60 – 64 seen and must be integer

Question 4

7 (a)	(Mode) = 11	1	**B1**
	(Median) = 12.5	2	**M1** for evidence of finding mid-value e.g. $(126 + 1) \div 2$ oe, (condone $126 \div 2$)
	(Mean) = 12.8 (0 ….)	3	**M1** for correct use of Σfx (allow one slip) **M1** (dependent) for $\div 126$
(b) (i)	15, 27, 30, …….	3	**B1 B1 B1**
(ii)	9.67 (9.674 to 9.675) cao www 4	4	**M1** for mid-values, condone one error or slip **M1** for use of Σfx, with x's anywhere in intervals and their frequencies (allow one slip) **M1** (dependent on second M) for $\div 126$ (or their Σf) isw any conversion into hours and minutes

Question 5

5	(a) 8 correct plots	P3	**P2** for 6 or 7 correct plots **P1** for 4 or 5 correct plots
	Joined by curve or ruled lines	C1ft	ft their points Must join minimum of 7 points
	(b) (i) 161 to 162	1	
	(ii) 171 to 172	1	
	(iii) Their (b)(ii) – 150	1ft	**Strict** ft provided > 0
	(c) (i) $\dfrac{55}{200}$ oe $\left(\dfrac{11}{40}\right)$	1	isw incorrect cancelling for both parts of (c)
	(ii) $\dfrac{1100}{39800}$ oe $\left(\dfrac{11}{398}\right)$	3	**M2** for $2 \times$ their $\dfrac{55}{200} \times \dfrac{10}{199}$ oe soi by 0.0276… or **M1** for their $\dfrac{55}{200} \times \dfrac{10}{199}$ oe $\left(\dfrac{11}{796}\right)$ soi by 0.0138…
	(d) (i) 30, 35, 20	2	**B1** for 1 correct value
	(ii) Blocks in correct position		
	w = 1cm, fd = 4	1	
	w = 1cm, fd = 6	1ft	**Strict** ft from their 30 unless 0
	w = 2cm, fd = 3.5	1ft	**Strict** ft from their 35 unless 0

Question 6

3	(a) (i) 63 to 63.5	1	
	(ii) 50 to 50.5	1	
	(iii) 21.5 to 22.5	1	
	(b) 46	2	**B1** for 34 seen (could be on graph)
	(c) (i) 12, 14	1, 1	
	(ii) {35 × 8 + 45 × their 12 + 55 × 14 + 65 × 22 + 75 × their 14 + 85 × 10} ÷ their 80 (or 80)	M3	**M1** for mid-values soi (allow 1 error/omit) and **M1** for use of $\sum fx$ with x in correct boundary including both ends (at least 4 products) (4920 seen implies M2) and **M1** depend on 2nd M for dividing by their 80 (or 80) (not 54 or less)
	61.5 cao	A1	www4

Question 7

10	(a) 7, 8, 8, 10, 11, 16 and 8, 8, 8, 10, 10, 16	5	Mark answer spaces only or clearly indicated lists. Allow numbers in any order but must be lists of 6 integers **B4** for either correct list If not **B4** then **B1** for a series with mode 8 and **B1** for a series with median 9 and **B1** for a series with sum 60
	(b) (i) $(30 \times 65 + 35 \times 85 + 40 \times 95 + 40 \times 110 + 15 \times 135) \div 160$	4	**M1** for mid-values soi (allow 1 error/omission) and **M1** for use of $\sum fx$ with x in correct interval including both boundaries allow one further error/omission and **M1** (dependent on second M) for ÷ 160 www 4
	94.7 (94.68 – 94.69)		
	(ii) Heights of 4, 2, 0.5 with correct interval widths	4	**B3** for 2 correct or **B2** for 1 correct or **B1** for all three freq. densities correct but no/incorrect graph

Question 8

8	14.2	3	M1 for Σ fx (10 × 11 + 8 × 12 + 16 × 13 + 11 × 14 + 7 × 15 + 8 × 16 + 6 × 17 + 9 × 18) (1065) (allow one error or omission) M1dep for ÷ Σf (10 + 8 + 16 + 11 + 7 + 8 + 6 + 9) (75) (allow one further error or omission)
	14	2	M1 for 37th, 37.5th or 38th seen
	13	1	
(b)	(i) 21, 30, 15	2	B1 for 2 correct
	(ii) 20 20 10 (10) 1.05 1.5 1.5 (0.9)	3	1, 1, 1 for each correct vertical pair
(c)	$\dfrac{10 \times 2.5 + 12 \times 3 + 4n}{10 + 12 + n}(=3.1)$	M2	M1 for either numerator or denominator seen
	multiplying across and collecting terms	M1	dep on linear numerator and denominator their $(68.2 - 25 - 36) =$ their $(4 - 3.1) \times n$
	$(n =)$ 8 www 4	A1	

Question 9

6 (a)	(i)	$45 < t \leqslant 55$	1	Allow any indication e.g. 4th interval
	(ii)	52.6 (52.63…..) www 3	3	M1 for $6 \times 10 + 15 \times 27.5 + 19 \times 40 + 37 \times 50 + 53 \times 62.5 + 20 \times 75$ (= 7895) Allow 1 error/omission and M1 dep for ÷ 150
(b)	(i)	40, 77, 130, 150	2	B1 for 2 or 3 correct values
	(ii)	Correct scales	S1	
		6 correct plots ft	P3**ft**	ft from (i) if increasing values. (35, 21) must be inside square 20 – 22 but (55, 77) may be inside or edge of square P2 for 4 or 5 correct plots ft P1 for 2 or 3 correct plots ft
		Curve or ruled lines through the 6 points	C1**ft**	ft their points if increasing condone graph starting at (20, 6)
(c)	(i)	54 to 55	1	
	(ii)	$18.5 - 22.5$	2	B1 for UQ = 62.5 to 65 or LQ = 42.5 to 44 seen
	(iii)	Their reading at 60 – their reading at 50	1	
	(iv)	$\dfrac{150 - \text{their reading at } 50\,(\pm 2)}{150}$ oe	2	SC1 for $\dfrac{\text{their reading at } 50(\pm 2)}{150}$ oe
	(v)	If their (iv) is $\dfrac{k}{150}$, then ft their $\dfrac{k}{150} \times \dfrac{k-1}{149}$	2**ft**	In (iv) and (v), condone answers as decimals to 3 sf Penalise first occurence only of 2sf decimals isw cancelling/conversion M1 for $\dfrac{k}{150} \times \dfrac{k-1}{149}$

Question 10

6 (a)	(i)	5.8	1	
	(ii)	4.6 to 4.65	1	
	(iii)	2.35 to 2.5	1	
	(iv)	172 or 171	2	SC1 for 28 or 29
(b)	(i)	72 to 76, 38 to 42	2	Must be integers. B1 either.
	(ii)	Their correct $\Sigma fx \div 200$	4	M1 for 3 or 4 correct mid-values seen 2, 5, 6.5, 8.5 M1 for Σfx, **ft** their frequencies and x anywhere in interval, including boundaries $36 \times 2 + (72 \text{ to } 76) \times 5 + (38 \text{ to } 42) \times 6.5 + 50 \times 8.5$ M1 for ÷ 200 or their 200 (dependent on second M1) (74, 40 give 1127 then 5.635 (or 5.64 or 5.63)) Other pairs of frequencies from (b)(i) must have a sum of 114 to gain the A mark.
	(iii)	$p \div 2, q$, where p, q are from (b)(i)	2**ft**	B1 either **ft** (ft their table)
		Histogram with two new columns of correct width		B1
		Two correct heights	2**ft**	B1 **ft** (ft their freq. densities)

Question 11

3					
	(a)	(i)	$1.6 < h \le 1.7$	1	Condone alt. notation used for class
		(ii)	$\{1.35 \times 4 + 1.45 \times 13 + 1.55 \times 33 + 1.65 \times 45 + 1.75 \times 19 + 1.85 \times 6\} \div 120$	M3	(194/120) **M1** for mid-values soi (allow one slip) and **M1** for use of $\sum fx$ with x in correct interval (allow one more slip) and **M1** depend on 2nd **M** for dividing by 120
			1.62 or 1.616 to 1.617	A1	www4
	(b)	(i)	$\dfrac{6}{120}$ oe	1	Accept dec/% to 3 sf or better but not ratio isw cancelling/conversion (also for **(ii)**)
		(ii)	$\dfrac{2147}{2380}$ oe (0.902(1..))	3	**M2** for $\dfrac{k}{120} \times \dfrac{k-1}{119}$ where $\dfrac{k}{120}$ is 1 – their **(b)(i)** or if $k = 114$ or **M1** for 1 – their **(b)(i)** or for 114/120 seen After 0 scored **SC2** for ans 1/476 oe or **SC1** for 6/120 × 5/119
	(c)	(i)	95, 120	1	
		(ii)	Plots 7 points correctly exact or in correct square	P2ft	**P1ft** for 5 or 6 correct plots
			Curve or lines through 7 points	C1ft	ft their **increasing** curve within 1 mm of points
	(d)	(i)	1.61 to 1.63	1ft	ft their 60th reading on inc. curve to nearest 0.01
		(ii)	1.555 to 1.57	1ft	ft their 36th reading on inc. curve

Question 12

5					
	(a)		63.45 or 63.5 cso	4	**M1** for 10, 30, 45, 55, 65, 75, 85, 95 At least 6 correct mid-values soi and **M1** for $\sum fx$ $(6 \times 10 + 12 \times 30 + 20 \times 45 + ... 5 \times 95)$ (12690) where x is in the correct interval allow one further slip and **M1** for their $\sum fx \div 200$ dep on second **M1**
	(b)	(i)	75 117 195 200	B2	**B1** for 2 or 3 correct
		(ii)	8 correct points plotted	P3ft	**P2ft** for 6 or 7 **P1ft** for 4 or 5
			Curve (or polygon) correct through 8 points	C1ft	ft their increasing curve only if at least **B1** in **(b)(i)**. Ignore $t = 0$ to 20
	(c)	(i)	65 to 67	B1ft	Or ft their curve at cf = 100
		(ii)	52 to 55	B1	
		(iii)	21 to 24	B1	
		(iv)	44 to 52	B1	Must be integer
		(v)	Integer value of 200 – reading at 45 secs	2ft	**B1ft** for integer value of reading at 45 secs

Question 13

7	(a)	$3 < t \le 4$	1	Condone alt. notation used for class
	(b)	1 2.5 3.5 6	M1	Mid-interval values soi
		$\sum fx$ with x in correct interval	M1	Allow 1 slip (24 170 252 216)
		$662 \div 200$	M1	M1 dep on second M1
		3.31 cso	A1	
	(c)	(i) 92, 164	1	
		(ii) (2, 24), (3, 92), (4, 164), (8, 200) ft	P2ft	P1ft for 3 points
		Curve/polygon through the 4 points	1ft	ft increasing curve/polygon
		(iii) $3 \le \text{med} \le 3.2$	B1	
		$2.4 \le \text{lq} \le 2.7$	B1	
		$0.9 \le \text{iqr} \le 1.5$	B1	

Question 14

5	(a) (i)	2.8 cao	1	accept 2 (h) 48, not 2.48
	(ii)	3.8 cao	1	accept 3 (h) 48 not 3.48
	(iii)	1.8 cao	1ft	ft their (a)(ii) – 2 accept 1 (h) 48 and 1.48
	(b)	6	1	
	(c) (i)	9, 4, 4	2	B1 for 2 correct
	(ii)	1 2.5 3.5 4.5 5.5 7	M1	At least 5 correct mid-values seen
		20×1 + 25×2.5 + 18×3.5 + *their* 9×4.5 + *their* 4×5.5 + *their* 4×7 $(= 236)$	M1	$\sum fx$ where x is in the correct interval $(20 + 62.5 + 63 + 40.5 + 22 + 28)$
		$\div 80$	M1	Dependent on second method mark
		2.95 cao	A1	Allow www 4
	(d)	Axes suitably numbered **or** horizontal axis suitably numbered **and** area scale stated	1	e.g. $4\text{cm}^2 = 10$
		6 columns with correct relative widths	1	no gaps, but condone reasonable freehand
		heights: 10 25, 18, *their* 9, *their* 4 *their* 4 ÷ 2	1 1 1	if vertical axis not labelled use correct relative heights

Question 15

1	(a)	(i)	6 correct plots	2	**P1** for 4 or 5 correct plots.
		(ii)	Positive	1	
		(iii)	Line of best fit	1	**Ruled** line at least from $x = 5$ to $x = 48$, with at least 3 points on each side and cuts axes between (5, 0) and (0, 20)
		(iv)	English (integer) value on line at $M = 22$	1ft	**Strict ft** from their single ruled line 5 ⌀ x ⌀ 48.
	(b)		$(26 + 39 + 35 + 28 + 9 + 37 + 45 + 33 + 16 + 12) \div 10$	M2	**M1** for $26 + 39 + 35 + 28 + 9 + 37 + 45 + 33 + 16 + 12$, condone one slip **or SC1**, for at least 2 values eg $(26 + 39 + \ldots) \div 10$
	(c)		46 cao www 3	3	**M2** for $(31 \times 12 - 28 \times 10) \div 2$ soi by $92 \div 2$ **or M1** for 31×12 soi by 372 or 92

Question 16

4	(a)	(i)	Median = 2 www 2	2	**M1** for identifying mid-value [e.g. List with indication or 10th and 11th seen in working] or 10.5 soi
			Mode = 3	1	
		(ii)	54 www 2	2	**M1** for $3 \div 20 \times 360$ oe
	(b)		184 www 4	4	**M1** for 175, 185, 195 soi **M1** for $5 \times a + 12 \times b + 3 \times c$ where a, b, c are in correct interval, including boundaries [3680] **M1** (dep on 2nd M) $\div 20$

Question 17

1	(a)	(i)	126	2	M1 for $x + x + 18 + 90 = 360$ or better
		(ii)	144	1 ft	ft their $x + 18$
	(b)		16.66 . . . to 16.67 or 16.7 oe	2	M1 for 60/360 × 100 oe (implied by answer 16.6)
	(c)	(i)	22.18 to 22.19 or 22.2 oe	3	M2 for (35 + 36)/320 × 100 or B1 for 36 or 35 or 71 seen
		(ii)	58 www	2 ft	For 2ft, 114 – their (a)(ii)/360 × 140 correctly evaluated (correct or to the nearest integer) or M1 for (360 – 60 – 72)/360 ×180 [114] or 56ft (their (a)(ii)/360 × 140) seen
	(d)	(i)	50, 70, 100, 135	M1	At least 3 correct mid-values seen
			(5 × 50 + 14 × 70 + 29 × 100 + 32 × 135) [= 8450]	M1	$\sum fx$ where x is in the correct interval allow one further slip
			÷ 80 or their $\sum f$	M1	Depend on second method
			106 or 105.6 or 105.625 or 105.62 or 105.63 cao www	A1	isw conversion to mins/secs & reference to classes
		(ii)	1		B3 for 2.9 and 4.27
			2.9 oe		or B2 for 2.9 or 4.27
			4.27 [4.266 to 4.267] oe	4	and B1 for 1
					Or SC2 for 0.25 oe and 0.725 oe and 1.066 to 1.07 oe seen
					Or SC1 for any pair of the above seen

Question 18

5	(a) 20, 60, 100, 140, 180, 220	M1	At least 5 correct mid - values soi
	$(6 \times 20 + 10 \times 60 + 28 \times 100 + 76 \times 140 + 22 \times 180 + 16 \times 220)$	M1	$\sum fm$ where m is in the correct interval, allow either end of interval as m
	$(= 21640)$		allow one further slip
	$\div 158$ or $\sum f$	M1	Depend on second method
	137 or 136.9 to 137.0	A1	SC2 for 137 or better ww
	(b) (i) 16, 126	1, 1	
	(ii) rectangular bar of height 0.2	1ft	Strict ft from *their* 16
	rectangular bar of height 1.05	1ft	Strict ft from *their* 126
	correct widths of 80 and 120 with no gaps	1	
	(c) 135	3	M2 for $\dfrac{15 \times 136 + 3 \times 130}{15 + 3}$ or M1 for 15×136 and 3×130 [2040] and [390]

Question 19

9	(a) (i) 72	1	
	(ii) 68	1	
	(iii) 8	1	
	(iv) 164	2	M1 for 36 seen may be on the graph
	(b) (i) 11	1	
	(ii) 35, 45, 55, 65, 75, 85	M1	At least 5 correct mid - values soi
	$(9 \times 35 + their \ 11 \times 45 + 16 \times 55 + 28 \times 65 + 108 \times 75 + 28 \times 85)$ [13990]	M1	$\sum fx$ where x is in the correct interval allow one further slip
	$\div 200$ or *their* $\sum f$	M1dep	Depend on second method
	69.95 or 69.9 or 70[.0] cao	A1	isw conversion to mins/secs & reference to classes SC2 for correct answer without working

Question 20

3	(a)	(i)	3.2	1	
		(ii)	4.2	1	
		(iii)	4.6	1	
		(iv)	196	1	
	(b)	(i)	100, 46, 12	2	**B1** for 2 correct
		(ii)	4	2	**M1** for frequency of 60 or 140 seen in workspace

Question 21

5	(a)	171.25 (or 171 or 171.2 or 171.3) www	3	**M1** for 5 × 155 + 9 × 162.5 + 18 × 172.5 + 10 × 185 [= 7192.5] and **M1** (dep on **M1**) for *their* $\Sigma fx \div 42$
	(b)	$160 < x \leq 165$ oe	1	
	(c)	Blocks with heights of 1.8, 1.2, 1, with correct interval widths and no gaps	4	**B3** for 2 correct blocks or **B2** for 1 correct block or **B1** for 3 correct frequency densities or heights or 3 correct widths

Question 22

9	(a)	(i)	14	1	
		(ii)	8	1	
		(iii)	30 – *their* (ii)	1FT	
	(b)		$\dfrac{11}{80}$	2	**SC1** for $\dfrac{69}{80}$
	(c)		16, 4	2	**B1** for each correct value
	(d)		18.0625 rot to 3sf or better or 18.1 www	3	**M1** for Σmf for *m* as mid values of 5, 12.5, 22.5, 35 and 45 (= 1445) **and M1 dep** for $\Sigma mf \div 80$, dep on **M1** earned
	(e)		Correct widths with no gaps 2nd block w = 5, fd = 2.4 3rd block w = 15 fd = 1.2 4th block w = 10 and fd = 1.6 5th block w = 10 and fd = 0.4	1 1 1 1FT 1FT	 **Strict FT** from *their* (c) **Strict FT** from *their* (c) After **0** scored for blocks, **SC1** for 4 correct fds soi by correct heights

Question 23

7	(a)	24.7 or 24.66 to 24.67	4	**M1** for midpoints soi (condone 1 error or omission) (5, 15, 25, 35, 45, 55) **and** **M1** for use of $\sum fx$ with x in correct interval including both boundaries (condone 1 further error or omission) **and** **M1** (dependent on second **M**) for $\sum fx \div 120$
	(b) (i)	50, 90, 114	2	**B1** for 2 correct
	(ii)	Correct curve or ruled polygon	3	Ignore section to left of $t = 10$ **B1** for 6 correct horizontal plots **and B1FT** for 6 correct vertical plots If 0 scored **SC1** for 5 out of 6 correct plots **and** **B1FT** for curve or polygon through at least 5 of *their* points dep on an increasing curve/polygon that reaches 120 vertically
	(iii)	21.5 to 23 15 to 16.5 24 to 26	4	**B1** **B1** **B2** or **B1** for 72 or 72.6 seen
	(c) (i)	50, 30	2	**B1** each
	(ii)	Correct histogram	3FT	**B1** for blocks of widths 0 – 20, 30 – 60 (no gaps) **B1FT** for block of height 2.5 or *their* 50 ÷ 20 **and B1FT** for block of height 1 or *their* 30 ÷ 30

Question 24

5	(a) (i)	3.81 or 3.812 to 3.813 or 3h 49min nfww	4	**M1** for midpoints soi (condone 1 error or omission and **M1** for use of $\sum fx$ with x in correct interval including both boundaries (condone 1 further error or omission) and **M1** (**dep** on 2nd M1) for $\sum fx \div 80$ (305 ÷ 80)
	(ii)	Correct histogram	4	**B1** for each correct block and **B1** for correct widths
	(b) (i)	$\dfrac{2}{5}, \dfrac{1}{4}, \dfrac{3}{4}, \dfrac{1}{4}$ oe	2	**B1** for $\dfrac{2}{5}$ or both $\dfrac{1}{4}$ s in correct place
	(ii)	$\dfrac{18}{20}$ nfww $\left[\dfrac{9}{10}\right]$	3	**M2 FT** for $1 - their\ \dfrac{2}{5} \times their\ \dfrac{1}{4}$ or $\dfrac{3}{5} \times \dfrac{3}{4} + \dfrac{3}{5} \times their\ \dfrac{1}{4} + their\ \dfrac{2}{5} \times \dfrac{3}{4}$ oe or **M1 FT** for $their\ \dfrac{2}{5} \times their\ \dfrac{1}{4}$ or $\dfrac{3}{5} \times their\ \dfrac{1}{4} + their\ \dfrac{2}{5} \times \dfrac{3}{4}$ oe
	(iii)	$\dfrac{27}{125}$ [0.216]	2	**M1** for $\dfrac{3}{5} \times \dfrac{3}{5} \times \dfrac{3}{5}$

Question 25

9	(a)	(i)	37.5 to 38.5	1	
		(ii)	19.5 to 20.5 nfww	2	**B1** for [LQ =] 23.5 to 24 or [UQ =] 43.5 to 44
		(iii)	43	2	**B1** for 56 seen or horizontal line drawn at cf = 56
	(b)	(i)	31.8[4…] nfww	4	**M1** for midpoints soi (condone 1 error or omission) and **M1** for use of $\sum ft$ with t in correct interval including both boundaries (condone 1 further error or omission) and **M1** (**dep** on 2nd **M1**) for $\sum ft \div 80$ (2547.5 ÷ 80)
		(ii)	Correct histogram	4	**B1** for each correct block with correct width and height If **B0** then **SC1** for four correct f.d.s or four correct widths

Question 26

7	(a)	(i)	(100 − 70) × 0.4 [= 12] or better	1	Accept $\dfrac{24}{78} \times 39$ oe
		(ii)	60.9 or 60.89… nfww	5	**B1** for 3 or 4 correct extra frequencies 3, 6, 10, 8 soi **M1** for at least 4 of mid-interval values 15, 40, 55, 65, 85 soi **M1** for $\sum fx$ where x is any value in each interval allow *their* frequencies provided integers and they must be shown [3 × 15 + 6 × 40 + 10 × 55 + 8 × 65 + 12 × 85] [2375] **M1** (**dependent on second M1**) for ÷ 39 **or** ÷ (3 + 6 + 10 + 8 +12)
	(b)		60.5	3	**M2** for 20 × 70 − 19 × 70.5 oe **or M1** for either 20 × 70 or 19 × 70.5

Question 27

2	(a)	$10 < x \le 25$ $25 < x \le 30$ $30 < x \le 35$ $35 < x \le 50$ $50 < x \le 60$	2	5 correct **B1** for 3 or 4 correct **or SC1** for all correct but in the form 10 to 25 or 10 − 25
		13 33 19 [4] 15 6	3	**B2** for 4 correct **or B1** for 3 correct
	(b)	25.1[0] or 25.13 to 25.14 nfww	4	**M1** for mid-values soi, condone one error or omission 5 17.5 27.5 32.5 42.5 55 soi **and M1** for Σfx for any x in intervals including boundaries, but all fs must be integers, condone one further error or omission **and M1 dep** for $\Sigma fx \div 90$ **Dep** on 2nd **M** mark earned

Question 28

6	(a)		2000 or 1998.75 or 1998.8 or 1999 nfww	4	**M1** for midpoints **soi** (condone 1 error or omission) (500, 1250, 1750, 2250, 3000) and **M1** for use of $\sum fx$ with x in correct interval including both boundaries (condone 1 further error or omission) (5000, 37500, 96250, 162000, 99000) and **M1** (dep on 2nd **M1**) for $\sum fx \div 200$
	(b)	(i)	10, 40, 95, 167, 200	2	**B1** for 2 correct
		(ii)	Correct curve or ruled polygon	3	**B1FT** *their* **(b)(i)** for 5 correct heights within 1mm vertically and **B1** for 5 points at upper ends of intervals on correct vertical line and **B1FT** (dep on at least **B1**) for increasing curve or polygon through 5 points After 0 scored, **SC1FT** for 4 correct points plotted
		(iii)	68 to 80	2	**M1** for 120 to 132 seen
	(c)		$\dfrac{21}{50}$ oe	4	**M3** for $\dfrac{9}{10} \times \dfrac{2}{5} + \dfrac{1}{10} \times \dfrac{3}{5}$ oe or better or **M2** for $\dfrac{9}{10} \times \dfrac{2}{5}$ or $\dfrac{1}{10} \times \dfrac{3}{5}$ or $\dfrac{18}{50}$ oe or $\dfrac{3}{50}$ oe or **M1** for sight of $\dfrac{1}{10}$ and $\dfrac{2}{5}$

Question 29

3	(a)		$35 < t \leqslant 40$	1	
	(b)		22.5, 27.5, 32.5, 37.5, 42.5, 47.5	M1	At least 4 correct mid-values soi
			$(2 \times 22.5 + 6 \times 27.5 + 7 \times 32.5 + 19 \times 37.5 + 9 \times 42.5 + 7 \times 47.5)$	M1	$\sum fx$ where x is in the correct interval allow one further slip [45 + 165 + 227.5 + 712.5 + 382.5 + 332.5 = 1865]
			$\div 50$ or their $\sum f$	M1dep	**Dependent** on second method
			37.3	A1	**SC2** for correct answer with no working
	(c)	(i)	15, 19, 16	1	
		(ii)	rectangular bars of height 1, 3.8 and 1.6	B2FT	**FT** their (c)(i), on correct boundary lines **B1FT** for 2 correct heights If 0 scored for heights then **SC1** for 3 correct frequency densities soi
			correct widths of 15, 5,10 and no gaps	B1	

Question 30

9	(a)	(i)	7	4	**M2** for $\dfrac{16 \times 11 + 17 \times 10 + 18p + 19 \times 4 + 20 \times 8}{11 + 10 + 4 + 8 + p} = 17.7$ or better or **M1** for sum of two correct products or better or for [total =] $11 + 10 + 4 + 8 + p$ and **B1** for $582 + 18p = 17.7 \,(33 + p)$
		(ii)	17	1FT	**STRICT FT** median for *their p* if integer
	(b)	(i)	64	2	**M1** for $\dfrac{320}{6.4} \times 1.28$ oe
		(ii)	40	2	**M1** for $\dfrac{320}{480} \times 60$ oe
		(iii)	1.6[0]	2FT	FT *their (b)(i)* / *their (b)(ii)* evaluated correctly to 2dp **M1** for *their (b)(i)* / *their (b)(ii)* or $\dfrac{480}{6.4} \times 1.28 \div 60$

	(c)		9.9125 cao	5	**B4** for answer 9912.5 or **M1** for 25 to 35 × 290 to 310 oe and **B1** for 32.5 used and **B1** for 305 or 5 mins 5 secs used and **M1** indep for any correct conversion seen m to km

Question 31

6	(a)	(i)	$24 < t \leqslant 30$	1	
		(ii)	30.9 or 30.875 nfww	4	**M1** for midpoints **soi** (condone 1 error or omission) 5, 17, 27, 35, 50, 65 soi **M1** for use of $\sum fx$ with x in correct interval including both boundaries (condone 1 further error or omission) (50, 1530, 3645, 2975, 3500, 650) and **M1** (dep on 2nd **M1**) for $\sum fx \div 400$
	(b)	(i)	[10 100] 235 320 390 [400]	2	**B1** for any two correct **SC1** for 235, n, $n + 70$ $n > 235$
		(ii)	Correct curve or polygon	3	**B1** for correct horizontal placement **B1FT** for correct vertical placement **B1FT dep on at least B1** for reasonable increasing curve or polygon through their 6 points If zero scored **SC1** for 5 out of 6 points correctly plotted
	(c)	(i)	27.5 to 29	1	
		(ii)	12 to 14	2	**B1** for 36 to 38 or 24 seen
		(iii)	18 to 20	2	**B1** for 60 seen or marked on grid
		(iv)	30 to 45	2	**B1** for 355 to 370 seen

Question 32

7	(a)	(i)	316	4	**M1** for 100, 250, 325, 375, 450 soi **M1** for Σfm with m's in intervals including boundaries [15800] **M1** (dep on 2nd **M1**) for *their* $\Sigma fm \div 50$
		(ii)	Three correct blocks with heights 0.09, 0.36, 0.24 with correct widths and no gaps	3	**B2** for two correct blocks or **B1** for one correct block or three correct frequency densities soi
	(b)		Students have a greater range of estimates oe	**B1**	
			[On average] adults estimated a greater mass oe	**B1**	

Question 33

4	(a)	72.5	3	**M1** for Σfm with correct frequencies and correct mid-interval values
				M1 for $\div$ 200 **dep** on first **M1**
	(b)	Correct histogram	4	**B1** four correct widths – no gaps
				B3 for blocks of correct heights 0.5, 5, 16, 4 or **B2** for 3 blocks of correct heights or **B1** for 2 blocks of correct heights If 0 scored for the heights then **SC1** for all four frequency densities soi

Question 34

6	(a)		1.35 nfww	4	**M1** for 0.5, 1.5, 2.5, 3.5, 4.5, 5.5 soi, **M1** for Σfm soi by 162 where m is in correct interval including boundaries **M1**dep for $\Sigma fm \div 120$ or $\Sigma fm \div \Sigma f$ dependent on **second M1** earned
	(b)	(i)	93, 102, 113, 118	2	**SC1FT** for 1 error
		(ii)	Correct diagram	3	**B1FT** for correct vertical plots and **B1** for correct horizontal plots and **B1FT dep on at least B1** for reasonable <u>increasing</u> curve or polygon through *their* 6 points If zero scored, **SC1FT** for 5 out of 6 correct plots
		(iii) (a)	0.6 to 0.85	1	
		(b)	1.3 to 1.7	2	**B1** for UQ = 1.7 to 1.9 or LQ = 0.2 to 0.4
		(c)	0.3 to 0.6	2FT	Allow in correct range provided there is no evidence of reading at 35 or **FT** *their* reading at 42 **B1** for 42 soi
	(c)	(i)	30 and 18	2	**B1** for each
		(ii)	0.75 and 0.3	3FT	**FT** (*their* 30) $\div$ 40 and (*their* 18) $\div$ 60 **B2FT** for either 0.75 or 0.3 or **M1** for *their* 30 $\div$ 2 or $\div$ 20 or for *their* 18 $\div$ 3 or $\div$ 20

Question 35

3	(a)	Correct diagram	3	**B1** for correct vertical plots and **B1** for correct horizontal plots and **B1 dep on at least B1** for reasonable <u>increasing</u> curve or polygon through *their* 6 points If zero scored, **SC1** for 5 out of 6 correct plots
	(b) (i)	32 to 34	1	
	(ii)	120 – reading at $r = 50$	2FT	**B1FT** for reading at $r = 50$ seen
	(c)	8 18 27	2	**B1** for 2 correct
	(d)	35.2 or $35\frac{1}{6}$ or 35.16 to 35.17 nfww	4	**M1** for mid-values soi **M1 FT** for $\sum fx$ with x in the correct interval including boundaries **M1dep** for $\sum fx \div 120$ dependent on second **M1** earned
	(e)	1.6 1.35 0.3	4FT	**FT** from **(c)** *their* $8 \div 5$ and *their* $27 \div 20$ **B3FT** for any 2 correct or **B2FT** for first **or** second answer correct or **B1** for 0.3 only

Question 36

6	(a)	101.5625 or 102 or 101.5 to 101.6 nfww	4	**M1** for 55, 90, 110, 160 soi **M1** for Σfm with frequencies and each m in or on a boundary of a correct interval 2750, 2700, 4400, 6400 **M1 dep on 2nd M** for $\div 160$
	(b)	Correct histogram drawn with correct widths and heights 1, 1.5 and 2 (no gaps)	3	**B1** for each correct block If zero scored, **SC1** for correct heights or frequency densities
	(c)	$\dfrac{40}{160}$ oe	1	
	(d) (i)	$\dfrac{1560}{25440}$ oe	2	**M1** for $\dfrac{40}{160} \times \dfrac{39}{159}$
	(ii)	$\dfrac{4000}{25440}$ oe	3	**M2** for $\dfrac{40}{160} \times \dfrac{50}{159} + \dfrac{50}{160} \times \dfrac{40}{159}$ oe or **M1** for one of these products soi

Question 37

9	(a)	$140 < h \leqslant 144$	1	
	(b)	144.875 nfww	4	**M1** for at least 4 correct mid-values soi
				M1 for $\sum fx$ where x is in the correct interval, allow one further error/omission
				M1 dep for $\div$ 40 dependent on second method mark
	(c)	4 correct blocks	4	**B3** for 3 correct blocks **B2** for 2 correct blocks **B1** for 1 correct block or at least 3 correct frequency densities (1.4, 1, 1, 0.65)

Question 38

4	(a)	(i)	64	1	
		(ii)	16 to 16.5	2	**M1** for UQ = 71 to 71.5 or LQ =55
		(iii)	62	2	**B1** for 24 indicated
		(iv)	6	2	**B1** for 54 seen
	(b)		[8] 12 23 11 [4] 2	3	**B2** for 1 incorrect reading FT others
					B1 for 2 correct
	(c)		Blocks of height 0.6 2.3 1.1 0.4 with correct widths	4FT	**FT** *their* **(b)** for heights **B1FT** for each correct block
					If **B0, SC1** for blocks of widths 20, 10, 10, 10 or for *their* correct frequency densities

Question 39

3	(a)	(i)	400	1	
		(ii)	350	1	
		(iii)	70	1	
		(iv)	170	2	**B1** for 30 seen
	(b)	(i)	Mid-values 40, 80, 125, 200 soi	**M1**	
			Σfx with correct frequencies and x's in correct intervals or on boundaries of correct intervals	**M1**	
			$\div 200$	**M1(dep)**	Dependent on second M1
			106 nfww	**A1**	**SC2** for correct answer without working
		(ii)	Correct histogram	4	**B1** for correct widths **and B1** for each rectangle of correct height at 0.8, 1.6, 1.6 (up to **B3**) After 0 scored, **SC1** for 3 correct frequency densities seen
		(iii)	$\frac{10712}{39800}$ oe isw	2	**M1** for $\frac{104}{200} \times \frac{103}{199}$ oe

Question 40

4	(a)	(i)	0.0025 or $\frac{1}{400}$ oe	2	**M1** for 0.05^2 oe
		(ii)	0.9975 or $\frac{399}{400}$ oe	1FT	**FT** for $1 - (their$ (a)(i)) oe
	(b)		0.171 or 0.1714 to 0.1715 or $\frac{6859}{40\,000}$	3	**M2** for $4(0.05 \times 0.95^3)$ oe **M1** for 0.05×0.95^3 oe seen or for the 4 combinations correctly identified
	(c)		376 nfww	4	**M1** for midpoints soi (condone 1 error or omission) (225, 275, 325, 375, 425, 475) and **M1** for use of Σfx with x in correct interval including both boundaries (condone 1 further error or omission) and **M1** (dependent on second M) for $\Sigma fx \div 200$
	(d)	(i)	16	1	
		(ii)	33	2	**M1** for $0.8 \times 50 + 0.26 \times 100$

Question 41

2(a)	$71 < t \leqslant 72$	1	
2(b)	72.3 or 72.27 to 72.28 nfww	4	**M1** for midpoints soi (condone 1 error or omission) **M1** for use of $\sum fx$ with x in correct interval including both boundaries **M1** (dep on 2nd **M1**) for $\sum fx \div 90$
2(c)(i)	41, 62, 80, 90	2	**B1** for 2 correct values
2(c)(ii)	Correct curve	3	**B1FT** *their* **(c)(i)** for 5 correct heights **B1** for 5 points plotted at upper ends of intervals **B1FT** (dep on at least **B1**) for increasing curve or increasing polygon through 5 points If zero scored, **SC1FT** for 4 correct points plotted
2(c)(iii)	72.1 to 72.4	1	
2(c)(iv)	1.9 to 2.2	2	**M1** for UQ = 73.2 to 73.4 or LQ = 71.2 to 71.3
2(d)	180 cao nfww	4	**B3** for 50 [m/s] nfww OR **M3** for $\dfrac{3725 \div 1000}{74.5 \div 3600}$ OR **M2** for $3725 \div 74.5$ or **M1** for 3725 or 74.5 seen or for $(3715 \text{ to } 3725) \div (74.5 \text{ to } 75.5)$ **M1** indep for multiply by 3.6 oe

Question 42

5(a)	54, 76, 96	3	**B1** for each
5(b)	187 or 186.8 to 186.9 nfww	4	**M1** for 155, 175, 185, 200, 225 soi **M1** for Σfm with *their* frequencies from **(a)** $155 \times \textit{their } 54 + 175 \times \textit{their } 76 + 185 \times \textit{their } 96 + 200 \times 92 + 225 \times 42$ **M1** (dep on second **M1**) for *their* $\Sigma fm \div 360$

Question 42b

2(a)(i)	20 $[< t \leqslant]$ 25	1	
2(a)(ii)	25 $[< t \leqslant]$ 30	1	
2(a)(iii)	28.3 or 28.33..	4	**M1** for 22.5, 27.5, 32.5, 37.5, 42.5 soi **M1** for $\sum fx$ where x is in the correct interval including boundaries **M1**dep for $\sum fx \div 120$ or $\sum fx \div (44 + 32 + 28 + 12 + 4)$
2(a)(iv)	$\dfrac{4}{120}$ oe isw	1	
2(b)(i)	76, 104, 116, 120	2	**B1** for one error FT other values or for 3 correct
2(b)(ii)	Correct curve	3	**B1** for correct horizontal placement for 6 plots **B1FT** for correct vertical placement for 6 plots **B1FT dep on at least B1** for reasonable increasing curve or polygon through *their* 6 points If 0 scored **SC1FT** for 5 out of 6 points correctly plotted
2(b)(iii)	27 to 27.5	1	
2(b)(iv)	8.5 to 9.5	2	**B1** for [UQ=] 32 to 32.5 or [LQ=] 23 to 23.5
2(b)(v)	8, 9, 10, 11 or 12	2	**B1** for 108 to 112 seen or **B1FT** *their* graph reading at 37 mins seen

Question 43

4(a)(i)	range = 7	1	
	mode = 21	1	
	median = 22.5	2	**M1** for evidence of middle value
	mean = 22.7 or 22.71…	2	**M1** for use of $\Sigma x \div 14$
4(a)(ii)	$\dfrac{3}{14}$ oe	1	
4(b)	$x - n + 1$ final answer	3	**M2** for $nx - (n-1)(x+1)$ or **M1** for $(n-1)(x+1)$
4(c)(i)	16.6 or 16.60 to 16.61 nfww	4	**M1** for 5, 12.5, 17.5, 22.5, 30 soi **M1** for Σfx where x is in correct interval, including boundaries **M1 dep** on second M1 for $\dfrac{\Sigma fx}{50+85+100+120+10}$
4(c)(ii)	Correct histogram	4	**B1** for each correct block If 0 scored, **SC1** for 5, 20, 24, 1 seen

Question 44

3(a)	41.4	4	**M1** for 10, 30, 42.5, 47.5, 55, 70 **M1** for Σfx where x lies in or on the boundary of each interval. **M1 dep** for $\dfrac{\Sigma fx}{200}$ dep on second M1
3(b)(i)	112, 170	1	
3(b)(ii)	Correct diagram	3	**B1** for correct horizontal plot **B1FT** for correct vertical plots **B1 FT** dep on at least B1 earned for reasonable increasing curve or polygon through their 6 points If 0 scored **SC1FT** for 5 out of 6 points plotted correctly
3(b)(iii)(a)	48	1	
3(b)(iii)(b)	160	2	**M1** for 40 seen
3(c)	$\dfrac{87}{3980}$ oe	2	**M1** for $\dfrac{30}{200} \times \dfrac{29}{199}$ oe
3(d)	Correct histogram	3	**B1** for each column If 0 scored **SC1** for correct frequency densities soi 1.25, 12, 1

Question 45

3(a)	Disagree: the median for the women is greater (than the median for the men) oe Disagree: the men have a smaller [interquartile] range of times oe	2	**B1** for each correct statement oe
3(b)(i)	87.4 nfww	4	**M1** for mid-points **soi** (30, 80, 130, 190, 270) **M1** for use of Σfm with m in correct interval including both boundaries **M1** (dep on 2nd M1) for $\Sigma fm \div (41 + 24 + 23 + 8 + 4)$
3(b)(ii)(a)	90	1	
3(b)(ii)(b)	8	2	**B1** for 92 seen
3(b)(iii)	2.4	2	**M1** for $\dfrac{24}{40}$ or $\dfrac{8}{60}$ Or **B1** for [multiplier] 18 or $\dfrac{1}{18}$