A-LEVEL

Statistics

Statistics 2 – SS02

Mark scheme

6380

June 2015

Version 1.0 Final

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts: alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this Mark Scheme are available from aqa.org.uk

Key to mark scheme abbreviations

M	mark is for method
m or dM	mark is dependent on one or more M marks and is for method
A	mark is dependent on M or m marks and is for accuracy
B	mark is independent of M or m marks and is for method and accuracy
E	mark is for explanation
√or ft or F	follow through from previous incorrect result
CAO	correct answer only
CSO	correct solution only
AWFW	anything which falls within
AWRT	anything which rounds to
ACF	any correct form
AG	answer given
SC	special case
OE	or equivalent
A2,1	2 or 1 (or 0) accuracy marks
–*x* EE	deduct *x* marks for each error
NMS	no method shown
PI	possibly implied
SCA	substantially correct approach
c	candidate
sf	significant figure(s)
dp	decimal place(s)

No Method Shown

Where the question specifically requires a particular method to be used, we must usually see evidence of use of this method for any marks to be awarded.

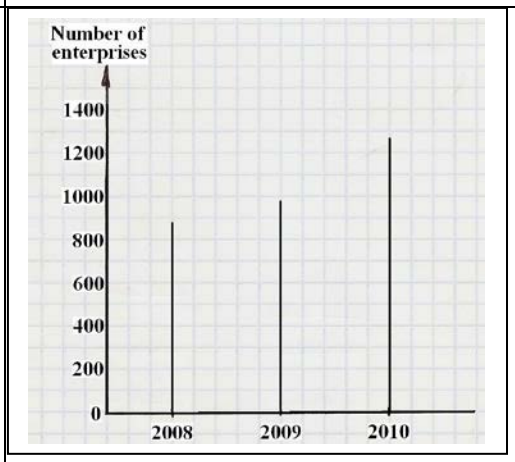
Where the answer can be reasonably obtained without showing working and it is very unlikely that the correct answer can be obtained by using an incorrect method, we must award **full marks**. However, the obvious penalty to candidates showing no working is that incorrect answers, however close, earn **no marks**.

Where a question asks the candidate to state or write down a result, no method need be shown for full marks.

Where the permitted calculator has functions which reasonably allow the solution of the question directly, the correct answer without working earns **full marks**, unless it is given to less than the degree of accuracy accepted in the mark scheme, when it gains **no marks**.

Otherwise we require evidence of a correct method for any marks to be awarded.

Q1	Solution	Marks	Total	Comments
(a)	8.5	B1		
			1	
(b)	**Similar:** Lower quartile Median **Different:** Upper quartile lower with new drug Interquartile range lower with new drug Range higher with new drug More skew with new drug Top value higher with new drug	 E1 E1 E1 E1 E1 E1 E1		Maximum of 2 similar and 2 different and overall maximum of 3
			3	
	SC for (b). Outliers totally disregarded so 7.5 in (a) and range comment reversed and top value comment reversed. Award E1 (and another E1 may be earned)			Note: first 3 comments only marked. Comments about mean, variance, standard deviation, average all score E0

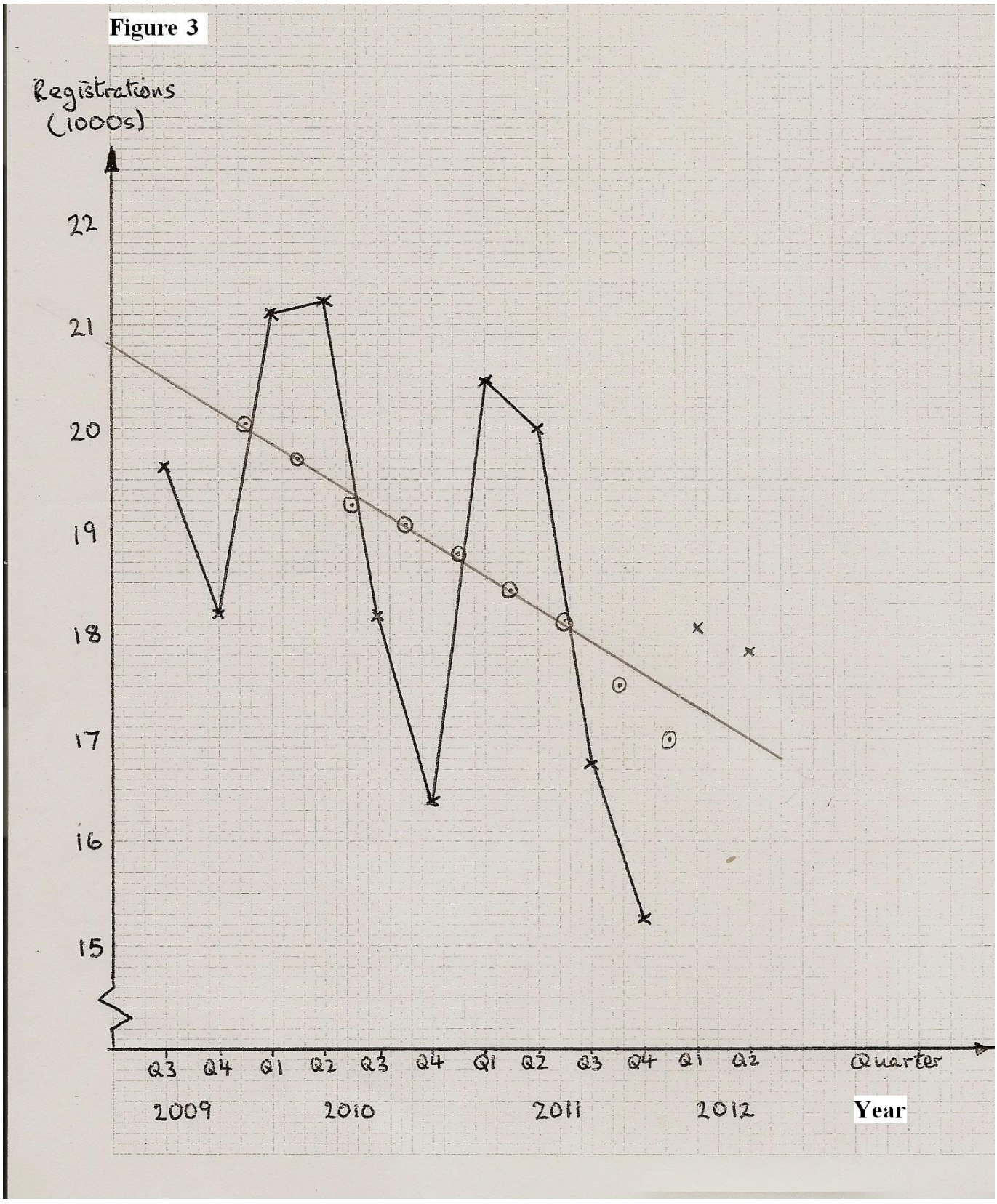
Q2				
(a)	2782 £million	B1		Condone omission of £
			1	
(b)	120779	B1		CAO
			1	
(c)	(868 – 375)/868 × 100 = 56.8%	M1 A1		Condone -56.8. Accept 57%. Allow B1 for 43(.2)%
			2	
(d)	2957000000/254000 = £11641	M1 A1		For 2957…./254… AWRT £11600 Condone omission of £
			2	
(e)(i)		B1		For ‘y’ values 880 to 920, 960 to 1000, 1240 to 1280
			1	
e(ii)	This shows an upward/increasing trend	E1		Or equivalent
			1	

Q3	Solution	Marks	Total	Comments
(a)	The times of the customers selected form a **random sample**	B1		There must be no mention of assuming "normal"
			1	
(b)	H_0: $\mu = 24.0$ H_1: $\mu > 24.0$ $z = \frac{(25.9 - 24)}{(\frac{9.5}{\sqrt{120}})}$ $= 2.19$ (p value = 0.014) c.v. = 2.0537 So test statistic in critical region, reject H_0. Significant evidence that mean time spent in store has increased.	B1 M1 m1 A1 B1 A1 E1		Both. μ or "population mean" $\sqrt{120}$ rest of formula for z (condone –) AWRT Unsupported -2.19 earns M2 implied A0 AWFW 2.05 to 2.06 Correct conclusion. Dep on preceding A1, B1. Conclusion in context. Dep on preceding A1, B1, A1 SC. Where cv is given as ±2.05, penalise B0, but allow final A1, E1 if earned. Similarly, where A0 is given for -2.19 allow final A1, E1 if earned.
			7	
(c)	Mean time had indeed increased So no error was made.	E1 E1		Dep on final A1 in (b) Note: If it is stated that "mean time has decreased" then the other E1 cannot be scored.
			2	

Q4	Solution	Marks	Total	Comments
(a)(i)	P(≤ 1) on Po(0.5) is 0.9098	B1		Or 0.91(0) or 0.909
			1	
(ii)	Use of Po(4.0) P(at least 5) = 1 – P(≤ 4) =1 – 0.6288 = 0.371(2)	M1 m1 A1		Stated or implied (eg. use of 0.7851 or 0.8893) AWRT 0.371 SC Unsupported 0.37 scores B2
			3	
(iii)	Use of Po(13) Require P(≤ 19) – P(≤ 10) 0.9573 – 0.2517 = 0.706	M1 M1 B1 A1		Any of 0.1658, 0.2517, 0.3532, 0.9573, 0.9750, 0.9859 used PI Indep of preceding M1 For either value used (even if 1 – either) AWFW 0.705 to 0.706
			4	
(b)	Using Po(2.0) P(> 5) = 1 – 0.9834 = 0.0166 = over 1% P(> 6) = 1 – 0.9955 = 0.0045 = below 1% **Or** P(run out) < 0.01 then P(not run out) ≥ 0.99 P(5 or fewer) = 0.9834 < 0.99 P(6 or fewer) = 0.9955 > 0.99 So need to have 6 in store.	B1 M1 A1		Stated or relevant probabilty seen For at least one of the relevant probabilities correctly stated.
			3	

Q5	Solution	Marks	Total	Comments
(a)	4	B1		
			1	
(b)	Reasonable trend line	B1		A straight line from (09 Q1, 19500-20000) to (11 Q1, 17000-17500)
			1	
(c)	Approximately 1240 and 1870 Averaging 1550 SC. Where thousands ignored on parts (c) and (d) only penalise once on each part, allowing 2 out of 3 for each part.	M1 A1 A1		Attempt at correct two values Both 1100 to 1400 and 1700 to 2000 1400 to 1700 If negative then M1 A0 A0
			3	
(d)	17300 (17000 to 17500) from trend line + their (c) 18800 (18400 to 19200)	B1 M1 A1		Consistent with their sign
			3	
(e)(i)	Accurately plotted	B1		Both within half square, "*x*" and "*y*"
(ii)	17522 16981 Accurately plotted SC. Where no calculated values written, but moving averages plotted within tolerance, B1 can be awarded.	B1 B1 B1Dep		CAO CAO Both within half square, "*x*" and "*y*"
(iii)	Trend has become more steeply downwards Forecast was too high/actual is lower	E1 E1		
			6	

Figure 3


Registrations (1000s)
22
21
20
19
18
17
16
15
Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2
Quarter
2009
2010
2011
2012
Year

Q6	Solution	Marks	Total	Comments
(a) (i)	Cluster sampling	B1		
(ii)	Because the list is alphabetical by family name so the sample may contain several members of the same family	E1		Any indication of the problems arising because the list is alphabetic
			2	
(b)	Use random numbers to select a patient between 1 and 80 Select every 80^{th} patient after that.	M1 A1		Allow even if method of random selection is not given SC If M0 then "every 80^{th}" gains B1
			2	
(c)(i)	Stratified sampling	B1		
(ii)	$737 \div 3200 \times 40$ (= 9.2125) = 9	M1 A1		 Must be integer
			3	
(d)(i)	2617 + 1 = 2618	M1 A1		
(ii)	Otherwise those numbered 1 to 400 would have a greater chance of being chosen than other numbers	E1		OE, being generous on details throughout part (d)
(iii)	Otherwise remainder 0 would not have a corresponding patient, Or otherwise patient 3200 could not be chosen	 E1		Or random number 0000, 3200, 6400 stated For either of these
(iv)	Rejecting/ignoring any repeats	E1		
			5	

Q7	Solution	Marks	Total	Comments
(a)	$p = 1 – (\text{sum of Ps}) = 0.12$ p is probability that Angus has to do all the work alone	B1 E1		 Anything conveying this concept
			2	
(b)	$E(X) = 0\times p + 1\times0.15 + 2\times0.2 + 3\times0.21 + 4\times0.18 + 5\times0.14 = 2.6$ $E(X^2) = 0^2\times p + 1^2\times0.15 + 2^2\times0.2 + 3^2\times0.21 + 4^2\times0.18 + 5^2\times0.14$ (= 9.22) Var(X) = '9.22' – '2.6'^{2} (= 2.46) s.d = $\sqrt{2.46} = 1.57$	M1 A1 M1 m1 A1		 Or B2 for answer alone Complete method incl – $E(X)^2$ Or similar totally correct working AG SC: $E(X^2) = 9.22$ with no explanation followed by $\text{Var(X)} = 9.22 – 2.6^2$, s.d = $\sqrt{2.46} = 1.57$ earns B2 SC: s.d. = $\sqrt{(9.22 – 2.6^2)}$ with no explanation for 9.22 earns B1
			5	
(c)(i)	Mean 2.6 variance 2.46 Similar so support suggestion	M1 E1		For consideration of mean & var
(ii)	Sudden cut off after 5 not like Poisson Volunteers may be friends so not independent	E1		For any suitable comment
			3	
(d)(i)	If $N = 20$, $X + 1 = 6$ so $X = 5$ So $P(N = 20) = 0.14$	M1 A1		Appreciation that $X = 5$ gives $N = 20$
(ii)	<table><tr><td>n</td><td>20</td><td>24</td><td>30</td><td>40</td><td>60</td><td>120</td></tr><tr><td>$P(N = n)$</td><td>0.14</td><td>0.18</td><td>0.21</td><td>0.20</td><td>0.15</td><td>0.12</td></tr></table>	M1 A1		For remaining n values For remaining P values
(iii)	$E(N) = 20\times0.14$ + etc. = 44.8(2)	M1 A1		 AWRT 45
			6	