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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Mathematics and Statistics 6320
Specification B

MBS5 Statistics 5

Mark Scheme

2005 examination – June series

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

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' 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.

Key to Mark Scheme

M	mark is for	method
m	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	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
sf		significant figure(s)
dp		decimal place(s)
A2,1		2 or 1 (or 0) accuracy marks
–*x* ee		deduct *x* marks for each error
pi		possibly implied
sca		substantially correct approach

Abbreviations used in Marking

MC – *x*	deducted *x* marks for mis-copy
MR – *x*	deducted *x* marks for mis-read
isw	ignored subsequent working
bod	given benefit of doubt
wr	work replaced by candidate
fb	formulae book

Application of Mark Scheme

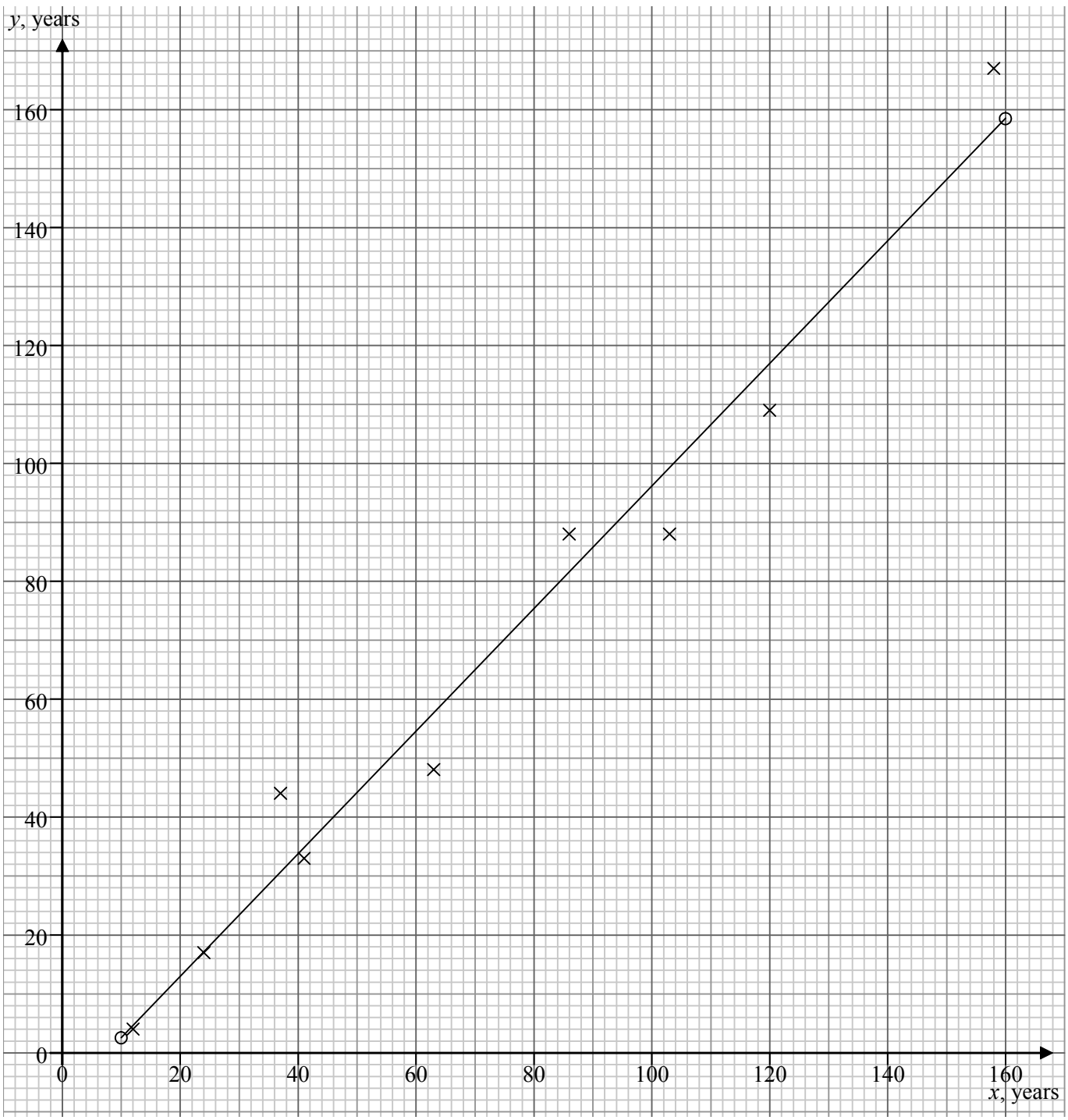
No method shown:	
Correct answer without working	mark as in scheme
Incorrect answer without working	zero marks unless specified otherwise
More than one method / choice of solution:	
2 or more complete attempts, neither/none crossed out	mark both/all fully and award the mean mark rounded down
1 complete and 1 partial attempt, neither crossed out	award credit for the complete solution only
Crossed out work	do not mark unless it has not been replaced
Alternative solution using a correct or partially correct method	award method and accuracy marks as appropriate

Mathematics and Statistics B Statistics 5 MBS5 June 2005

Q	Solution	Marks	Total	Comments
1(a)	See graph on next page	M1		
		B1		Scales and labels
		A1	3	Reasonably accurate plot – allow one small slip
(b)	$y = -7.90 + 1.04x$	B2		1.04 (1.035 to 1.045) allow M1A1 if method shown
		B1		– 7.90(– 7.89 to – 7.91)
	$x = 10$ $y = 2.5$ $x = 160$ $y = 158.3$ + line	M1		Method for their line
		A1	5	Accurate line - by eye
(c)	B $4 - (-7.90) - 1.04 \times 12 = -0.56$	M1		Method for residuals - ignore sign
	G $88 - (-7.90) - 1.04 \times 86 = 6.55$	m1		Method for residuals - consistent signs must be demonstrated - eg. disallow if one residual is zero
		A1	3	$-0.56(-0.55$ to $-0.6)$ and $6.55(6.45$ to $6.6)$
(d)	B has a small residual but 4 is a poor estimate of 12	E1		Small residual not necessarily good
	G has relatively large residual but 88 is a good estimate of 86	E1		Illustrated by B or G
	Small residual indicates consistent with pattern of other estimates - not necessarily good or bad.	E1	3	Small residual $\Rightarrow$ consistent with pattern or other relevant comment
(e)	Actual age is reduced by 7. Equation becomes $y = -0.90 + 1.04x$ - which is	E1		Estimates improved - disallow if no or clearly incorrect reason
	very close to ideal $y = x$. Eamon's estimates better than appeared in part (b)	E1	2	Corrected equation or ideal is $y = x$ or other sensible comment
	Total		**16**	

MBS5 (cont)

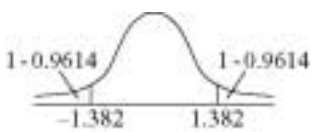
Graph for question 1



MBS5 (cont)

Q	Solution	Marks	Total	Comments
2(a)	$z = \frac{20-26}{8} = -0.75$	M1		Method for z - ignore sign
	Probability no need to refill $1 - 0.77337 = 0.227$	M1 A1		Completely correct method 0.227 (0.226 to 0.227)
	$z = \frac{40-26}{8} = 1.75$			
	Probability exactly one refill i.e between 20 and 40 = 0.95994 – 0.2263 = 0.733	M1 A1	5	Correct method 0.733 (0.733 to 0.734)
(b)(i)	$0.22623^5 = 0.000598$	M1 A1	2	0.000598 (0.00059 to 0.00061)
(ii)	$z = \frac{20-26}{\frac{8}{\sqrt{5}}} = -1.677$	M1		Use of $\frac{8}{\sqrt{5}}$
	probability mean less than 20 = 1 – 0.9532 = 0.0468	m1 A1	3	Completely correct method 0.0468(0.046 to 0.048)
(c)	$\mu - 0.9945\sigma = 20$	B1		0.9945 (0.994 to 0.995)
	$\mu - 1.175\sigma = 40$	B1		1.175 (1.17 to 1.18)
		M1		Good attempt at equations - ignore sign
		m1		Completely correct equations
	$2.169\sigma = 20$	m1		Method of solution
	$\sigma = 9.222$	A1	6	$\sigma = 9.222$ (9.21 to 9.23) and
	$\mu = 29.2$			$\mu = 29.2$ (29.1 to 29.3)
	Total		**16**	

MBS5 (cont)

Q	Solution	Marks	Total	Comments
3(a)(i)	$197 \pm 1.96 \times \frac{103}{\sqrt{90}}$	M1		Use of $\frac{103}{\sqrt{90}}$
		B1		1.96
		m1		Completely correct method - their z
	197 ± 21.3	A1	4	197 ± 21.3(21.25 to 21.35) or
	$176 \sim 218$			176(175.5 to 176) and 218 (218 to 218.5)
(ii)	42.6	B1	1	42.6(42.5 to 42.6)
(iii)	$2z \times \frac{103}{\sqrt{90}} = 30$	M1		Reasonable attempt at equation containing z - ignore omission of 2
		m1		Completely correct equation containing z
	z = 1.382 	m1		Method for finding z
	$1 - 2(1 - 0.9164) = 0.833$	M1		Method for probability - their z
	83.3%	A1	5	83.3 (83 to 83.5)
		B1		2.5758 (2.57 to 2.58)
(iv)	$2 \times 2.5758 \times \frac{103}{\sqrt{n}} = 30$	M1		Reasonable attempt at equation involving n - ignore omission of 2, incorrect z
	$n = 312.8$	m1		Method of solution of equation
	313 needed	A1	4	313 cao
(b)(i)	large sample $\Rightarrow$ sample mean normally distributed	E1 E1	2	Large sample / CLT **Mean** normally distributed
(ii)	Mean less than 2 s.d. above zero $\Rightarrow$ non-trivial probability of negative values which are not possible	E1 E1	2	Mean less that 2 s.d. above zero / possibility of negative values / money discrete variable
	Total		**18**	

MBS5 (cont)

Q	Solution	Marks	Total	Comments
4(a)	0.3	B1	1	0.3 cao
(b)(i)	$\frac{10}{30}=\frac{1}{3}$	B1	1	$\frac{1}{3}$ acf
(ii)	$\frac{1}{3}\times 0.06 = 0.02$	M1	1	Method - their (b)(i)
(iii)	$\frac{15}{30}(0.30+0.15)=0.225$	M1 A1	2	Method - generous 0.225
(iv)	$\frac{1}{3}\times 0.06+\frac{1}{2}\times 0.15+\frac{5}{30}\times 0.18=0.125$	M1 m1 A1	3	Attempt at P(4* comedy) + P(4* drama) + P(4* other) Completely correct method 0.125 cao
(v)	$\frac{3}{4}\times(0.20+0.35)+\frac{1}{4}(0.40+0.10)=0.5375$	M1 m1 A1	3	Reasonable attempt Completely correct method 0.5375 (0.537 to 0.538)
(c)	$3\times\frac{10}{30}\times\frac{9}{29}\times\frac{15}{28}=0.166$	B1 M1 A1	3	3 Allow omission of or incorrect '3' - allow with replacement 0.166 (0.166 to 0.1665)
	Total		**14**	

MBS5 (cont)

Q	Solution	Marks	Total	Comments
5(a)(i)	$H_0 : \mu = 40$	B1		One correct hypothesis – generous
	$H_1 : \mu \neq 40$ (allow $\mu > 40$ and 1.6449)	B1		Both hypotheses correct – ungenerous Allow $H_1\ \mu > 40$
	$z = \dfrac{46.5 - 40}{\dfrac{12}{\sqrt{8}}} = 1.53$	M1		Use of $\dfrac{12}{\sqrt{8}}$
		m1		Completely correct method for z ignore sign
	c.v ± 1.96; 1.53 lies between	A1		1.53 (1.525 to 1.535)
	± 1.96 so accept H_0, mean is 40 mins	B1		1.96 - ignore sign (cv 1.895 for one tail test)
		A1√		Correct conclusion – must be compared with z ***N.B. apply this mark scheme to (a)(ii) and vice versa if more favourable to candidate***
(ii)	$H_0 : \mu = 50$	B1		Both hypotheses correct – ungenerous
	$H_1 : \mu \neq 50$ (allow $\mu < 50$ and -1.6449)			
	$z = \dfrac{46.5 - 50}{\dfrac{12}{\sqrt{8}}} = -0.825$	A1		-0.825 (-0.8245 to -0.8255)
	c.v ± 1.96; -0.825 lies between			
	± 1.96 so accept H_0, mean is 50 mins	A1√	10	Correct conclusion must be compared with both tails or lower tail of t
(b)	Claim 1. **C** Not true - no null hypothesis rejected so no Type 1 error made	E2,1		Correct conclusion for correct reason - be generous for E1 but disallow no or clearly incorrect reason
	Claim 2. **B** Possibly true - true if population mean is equal to neither 40 nor 50	E2,1		Correct conclusion for correct reason - be generous for E1 but disallow no or clearly incorrect reason
	Claim 3. **A** Definitely true - since mean cannot equal both 40 and 50	E2,1	6	Correct conclusion for correct reason - be generous for E1 but disallow no or clearly incorrect reason
	Total		**16**	
	TOTAL		**80**	