Version : 08/06

ASSESSMENT and QUALIFICATIONS ALLIANCE

Free-Standing Mathematics Qualification

Using and Applying Statistics
6990/2

Mark Scheme

2006 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 and abbreviations used in marking

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	MC	mis-copy
CAO	correct answer only	MR	mis-read
CSO	correct solution only	RA	required accuracy
AWFW	anything which falls within	FW	further work
AWRT	anything which rounds to	ISW	ignore subsequent work
ACF	any correct form	FIW	from incorrect work
AG	answer given	BOD	given benefit of doubt
SC	special case	WR	work replaced by candidate
OE	OE	FB	formulae book
A2,1	2 or 1 (or 0) accuracy marks	NOS	not on scheme
–*x* EE	deduct *x* marks for each error	G	graph
NMS	no method shown	c	candidate
PI	possibly implied	sf	significant figure(s)
SCA	substantially correct approach	dp	decimal place(s)

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

Free-Standing Mathematics Qualification

Advanced Level: Using and Applying Statistics (6990/2)

June 2006

Answers and Marking Scheme

Question 1

(a)(i)	$\bar{l} = 21.75 = 21.8$ cm (to 3sf) $\bar{w} = 35.08\dot{3} = 35.1$ cm (to 3sf)	**B1** **B1**	 Allow other correctly rounded values
(ii)	0.932 (to 3sf)	**B1**	from 0.93227968 SC1 for Spearman's used correctly
(iii)	$w = 1.47l + 3.14$ (coefficients to 3sf)	**B1** **B1**	from 1.4687129 from 3.13882765
(b)	Line through mean point (21.8, 35.1) Intercept 3.14	**B2**√ **B2**√	Within 1 square Within 1 square
(c)	Wingspan increases by 1.47 cm for each extra centimetre of length	**B2**√	B1 for less carefully worded statement
(d)	Correlation coefficient is lower for seabirds than for garden birds. Weaker relationship between wingspan and length for seabirds than garden birds.	**B1**√ **B1**√	or equivalent (comparison) or equivalent (strength of relationship) Allow B1 for statements such as "Strong correlation in both cases" (without comparison).
	TOTAL	**13**	

Question 2

(a)(i)	Number of guillemots in 2002 $= 2.36 \times 601\,000$	**M1**	
	$= 1\,418\,360$ $= 1\,420\,000$ (to 3sf)	**A1**	Allow other correctly rounded values eg 1418000 (to nearest thousand)
(ii)	$1.31 \times$ Number of guillemots in 1988 = 1418 360	**M1**	May be implied
	Number of guillemots in 1988 $= \frac{1418360}{1.31}$	**M1**	
	$= 1\,082\,718$ $= 1080\,000$ (to 3sf)	**A1√**	Allow other correctly rounded values eg 1083000 (to nearest thousand)
(b)	$x \times 1.19 = 1.37$ $x = \frac{1.37}{1.19}$ $= 1.15126....$	**B1, B1** **M1**	B1 for 1.19, B1 for 1.37 or equivalent %
	15.1% increase between 1970 and 1988 (3sf)	**A1**	Allow 15%
	TOTAL	**9**	

Question 3

(a)(i)	Proportion of vehicles observed on urban roads that were cars = $\frac{315}{360}$ or $\frac{7}{8}$ or 0.875 or 87.5%	**B1**	Allow value given to 2sf (eg 88%) or more
(ii)	Proportion of vehicles observed on motorways that were cars = $\frac{277}{360}$ or 0.769 or 76.9% (3sf)	**B1**	Allow value given to 2sf (eg 77%) or more
(iii)	Bigger proportion of vehicles were cars on urban roads	**B1**	
(b)(i)	Angle for cars = 277°		
	Total number of vehicles observed on motorways		Allow use of proportion from part (a)
	$= \frac{360 \times 412}{277}$	**M1**	eg $\frac{412}{0.77}$ million
	= 535.45126…		
	= 535 million (to 3sf)	**A1**√	or $\frac{412}{0.769}$ = 536 million
(ii)	Radii of circles are 2 cm and 4.5 cm	**B1**	or diameters 4cm, 9cm
	Total number of vehicles on urban roads		
	$= 535.45126.... \times \frac{2^2}{4.5^2}$	**M1**	M1 for any indication of use of squares of radii or diameters
	= 105.768….		
	= 106 million (to 3sf)	**A1**	ft from answer to (b)(i)
	TOTAL	**8**	

Question 4

	Number of cars breaking speed limit $= 16\,400 \times 5 + 13\,100 \times 5 + 6100 \times 10 + 1200 \times 10$ $= 220500$ thousand Percentage of cars breaking speed limit $= \frac{220.5}{412} \times 100 = 53.5\%$ (to 3sf)	**B1** **M1** **A1**√ **B1**√	 Must have 3 parts correct Frequency densities Accept 53 or 54%
	TOTAL	**4**	

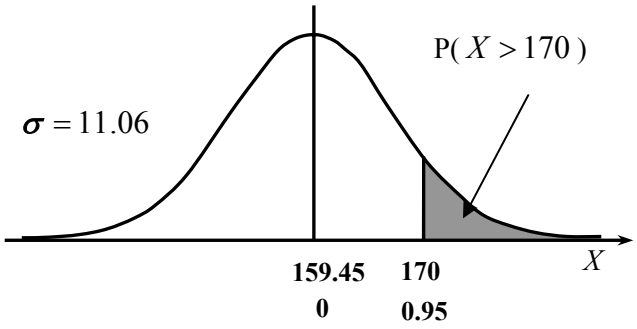
Question 5

(a)(i) **(ii)**	Median = 73 mph UQ = 81 mph LQ = 62 mph IQR = 81 – 62 = 19 mph	**B1** **M1** **A1**√	Allow ± 1 mph Each quartile within ± 1 mph ± 2 mph
(b)	Number of observed motorcycles breaking speed limit $= 2500 - 1050$ $= 1450$ thousand % breaking speed limit $= \frac{1450}{2500} \times 100$ $= 58\%$	 **M1** **A1**√ **B1**√	 ± 50 thousand SC2 for $\frac{1050}{2500} \times 100 = 42\%$
	TOTAL	**6**	

Question 6

(a)(i)	Mean = 158.235 cm = 158.24 cm (to 2dp)	**B2**	Allow B1 for 158 or 158.2 cm
(ii)	Standard Deviation = 9.0365… cm = 9.04 cm (to 2 dp)	**B2**	SC1 in each part for consistent use of upper or lower bounds B1 for 9 or 9.0
(b)	Use of mid-interval values rather than individual values.	**B1**	
(c)(i)	On average height increases with age for both girls and boys. Girls on average taller at 11 and 12 years, but boys taller at 13 years.	**B1**√ **B1** **B1**√	
(ii)	Standard deviation for boys increases with age implies heights of older boys are more widely spread	**B2**	B1 for first part only
	TOTAL	**10**	

Question 7

(a)	$P(X > 170) = P\left(\frac{X-\mu}{\sigma} > \frac{170-159.45}{11.06}\right)$ $= P(Z > 0.95)$  $= 1 - \Phi(0.95)$ $= 1 - 0.8289$ $= 0.171$	**M1** **A1** **M1** **B1√** **A1√**	Standardisation or other values rounded from 0.953887884 Correct use of tables (Allow value from linear interpolation)
(b)	Number expected = 1000×0.171 $= 171$	**M1** **A1√**	 Must be rounded to nearest whole number Accept 170
(c)	Number in sample greater than 170 cm tall = 150 This is less than expected (ie. Correct comparison with 150) Comment on theoretical nature of Normal and/or that actual samples vary	**B1** **B1√** **B1**	
	TOTAL	**10**	
	GRAND TOTAL	**60**	