GCE Examinations

Advanced Subsidiary / Advanced Level

Statistics
Module S1

Paper I

MARKING GUIDE

This guide is intended to be as helpful as possible to teachers by providing concise solutions and indicating how marks should be awarded. There are obviously alternative methods that would also gain full marks.

Method marks (M) are awarded for knowing and using a method.

Accuracy marks (A) can only be awarded when a correct method has been used.

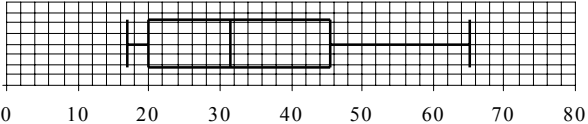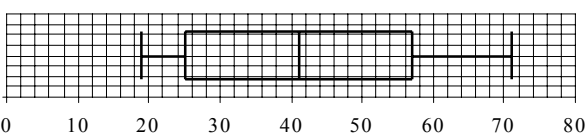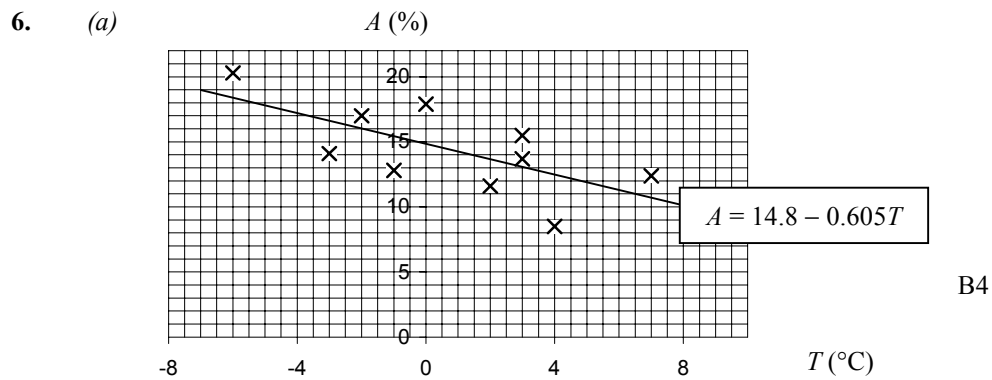(B) marks are independent of method marks.

S1 Paper I – Marking Guide

1. (a) (i) normal   A1

       (ii) e.g. producer must ensure that most bottles contain at least 75 cl   B1

    (b) (i) discrete uniform   A1

       (ii)

x	1	2	3	4
$P(X=x)$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$

       mean $= \frac{5}{2}$ (symmetry)   A1

       $E(X^2) = \sum x^2 P(x) = \frac{1}{4} + 1 + \frac{9}{4} + 4 = \frac{15}{2}$ M1 A1

       $Var(X) = \frac{15}{2} - (\frac{5}{2})^2 = \frac{5}{4}$ M1 A1   **(8)**

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2. (a) $P(A \cap B) = P(A) \times P(B) = 2P(B) \times P(B) = 2[P(B)]^2$ M2

       $\therefore 2[P(B)]^2 = \frac{1}{8}$; $\therefore [P(B)]^2 = \frac{1}{16}$; $\therefore P(B) = \frac{1}{4}$ M2 A1

    (b) $P(A \cup B) = P(A) + P(B) - P(A \cap B) = \frac{1}{2} + \frac{1}{4} - \frac{1}{8} = \frac{5}{8}$ M2 A1

    (c) A and B independent $\therefore A$ and B' independent

       $\therefore P(A \,|\, B') = P(A) = \frac{1}{2}$ M1 A1   **(10)**

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3. (a) $12.7 + 5.8 = 18.5$ minutes   A1

    (b) $P(X < 12.7) = 0.25$; $P(Z < \frac{12.7 - \mu}{\sigma}) = 0.25$ M1

       $\frac{12.7 - \mu}{\sigma} = {}^-0.67$; $12.7 - \mu = {}^-0.67\sigma$ M1 A1

       $P(X < 18.5) = 0.75$; $P(Z < \frac{18.5 - \mu}{\sigma}) = 0.75$ M1

       $\frac{18.5 - \mu}{\sigma} = 0.67$; $18.5 - \mu = 0.67\sigma$ M1 A1

       solve simul. giving $\mu = 15.6$, $\sigma = 4.3284$; so $\mu = 15.6$, $\sigma^2 = 18.7$ M1 A1

    (c) e.g. would expect normal dist. and mean and variance seem close

       to actual values so seems a fairly suitable model   B2   **(11)**

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4. (a) median $= 15.5^{th} = \frac{31+32}{2} = 31.5$ M1 A1

       $Q_1 = 7.75^{th} = 20$ A1

       $Q_3 = 23.25^{th} = 45.5$ A1

    (b)   B3

    (c)   B3

    (d) e.g. similar range, youngest and oldest both a bit higher for E

       median of M lower meaning younger students on average

       IQR of M smaller meaning student ages more similar

       E roughly symmetrical, M +vely skewed   B4   **(14)**

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5. (a) $(0.6 \times 0.5 \times 0.7) + (0.6 \times 0.5 \times 0.3) + (0.4 \times 0.5 \times 0.3) = 0.36$ M3 A1

(b) $P(W = 0) = 0.4 \times 0.5 \times 0.7 = 0.14$
$P(W = 3) = 0.6 \times 0.5 \times 0.3 = 0.09$
$P(W = 1) = 1 - (0.14 + 0.36 + 0.09) = 0.41$

w	0	1	2	3
$P(W = w)$	0.14	0.41	0.36	0.09

M2 A2

(c) $E(W) = \sum wP(w) = 0 + 0.41 + 0.72 + 0.27 = 1.4$ M1 A1
$E(W^2) = \sum w^2P(w) = 0 + 0.41 + 1.44 + 0.81 = 2.66$ M1 A1
$Var(W) = 2.66 - 1.4^2 = 0.7$ M1 A1

(d) e.g. unlikely to be valid as result of each match will probably raise or
lower confidence changing probability of success in the next match   B2   **(16)**

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6. (a)

$A = 14.8 - 0.605T$

B4

(b) $S_{TT} = 137 - \frac{7^2}{10} = 132.1$ M1

$S_{AA} = 2172.66 - \frac{143.8^2}{10} = 104.816$ M1

$S_{TA} = 20.7 - \frac{7 \times 143.8}{10} = {}^-79.96$ M1

$r = \frac{-79.96}{\sqrt{132.1 \times 104.816}} = {}^-0.6795$ M1 A1

e.g. fairly strong –ve correlation so belief seems reasonable   B1

(c) $q = \frac{-79.96}{132.1} = {}^-0.60530$ M1 A1

$p = \frac{143.8}{10} - ({}^-0.60530 \times \frac{7}{10}) = 14.804$ M1 A1

$A = 14.8 - 0.605T$

(d) line on graph above   B2   **(16)**

Total   **(75)**

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Performance Record – S1 Paper I

Question no.	1	2	3	4	5	6	Total
Topic(s)	modelling, discrete uniform dist.	probability	normal dist.	stem & leaf, quartiles, boxplot	discrete r. v.	scatter diagram, pmcc, regression	
Marks	8	10	11	14	16	16	75
Student							

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