GCE Examinations

Advanced Subsidiary / Advanced Level

Statistics

Module S3

Paper A

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.

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S3 Paper A – Marking Guide

1. *(a)* $\hat{\mu} = \bar{V} = \frac{1439}{10} = 143.9$ M1 A1

(b) $\bar{V} \pm 1.96\frac{\sigma}{\sqrt{n}} = 143.9 \pm 1.96.\frac{\sqrt{130}}{\sqrt{10}}$ M1 A1

giving (136.8, 151.0) A2 **(6)**

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2. *(a)* a sample taken such that all possible samples of required size have an equal chance of being selected B2

(b) number members on list 01 to 70
start at random place in table write down each 2-digit number ignoring 00, 71+ and numbers already selected until twelve numbers chosen
identify members corresponding to selected numbers B3

(c) e.g. survey of opinions on changing surgery hours
may wish to know views of groups such as working / not working B2 **(7)**

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3. *(a)* let F = time on French and E = time on English
let $A = F + E \ \therefore A \sim N(55 + 90, 10^2 + 18^2) = \sim N(145, 424)$ M1 A1
$P(A > 120) = P(Z > \frac{120-145}{\sqrt{424}})$ M1
$= P(Z > {}^{-}1.21) = 0.8869$ M1 A1

(b) $P(E > 2F) = P(E - 2F > 0)$ M1
let $B = E - 2F \ \therefore B \sim N(90 - 2\times55, 18^2 + 4\times10^2) = \sim N({}^{-}20, 724)$ M1 A1
$P(B > 0) = P(Z > \frac{0+20}{\sqrt{724}})$ M1
$= P(Z > 0.74) = 1 - 0.7704 = 0.2296$ M1 A1 **(11)**

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4. expected freq. males/watched $= \frac{36\times40}{80} = 18$
males/stranded $= \frac{16\times40}{80} = 8$ M1 A2
giving expected freqs 18 8 14
18 8 14 A1
H_0 : no difference in preference of males and females
H_1 : difference in preference of males and females B1

O	E	$(O-E)$	$\frac{(O-E)^2}{E}$
21	18	3	0.5
6	8	${}^{-}2$	0.5
13	14	${}^{-}1$	0.0714
15	18	${}^{-}3$	0.5
10	8	2	0.5
15	14	1	0.0714

$\therefore \Sigma\frac{(O-E)^2}{E} = 2.143$ M1 A2
$\nu = 2, \chi^2_{crit}(10\%) = 4.605$ M1 A1
$2.143 < 4.605 \ \therefore$ not significant
there is no evidence of a difference in preference of males and females A1 **(11)**

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5. *(a)*

temp.	16	9	11	5	7	21	12	15
position	2	15	5	19	10	4	6	11
temp. rank	2	6	5	8	7	1	4	3
pos'n rank	1	7	3	8	5	2	4	6
d^2	1	1	4	0	4	1	0	9

$\Sigma d^2 = 20$ M2 A2

$r_s = 1 - \frac{6\times20}{8\times63} = 0.7619$ M1 A1

(b) $H_0 : \rho = 0 \quad H_1 : \rho > 0$ B1

$n = 8$, 5% level $\therefore$ C.R. is $r_s > 0.6429$ M1 A1

$0.7619 > 0.6429 \ \therefore$ significant

there is evidence that she will do better at higher temperatures A1

(c) e.g. this would not answer her query which relates to how well she does compared to others, all runners may be slower in higher temps B2 **(12)**

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6. *(a)* let W = weight of component $\therefore W \sim N(46.7, 1.8)$

$\overline{W} \sim N(46.7, \frac{1.8}{12}) = \sim N(46.7, 0.15)$ M1 A1

(b) $P(\overline{W} > 47) = P(Z > \frac{47-46.7}{\sqrt{0.15}})$ M1

$= P(Z > 0.77) = 1 - 0.7794 = 0.2206$ M1 A1

(c) $H_0 : \mu = 46.7 \quad H_1 : \mu \neq 46.7$ B1

5% level $\therefore$ C.R. is $z < -1.96$ or $z > 1.96$ B1

test statistic $= \frac{46.5-46.7}{\sqrt{\frac{1.8}{30}}} = -0.816$ M2 A2

not in C.R. do not reject H_0

no evidence of change in mean weight A1 **(12)**

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7. *(a)* H_0 : B(16, 0.1) is a suitable model

H_1 : B(16, 0.1) is not a suitable model B1

$P(0) = (0.9)^{16} = 0.1853$

$P(1) = 16(0.1)(0.9)^{15} = 0.3294$

$P(2) = \frac{16\times15}{2}(0.1)^2(0.9)^{14} = 0.2745$

$P(3) = \frac{16\times15\times14}{3\times2}(0.1)^3(0.9)^{13} = 0.1423$ M1 A2

$P(4) = \frac{16\times15\times14\times13}{4\times3\times2}(0.1)^4(0.9)^{12} = 0.0514$

$\times 50$ to give exp. freqs then freq of ≥ 5 = (50 – sum of others)

$\therefore$ exp. freqs are 9.27, 16.47, 13.73, 7.12, 2.57, 0.84 M1 A1

combining groups ≥ 3 M1

O	E	$(O-E)$	$\frac{(O-E)^2}{E}$
4	9.27	−5.27	2.9960
12	16.47	−4.47	1.2132
18	13.73	4.27	1.3280
16	10.53	5.47	2.8415

$\therefore \Sigma \frac{(O-E)^2}{E} = 8.379$ M1 A2

$\nu = 4 - 1 = 3, \chi^2_{crit}(5\%) = 7.815$ M1 A1

$8.379 > 7.815 \ \therefore$ reject H_0

B(16, 0.1) is not a suitable model A1

(b) $\nu = 5 - 2 = 3, \chi^2_{crit}(5\%) = 7.815$ M1 A1

$2.127 < 7.815 \ \therefore$ do not reject H_0, the binomial dist. is a suitable model A1 **(16)**

Total **(75)**

Performance Record – S3 Paper A

Question no.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	Total
Topic(s)	confidence interval	sampling	linear comb. of Normal r.v.	conting. table	Spearman's, hyp. test	dist. of sample mean, hyp. test	goodness of fit, binomial	
Marks	6	7	11	11	12	12	16	75
Student								