GCE Examinations

Advanced Subsidiary / Advanced Level

Statistics

Module S3

Paper F

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.



Written by Shaun Armstrong & Chris Huffer

© Solomon Press

These sheets may be copied for use solely by the purchaser's institute.

S3 Paper F – Marking Guide

1. *(a)* e.g. get information on views of each age group — B1

(b) 26, 31, 65, 44, 01, 48, 43, 12 — M1 A2

(c) e.g. whether or not they have children — B1 **(5)**

---

2. *(a)* $r = \frac{2564.33}{\sqrt{3747.73 \times 2791.33}} = 0.7928$ — M1 A1

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

$n = 15$, 5% level $\therefore$ C.R. is $r > 0.4409$ — M1 A1

$0.7928 > 0.4409 \therefore$ significant

there is evidence that those good at maths are better at visio-spatial — A1 **(6)**

---

3. *(a)* C.I. $\bar{x} \pm 1.6449 \frac{\sigma}{\sqrt{n}} = 31.4 \pm 1.6449 . \frac{6.8}{\sqrt{60}}$ — M1 A1

giving (29.96, 32.84) — A2

(b) width $= 2 \times 1.6449 \times \frac{6.8}{\sqrt{n}} \quad \therefore 2 \times 1.6449 \times \frac{6.8}{\sqrt{n}} < 1.5$ — M1 A1

$\therefore \sqrt{n} > 14.91376$ — A1

giving $n > 222.42$ so need 223 observations — M1 A1 **(9)**

---

4. *(a)* $P(0) = (\frac{4}{5})^6 = 0.2621$

$P(1) = 6(\frac{1}{5})(\frac{4}{5})^5 = 0.3932$ [or from tables]

$P(2) = \frac{6 \times 5}{2}(\frac{1}{5})^2(\frac{4}{5})^4 = 0.2458$

$\times 120$ to give exp. freqs. 31.46, 47.19, 29.49 — M1 A2

(b) H_0 : B(6, $\frac{1}{5}$) is a suitable model

H_1 : B(6, $\frac{1}{5}$) is not a suitable model — B1

combining groups ≥ 3 — M1

O	E	$(O-E)$	$\frac{(O-E)^2}{E}$
26	31.46	−5.46	0.9476
56	47.19	8.81	1.6448
28	29.49	−1.49	0.0753
10	11.86	−1.86	0.2917

$\therefore \Sigma \frac{(O-E)^2}{E} = 2.959$ — M1 A2

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

$2.9594 < 7.815 \therefore$ do not reject H_0

B(6, $\frac{1}{5}$) is a suitable model — A1

(c) B(6, $\frac{1}{5}$) is the dist. expected with guessing

$\therefore$ suggests the group are not telepathic — B1 **(12)**

© *Solomon Press*

5. *(a)* expected freq. 18-34/Pro = $\frac{100\times64}{200}$ = 32

35-54/Pro = $\frac{100\times66}{200}$ = 33 M1 A2

giving expected freqs 32 32
33 33
35 35 A1

H_0 : no association between age and attitude to Europe
H_1 : association between age and attitude to Europe B1

O	E	$(O-E)$	$\frac{(O-E)^2}{E}$
43	32	11	3.7813
21	32	¯11	3.7813
30	33	¯3	0.2727
36	33	3	0.2727
27	35	¯8	1.8286
43	35	8	1.8286

$\therefore \Sigma\frac{(O-E)^2}{E} = 11.765$ M1 A2

$\nu = 2, \chi^2_{\text{crit}}(5\%) = 5.991$ M1 A1

$11.765 > 5.991$ $\therefore$ significant
there is an association between age and attitude to Europe A1

(b) $\nu = 2, \chi^2_{\text{crit}}(5\%) = 5.991$
$4.872 < 5.991$ $\therefore$ not significant
there is no association amongst those who voted, get different result M1 A1 **(13)**

---

6. *(a)* let E = how much longer for first two legs than next two
$\therefore E \sim N(63.1 + 65.7 - 65.4 - 62.5, 1.2^2 + 1.5^2 + 1.8^2 + 0.9^2)$
$= \sim N(0.9, 7.74)$ M1 A2

$P(E < 0) = P(Z < \frac{0-0.9}{\sqrt{7.74}})$ M1

$= P(Z < ¯0.32) = 1 - 0.6255 = 0.3745$ M1 A1

(b) let F = total time for first team
$\therefore F \sim N(63.1 + 65.7 + 65.4 + 62.5, 7.74) = \sim N(256.7, 7.74)$ M1
let G = how much longer second team take in total
$\therefore G \sim N(259.0 - 256.7, 3.4^2 + 7.74) = \sim N(2.3, 19.3)$ M1 A1

$P(\text{first team wins one race}) = P(G > 0) = P(Z > \frac{0-2.3}{\sqrt{19.3}})$ M1

$= P(Z > ¯0.52)) = 0.6985$ M1 A1

$P(\text{first team wins all four}) = (0.6985)^4 = 0.238$ M1 A1 **(14)**

---

7. *(a)* $\hat{\mu} = \bar{t} = \frac{7335}{500} = 14.7$ M1 A1

$\hat{\sigma}^2 = s^2 = \frac{500}{499}(\frac{172040}{500} - 14.67^2) = 129.1$ M2 A1

(b) $H_0 : \mu_L = \mu_M$ $H_1 : \mu_L > \mu_M$ B1
5% level $\therefore$ C.R. is $z > 1.6449$ M1 A1
test statistic = $\frac{15.9-14.7}{\sqrt{\frac{108.5}{200}+\frac{129.1}{500}}} = 1.34$ M2 A2

$1.34 < 1.6449$ $\therefore$ do not reject H_0 M1
no evidence of difference in mean length of calls A1

(c) distributions not necessarily normal but by CLT sample mean distributed approximately normally whatever dist. for large sample $\therefore$ can do test B2 **(16)**

Total **(75)**

© *Solomon Press*

Performance Record – S3 Paper F

Question no.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	Total
Topic(s)	sampling	pmcc, hyp. test	confidence interval	goodness of fit, binomial	conting. table	linear comb. of Normal r.v.	unbiased estimates, diff. of means hyp. test	
Marks	5	6	9	12	13	14	16	75
Student								

© *Solomon Press*