ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Advanced Level

MARKING SCHEME

NOVEMBER 2020 SESSION

STATISTICS **6046/2**

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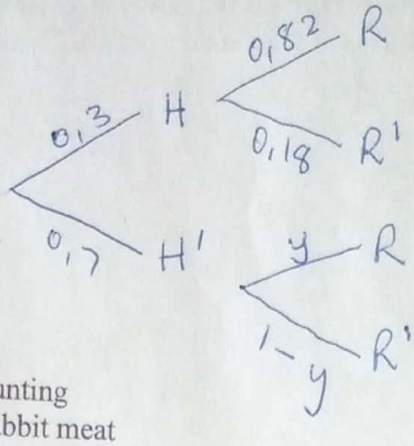


H - Hunting
R - Rabbit meat

$P(R) = 0{,}3 \times 0{,}82 + 0{,}7y = 0{,}6$ M1

$0{,}7y = 0{,}6 - 0{,}246$ attempt to solve. √M1

$y = 0{,}506$ $\frac{177}{350}$ A1 [3]

$P(H/R) = \frac{0{,}3 \times 0{,}82}{0{,}6}$ corr. numerator B1 s.o.i

M1

0,41 A1 [3]

6

2 No. of ways of choosing exactly 2 pairs of shoes

$= {}^4C_2$ M1 s.o.i

$= 6$ A1 s.o.i

No. of ways of choosing 2 from the remaining 5

$= {}^5C_2 = 10$ M1A1 s.o.i

$\therefore$ Number of ways of choosing 6 among which there are exactly 2 pairs.

$= 6 \times 10$ √M1

$= 60$ A1 [6]

6

3 (a) (i) $\int_0^\infty ae^{-2x}dx = 1$ corre lims + equating to 1, B1

$-\frac{a}{2}e^{-2x}\Big|_0^\infty = 1$ attempt to int. see e^{-2x} M1

$0 + \frac{a}{2} = 1$

$a = 2$ or B3 A.N.W. A1 [3]

(ii) $P(0 \le X \le 1) = \int_0^1 2e^{-2x} dx$

$= \left.\frac{2e^{-2x}}{-2}\right|_0^1$ attempt to int. √M1

$= -e^{-2} + 1$

$= 0,8647$

A1 [2]

(b) $\int_b^\infty 2e^{-2x} dx = 0,3$ ~~M1~~*

$-e^{-2x}\Big|_b^\infty = e^{-2b} = 0,3$ attempt to int wt correct lims equating to 0,3 √M1

$-2b = ln0,3$ √M1

$b = 0,60$ 0,60198 A1 [3]

8

4 (a) (i) $a + 2\times\frac{2}{10} + 3\times\frac{1}{10} + 4\times\frac{2}{10} + 5b = 3,9$ M1

$a + 5b + 1,5 = 3,9$

$a + 5b = 2,4$ A1 [2]

(b) (i) $a + 0,2 + 0,1 + 0,2 + b = 1$ total prob. B1

$a + b = 0,5$

$a + 5b = 2,4$ } ~~Any one~~ ~~B1~~

$4b = 1,9$ √M1

$b = 0,475$

$= 0,48$ A1

$a = 0,025$

$= 0,03$ A1 [4]

(ii) $E(X^2) = 1\times 0,\overset{0}{3} + 4 \times 0,2 + 9 \times 0,1 + 16 \times 0,2 + 25 \times 0,48$

$= 16,93$ 16.8

$Var(X) = 16,93 - (3,9)^2$ $16,8 - (3,9)^2$ √M1

$= 1,72$ 1.59 A1 [2]

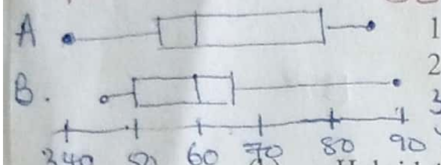
8

5 (a) (i) Advantages:

B1 uniform scale
B1 labels
each
lowest + greatest B2
quartiles B2

1. probing B1
2. rephrasing question B1

Disadvantages Complex rigorous training of personnel.
Inapproachable mediu.



1. stage managing by interviewee B1
2. Bias B1
3. Expensive (large grps + long dist). [4]
4. Time consuming.

on same scale

(b) Hybrid A is preferable because information is negatively skewed. [2]

* Award 1 box for on diff. scale.

6 (a) (i) $X \sim B(11, 0.16)$ $q = 0,84$ wt corr parameters B1 s.o.i

$P(X < 3) = P(X = 0) + P(X = 1) + P(X = 2)$

${}^{11}C_0\,(0,16)^0(0,84)^{11} + {}^{11}C_1 0,16 \times 0,84^{10} + {}^{11}C_2(0,16)^2 \times (0,84)^9$ M1

$= 0,1469 + 0,3078 + 0,2932$

$= 0,7479$ A1 [3]

(ii) $X \sim N(80, 28.8)$ B1 s.o.i

$P(X > 73) = P(X > 73,5)$ i.c.c. B1 s.o.i

$= P\left(Z > \frac{73,5-80}{\sqrt{28,8}}\right)$ wt or wtout cc M1

$= P(Z > -1,211)$

$= \Phi(1,211)$

$= 0,8871$ A1 [4]

(b) (i)

X	0	1	2
$P(X = x)$	$\frac{1}{4}$	$\frac{1}{2}$	$\frac{1}{4}$

B1
B1

[2]

(ii) $E(X) = 0 \times \frac{1}{4} + 1 \times \frac{1}{2} + 2 \times \frac{1}{4} = 1$ √M1A1

$E(X^2) = 1 \times \frac{1}{2} + 4 \times \frac{1}{4}$

$= \frac{3}{2}$

$Var(X) = \frac{3}{2} - 1$ √M1

$= \quad \frac{1}{2}$ A1 [4]

(iii) Var(2y – 1)

$= 4\text{Var}(y) + \text{Var}(1)$ ~~M1~~ B1

$= 4 \times 8 \times \text{Var}(X)$ ~~M1~~

$= 4 \times 8 \times \frac{1}{2}$ √M1

$= 16$ A1 [3]

16

7 (a) (i) $E(X) = \frac{1}{\lambda} = \frac{1}{2}$ B1

(ii) $\text{Var}(X) = \frac{1}{\lambda^2} = \frac{1}{4}$ B1

(iii) $P(X > 2) = 1 - \cancel{P(X \le 2)}$ $\int_2^{\infty} 2 \cdot e^{-2x}\, dx$

$= 1 - F_x(2)$ attempt to int

$= 1 - [1 - e^{-4}]$ $-e^{-2x}\Big|_2^{\infty}$ M1 wt corr lims

$= \cancel{e^{-4}} = \cancel{0{,}1353}$ $e^{-4} = 0{,}0183$ A1

(iv) $P(2 \le X \le 4) = [1 - e^{-4ln3}] - [1 - e^{-2ln3}]$ $-e^{-2x}\Big|_2^{4}$ M1 wt corr lims

$= e^{2ln\frac{1}{3}} - e^{4ln\frac{1}{3}}$

$= \cancel{0{,}099}$ $e^{-4} - e^{-8} = 0{,}01798$ A1 [6]

(b) $\bar{x} = \frac{20164}{15} = 1344{,}27$ s.o.i B1

$\hat{\sigma} = \sqrt{\frac{15(27852834) - (20164)^2}{15 \times 14}}$ or $\hat{\sigma}^2 = 53443$ M1

$= \$231$ A1 s.o.i

H0: μ = \$1123

H₁: μ > \$1123 B1

$t_{5\%}(14) = 1{,}761$ s.o.i B1B1 or B2

$t = \frac{1334{,}37 - 1123}{231/\sqrt{15}}$ √M1

$= 3{,}710$ A1

3,710 > 1,761 Reject H0 provided Ho is stated. √M1A1 [10]

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8 (a) Lower quartile

$P\left(Z < \frac{Q_{1}-50}{4}\right) = 0{,}25$

$\therefore \frac{Q_1-50}{4}$ is negative

$P\left(Z > \frac{50-Q_1}{4}\right) = 0{,}25$ standardising and equating to 0.25 M1

$1 - \Phi\left(\frac{50-Q_1}{4}\right) = 0{,}25$ interpretation ~~M1~~

$\Phi\left(\frac{50-Q_1}{4}\right) = 0{,}75$

$\frac{50-Q_1}{4} = 0{,}674$ table value M1 B1

$Q_1 = 47{,}3$ A1

Upper quartile

$P\left(Z < \frac{Q_3-50}{4}\right) = 0{,}75$ M1

$\frac{Q_3-50}{4} = 0{,}674$ B ~~M~~1

$Q_3 = 52{,}7$ A1 [7]

(b) (i) By Central Limit Theorem

$\bar{x} \sim N\left(\mu; \frac{\sigma}{n}\right)$

For 95% confidence interval

$\bar{x} - 1{,}96\ \frac{\sigma}{7} = 94{,}5$ table value B1 soi

$\bar{x} + 1{,}96\ \frac{\sigma}{7} = 105{,}3$ any one equation M1

Solving simultaneously M1

$\bar{x} = 99{,}9$ A1

$\sigma = 19{,}29$ A1

[5]

(ii) Confidence interval

$= 99{,}9 \pm 2{,}576 \times \frac{19{,}29}{7}$ B1M1

$= [92{,}8;\ \ 107]$ A1A1 [4]

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9 (a) (i) $X \sim P(3)$

$P(X > 0) = 1 - P(X = 0)$ ~~M1~~ B1 s.o.i

$= 1 - \frac{e^{-3}.3^0}{0!}$ M1

$= 0,9502$ A1 [3]

(ii) $P(2 \leq x < 5) = P(X = 2) + P(X = 3) + P(X = 4)$ ~~M1~~ B1 s.o.i

$= \frac{e^{-3}.3^2}{2!} + \frac{e^{-3}.3^3}{3!} + \frac{e^{-3}.3^4}{4!}$ M1

$= 0,6161$ A1 [3]

(iii) $\lambda = \frac{3}{5}$ B1

$= 0,6$

$P(X = 1) = \frac{e^{-0,6}(0,6)^1}{1!}$ $\lambda \neq 3$ √M1

$= 0,3293$ A1 [3]

(b) Total number of flaws = 46

$\lambda = \frac{46}{20} = 2,3$ B1

or $\frac{2+4+1+1}{20} = \frac{8}{20} = 0,40$

$P(X \geq 3) = 1 - [P(X = 0) + P(X = 1) + P(X = 2)$ ~~M1~~

$= 1 - \left[\frac{e^{-2,6}(2,3)^0}{0!} + \frac{e^{-2,3}(2,3)^1}{1!} + \frac{e^{-2,3}(2,3)^2}{2!}\right]$ $\lambda \neq 3$ √M1

$= 0,404$ A1 [3]

(c) $X \sim B(300, 0.01)$

$\lambda = 300 \times 0,01$

$X \sim P(3)$ distrib + param. B1B1 s.o.i

$P(X = 5) = \frac{e^{-3}.3^5}{5!}$ √M1

$= 0,1$ A1 [4]

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10 (a) Positively skewed Area under the curve is 1 B1 [1]
Symmetrical when d.f. is 1

(b) H0: There is no relationship between age and preference of toys. B1

H1: There is a relationship between age and preference.

Expected frequencies

Age	A	B	C	TOTAL	
5 – 6 yrs	12	18	30	60	M1
7 – 8 yrs	14	21	35	70	A1 any one correct
9 – 10 yrs	14	21	35	70	A1 any 3 correct.
	40	40	100	200	A1 All correct

V = 4 d.f. B1 s.o.i

$\chi^2_{5\%}(4) = 9{,}488$ table value B1

O	E	O – E	$\frac{(O-E)^2}{E}$
18	12	6	3
22	18	4	0,89
20	30	–10	3,33
2	14	–12	10,29
28	~~12~~ 21	7	2,33
40	35	5	0,71
20	14	6	2,57
10	21	11	5,76
40	35	5	0,71
			29,6

√M1
A1 any 1 correct
A1 any 3 correct
A1 all correct

29,6 √M1A1
29 – 30,5

29,6 > 9,488 √M1

∴Reject H0 provided H0 is stated. A1 [15]

11 (a) suitable correct scale and labels B1
any 3 corr plots B1

16

(b) $\sum x = 40\cancel{7}4$ $\sum y = 335$

$\sum x^2 = 17\,608$ $\sum y^2 = 11\,933$

$\sum xy = 14\,268$ $\bar{x} = 40{,}7$ $\bar{y} = 33{,}5$

$n = 10$

$b = \frac{10\times14268 - 40\cancel{7}4\times335}{10\times17608 - 407^2}$ M1

$= \frac{6335}{10431}$

$= 0{,}607$ 0,57 A1

$y - 33{,}5 = \overset{0.57}{0{,}607}(x - 40{,}7)$ √M1A1

$y = 0{,}607x + 8{,}795$ $0{,}57x + 10{,}4$ B4. [4]

$d = \frac{10\times14268 - 40\cancel{7}4\times335}{10\times11933 - 335^2}$ M1

$\frac{6335}{7105} = 0{,}892$ 1,03 A1

$x - 40{,}\cancel{7}4 = \overset{1{,}03}{0{,}892}(y - 33{,}5)$ √M1A1

$x = 0{,}892y + 10{,}818$ $1.03y + 5.79$ [4]

(c) $y = \overset{0{,}57}{\cancel{0{,}607}}\times44 + \overset{10.4}{\cancel{8{,}795}}$ √M1

$= 35{,}503$ 35.48 A1 [2]

(d) $r = \sqrt{0{,}607\times0{,}892}$ $= \sqrt{0{,}57\times1{,}03}$ √M1

$= 0{,}756$ 0,766 accept 1 d.p. A1 [4]

(e) There is a strong positive linear relationship between the values of x and y. dep* B1B1 [2]

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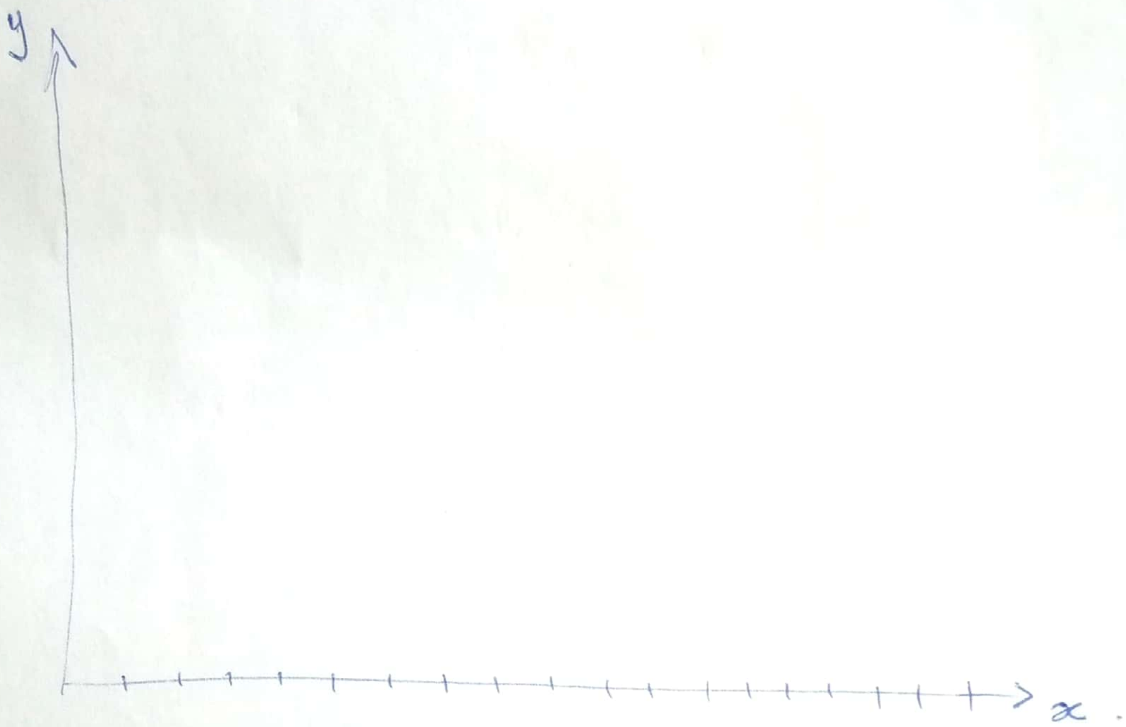
(d) Sales in 2006 Term One

$= (0,3964 \times 16 + \overset{8,3621}{\cancel{4,8288}})\ \$1\,000$

$= 11,1712 \times \$1\,000$ subst $x = 16$ and $\times 1000$ √M1

$= \$11\,171$ 14,704,50 A1 [2]



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M1

A1 any one correct

A1 any 3 correct

A1 All correct

V = 4 d.f. — B1 s.o.i

$\chi^2_{5\%}(4) = 9{,}488$ table value — B1

O	E	O – E	$\frac{(O-E)^2}{E}$
18	12	6	3
22	18	4	0,89
20	30	−10	3,33
2	14	−12	10,29
28	~~12~~ 21	7	2,33
40	35	5	0,71
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10	21	11	5,76
40	35	5	0,71
			29,6

√M1

A1 any 1 correct

A1 any 3 correct

A1 all correct

29,6 — 29 – 30,5 — √M1A1

29,6 > 9,488 — √M1

∴ Reject H0 provided H0 is stated — A1 [15]

11 (a) suitable correct scale and labels — B1

any 3 corr plots — B1

16