A2 Statistics Practice Paper E
60 Marks

60 Minutes

1. A teacher selects a random sample of 56 students and records, to the nearest hour, the time spent watching television in a particular week.

Hours	1 – 10	11 – 20	21 – 25	26 – 30	31 – 40	41 – 59
Frequency	6	15	11	13	8	3
Mid-point	5.5	15.5		28		50

a. Find the mid-points of the 21 - 25 hour and 31 - 40 hour groups. **(2)**

A histogram was drawn to represent these data. The 11 - 20 group was represented by a bar of width 4 cm and height 6 cm.

b. Find the width and height of the 26 - 30 group **(3)**

c. Estimate the mean and standard deviation of the time spent watching television by these students. **(5)**

d. Use linear interpolation to estimate the median length of time spent watching television by these students. **(2)**

e. State, giving a reason, the skewness of these data. **(2)**

(Total marks: 14)

2. Helen believes that the random variable C, representing cloud cover from the large data set, can be modelled by a discrete uniform distribution.

a. Write down the probability distribution for C. **(2)**

b. Using this model, find the probability that cloud cover is less than 50% **(1)**

Helen used all the data from the large data set for Hurn in 2015 and found that the proportion of days with cloud cover of less than 50% was 0.315

c. Comment on the suitability of Helen's model in the light of this information. **(1)**

(Total marks: 4)

3. The weight, w grams, and the length, l mm, of 10 randomly selected newborn turtles are given in the table below.

l	49.0	52.0	53.0	54.5	54.1	53.4	50.0	51.6	49.5	51.2
w	29	32	34	39	38	35	30	31	29	30

(You may use $S_{ll} = 33.381$ $\quad S_{wl} = 59.99$ $\quad S_{ww} = 120.1$)

a. Find the equation of the regression line of w on l in the form $w = a + bl$ **(5)**

b. Use your regression line to estimate the weight of a newborn turtle of length 60 mm. **(2)**

(Total marks: 7)

4. In a factory, three machines, J, K and L, are used to make biscuits.

Machine J makes 25% of the biscuits.
Machine K makes 45% of the biscuits.
The rest of the biscuits are made by machine L.

It is known that 2% of the biscuits made by machine J are broken, 3% of the biscuits made by machine K are broken and 5% of the biscuits made by machine L are broken.

a. Draw a tree diagram to illustrate all the possible outcomes and associated probabilities **(2)**

A biscuit is selected at random.

b. Calculate the probability that the biscuit is made by machine J and is not broken. **(2)**

c. Calculate the probability that the biscuit is broken. **(2)**

d. Given that the biscuit is broken, find the probability that it was not made by machine K **(3)**

(Total marks: 9)

5. A sample of 13 values of x and $y$are taken.
For those values, the PMCC is $r = -0.43$.

Using a 5% level of significance, test whether the correlation between x and y is negative. **(2)**

(Total marks: 2)

6. A cadet fires shots at a target at distances ranging from 25 m to 90 m. The probability of hitting the target with a single shot is p. When firing from a distance d m, $p = \frac{3}{200}(90 - d)$

Each shot is fired independently.
The cadet fires 10 shots from a distance of 40 m.

a. Find the probability that exactly 6 shots hit the target. **(3)**

b. Find the probability that at least 8 shots hit the target. **(2)**

The cadet fires 20 shots from a distance of x m.

c. Find, to the nearest integer, the value of x if the cadet has an 80% chance of hitting the target at least once. **(4)**

(Total marks: 9)

7. The lifetimes of bulbs used in a lamp are normally distributed.

A company X sells bulbs with a mean lifetime of 850 hours and a standard deviation of 50 hours.

a. Find the probability of a bulb, from company X, having a lifetime of less than 830 hours. **(3)**

b. In a box of 500 bulbs, from company X, find the expected number having a lifetime of less than 830 hours.

(2)

A rival company Y sells bulbs with a mean lifetime of 860 hours and 20% of these bulbs have a lifetime of less than 818 hours.

c. Find the standard deviation of the lifetimes of bulbs from company Y. **(4)**

(Total marks: 9)

8. The probability of Richard winning a prize in a game at the fair is 0.15

Richard plays a number of games.

The probability of Richard winning his second prize on his 8th game is calculated and is 0.0594

a. State two assumptions that have to be made, for this model to be valid. **(2)**

Mary plays the same game, but has a different probability of winning a prize. She plays until she has won r prizes. The random variable G represents the total number of games Mary plays.

b. Given that the mean and standard deviation of G are 18 and 6 respectively, determine whether Richard or Mary has the greater probability of winning a prize in a game.

(4)

(Total marks: 6)

Total Marks for Paper: 60

Mark Scheme

1a	23	**B1**
	35.5	**B1**
1b	Width of 10 units = 4cm therefore, width of 5 units is 2cm	**B1**
	Height = 2.6 x 4 = 10.4	**M1** **A1**
1c	$\sum fx = 1316.5$ $\bar{x} = \frac{1316.5}{56} = 23.5$	**M1** **A1**
	$\sum fx^2 = 37378.25$	**B1**
	So, $\sigma = \sqrt{\frac{37378.25}{56} - \overline{x^2}}$	**M1**
	$\sigma = 10.7$	**A1**
1d	$Q_2 = (20.5) + \frac{28-21}{11} \times 5$	**M1**
	= 23.68	**A1**
1e	$Q_3 - Q_2 = 5.6$ $Q_2 - Q_1 = 7.9$	**M1**
	7.9 > 5.6, therefore negative skew	**A1**

2a

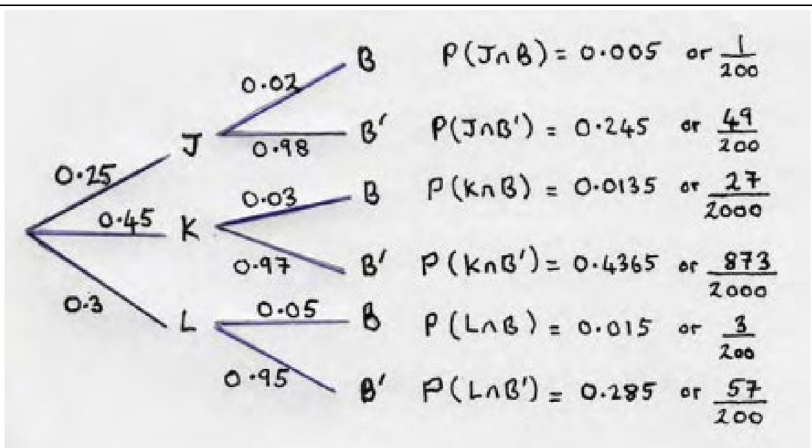
c	0	1	2	3	4	5	6	7	8
P($C = c$)	$\frac{1}{9}$	$\frac{1}{9}$	$\frac{1}{9}$	$\frac{1}{9}$	$\frac{1}{9}$	$\frac{1}{9}$	$\frac{1}{9}$	$\frac{1}{9}$	$\frac{1}{9}$

B1
B1ft

2b	$P(C < 4) = \frac{4}{9}$	**B1**
2c	Probability lower than expected suggests model is not good	**B1**

3a	$b = \frac{59.99}{33.381}$	**M1**
	$b = 1.79713 \ldots$ $b = 1.8$	**A1**
	$a = 32.7 - 1.79713 \ldots \times 51.83$	**M1**
	$a = -60.44525$	**A1**
	$w = -60.445251 + 1.79713l$ $w = -60 + 1.8l$	**M1**
3b	$w = -60 + 1.8 \times 60$	**M1**
	$w = 47.3825 \ldots$ $w = 47.3 - 37.6g$	**A1**

4a



M1
A1

4b	0.25×0.98	**M1**

	= 0.245	**A1**
4c	$0.25 \times 0.02 + 0.45 \times 0.03 + 0.3 \times 0.05$	**M1**
	= 0.0335	**A1**
4d	$= \frac{0.25 \times 0.02 + 0.3 \times 0.05}{0.0335}$	**M1**
	= 0.5970	**A1**

5	-0.4762	**M1**
	Greater therefore accept	**A1**

6a	X is the random variable the Number of successes, $X \sim B(10, 0.75)$	**B1**
	P(X = 6) = $P(X \leq 6) - P(X \leq 5)$	**M1**
	= 0.145998.. = 0.146	**A1**
6b	Using, $X \sim B(10, 0.75)$ $P(X \geq 8) = P(X = 8) + P(X = 9) + P(X = 10)$	**M1**
	= 0.52559	**A1**
6c	$1 - P(0) = 0.8$	**M1**
	$(1-p)^{20} = 0.2$ $1 - p = 0.9227$ $p = 0.0773$	**A1**
	$\frac{3}{200}(90 - x) = 0.0773$	**M1**
	$x = 84.84 \ldots$ $x = 85$	**A1**

7a	Let the random variable X be the lifetime in hours of bulb $P(X < 830) = P\left(Z < \frac{830-850}{50}\right)$	**M1**
	$P(Z < -0.4)$ $1 - P(Z - 0.4)$	**M1**
	$1 - 0.6554$ = 0.3446	**A1**
7b	0.3446×500	**M1**
	= 172.3	**A1**
7c	Standardise with 860 and σ and equate to z value $\frac{818-860}{\sigma} = z\ value$	**M1**
	$\frac{818-860}{\sigma} = -0.8416 \ldots$	**A1**
	$\sigma = 49.9$	**B1** **A1**

8a	The model is only valid if, 1) The game trials are independent	**B1**
	2) The probability of winning a prize, 0.15, is constant for each game	**B1**
8b	$18 = \frac{r}{p}$ $6^2 = \frac{r(1-p)}{p^2}$	**M1** **A1**
	Solving, $2p = 1 - p$	**M1**
	$p = \frac{1}{3}$ (> 0.15) so Mary has the greater chance of winning a prize	**A1**