AS Statistics Practice Paper E
45 Marks

45 Minutes

1. The lengths in cm of 15 squirrels in a park are recorded below.

24 30 25 24 29 30 22 25 28 23 24 24 27 30 28

Describe how you would take a sample of 5 squirrels using an appropriate method. **(3)**

(Total marks: 3)

2. A shopkeeper knows, from past records, that 15% of customers buy an item from the display next to the till.

After a refurbishment of the shop, he takes a random sample of 30 customers and finds that only 1 customer has bought an item from the display next to the till.

Stating your hypotheses clearly, and using a 5% level of significance, test whether or not there has been a change in the proportion of customers buying an item from the display next to the till.

(6)

During the refurbishment a new sandwich display was installed. Before the refurbishment 20% of customers bought sandwiches.

The shopkeeper claims that the proportion of customers buying sandwiches has now increased. He selects a random sample of 120 customers and finds that 31 of them have bought sandwiches.

b. Using a suitable approximation and stating your hypotheses clearly, test the shopkeeper's claim. Use a 10% level of significance.

(8)

(Total marks: 14)

3. An experiment consists of selecting a ball from a bag and spinning a coin. The bag contains 5 red balls and 7 blue balls. A ball is selected at random from the bag, its colour is noted and then the ball is returned to the bag.

When a red ball is selected, a biased coin with probability $\frac{2}{3}$ of landing heads is spun.

When a blue ball is selected a fair coin is spun.

a. Draw a tree diagram of the possible outcomes. **(2)**

b. Find the probability that she obtains a head. **(2)**

c. Given that Tom selected a ball at random and obtained a head when he spun the appropriate coin, find the probability that Tom selected a red ball.

(3)

Shivani and Tom selected a ball and spins the appropriate coin.

Shivani and Tom each repeat this experiment.

d. Find the probability that the colour of the ball Shivani selects is the same as the colour of the ball Tom selects.

(3)

(Total marks 10)

4. The probability that Janice sees a kingfisher on any particular day is 0.3. She notes the number, X, of days in a week on which she sees a kingfisher.

a. State one necessary condition for X to have a binomial distribution **(1)**

Assume that X has a binomial distribution.

b. Find the probability that, in a week, Janice sees a kingfisher on exactly 2 days. **(1)**

Each week Janice notes the number of days on which she sees a kingfisher.

c. Find the probability that Janice sees a kingfisher on exactly 2 days in a week during at least 4 of 6 randomly chosen weeks.

(3)

(Total marks 5)

5. Sheila recorded the number of months (to the nearest month) different washing machines could run for, before they became self aware and attempted to destroy humanity. She recorded this data in a table, before she herself was extinguished at the hand of her Bosch.

Age (months)	Frequency
1-4	4
5-8	9
9-12	11
13-20	6

Use linear interpolation to estimate the lower and upper quartiles of the running time, and hence the interquartile range.

(4)

(Total marks 4)

6. A potter believes that 20% of pots break whilst being fired in a kiln. Pots are fired in batches of 25.

Let X denote the number of broken pots in a batch.

A batch is selected at random.

a. Using a 10% significance level, find the critical region for a two tailed test of the potter's belief. **(4)**

The potter aims to reduce the proportion of pots which break in the kiln by increasing the size of the batch fired. He now fires pots in batches of 50. He then chooses a batch at random and discovers there are 6 pots which broke whilst being fired in the kiln.

b. Test, at the 5% level of significance, whether or not there is evidence that increasing the number of pots in a batch has reduced the percentage of pots that break whilst being fired in the kiln. State your hypotheses clearly.

(5)

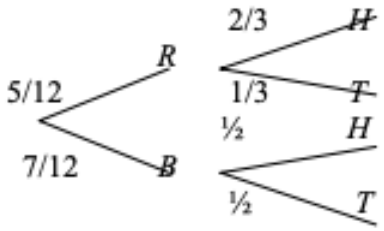
(Total marks 9)

Total Marks for Paper: 45

Mark Scheme

1	Systematic sample	**M1**
	Take every 3rd squirrel	**M1**
	24, 24, 22, 23, 27	**A1**

2a	$H_0 : p = 0.15 \quad H_1 : p \neq 0.15$	B1 B1
	$X \sim B(30, 0.15)$	M1
	$P(X \leq 1) = 0.0480$ or CR: $X = 0$	A1
	$(0.0480 > 0.025)$	
	not a significant result or do not reject H_0 or not in CR	M1
	there is no evidence of a change in the proportion of customers buying an item from the display.	A1ft
2b	$H_0 : p = 0.2 \quad H_1 : p > 0.2$	B1
	Let S = the number who buy sandwiches, $S \sim B(120, 0.2)$,	
	$S \approx W \sim N\left(24, \sqrt{19.2}^2\right)$	M1 A1
	$P(S \geq 31) = P(W \geq 30.5)$	M1
	$= P\left(Z > \frac{30.5 - 24}{\sqrt{19.2}}\right)$ or $\frac{x - 0.5 - 24}{\sqrt{19.2}} = 1.2816$	M1
	$[= P(Z > 1.48..)]$	
	$= 1 - 0.9306$	M1
	$= 0.0694$ $\qquad x = 30.1$	A1
	< 0.10 so a significant result, there is evidence that more customers are purchasing sandwiches or the shopkeepers claim is correct.	B1ft

3a		
	P(R) and P(B)	B1
	2nd set of probabilities	B1
		(2)
3b	$P(H) = \frac{5}{12} \times \frac{2}{3} + \frac{7}{12} \times \frac{1}{2}$	**M1**
	$P(H) = \frac{41}{72}$	**A1**
3c	$\frac{20}{41}$	**M1** **A1** **A1**
3d	$\left(\frac{5}{12}\right)^2 + \left(\frac{7}{12}\right)^2$	**M1** **A1**
	$= \frac{74}{144}$	**A1**

4a	The probablity of seeing a kingfisher is the same each day	**B1**
4b	0.318/0.32	**B1**
4c	$1 - P(X \leq 3)$	**M1**
	1 – 0.318..	**M1**
	= 0.0854	**A1**

5	Attept at intepolation	**M1**
	LQ = 6.06 month	**A1**
	UQ = 11.95 month	**A1**
	IQR = 5.9 month	**A1**

6a	$X \sim B(25, 0.2)$	**M1** Writing or using B(25,0.2)or B(25,1/5) [allow Po(5)] May be written in full or implied by a correct CR (allow written as a probability statement)	M1
	$[P(X \geq 9) =]0.0468$ $[P(X \leq 1) =]0.0274$	**1st A1** both awrt 0.0468 and awrt 0.0274 seen.	A1
	$X = [0 \leq] \ X \leq 1$	**2nd A1** $X \leq 1$ or $X < 2$ or $0 \leq X \leq 1$ or [0,1] or 0,1 or equivalent statements. $X \leq c$ and $c = 1$	A1
	$9 \leq X \ \ [\leq 25]$	**3rd A1d** dependent on seeing a probability from the B(25, 0.2) and $X \geq 9$ or $X > 8$ or $9 \leq X \leq 25$ or 9,10,11,12,13,14,15,16,17,18,19,20,21,22, 23,24,25 or [9,25] or equivalent statements. $X \geq c$ and $c = 9$	A1d

6b	$H_0: p = 0.2$ $H_1: p < 0.2$	**B1** both hypotheses with p or π and clear which is H_0 and which is H_1	**B1**
	$P(X \leq 6) = 0.1034$ or CR $X \leq 5$	**1st M1** writing or using B(50, 0.2) and writing or using $P(X \leq 6)$ or $P(X \geq 7)$ on its own. May be implied by a correct CR	**M1**
		1st A1 awrt 0.103. Allow CR $X \leq 5$ or $X < 6$. or if not using CR allow awrt 0.897.	**A1**
	Insufficient evidence to reject H_0, Accept H_0, Not significant. 6 does not lie in the Critical region.	**2nd M1** dependent on previous M being awarded. A correct statement (do not allow if there are contradicting non-contextual statements). ft their Prob/CR compared with 0.05/6/(0.95 if using 0.8979). Do not follow through their hypotheses	**M1d**
	No evidence that increasing the batch size has **reduced** the **percentage** of broken **pots (oe)** **or** evidence that there is **no change** in the **percentage** of broken **pots (oe)**	**2nd A1cso** Conclusion must contain the words **reduced/ no change/not affect oe number/percentage/proportion/ probability oe**, and **pots**. All previous marks must be awarded for this mark to be awarded. Do **not** allow the potters claim /belief is wrong/true **NB** Correct contextual statement on its own scores M1A1	**A1cso**