Statistics Year 1 exam questions (AS maths) - AQA

NOTE:
Please be aware that in the Year 12 collections, you will find questions from the Year 13 papers. However, these questions are intentionally included because they align with Year 12 content and topics.
Happy studying!

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Ch 17 The binomial distribution

June 2022 Question 14 Paper 3 (A-Level)

14 A customer service centre records every call they receive.

It is found that 30% of all calls made to this centre are complaints.

A sample of 20 calls is selected.

The number of calls in the sample which are complaints is denoted by the random variable X.

14 (a) State **two** assumptions necessary for X to be modelled by a binomial distribution.

[2 marks]

14 (b) Assume that X can be modelled by a binomial distribution.

14 (b) (i) Find $\mathrm{P}(X = 1)$

[1 mark]

14 (b) (ii) Find $\mathrm{P}(X < 4)$

[2 marks]

14 (b) (iii) Find $\mathrm{P}(X \geq 10)$

[2 marks]

14 (c) In a random sample of 10 calls to a school, the number of calls which are complaints, Y, may be modelled by a binomial distribution

$$Y \sim \mathrm{B}(10, p)$$

The standard deviation of Y is 1.5

Calculate the possible values of p.

[3 marks]

ANSWER

Q	Marking instructions	AO	Marks	Typical solution
14(a)	States one of the following assumptions in context • probability of complaint call is constant • calls or complaint calls occur independently of each other or have no effect on each other • only two outcomes of complaint or non-complaint calls Condone ‘complaint’ for ‘complaint call’ Do not allow probability being independent Do not allow fixed number of calls	3.5b	B1	The probability of getting a complaint call is fixed Calls occur independently of each other
	States a second assumption in context	3.5b	B1	
	Subtotal		**2**	

Q	Marking instructions	AO	Marks	Typical solution
14(b)(i)	Calculates the correct probability ACF AWFW [0.0068, 0.007]	1.1b	B1	0.00684
	Subtotal		**1**	

Q	Marking instructions	AO	Marks	Typical solution
14(b)(ii)	Finds $P(X \le 4)$ *or* $P(X \le 3)$ PI by 0.2375 or 0.107 Allow figures to 2sf	1.1a	M1	$P(X \le 3)$ =0.107
	Obtains correct probability ACF AWFW [0.107, 0.11]	1.1b	A1	
	Subtotal		**2**	

Q	Marking instructions	AO	Marks	Typical solution
14(b)(iii)	Finds their $P(X \leq 9)$ or $P(X \leq 10)$ or $P(X \geq 10)$ or $P(X > 10)$ PI by 0.952 or 0.983 or 0.0172 or correct answer Allow figures to 2sf	1.1a	M1	$P(X \geq 10) = 1 - P(X \leq 9)$ $= 1 - 0.952$ $= 0.048$
	Obtains correct probability ACF AWFW [0.0479, 0.048]	1.1b	A1	
	Subtotal		**2**	

Q	Marking instructions	AO	Marks	Typical solution
14(c)	Uses $np(1-p)$	1.1a	M1	
	Forms a correct equation in p using 10 and 1.5 ACF	3.1a	A1	$10p(1-p) = 1.5^2$ $-10p^2 + 10p - 2.25 = 0$ $p =$ 0.34 and 0.66
	Obtains values for p ACF ISW Allow AWFW [0.34, 0.342] and [0.658, 0.66] for p or $p = \frac{10 \pm \sqrt{10}}{20}$	1.1b	A1	
	Subtotal		**3**	

November 2021 Question 14 Paper 2

14 The random variable T follows a binomial distribution where

$$T \sim \mathrm{B}(16, 0.3)$$

The mean of T is denoted by μ.

14 (a) Find $\mathrm{P}(T \leq \mu)$.

[2 marks]

14 (b) Find the variance of T.

[1 mark]

ANSWER

Q	Marking instructions	AO	Marks	Typical solution
14(a)	Uses np to find μ PI by 4.8	1.1a	M1	μ = np = 16 × 0.3 = 4.8 $\mathrm{P}(T \leq 4.8) = \mathrm{P}(T \leq 4)$ = 0.4499
	Obtains the correct probability (AWRT 0.45)	3.4	A1	
	Subtotal		**2**	
14(b)	Finds the correct variance (CAO)	1.1b	B1	Variance = 16 × 0.3 × 0.7 = 3.36
	Subtotal		**1**	

November 2021 Question 11 Paper 3 (A-Level)

11 The random variable X is such that $X \sim \mathrm{B}(n, p)$

The mean value of X is 225

The variance of X is 144

Find p.

Circle your answer.

[1 mark]

0.36 0.6 0.64 0.8

ANSWER

Q	Marking Instructions	AO	Marks	Typical Solution
11	Circles correct answer	1.1b	B1	0.36
	Total		**1**	

November 2020 Question 13 Paper 2

13 The random variable X is such that $X \sim B\left(n, \frac{1}{3}\right)$

The standard deviation of X is 4

Find the value of n.

Circle your answer.

[1 mark]

9 12 18 72

ANSWER

Q	Marking Instructions	AO	Marks	Typical Solution
13	Circles correct answer	1.1b	B1	72
	Total		**1**	

June 2019 Question 13 Paper 3 (A-Level)

13 Patrick is practising his skateboarding skills. On each day, he has 30 attempts at performing a difficult trick.

Every time he attempts the trick, there is a probability of 0.2 that he will fall off his skateboard.

Assume that the number of times he falls off on any given day may be modelled by a binomial distribution.

13 (a) (i) Find the mean number of times he falls off in a day.

[1 mark]

13 (a) (ii) Find the variance of the number of times he falls off in a day.

[1 mark]

13 (b) (i) Find the probability that, on a particular day, he falls off exactly 10 times.

[2 marks]

13 (b) (ii) Find the probability that, on a particular day, he falls off 5 or more times.

[3 marks]

13 (c) Patrick has 30 attempts to perform the trick on each of 5 consecutive days.

13 (c) (i) Calculate the probability that he will fall off his skateboard at least 5 times on each of the 5 days.

[2 marks]

13 (c) (ii) Explain why it may be unrealistic to use the same value of 0.2 for the probability of falling off for all 5 days.

[1 mark]

ANSWER

Q	Marking Instructions	AO	Mark	Typical Solution
13 (a)(i)	Obtains correct mean	1.1b	B1	6
13 (a)(ii)	Obtains correct variance	1.1b	B1	4.8
13 (b)(i)	Uses the Binomial formula with n = 30, p = 0.2 or $P(X \leq 10) - P(X \leq 9)$ **PI** by correct answer	1.1a	M1	$P(X = 10) = \binom{30}{10} 0.2^{10} 0.8^{20}$ $= 0.0355$
	Obtains correct probability **AWFW** [0.035, 0.036]	1.1b	A1	
13 (b)(ii)	Calculates either $P(X \leq 4) = 0.255$ or $P(X \leq 5) = 0.4275$ using the Binomial distribution	3.1b	M1	$P(X \leq 4) = 0.255$ $P(X \geq 5) = 1 - P(X \leq 4)$ $= 1 - 0.255$ $= 0.745$
	States $P(X \geq 5) = 1 - P(X \leq 4)$ or subtracts their stated value of $P(X \leq 4)$ from 1	1.1b	M1	
	Obtains correct probability **AWFW** [0.74, 0.75]	1.1b	A1	
13 (c)(i)	Raises their 0.745 to power of 5	3.1b	M1	$0.745^5 = 0.229$
	Obtains their correct probability **FT** their 0.745 **AWRT** their 0.229	1.1b	A1F	
13 (c)(ii)	Gives a valid reason that probability/likelihood/chances may change/increase/decrease as a result of external factor change over 5 day period or Patrick improves	3.5b	E1	Probability may change as Patrick improves
	Total		**10**	

June 2018 Question 15 Paper 2

15 Nicola, a darts player, is practising hitting the bullseye. She knows from previous experience that she has a probability of 0.3 of hitting the bullseye with each dart.

Nicola throws eight practice darts.

15 (a) Using a binomial distribution, calculate the probability that she will hit the bullseye three or more times.

[2 marks]

15 (b) Nicola throws eight practice darts on three different occasions. Calculate the probability that she will hit the bullseye three or more times on all three occasions.

[2 marks]

15 (c) State two assumptions that are necessary for the distribution you have used in part **(a)** to be valid.

[2 marks]

ANSWER

Accept probabilities as percentages in all questions

Q	Marking Instructions	AO	Marks	Typical Solution
15(a)	Calculates $P(X \leq 2)$ or $P(X \leq 3)$ using the binomial dist	AO3.4	M1	$P(X \leq 2) = 0.55(177 \ldots)$ $(P(X \leq 3) = 0.80(589 \ldots)$ $P(X \geq 3) = 1 - P(X \leq 2) = 0.448$
	Obtains correct answer AWRT 0.448	AO1.1b	A1	
15(b)	Calculates the cube of their answer to (a). Do not accept as part of a larger calculation or multiples of their cube.	AO1.1a	M1	$0.448 \ldots^3$ = 0.090 (3dp)
	Obtains correct answer(FT if AWFW 0.0899 to 0.0901)	AO1.1b	A1F	
15(c)	States first appropriate assumption in context	AO3.5b	E1	The probability of hitting the bullseye is fixed at 0.3 or Hitting the bullseye with each dart is independent of hitting the bullseye with any other dart or There are 2 possible outcomes, hit bullseye or does not hit bullseye
	States second appropriate assumption in context Accept probability of hitting bullseye 'is constant' Do not accept 'fixed number of trials'	AO3.5b	E1	
	Total		**6**	

June 2018 Question 15 Paper 3 (A-Level)

15 Abu visits his local hardware store to buy six light bulbs.

He knows that 15% of all bulbs at this store are faulty.

15 (a) State a distribution which can be used to model the number of faulty bulbs he buys.

[1 mark]

15 (b) Find the probability that all of the bulbs he buys are faulty.

[1 mark]

15 (c) Find the probability that at least two of the bulbs he buys are faulty.

[2 marks]

15 (d) Find the mean of the distribution stated in part **(a)**.

[1 mark]

15 (e) State two necessary assumptions in context so that the distribution stated in part **(a)** is valid.

[2 marks]

ANSWER

Q	Marking Instructions	AO	Marks	Typical Solution
15(a)	States the correct binomial distribution	AO3.3	B1	B(6, 0.15)
15(b)	Calculates the correct probability	AO1.1b	B1	0.0000114
15(c)	Calculates $P(X \le 1)$ or $P(X \le 2)$ using the binomial distribution	AO1.1a	M1	$P(X \le 1) = 0.7764$ $P(X \ge 2) = 1 - P(X \le 1)$ $P(X \ge 2) = 0.224$
	Obtains the correct answer	AO1.1b	A1	
15(d)	Finds the correct mean	AO1.1b	B1	0.9
15(e)	States a first appropriate assumption in context	AO3.5b	B1	The probability of a light bulb being faulty is fixed
	States a second appropriate assumption in context	AO3.5b	B1	A light bulb being faulty is independent of any other light bulb being faulty
	Total		**7**	