

Write your name here

Surname

Other Names

AS/A Level Mathematics

The Binomial Distribution and Hypothesis Testing

Candidates may use any calculator allowed by the regulations of the Joint Council for Qualifications. Calculators must not have the facility for symbolic algebra manipulation, differentiation and integration, or have retrievable mathematical formulae stored in them.

Instructions

- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- **Fill in the boxes** at the top of this page with your name.
- Answer **all** questions and ensure that your answers to parts of questions are clearly labelled..
- Answer the questions in the spaces provided
– there may be more space than you need.
- You should show sufficient working to make your methods clear.
Answers without working may not gain full credit.
- Answers should be given to three significant figures unless otherwise stated.

Information

- The marks for **each** question are shown in brackets
– use this as a guide as to how much time to spend on each question.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

1 The discrete random variable $X \sim B(15, 0.35)$

Find:

- (a) $P(X = 5)$
- (b) $P(X < 4)$
- (c) $P(X \leq 10)$

(Total for question 1 is 3 marks)

2 The probability of Harry being late for school is 0.1. Over a term of 30 days find the probability that Harry is late:

- (a) Exactly one time
- (b) More than four times
- (c) Less than three times

(Total for question 2 is 3 marks)

3 The discrete random variable $X \sim B(20, 0.41)$

- (a) Find $P(3 < X \leq 7)$ **(2)**

Previous research by a restaurant found that 30% of customers will order a starter. One one day a random sample of 40 customers is taken and 7 order a starter.

- (b) Test at the 5% significance level whether the proportion of customers ordering a starter has decreased. **(5)**
- (c) State the conclusion you would have reached if you tested at the 10% significance level. **(1)**

(Total for question 3 is 8 marks)

4 The discrete random variable $X \sim B(30, 0.58)$

- (a) Find $P(X \geq 12)$ **(2)**

A cafe expects 30% of customers to order a coffee with their breakfast.

On one particular day a random sample of 40 customers that ordered breakfast is taken and 19 of them ordered a coffee.

- (b) Test at the 1% significance level whether the proportion of customers ordering a coffee had increased. State your hypotheses clearly. **(5)**
- (c) State the conclusion you would have reached if a 5% significance level had been used for this test. **(1)**

(Total for question 4 is 8 marks)

5 A company produces pens. The probability that any pen is defective is 0.08.

(a) A sample of 15 pens is taken. Find the probability that 2 or more pens are defective. (2)

An employee claims that the probability that a pen is defective is more than 0.08. They take a sample of 20 pens and 3 are defective.

(b) Stating your hypothesis clearly, test the employee's claim at the 5% significance level. (5)

(Total for question 5 is 7 marks)

6 Andy plays tennis. The probability that Andy will get one of his serves in court is 60%.

Andy serves 20 times.

(a) Find the probability Andy gets:

- (i) exactly 15 serves in court
- (ii) more than 15 of the serves will be in court.

(b) Andy's coach thinks that the probability of Andy getting a serve in court has changed. Andy serves 50 times in a set and 35 are in court. Stating your hypothesis clearly, test the coach's claim at the 10% significance level.

(Total for question 6 is 7 marks)

7 The probability of a bias dice landing on 6 is 0.4. The dice is going to be rolled 20 times.

(a) Find the probability that the dice will land on 6 exactly 5 times.

Polly thinks that the probability that the dice will land on 6 is incorrect.

(b) Write down the hypotheses that should be used to test Polly's suspicion

(c) Using a 10% significance level find the critical region for a two tailed test to test Polly's suspicion. You should state the probability of rejection in each tail, which should be less than 0.05

(d) Find the actual significance level of a test based on your critical region from part (c)

Polly rolls the dice 20 times. The dice lands on six 11 times.

(e) Comment on Polly's suspicion in light of the experiment