

Write your name here

Surname

Other Names

# AS/A Level Mathematics

## Using the Normal Distribution to approximate the Binomial Distribution

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 (a) State the conditions under which the binomial distribution can be approximated by the normal distribution. (2)
- $X \sim B(30, 0.4)$
- (b) Use the normal distribution to calculate an approximation for  $P(X < 8)$  (3)
- (c) Use the binomial distribution to find  $P(X < 8)$  (2)
- (d) Calculate the percentage error in the approximation found in part b. (2)
- (Total for question 1 is 9 marks)**
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- 2 A company produces light bulbs. The company claims that more than 55% of the light bulbs will last longer than 1000 hours.
- (a) Give a reason why the company should not justify the claim by testing all of the light bulbs. (1)
- To test the company's claim 200 light bulbs are tested.
- (b) State the hypotheses for a one-tailed test of the company's claim. (1)
- (c) Given that 126 of the 200 light bulbs lasted longer than 1000 hours use a normal approximation to test, at the 5% level of significance, whether or not the manufacturer's claim is justified. (5)
- (Total for question 2 is 7 marks)**
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- 3 Andy claims that 60% of his first serves are in.
- Andy serves 50 times and 26 are in.
- (a) Assuming Andy's claim is correct, use a normal approximation, to find the probability that exactly 26 serves are in. (3)
- (b) Using your answer to part a comment on whether or not the proportion of Andy's serves in court is different from his claim of 60%. (1)
- (Total for question 3 is 4 marks)**
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- 4 The probability a biased dice lands on 6 is 0.38.
- The dice is rolled  $n$  times. Using a normal approximation, the probability that the dice lands on 6 more than 65 times is 0.0438 to 4 decimal places.
- Find the value of  $n$ .
- (Total for question 4 is 7 marks)**
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