

Binomial Distribution & Hypothesis Testing

Question Paper 6

Level	A Level
Subject	Maths
Exam Board	OCR - MEI
Module	Statistics 1
Topic	Binomial Distribution & Hypothesis Testing
Sub Topic	Binomial Distribution & Hypothesis Testing
Booklet	Question Paper 6

Time Allowed: 72 minutes

Score: /60

Percentage: /100

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	77.5%	70%	62.5%	57.5%	45%	<45%

- 1** A multinational accountancy firm receives a large number of job applications from graduates each year. On average 20% of applicants are successful.

A researcher in the human resources department of the firm selects a random sample of 17 graduate applicants.

- (i) Find the probability that at least 4 of the 17 applicants are successful. [3]
- (ii) Find the expected number of successful applicants in the sample. [2]
- (iii) Find the most likely number of successful applicants in the sample, justifying your answer. [3]

It is suggested that mathematics graduates are more likely to be successful than those from other fields. In order to test this suggestion, the researcher decides to select a new random sample of 17 mathematics graduate applicants. The researcher then carries out a hypothesis test at the 5% significance level.

- (iv) (A) Write down suitable null and alternative hypotheses for the test.
(B) Give a reason for your choice of the alternative hypothesis. [4]
- (v) Find the critical region for the test at the 5% level, showing all of your calculations. [4]
- (vi) Explain why the critical region found in part (v) would be unaltered if a 10% significance level were used. [2]

- 2 When onion seeds are sown outdoors, on average two-thirds of them germinate. A gardener sows seeds in pairs, in the hope that at least one will germinate.
- (i) Assuming that germination of one of the seeds in a pair is independent of germination of the other seed, find the probability that, if a pair of seeds is selected at random,
- (A) both seeds germinate,
(B) just one seed germinates,
(C) neither seed germinates. [3]
- (ii) Explain why the assumption of independence is necessary in order to calculate the above probabilities. Comment on whether the assumption is likely to be valid. [2]
- (iii) A pair of seeds is sown. Find the expectation and variance of the number of seeds in the pair which germinate. [3]
- (iv) The gardener plants 200 pairs of seeds. If both seeds in a pair germinate, the gardener destroys one of the two plants so that only one is left to grow. Of the plants that remain after this, only 85% successfully grow to form an onion. Find the expected number of onions grown from the 200 pairs of seeds. [3]

If the seeds are sown in a greenhouse, the germination rate is higher. The seed manufacturing company claims that the germination rate is 90%. The gardener suspects that the rate will not be as high as this, and carries out a trial to investigate. 18 randomly selected seeds are sown in the greenhouse and it is found that 14 germinate.

- (v) Write down suitable hypotheses and carry out a test at the 5% level to determine whether there is any evidence to support the gardener's suspicions. [7]

- 3 Douglas plays darts, and the probability that he hits the number he is aiming at is 0.87 for any particular dart.

Douglas aims a set of three darts at the number 20; the number of times he is successful can be modelled by $B(3, 0.87)$.

- (i) Calculate the probability that Douglas hits 20 twice. [3]
- (ii) Douglas aims fifty sets of 3 darts at the number 20. Find the expected number of sets for which Douglas hits 20 twice. [1]
- (iii) Douglas aims four sets of 3 darts at the number 20. Calculate the probability that he hits 20 twice for two sets out of the four. [2]

- 4 A geologist splits rocks to look for fossils. On average 10% of the rocks selected from a particular area do in fact contain fossils.

The geologist selects a random sample of 20 rocks from this area.

- (i) Find the probability that
 - (A) exactly one of the rocks contains fossils, [3]
 - (B) at least one of the rocks contains fossils. [3]
- (ii) A random sample of n rocks is selected from this area. The geologist wants to have a probability of 0.8 or greater of finding fossils in at least one of the n rocks. Find the least possible value of n . [3]
- (iii) The geologist explores a new area in which it is claimed that less than 10% of rocks contain fossils. In order to investigate the claim, a random sample of 30 rocks from this area is selected, and the number which contain fossils is recorded. A hypothesis test is carried out at the 5% level.
 - (A) Write down suitable hypotheses for the test. [3]
 - (B) Show that the critical region consists only of the value 0. [4]
 - (C) In fact, 2 of the 30 rocks in the sample contain fossils. Complete the test, stating your conclusions clearly. [2]