

- 1 A drug for treating a particular minor illness cures, on average, 78% of patients. Twenty people with this minor illness are selected at random and treated with the drug.
- (i) (A) Find the probability that exactly 19 patients are cured. [3]  
(B) Find the probability that at most 18 patients are cured. [3]  
(C) Find the expected number of patients who are cured. [1]
  - (ii) A pharmaceutical company is trialling a new drug to treat this illness. Researchers at the company hope that a higher percentage of patients will be cured when given this new drug. Twenty patients are selected at random, and given the new drug. Of these, 19 are cured. Carry out a hypothesis test at the 1% significance level to investigate whether there is any evidence to suggest that the new drug is more effective than the old one. [8]
  - (iii) If the researchers had chosen to carry out the hypothesis test at the 5% significance level, what would the result have been? Justify your answer. [2]
- 2 It is known that on average 85% of seeds of a particular variety of tomato will germinate. Ramesh selects 15 of these seeds at random and sows them.
- (i) (A) Find the probability that exactly 12 germinate. [3]  
(B) Find the probability that fewer than 12 germinate [2]
- The following year Ramesh finds that he still has many seeds left. Because the seeds are now one year old, he suspects that the germination rate will be lower. He conducts a trial by randomly selecting  $n$  of these seeds and sowing them. He then carries out a hypothesis test at the 1% significance level to investigate whether he is correct.
- (ii) Write down suitable null and alternative hypotheses for the test. Give a reason for your choice of alternative hypothesis. [4]
  - (iii) In a trial with  $n = 20$ , Ramesh finds that 13 seeds germinate. Carry out the test. [4]
  - (iv) Suppose instead that Ramesh conducts the trial with  $n = 50$ , and finds that 33 seeds germinate. Given that the critical value for the test in this case is 35, complete the test. [3]
  - (v) If  $n$  is small, there is no point in carrying out the test at the 1% significance level, as the null hypothesis cannot be rejected however many seeds germinate. Find the least value of  $n$  for which the null hypothesis can be rejected, quoting appropriate probabilities to justify your answer. [3]

**3** At a dog show, three out of eleven dogs are to be selected for a national competition.

**(i)** Find the number of possible selections.

**[2]**

**(ii)** Five of the eleven dogs are terriers. Assuming that the dogs are selected at random, find the probability that at least two of the three dogs selected for the national competition are terriers.

**[5]**