90646

Level 3 Statistics and Modelling, 2005

90646 Use probability distribution models to solve straightforward problems

Credits: Four

9.30 am Thursday 24 November 2005

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

Make sure that you have a copy of the Formulae and Tables Booklet L3-STATF.

You should answer ALL the questions in this booklet.

If you need more space for any answer, use the page(s) provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2–8 in the correct order and that none of these pages is blank.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

For Assessor's use only	Achievement Criteria		
Achievement		**Achievement with Merit**	**Achievement with Excellence**
Use probability distribution models to solve straightforward problems.		Use probability distribution models to solve problems.	Use and justify probability distribution models to solve complex problems.
Overall Level of Performance			

You are advised to spend 30 minutes answering the questions in this booklet.

Show **ALL** working.

QUESTION ONE

According to a food crop inspector, a particular potato disease occurs randomly and independently in plants. In a particular region, the inspector estimates that the disease is evident in 1.5 plants per hectare on average.

Assuming the number of infected plants can be modelled by a Poisson distribution, calculate the probability that a randomly selected hectare of potato crops has no more than two infected plants.

QUESTION TWO

Of the crop farms in the region in Question One, 18% have potato crops. As part of an audit, the inspector randomly selects 12 crop farms to visit in that region.

Calculate the probability that two of twelve randomly selected farms will have potato crops.

QUESTION THREE

The weights of potatoes produced by one particular farm are found to be approximately normally distributed, with a mean weight of 147 g and a standard deviation of 23 g.

(a)   What proportion of potatoes produced by this farm will weigh less than 160 g?

(b)   Of all the potatoes produced on the farm, 5% are considered too light. What is the maximum weight that would be considered too light?

(c) The inspector randomly selects a sample of 50 potatoes from this farm and places them in a bag. The bag is designed to hold up to 7.5 kg (7 500 g).

As stated on page 3, the weights of the potatoes are approximately normally distributed, with a mean weight of 147 g and a standard deviation of 23 g.

Calculate the probability that the weight of a sample of 50 potatoes will exceed 7.5 kg.

QUESTION FOUR

In another region the inspector notices that some of the potatoes are a very unusual shape. Further studies suggest that the occurrence of these unusually-shaped potatoes appears to be entirely random. The inspector discovers that potatoes with the very unusual shape occur on average in one potato plant per hectare in the region.

Over a two-day period the inspector is checking for the presence of the unusually-shaped potatoes in plants from the region. On each day, an area of five hectares will be randomly chosen, and the plants studied.

What is the probability that on both days the inspector finds no plants with the unusually-shaped potatoes?

QUESTION FIVE

The company that employs the food crop inspectors has a variety of procedures in place to ensure that all tests carried out to check the quality of the potatoes are accurate.
The inspector carries out testing on the basis that 1.8% of test results are misinterpreted.
A random sample of 200 test results is studied.
One of the company managers states that if more than three of the test results in the sample are found to have been misinterpreted, then all of those potato crops will need to be retested.

Let the random variable X represent the number of misinterpreted test results in the sample.

(a)   State the name of the distribution that X will have and the value(s) of any parameter(s). Fully justify why X has this distribution.

(b) The distribution in (a) can be approximated by another distribution.
State the name of the approximating distribution, give the value(s) of any parameter(s) of the approximating distribution, and state how it is known that the distribution in (a) may be approximated by this distribution.

(c) Calculate the probability that no more than three of the 200 test results are misinterpreted.

Extra paper for continuation of answers if required.
Clearly number the question.

Question
number