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SUPERVISOR'S USE ONLY

Level 3 Mathematics and Statistics (Statistics), 2019

91586 Apply probability distributions in solving problems

9.30 a.m. Thursday 28 November 2019
Credits: Four

Achievement	Achievement with Merit	Achievement with Excellence
Apply probability distributions in solving problems.	Apply probability distributions, using relational thinking, in solving problems.	Apply probability distributions, using extended abstract thinking, in solving problems.

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

You should attempt ALL the questions in this booklet.

Show ALL working.

Make sure that you have the Formulae and Tables Booklet L3–STATF.

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

Check that this booklet has pages 2–12 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.

TOTAL

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QUESTION ONE

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(a) Last year, 45% of the zucchini seeds planted in a suburban garden successfully germinated and grew into zucchini plants.

This year, in this garden, it is planned to grow at least 6 zucchini plants. There is space for a maximum of 10 zucchini plants. 10 zucchini seeds are planted from a new packet of seeds.

(i) Using an appropriate probability distribution model, calculate an estimate for the probability that at least 6 zucchini plants will grow from this year's seed planting.

(ii) To apply the distribution used in part (a)(i), at least one assumption needs to be made.

Identify ONE such assumption that may be **invalid** and discuss why this is the case.

Discuss the impact that making this assumption may have on your calculation in part (a)(i).

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(b) The zucchinis are picked (harvested) when they are more than 190 mm long, and before they grow to reach 270 mm long. The most common length of picked zucchinis is 220 mm long.

(i) Using an appropriate probability distribution, calculate an estimate for the probability that a picked zucchini is less than 220 mm long.

(ii) Is the median length of picked zucchinis more, or less, than 220 mm?

Support your answer with statistical reasoning.

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(iii) Small zucchinis (less than 215 mm long) are preferred for eating.

Calculate an estimate for the probability that at most five of the next ten zucchinis picked are small zucchinis.

As part of your answer, clearly identify your choice of distribution(s) and associated parameter(s), and state any assumption(s) you have made.

QUESTION TWO

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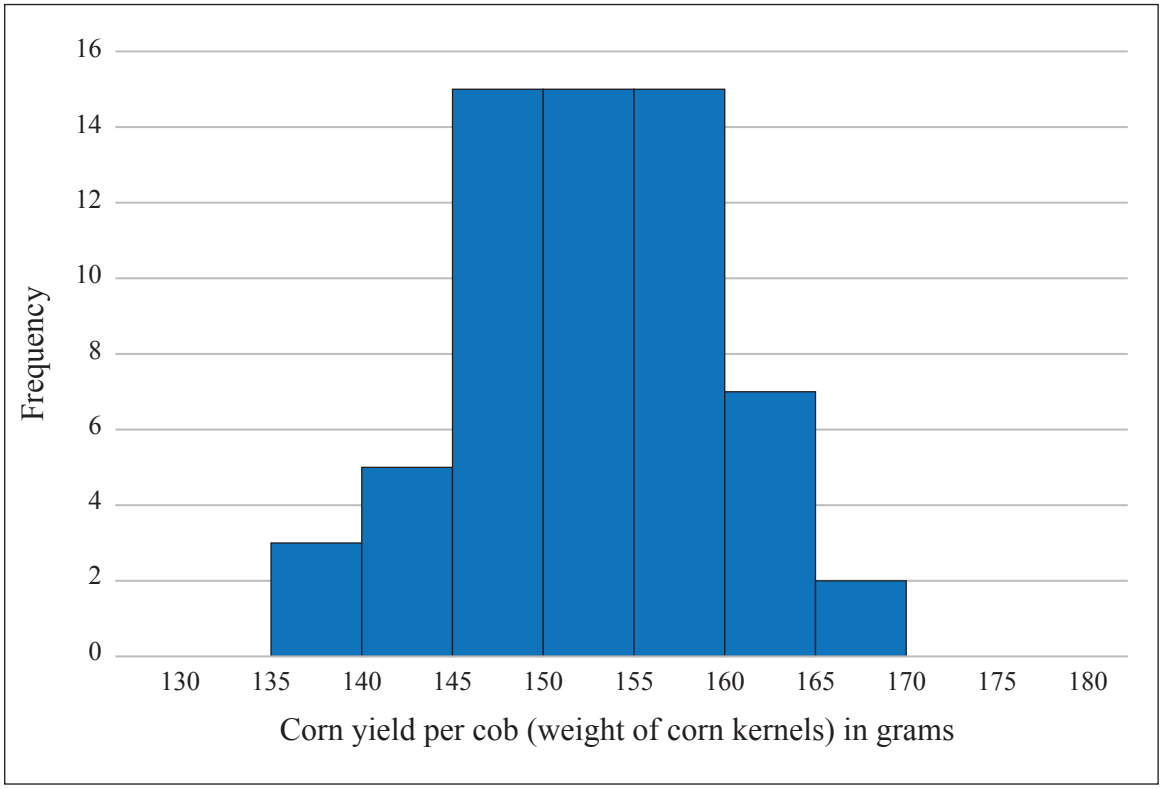
(a) Data from last year's Super-Sweet corn crop from one suburban vegetable garden was collected. A total of 62 cobs of corn were produced. The distribution of the corn yield (weight of corn kernels) per cob for this garden is displayed on the graph below.



(i) For this data, the mean yield per cob is 152.3 grams of corn kernels and the standard deviation is 7.0 grams. It is claimed that over 10% of the corn cobs from this garden yield more than 160 grams of kernels.

Is this claim correct?

Use a calculation to support your answer.

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(ii) Justify the use of a normal distribution to model the distribution of yield per cob for all Super-Sweet corn.

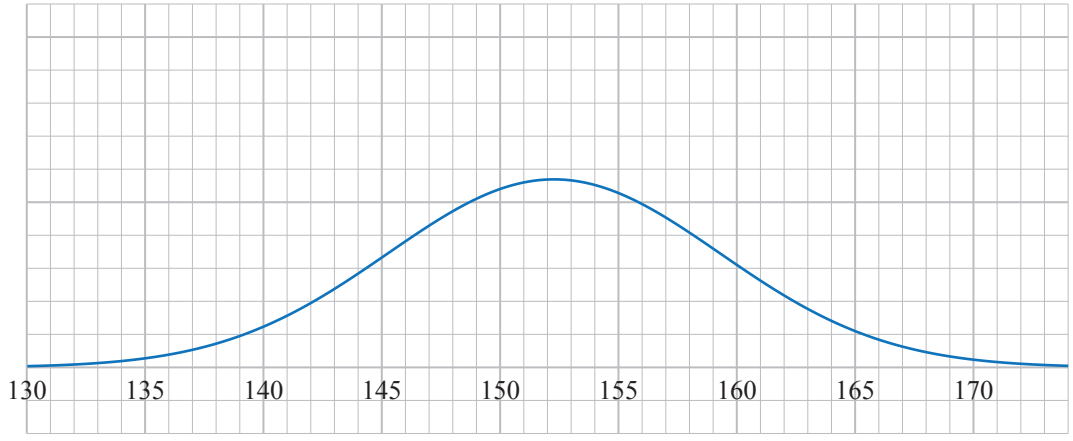
Support your answer with statistical reasoning.

As part of your answer, describe at least TWO features of the distribution of corn yield per cob, and include at least ONE calculation.

(iii) A normal distribution model for Super-Sweet corn yield per cob is shown in the graph below.

A new variety of corn (Ambrosia-Sweet) is developed. Data from field trials shows that the yield per Ambrosia-Sweet corn cob, in grams of corn kernels per cob, can be well modelled by a normal distribution. The normal distribution model for Ambrosia-Sweet corn yield per cob has mean 149 grams and standard deviation 4 grams.

Sketch the normal distribution model for Ambrosia-Sweet corn yield per cob on the diagram below.



If you need to redraw your curve, use the diagram on page 11.

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(iv) Compare the normal distribution models for Super-Sweet corn yield per cob and Ambrosia-Sweet corn yield per cob.

(b) Around 25% of 'Bush Road' potatoes are lighter than 186 grams.

A normal distribution with mean 235 grams is used to model the weight of 'Bush Road' potatoes.

Using this normal distribution model, would you expect the percentage of 'Bush Road' potatoes that weigh greater than 300 grams to be around 25%?

Support your answer with statistical reasoning.

QUESTION THREE

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(a) The mean number of weed plants per square metre in one suburban garden is known to be 6.

(i) Using an appropriate probability distribution model, calculate an estimate for the probability that more than 8 weed plants will be found in one square metre of garden.

(ii) Using an appropriate probability distribution model, calculate an estimate for the probability that at least 4 weed plants will be found in each of 5 different square metres of garden.

(iii) Consider an assumption you made when you calculated your answer to part (a)(ii). Discuss whether (or not) this assumption is likely to be valid.

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Question Three continues on the following page.

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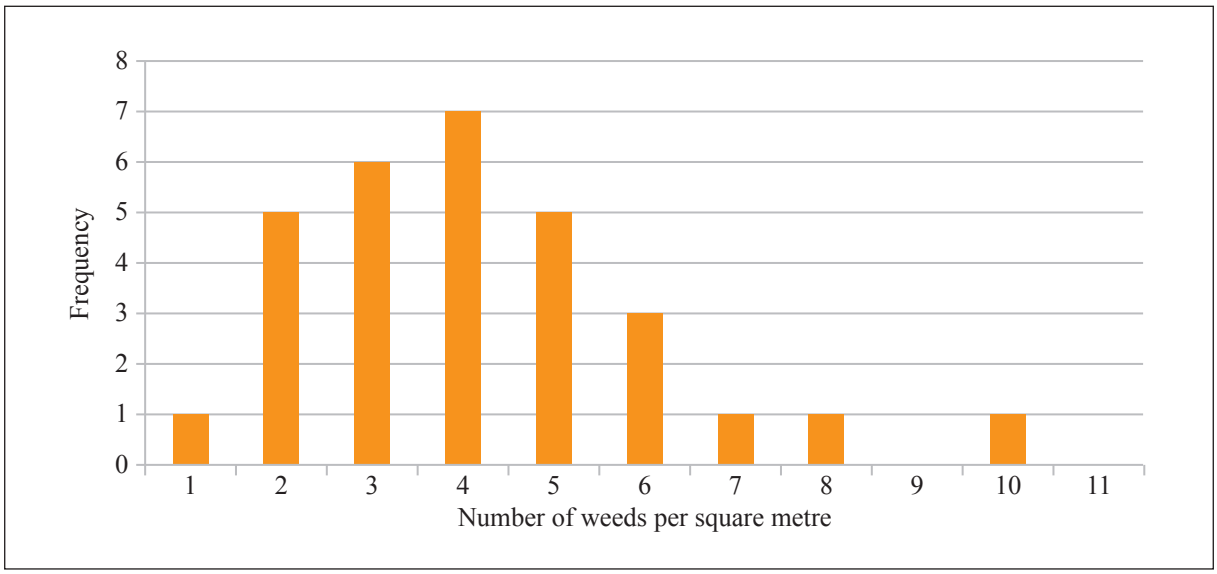
(b) A new organic weedkiller is used in an attempt to reduce the number of weeds in the garden. The plot below displays the number of weeds observed in 30 separate areas of one square metre of garden after the weedkiller has been used.

Number of weeds observed



(i) Calculate the mean for the number of weeds per square metre after the weedkiller has been used.

(ii) Using your answer to part (i) and an appropriate probability distribution to model this situation, comment on the chance that 10 weeds will be found in a garden plot that has an area of 3 square metres.

In your answer, you should justify your choice of distribution and identify the parameter(s) of this distribution.

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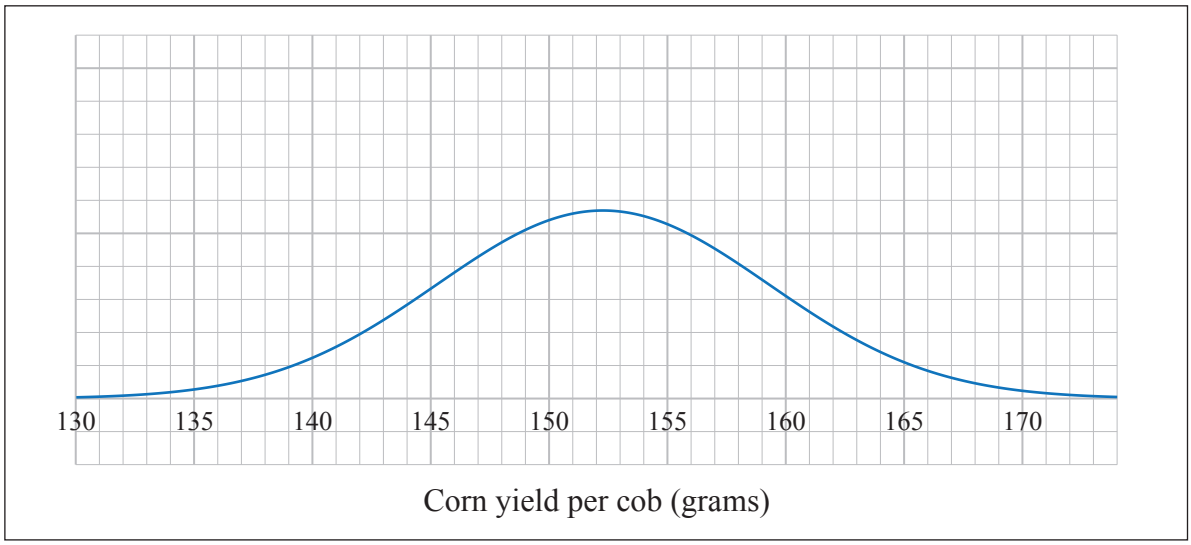
(iii) The mean number of weed plants per square metre is known to be 6. The weedkiller manufacturer states that this weedkiller has achieved reductions of up to 40%.

Based on the data provided, can you conclude that the weed reduction rate for the new weedkiller is at least 40%?

Support your answer with statistical reasoning.

SPARE DIAGRAM

If you need to redraw your curve for Question Two (a)(iii), use the diagram below. Make sure it is clear which diagram you want marked.



Extra paper if required.
Write the question number(s) if applicable.

QUESTION NUMBER

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