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SUPERVISOR'S USE ONLY

Level 3 Mathematics and Statistics (Statistics), 2018

91586 Apply probability distributions in solving problems

9.30 a.m. Thursday 22 November 2018
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) The mean number of emails per hour received by one email account is 1.3.

(i) Using an appropriate probability distribution model, calculate an estimate for the probability that this email account receives either zero or one email during any hour.

(ii) Using an appropriate probability distribution model, calculate an estimate for the probability that this email account receives at least two emails during 8 a.m. to 11 a.m.

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

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

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(b) The table below shows the probability distribution of the random variable M, the number of mobile phones owned by one person.

m	0	1	2	3
P($M = m$)	0.09	0.63	0.22	0.06

Suppose that, on average, each mobile phone costs $130.

(i) Calculate the expected cost of the mobile phones owned by one person.

(ii) Let the random variable N be the number of email accounts held by one person.

The random variable N has SD(N) = 1.4.

Show that N has a larger standard deviation than M and give ONE reason why this might be the case.

(iii) SD($M + N$) = 1.893.

Are M and N independent?

Support your answer with appropriate statistical statements and calculations.

QUESTION TWO

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(a) The time it takes for a web page to load is one measure used to determine a website's performance. A recent study found 46 per cent of users do not revisit poorly performing websites.

(i) 12 people visit a poorly performing website.

Using an appropriate probability distribution model, calculate an estimate for the probability that no more than half of these people do not revisit this website.

(ii) Give TWO reasons why you selected the probability distribution model in part (i).

1.

2.

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(iii) A company created two versions of their website (A and B), and randomly redirected people to one of these versions when they visited the website. Of the visitors redirected to version A of the website, 20% did not revisit the website. Of the visitors redirected to version B of the website, 45% did not revisit the website. Suppose 10 new visitors to the website are randomly redirected to version A of the website and another 10 new visitors to the website are randomly redirected to version B of the website.

Using the information given above and an appropriate distribution model, calculate an estimate for the probability that at least one of these 20 visitors does not revisit the website, and discuss why independence can be assumed in this situation.

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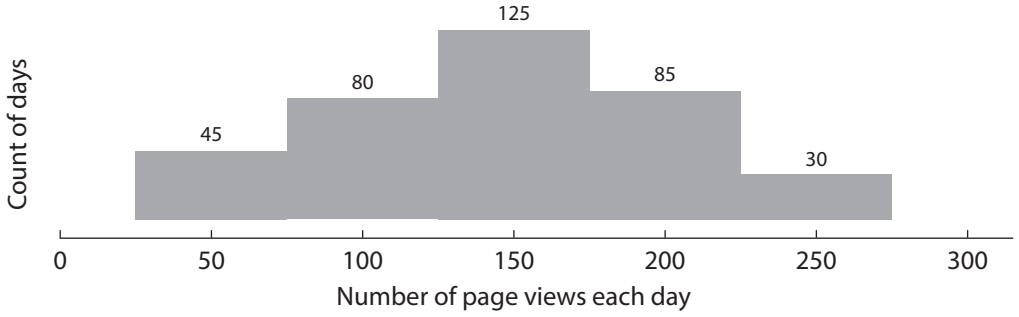
(b) The number of page views the website received each day was recorded over 365 days. This data was used to construct the graph below.



(i) The owner of the website states that the website received between 75 and 225 page views on 95% of the days.

- Show that the website owner is wrong, and,
- show how the lower and upper values for the central 95% of page views could be approximately 35 and 260 respectively.

You can draw on the graph above to help you with your calculations.

Suppose that a triangular distribution was used as a model for the number of page views the website receives each day.

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(ii) Based on the data shown on the opposite page, give parameters for a triangular distribution model.

(iii) Explain whether a continuity correction needs to be used when calculating an estimate for the probability that the website receives more than 150 page views tomorrow, using your triangular distribution model in part (b)(ii).

Support your answer with calculations that compare the use and the non-use of a continuity correction.

QUESTION THREE

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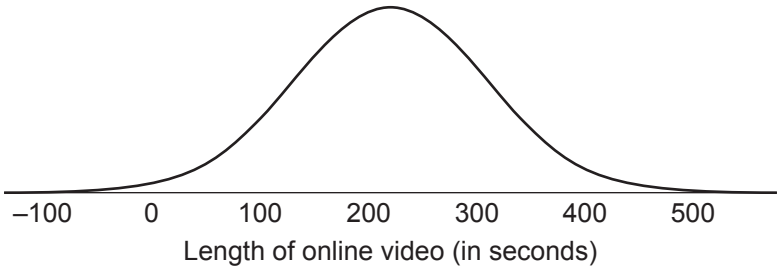
(a) Two different marketing companies have modelled the length (in seconds) of online videos.

Company A used a normal distribution with a mean of 220 seconds and a standard deviation of 90 seconds, while Company B used a normal distribution with a mean of 200 seconds and a standard deviation of 50 seconds.

(i) The normal distribution model for Company A is shown on the graph below.

Sketch the probability distribution model for Company B on this graph.



(ii) From past data it was found that 10% of online videos are longer than 330 seconds.

Based on this data, which company has a better model for the length of online videos?

Support your answer with statistical reasoning.

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(iii) Using Company A's model for the length of online videos, calculate an estimate for the probability that a randomly selected online video is shorter than 150 seconds, given that its length is between 100 and 300 seconds.

(b) The length of advertisements shown at the beginning of an online video can be modelled by a random variable that takes on values between 3 seconds and 43 seconds. The most likely length of the advertisement is 18 seconds.

Using an appropriate model, calculate an estimate for the probability that two randomly selected advertisements are both longer than 30 seconds.

Question Three continues on the following page.

(c) A student came across the problem shown below while browsing for practice problems online.

The number of raisins packed in a box by a manufacturer is normally distributed with a mean of 200 and a standard deviation of 30.

Discuss TWO reasons why the model suggested for the number of raisins in a box is not realistic.

Support your discussion with calculations and sketches where appropriate.

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1.

2.

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

QUESTION NUMBER

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