

# 3

91586



NEW ZEALAND QUALIFICATIONS AUTHORITY  
MANA TOHU MĀTAURANGA O AOTEAROA

SUPERVISOR'S USE ONLY

## Level 3 Mathematics and Statistics (Statistics), 2014

### 91586 Apply probability distributions in solving problems

9.30 am Thursday 20 November 2014

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 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.**

**TOTAL**

ASSESSOR'S USE ONLY

**QUESTION ONE**

- (a) The amount of caffeine in a “single shot” coffee can be modelled by a normal distribution, with mean 115 mg and standard deviation 10 mg.

Suppose that a customer orders three “single shot” coffees.

Calculate the probability that **all three** coffees contain between 108 mg and 122 mg of caffeine.

Give any assumption(s) that need to be made.

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- (b) The time it takes for a person to feel the effects of the caffeine in their coffee after they drink it can be modelled by a random variable that takes on values between 0 minutes and 40 minutes. The most likely time it takes a person to feel the effects of the caffeine in their coffee is 10 minutes.

Using an appropriate model, calculate the probability that it will take less than five minutes OR more than 10 minutes for a person to feel the effects of the caffeine in their coffee.

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**QUESTION TWO**

(a) A café owner estimates that 30% of latte coffees are made with trim milk. Over a period of a week, the café owner has recorded how many lattes were made with trim milk or with other milk for “sets” of five consecutive latte orders.

(i) Justify the use of the binomial distribution to model the number of lattes in a set of 5 that are made with trim milk.

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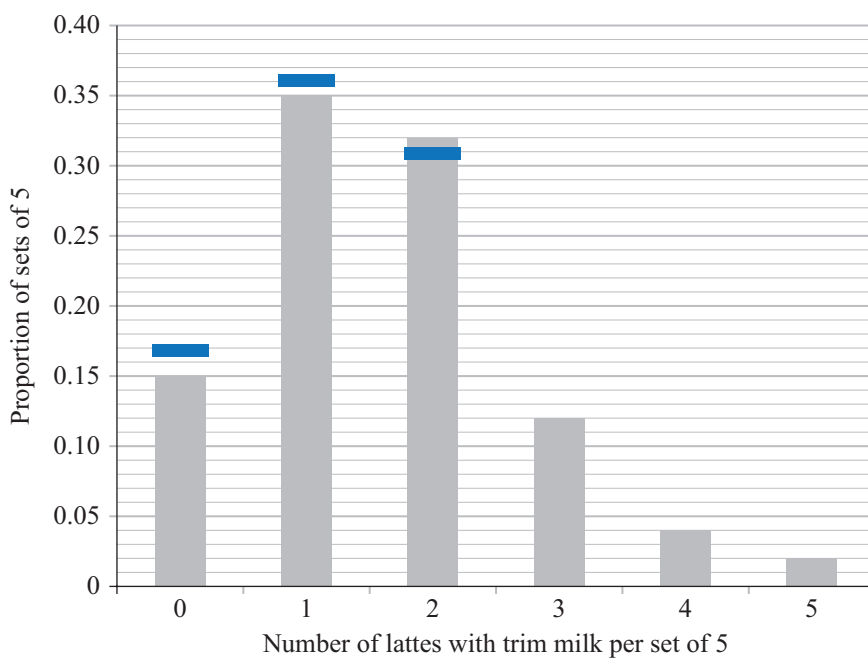
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(ii) The café owner has begun to produce a graph comparing the data collected (the experimental distribution shown shaded) and the binomial distribution model (the theoretical distribution shown in blue).

Complete the graph by showing the remaining values for the binomial distribution model.



- (iii) Discuss what conclusion(s) the café owner could draw from the completed graph on page 4.

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- (b) The mean number of phone orders for coffee per hour received by the café is 4.6.

- (i) Using a suitable probability distribution model, calculate the probability that the café receives at most two phone orders for coffee over any half-hour period.

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- (ii) To apply the distribution used in part (b)(i), 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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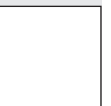
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**QUESTION THREE**

- (a) The table below shows the probability distribution of the random variable  $N$ , the number of takeaway coffees ordered by a customer.

$n$	1	2	3	4	5
$P(N = n)$	0.49	0.31	0.1	0.08	0.02

- (i) Calculate the mean number of takeaway coffees ordered by customers.

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- (ii) All customers are given a cardboard tray to carry their takeaway coffees.

The cost to make each coffee, including the cost of the materials and labour, is \$1.80.

The cost of a tray that can hold up to two coffees is \$0.20.

The cost of a tray that can hold three to five coffees is \$0.40.

Calculate the expected cost of each takeaway coffee order.

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- (b) A café has a jar on the front counter for customers to give money for a local charity. The café is not sure how much each customer will give each time, but expects an amount between 50 cents and five dollars.

- (i) Using an appropriate model, determine the maximum amount that the café would expect 80% of customers to donate less than.

- (ii) Justify your selection of an appropriate probability distribution model.

- (c) A company that sells coffee beans recorded the number of visits to its website in 15-minute periods over the last two months. The company found that in 96% of such periods, there was at least one visit to the website.

Calculate the probability that the website will receive more than 10 visits in any given 30-minute period.

