Level 3 Statistics: practice paper 2026

AS 91586 Apply probability distributions in solving problems · Vertex Academy practice paper, not an NZQA paper

Attempt ALL the questions. Show ALL working. Use NZQA's Level 3 formulae sheet. Write your answers on lined paper, or in the space under each question.

QUESTION ONE

(a) The crossing time of a passenger ferry from downtown Auckland to Waiheke Island is modelled by a normal distribution with mean 42 minutes and standard deviation 3.5 minutes. Use this model to estimate the probability that a crossing takes more than 48 minutes.

(b) A commuter catches the 7.00 am ferry to Waiheke and the 8.00 am ferry back on the same morning.
(i) Use the model in part (a) to estimate the probability that exactly one of the two crossings takes more than 45 minutes.
(ii) State the assumption you made in part (i). Explain, in context, why it may not be valid and how this could affect your estimate.

(c) Ferries leave Matiatia wharf every 30 minutes. A visitor arrives at the wharf at a random time without checking the timetable. Their waiting time, W minutes, is modelled by a uniform distribution from 0 to 30 minutes.

(i) Describe the graph of this distribution, including its height, and find the mean and standard deviation of W.

(ii) The visitor has already waited 10 minutes. Find the probability that their total wait is more than 25 minutes.

(d) A new operator takes over the Waiheke route with faster boats. In its first month it makes 400 crossings, and reports that 10% of them take longer than 47 minutes and 2% take less than 36 minutes. Assume crossing times are normally distributed.

(i) Find the mean and standard deviation of the new crossing times.

(ii) The operator advertises a '45 minute crossing'. Estimate the proportion of crossings that take longer than 45 minutes, and comment on the advert.

(iii) The operator wants only 5% of crossings to take longer than 45 minutes, without changing the standard deviation. Find the mean crossing time needed.

(e) Of the operator's 400 crossings in part (d), 31 took longer than 48 minutes, and the longest took 58 minutes.

Use the normal model from part (d) to evaluate whether a normal distribution is a suitable model for these crossing times. Discuss how your conclusion affects the mean found in part (d)(iii).

QUESTION TWO

(a) A vehicle testing station in Christchurch recorded how long 150 customers waited for a Warrant of Fitness (WOF) inspection. The shortest wait was 5 minutes and the longest was 64 minutes. The results are in the table.
The station's manager claims that at least one customer in five waits more than half an hour. Does this data support the claim?

Waiting time (minutes)	Number of customers
5 to under 10	14
10 to under 15	33
15 to under 20	30
20 to under 25	24
25 to under 30	17
30 to under 35	12
35 to under 40	8
40 to under 45	5
45 to under 50	3
50 to under 55	2
55 to under 60	1
60 to under 65	1

(b) A triangular distribution with a = 5, c = 15 and b = 65 is suggested to model the waiting times.
(i) Justify the choice of each parameter. Include an observation from the table in your answer.
(ii) Use this model to estimate the probability that a customer waits more than 30 minutes.

(c) A staff member suggests changing the model to a = 5, c = 15 and b = 50, because only 4 customers waited 50 minutes or more.
Use this model to estimate the probability that a customer waits more than 30 minutes. Compare both triangular models with the data, and state which model fits this data better. Give one drawback of the model you choose.

(d) The station plans a promotion: if a customer waits longer than t minutes, their WOF is free. The manager wants only 5% of customers to get a free WOF.

(i) Use the triangular model with a = 5, c = 15 and b = 50 to find t, to 1 decimal place.

(ii) Use the table to estimate the proportion of customers who would actually wait longer than this t. Explain why it differs from 5%.

(e) The station sees 200 customers a week and budgets for at most 15 free WOFs a week, using t from part (d).
Assuming 5% of customers get a free WOF, find the probability that the budget is exceeded in a week. Use your answer to part (d)(ii) to discuss whether the budget is safe, and state any assumption you make.

QUESTION THREE

(a) At a kiwifruit packhouse in Te Puke, 4% of kiwifruit are rejected for skin blemishes. A tray holds 30 kiwifruit.

Use a probability distribution model to estimate the probability that a tray has at most 2 rejected kiwifruit. State the name and parameters of the distribution as part of your answer.

(b) The random variable X is the number of trucks arriving at the packhouse loading dock in a 15-minute period during the harvest. Its probability distribution is shown in the table.

(i) Find the value of k.

(ii) Find the mean and standard deviation of X, and explain what the mean tells you in context.

(iii) The dock can unload 3 trucks in 15 minutes. Find the probability that at least one truck has to wait in a 15-minute period.

x	**0**	**1**	**2**	**3**	**4**	**5**
P(X = x)	0.08	0.22	0.30	k	0.12	0.06

(c) The packhouse's forklifts break down at an average rate of 0.6 breakdowns per week during the harvest.

(i) Use a Poisson distribution to find the probability of at least 2 breakdowns in a 4-week period.

(ii) Describe two conditions needed for the Poisson model in this context, and discuss whether one of them is likely to hold.

(d) To check the binomial model from part (a), a quality controller counted the rejected kiwifruit in 200 trays of 30. The results are in the table.

(i) Find the mean and standard deviation of the number of rejects per tray in this data.

(ii) Use the model X ~ Bin(30, 0.04) to find the expected number of the 200 trays with 0 rejects and with 4 or more rejects.

(iii) Use these results to evaluate whether the binomial model is suitable. Give a reason in context for any difference between the model and the data.

Rejects in a tray	**0**	**1**	**2**	**3**	**4**	**5**	**6**
Number of trays	78	54	32	18	10	6	2

(e) A tray with 3 or more rejected kiwifruit is downgraded. The packhouse wants at least 95% of trays to have at most 2 rejects, and is considering a new grading machine that lowers the reject rate.

(i) Using a binomial model for trays of 30, find the largest reject rate p that meets the target, to 4 decimal places.

(ii) Using your findings from part (d), discuss whether a machine that achieves this reject rate would actually meet the target.

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