Assessment schedule: practice paper 2026

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

QUESTION ONE

Part	Evidence	Achievement (u)	Merit (r)	Excellence (t)
(a)	$X \sim N(42, 3.5^2)$ $z = \frac{48 - 42}{3.5} = 1.714$ $P(X > 48) = P(Z > 1.714)$ $P(X > 48) = 0.0432$	Correct probability 0.0432 (accept 0.043).		
(b)	$P(X > 45) = P(Z > 0.857) = 0.1957$ $P(X \le 45) = 1 - 0.1957 = 0.8043$ $P(\text{exactly one}) = 2 \times 0.1957 \times 0.8043$ $P(\text{exactly one}) = 0.3148$ Independence doubtful: same morning, same weather and boat, so the estimate is likely too high	$P(X > 45)$ = 0.1957 correct, OR the probability of one order (0.1574) correct, OR independence assumption stated.	Combined probability 0.3148 correct, AND independence stated in context with a reason it may not be valid (shared weather, same boat or crew).	
(c)	$W \sim$ uniform, $a = 0$, $b = 30$ $E(W) = 15$, $SD(W) = \frac{30}{\sqrt{12}} = 8.66$ minutes $P(W > 25$ $= (\frac{5}{30})/(\frac{20}{30}) = \frac{5}{20}$ $P(W > 25$	Graph described as a rectangle with correct height 1/30, OR mean and standard deviation correct, OR one of $P(W > 25)$ and $P(W > 10)$ correct.	Conditional probability 0.25 correct, with the graph, mean and standard deviation correct.	
(d)	$\mu + 1.2816\sigma = 47$ $\mu - 2.0537\sigma = 36$ $3.3353\sigma = 11$, so $\sigma = 3.298$ $\mu = 47 - 1.2816 \times 3.298 = 42.77$ $P(X > 45) = P(Z > 0.675) = 0.2498$ $45 = \mu + 1.6449 \times 3.298$ $\mu = 42.77$, $\sigma = 3.30$; $P(X > 45) = 0.2498$; new mean 39.58 minutes	Both z-values correct, OR one correct equation in μ and σ.	$\mu = 42.77$ and $\sigma = 3.30$ correct, AND $P(X > 45) \approx 0.25$ found.	μ and σ correct, AND $P(X > 45)$ used to comment on the advert in context, AND the new mean of 39.58 minutes found without early rounding.

(e)	$z = \frac{48 - 42.77}{3.298} = 1.585$, $P(X > 48) = 0.0565$ expected $400 \times 0.0565 = 22.6$, observed 31 $z = \frac{58 - 42.77}{3.298} = 4.62$, $P(X > 58) \approx 0.000002$ observed upper tail longer than the model: right skew (lower limit, delays add time) Normal model not suitable for the upper tail; $\mu = 39.58$ would give more than 5% over 45, so a lower mean or less variation is needed	$P(X > 48) = 0.0565$ found, OR z-value for 58 minutes found.	Expected count of 22.6 compared with the observed 31, OR the 58-minute crossing shown to be very unlikely under the model.	Normal model evaluated using the upper tail (expected against observed AND the extreme value), with right skew explained in context, AND the effect on the mean in part (d)(iii) explained (more than 5% would still exceed 45 minutes).

QUESTION TWO

Part	Evidence	Achievement (u)	Merit (r)	Excellence (t)
(a)	$12 + 8 + 5 + 3 + 2 + 1 + 1 = 32$ $\frac{32}{150} = 0.213$ $0.213 \geq 0.2$ 21.3% waited more than 30 minutes, so the data supports the claim	Correct proportion (0.213) AND conclusion that the data supports the claim.		
(b)	$a = 5$ (shortest wait), $c = 15$ (tallest classes), $b = 65$ (longest wait 64) peak $= \frac{2}{65 - 5} = \frac{1}{30}$ $f(30) = \frac{65 - 30}{65 - 15} \times \frac{1}{30} = 0.02333$ $P(X > 30) = \frac{1}{2} \times 35 \times 0.02333$ $P(X > 30) = 0.4083$	Two parameters justified in context, OR height at $X = 30$ correct.	Three parameters justified in context using the table, AND $P(X > 30) = 0.4083$ correct.	
(c)	peak $= \frac{2}{50 - 5} = \frac{2}{45}$ $f(30) = \frac{20}{35} \times \frac{2}{45} = 0.02540$ $P(X > 30) = \frac{1}{2} \times 20 \times 0.02540 = 0.2540$ data 0.213; b = 65 model 0.4083; b = 50 model 0.2540 b = 50 fits better, but gives $P(X \geq 50) = 0$ when 4 customers waited that long	$P(X > 30) = 0.2540$ for the new model, OR a comparison of one model's estimate with the data's 0.213.	Both models compared with the data, identifying that the b = 65 model greatly overestimates, AND the b = 50 model chosen with a valid drawback in context.	

(d)	$\frac{(50-t)^2}{45\times 35} = 0.05$ $(50-t)^2 = 78.75$, so $t = 50 - 8.874 = 41.1$ data: $7 + 5 \times \frac{3.9}{5} \approx 10.9$ customers $\frac{10.9}{150} \approx 0.072$ t = 41.1 minutes; about 7% of customers in the data would get a free WOF, more than 5%, because the model leaves out waits over 50	Equation $(50-t)^2/1575 = 0.05$ set up.	t = 41.1 minutes correct.	t correct, AND the data proportion above t estimated (about 7%), AND the difference explained by the long right tail that the model leaves out.
(e)	X ~ Bin(200, 0.05) $P(X > 15) = 1 - P(X \le 15) = 0.0444$ data rate ≈ 0.07 from part (d)(ii) X ~ Bin(200, 0.07): $P(X > 15) = 0.327$ P(budget exceeded) = 0.0444 on the model, but about 0.33 at the data's rate, so the budget is not safe	Binomial distribution named with n = 200 and p = 0.05.	$P(X > 15)$ = 0.0444 correct, with the independence assumption stated in context.	Budget's safety discussed using the rate from the data ($P(X > 15) \approx$ 0.33 at 7%), AND the effect of dependence between customers' waits (busy days) on the conclusion explained.

QUESTION THREE

Part	Evidence	Achievement (u)	Merit (r)	Excellence (t)
(a)	X ~ Bin(30, 0.04) $P(X \le 2) = P(X = 0) + P(X = 1) + P(X = 2)$ $= 0.2939 + 0.3673 + 0.2219$ $P(X \le 2) = 0.8831$	Binomial distribution with n = 30 and p = 0.04 identified, AND correct probability 0.8831.		
(b)	$0.78 + k = 1$, so $k = 0.22$ $E(X) = 0.22 + 0.60 + 0.66 + 0.48 + 0.30 = 2.26$ $E(X^2) = 0.22 + 1.20 + 1.98 + 1.92 + 1.50 = 6.82$ $Var(X) = 6.82 - 2.26^2 = 1.7124$, SD = 1.309 $P(X \ge 4) = 0.12 + 0.06 = 0.18$ k = 0.22; mean 2.26 trucks, SD 1.309 trucks; P(a truck waits) = 0.18	k = 0.22, OR E(X) = 2.26, OR $P(X \ge 4)$ = 0.18.	E(X) = 2.26 interpreted as a long-run average in context, AND SD(X) = 1.309 correct.	

(c)	$\lambda = 0.6 \times 4 = 2.4$ $X \sim Po(2.4)$ $P(X \geq 2) = 1 - 0.0907 - 0.2177$ $P(X \geq 2) = 0.6916$ Conditions: independent breakdowns, constant rate; constant rate doubtful in peak harvest	$\lambda = 2.4$ with correct probability 0.6916, OR one condition described in context.	Correct probability AND two conditions described in context, with reasoning about whether one of them is valid.	
(d)	mean $= \frac{254}{200} = 1.27$, SD = 1.42, variance ≈ 2.03 $200 \times P(X = 0) = 200 \times 0.2939 = 58.8$ $200 \times P(X \geq 4) = 200 \times 0.0306 = 6.1$ $np = 1.2$, $np(1 - p) = 1.152$ data variance 2.03 $\gg$ 1.152: too many trays with 0 and with 4+ Binomial not suitable: rejects cluster by orchard, so independence and constant p fail	Mean 1.27 OR standard deviation 1.42 of the data correct, OR one expected count correct.	Both expected counts (58.8 and 6.1) compared with the observed 78 and 18, OR data variance compared with $np(1 - p) = 1.152$.	Model evaluated using the spread (variance much larger than the binomial's) and the tails, AND the failure of independence or constant p explained in context, with a conclusion about the model's suitability.
(e)	$X \sim Bin(30, p)$, need $P(X \leq 2) \geq 0.95$ $(1 - p)^{30} + 30p(1 - p)^{29} + 435p^2(1 - p)^{28} = 0.95$ p = 0.0278: 0.9501; p = 0.0279: below 0.95 data: $P(X \leq 2) = \frac{164}{200} = 0.82$ against 0.883 from the model $p \leq 0.0278$; clustering means this rate would likely still give fewer than 95% of trays with at most 2 rejects	$P(X \leq 2)$ written as a binomial expression in p, OR $P(X \leq 2)$ at p = 0.04 found (0.8831).	p = 0.0278 correct.	p = 0.0278 correct, AND clustering or extra variation from part (d) used to explain that this rate would likely not meet the target, with supporting evidence from the data (e.g. 0.82 against 0.883).

Judgement for each question

N0	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	Attempts at least one part of the question.	1 of u	2 of u	3 of u	1 of r	2 of r	1 of t	2 of t

Grade score out of 24 (each question's grade: N0 = 0 to E8 = 8): Not Achieved 0 to 7, Achieved 8 to 13, Merit 14 to 18, Excellence 19 to 24 (the 2025 exam's cut scores).