Assessment Schedule – 2018

Mathematics and Statistics: Apply probability methods in solving problems (91267)

Evidence Statement

Q	Expected Coverage	Achievement (u)	Merit (r)	Excellence (t)
ONE (a)(i)	$P(11.6 < x < 18.8)$ $= P(0 < z < 1.5)$ $= 0.4332$	Correct probability obtained.		
(ii)	$P(x > 17)$ $= P(z > 1.125)$ $= 0.5 – P(0 < z < 1.125)$ $= 0.5 – 0.3696$ $= 0.1304$ (tables) 0.1303 (GC)	Correct probability obtained.		
(iii)	$P(\text{temp} > Q) = 0.01$ $P(Z > 2.326[2.329]) = 0.01$ So $\frac{x-11.6}{4.8} = 2.326[2.329]$ $Q = 22.7648[22.7792]$°C, 22.766 (GC)	Correct set-up of probability statement in words or diagram. OR CAO	Correct answer.	
(iv)	$P(9 < x < \text{new mean}) = 0.3$ $P(–0.841 < z < 0) = 0.3$ Hence, $\frac{9-\text{new mean}}{4.8} = –0.841$ And new mean = 13.0368 OR By guess and check, result needs to give $p(x < 9) = 20.0\%$ to 3 sf. So mean must be between 13.032 and 13.048 Do not penalise use of $z = {}^{+}0.841$ if it leads to correct answer.	CAO	Correct z-value found. OR Record of estimations leading to result out of range.	Correct answer obtained. OR Record of estimations leading to result within range.

(b)	The IQR is the middle 50% $P(-0.674 < z < 0.674) = 0.5$ So the IQR $= 2 \times 0.674$ = 1.348 standard deviations wide Hence the IQR is more than 1 standard deviation. If response uses the given distribution specifically: P(temp > UQ) = 0.25 UQ = 14.83 P(temp < LQ) = 0.25 LQ = 8.36 IQR = 14.83 – 8.36 = 6.47 °C 6.47 > 4.8, so the IQR is more than 1 SD OR $\frac{IQR}{SD} = \frac{6.47}{4.8}$ so IQR is more than 1SD wide. This would generally be true because any normal distribution has 50% of the data within 0.674SDs either side of the mean, so the result will still apply.	Identifies IQR with middle 50% (or LQ with bottom 25%, etc.). Finds one quartile correctly.	Finds IQR in terms of sd. Makes correct conclusion for this given distribution.	Makes clear conclusion that IQR is bigger than the sd. Response must be based on the z-axis, not probabilities alone. Makes clear generalisation to all normal distributions.

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	Valid attempt at ONE question.	1u	2u	3u	1r	2r	1t	2t

Q	Expected Coverage	Achievement (u)	Merit (r)	Excellence (t)
TWO (a)(i)	$\frac{1646}{2556} = 0.6440$ (4 dp)	Correct answer.		
(ii)	$\frac{88}{641} = 0.1373$ (4 dp)	Correct answer.		
(iii)	P(wet when windy) = $\frac{553}{1646} = 0.3360$ (4 dp) P(wet when still) = $\frac{88}{910} = 0.0967$ (4 dp) So more likely to be wet on a windy day.	Correct answer for one P(wet).	Both probabilities correct with conclusion.	
(iv)	Possible reasons: 1: OLD DATA: The data is now getting quite old so, if conditions are changing, the table may not accurately reflect weather now. 2: SEASONS: The probabilities will vary during the year, but this table lists results for the whole year. It is not an accurate reflection of February, where it is probably much more likely to have a dry and calm day than the rest of the year.	Clear explanation using reason 1.	Clear explanation using reason 2 or equivalent level of thinking.	
(b)	Probabilities of wind when it is dry: Reefton = $\frac{53}{1673} = 0.0317$ Kaitaia = $\frac{1093}{1915} = 0.5708$ Relative risk of wind when dry in Kaitaia, compared to Reefton = 18.0165. OR $20 \times 0.0317 = 0.634 > 0.5708$ so it is not 20 times more likely. Conclusion: It is much more likely to be windy when it is dry in Kaitaia – but about 18 times more likely, not 20, so Matiu's claim is not correct.	One probability correct.	Relative risk for Kaitaia compared to Reefton obtained correctly. OR Relative risk obtained but the risk is taken to be 18% greater in Kaitaia.	T1: Calculates the correct relative risk, but concludes that Matiu is correct through rounding or otherwise. T2: Calculates the correct relative risk, and concludes that Matiu is NOT correct by accurately using the relative risk or equivalent multiplicative method.

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	Valid attempt at ONE question.	1u	2u	3u	1r	2r	T1	T2

Q	Expected Coverage	Achievement (u)	Merit (r)	Excellence (t)
THREE (a)(i)	P(dry in both towns) $= 0.55 \times 0.88$ $=0.484$	Correct probability.		
(ii)	P(wet in only one town) $= 0.45 \times 0.37 + 0.55 \times 0.12$ $= 0.2325$	Correct probability obtained.		
(iii)	P(dry in Timaru) $= 0.45 \times 0.37 + 0.55 \times 0.88$ $= 0.1665 + 0.484$ $= 0.6505$ P(dry in Ashburton on a day when it is dry in Timaru) $= \frac{0.484}{0.6505}$ $= 0.7440$	P(dry in Timaru) correct, clearly identified.	Correct probability obtained.	
(b)	If P(dry in all 3) = 0.3, $0.55 \times 0.88 \times$ P(dry in Waimate) = 0.3 So P(dry in Waimate) = 0.6198 If P(dry in all 3) = 0.35, $0.55 \times 0.88 \times$ P(dry in Waimate) = 0.35 So P(dry in Waimate) = 0.723 Lowest P(wet in Waimate) = 1 – 0.723 = 0.2769	P(dry in Waimate) values correct using 0.3	P(dry in Waimate) value correct using 0.35	Correct probability obtained with mathematical support for the answer.

(c)	For p(dry in both towns), Teri would get $0.55 \times 0.65 =$ **0.3575** From part a(i), I got **0.484** which is much higher. This shows that the probability of no rain in both towns is higher than Teri would calculate. This is because the towns are quite close, so if it is dry in one, it is more likely to be dry in the other as well. Teri should not just use the simple overall averages. OR As we are given in part (a), p(dry in Timaru when it is dry in Ashburton) = **0.88** which is much higher than the **0.65** Teri is using from the simple overall average. This reflects the fact that the towns are quite close together, so if it is dry in Ashburton, the chance that it is dry in Timaru is much higher than the overall average. Key points: The towns are quite close together, so are likely to have similar weather on the same day. Probability of dry in Timaru will be higher if it is dry in Ashburton that day [i.e. probability of both dry will be higher than expected]. The figures Teri is using are overall averages, and don't take into account the weather in the other town. *Answers from candidates at this level should be in context and only informal perspectives on the idea of independence. However, to award T, the response must be a clear and complete description of the issue in this case.*	Teri's p(dry in both towns) correct OR The concept of the lack of independence of weather conditions in the 2 towns is developed.	Teri's p(dry in both towns) correct AND The concept of the lack of independence of weather conditions in the 2 towns is developed.	Clear, developed **connection** between the fact that the probabilities are significantly different AND the lack of independence.

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	Valid attempt at ONE question.	1u	2u	3u	1r	2r	1t	2t

Cut Scores

Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
0 – 7	8 – 13	14 – 19	20 – 24